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.

QUEENSLAND AGRICULTURAL JOURNAL

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Event and Comment

The March of Progress in North Queensland.

IN the course of a recent extensive tour of the Far North, his Excellency the Governor, Sir Leslie Wilson, was deeply impressed with the potentialities of the country north of Townsville, the enterprise of its people and the advance it has made in rural development.

Factors to which he drew attention in a Press interview on his return to Brisbane were the advantages of a road development policy, water conservation for electric power and irrigation, and the timber and tobacco industries.

On the Atherton Tablelands, he said, the most striking development was road construction. He was able for the first time to motor from Cairns to Innisfail, and on to Yungaburra, where he made his headquarters.

"The policy of the Government in regard to road development is a very good one," he stated. "It not only opens land for settlement, but it is giving haulier access to new country, enabling timber to be brought in to the mills in far larger quantities than ever before, and the settlers are provided with main roads by which they can get their necessary supplies.

"Any expenditure on these roads will be amply refunded by the access given to valuable timber, and there is no doubt whatever that

now that the tractor can be used, very valuable timbers, which were practically impossible to deal with in the past, can now be brought to the various mills. At the same time we have to be careful in regard to reafforestation, because we have to look to the future as well as to the present."

The people of Cooktown were very hopeful for a revival of that area, his Excellency added. That was due largely to the timber which was now being worked. Aviation activities had expanded, and they had a fine aerodrome. They were anxious for the completion of the road from Daintree to Cooktown, but difficult country had to be overcome and a survey was not yet completed. They wished for a start to be made from Cooktown, as it would open the way to good timber country, which was along the route that obviously had to be followed.

One thing that impressed the Governor more than anything else was the success of the hydro-electric scheme from the Barron Falls, which he had opened. Power had now been distributed to Cairns and to many places on the Tablelands, and great progress was being made in extending the centres of distribution. A commission was to investigate whether more water could be impounded to enlarge the scheme. If that was not found practicable, there were other places, such as the Tully Falls, where water could be impounded. The scheme was an example of what could be done in Queensland. It had an immense value in giving cheap power to farmers for all their activities as well as for domestic convenience. There were many other places in the State where water could be used for similar purposes and for irrigation to excellent advantage, more particularly for the growing of tobacco, cotton, and vegetables and for fodder to offset drought in dairying and agricultural districts.

His Excellency stated that North Queensland was much more appreciated now than in the past, and many southern visitors, who thought that he had exaggerated its attractions, later informed him that he had not overestimated the definite assets that North Queensland possessed.

After visiting Mount Garnet and inspecting tin mining operations there, his Excellency remarked that the work presaged great success for the tin mining industry of the State.

Animal Health—New School of Veterinary Science.

ONE of the more notable of recent events was the opening by the Minister for Agriculture and Stock, Hon. Frank W. Bulcock, of the new School of Veterinary Science, within the University of Queensland, at the Animal Health Station at Yeerongpilly. For stock-owners, this is certainly an important advance, although there are still a few who are inclined to question the wisdom of establishing a veterinary school at the present time. That idea, however, falls to the ground when it is remembered—as pointed out by Mr. Bulcock in the course of a notable opening address—that Queensland industries lose, it is estimated, no less a sum than £10,000,000 every year, through disease, wrong feeding, and other causes. As 80 per cent. of Queensland's export wealth comprises primary products, it is plain that much of that enormous loss is sustained by graziers and dairy farmers.

"I wonder," said Mr. Bulcock, "how often we bother to think what unscientific feeding costs stockowners every year! It is no exaggeration to say that the aggregate cost runs into millions of pounds, while the

pig industry alone loses tens of thousands annually through the same cause. It is worth thinking about obviously, and if by training our own veterinary surgeons and nutrition experts we can prevent only a tenth of those avoidable losses the Veterinary School will more than pay for itself in quick time.

"Modern transport has brought Queensland closer to other countries—our next door neighbours, so to speak—and there is real risk of new diseases of live stock being introduced. Animals *will* catch disease, and our own young Queenslanders trained in veterinary science in our own school will, surely, prove one of the best means of preventing the disastrous diseases prevalent among the stock of some other countries becoming a menace to our own flocks and herds.

"There is certainly a great and growing need for veterinary surgeons in Queensland, and the future of veterinary practice in this State will depend upon the number of graduates turned out by the Queensland School of Veterinary Science. Only trained men—and under Professor Seddon there will be no doubt about the soundness of that training—can safeguard animal health and the animal wealth of the State.

"Already nineteen students have been enrolled and they are young men—and women, too—who would be a credit to any profession. The new school is certain to have a great influence on the development of pastoral and general farming industries in Queensland in future years."

A New Book on Plant Pest and Disease Control.

PESTS and diseases are responsible for considerable damage to valuable crops in Queensland. There is therefore a definite need for some reference publication, written in terms intelligible to the farmer or fruitgrower, containing information necessary for the diagnosis of the cause of the damage and for its effective control. This need was recognised by the Department of Agriculture and Stock some years ago in publishing "Pests and Diseases of Queensland Fruits and Vegetables" by Messrs Veitch and Simmonds, a profusely illustrated work in the field of economic entomology and plant pathology, adapted to Queensland requirements. Recently, this publication has been superseded by Volume III.* of *The Queensland Agricultural and Pastoral Handbook*. The new publication breaks a great deal of fresh ground and covers the whole field of plant pest and disease problems of any moment to agriculturalists and fruitgrowers in the State, with the exception of the problems associated with sugar-cane. As the Department sponsoring the publication is responsible for most of the entomological and plant pathological advisory and research services in Queensland, the volume constitutes a summary of the latest available information and is noteworthy for the clarity of presentation of the subject-matter.

Altogether, the volume summarises the fund of knowledge possessed by an extensive staff of officers familiar with pest and disease problems and with the fruitgrowers' and farmers' difficulties in coping with them. It is therefore indispensable to anyone who aims at the maximum production from his property and the lessening of natural hazards in agricultural and fruitgrowing pursuits.

* *The Queensland Agricultural and Pastoral Handbook*, Volume III; Price, 3s., post free; Department of Agriculture and Stock, Brisbane.

New Departmental Chief.

APPOINTMENT OF Mr. ROBERT WILSON.

MR. ROBERT WILSON, who has succeeded the late Mr. Ernest Graham in the offices of Under Secretary and Director of Marketing of the Department of Agriculture and Stock, is a native of Queensland, having been born on the Logan River, where his father was engaged in cotton and cane planting and sugar manufacture.

On leaving the Brisbane Grammar School, Mr. Wilson entered the Public Service as a junior on the staff of the Department of Agriculture, in every branch of which he has served in the course of a career of well-merited distinction. Among various appointments, he has held the secretaryships of the Australian Rust in Wheat Conference, the annual agricultural conferences held in different parts of Queensland from 1897 to 1903, the Board of Advice under the Diseases in Plants Act, the Meat and Dairy Board, and the Royal Commission on Central Sugar Mills (1910-11). While holding these and similar positions, he travelled extensively throughout the State on business relating to agricultural and pastoral development and administration.

In January, 1925, Mr. Wilson was appointed Assistant Under Secretary, assuming the administrative responsibility, under Ministerial direction and by delegation from the Under Secretary, of a great department with activities and influence covering rural industry throughout Queensland. He is a member of the Agricultural Bank Board, Deputy Chairman of the Rural Assistance (Farmers' Rehabilitation Scheme) Board, and a member of the Dairy Products Stabilisation Board; and also has been appointed Government representative on the Butter and Cheese Boards and other commodity boards operating under the Primary Producers' Organisation and Marketing Acts and related legislation. He has frequently accompanied the Minister, Hon. Frank W. Bulcock, to interstate Ministerial conferences and to meetings of the Australian Agricultural Council.

Mr. Wilson volunteered for active service with the Australian Imperial Force in the Great War and served with the 47th Battery, 12th Australian Field Artillery Brigade, on the Somme during the 1916-17 winter, through the autumn operations in the Ypres area in 1917 and the subsequent winter campaign, and during the stirring and memorable events on the Somme and the Lys in the last year of the war.

Mr. Wilson was well known in amateur sporting circles and was associated with rowing for many years. He rowed with the Commercial champion eight of 1909. At different times he has held the offices of secretary, captain, and president of the Commerical Rowing Club (Brisbane), and selector for the Queensland Rowing Association. He was equally interested in cycling and for long terms was treasurer of the Queensland Cyclists' Union and captain of the Brisbane Safety Bicycle Club, of which he won the championship in 1903 and 1904. Among other noteworthy achievements in amateur sport, he won the road team (cycle) premiership of Queensland, the Brisbane Grammar School Old Boys' cycle race twice, and was second in the 5-mile championship of Australasia in 1900.

For many years, Mr. Wilson has been a member of the Royal National Agricultural and Industrial Association, and is a vice-president of the State Service Branch of the Returned Sailors and Soldiers' Imperial League of Australia.

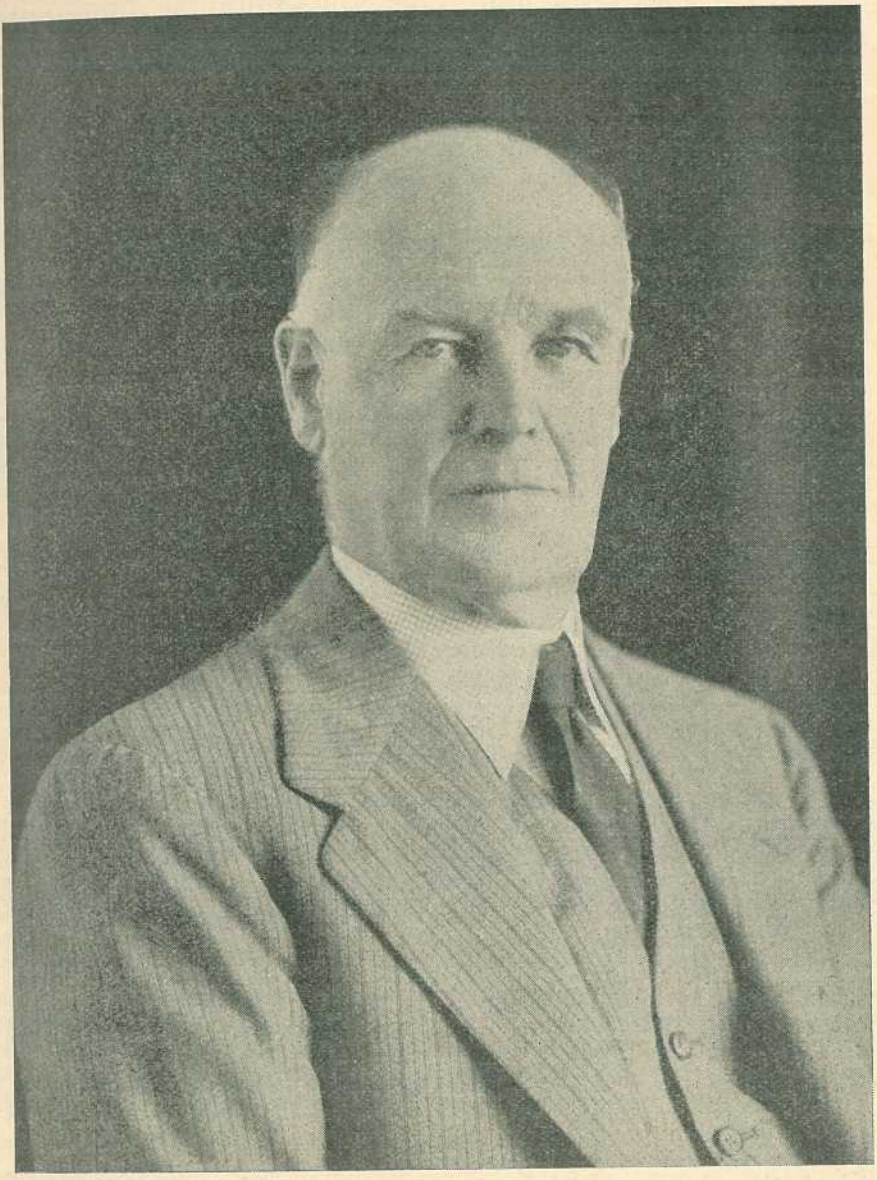

Plate 186A.

MR. ROBERT WILSON, Acting Under Secretary and Director of Marketing, Department of Agriculture and Stock.

The Soils of the Beerburrum-Glasshouse Mountains-Beerwah Area and their Suitability for Pineapple Culture.*

L. G. VALLANCE, B.Sc., Assistant Research Officer, and H. K. LEWCOCK, M.Sc., Senior Research Officer.

DURING the latter part of 1937 a soil survey was carried out in the Beerburrum-Glasshouse Mountains-Beerwah area for the purpose of determining—

(1) The various soil types occurring in these districts;

(2) The physical and chemical characteristics of the various soil types; and

(3) The relative suitability of these soil types for pineapple culture.

The data obtained from this survey has provided a basis, not only for effecting immediate improvements in fertilizing and cultural practices on pineapple soils in this area, but also for carrying out further research on these soils.

The survey has shown that the soils of the Beerburrum-Glasshouse Mountains-Beerwah area may be classified into four major types. These types, listed in the order of their potential agricultural value, have been designated as follows:—

(1) Glasshouse Sandy Loam.

(2) Glasshouse Sand.

(3) Beerburrum Fine Sand.

(4) Beerwah Sand.

In accordance with accepted practice, these names include a reference both to the distinguishing physical characteristic of the surface soil and to the district in which it is most commonly encountered. This does not mean, however, that the occurrence of any one of the types is necessarily limited to the district in which it was first recognised and from which it derives its name.

In the recognition of a particular soil type it is necessary to consider the surface, sub-surface, and subsoil layers as parts of one complete unit. The "surface" layer may be designated as that portion of the topmost soil which, because of its relatively high content of organic matter, is somewhat darker in colour than that underlying it. The depth of the surface soil varies considerably, and is not always easily discernible in dark or reddish coloured soils, such as the Glasshouse Sandy Loam. The "sub-surface" layer, as the name indicates, occurs directly below the surface layer proper, from which it is

* The first of a projected series of soil surveys covering the major pineapple-producing areas in southern Queensland was recently carried out in the Beerburrum-Glasshouse Mountains-Beerwah area, and forms the subject of a paper presented elsewhere in this issue. As this paper is necessarily somewhat technical in character, it has been considered desirable to present separately a short non-technical discussion of the data embodied in it, with particular reference to its bearing on pineapple production in the districts mentioned.

distinguished by a sharp drop in the amount of organic matter it contains, although it possesses essentially the same sand—clay ratio. The "subsoil" differs from the surface and sub-surface layers in that it is almost completely devoid of organic matter and usually contains a much higher proportion of clay. Throughout the Beerburrum-Glasshouse Mountains-Beerwah area the subsoil is generally red or yellowish-red in colour.

Although the roots of the pineapple plant rarely penetrate below the surface and sub-surface layers, the nature of the underlying subsoil exerts a marked influence on the rate and extent of root growth, since the movement and retention of soil moisture and, hence, the availability of mineral plant foods, is largely determined by the physical characteristics of the deeper soil layers. The following descriptions of the soil types which occur in the Beerburrum-Glasshouse Mountains-Beerwah area are based on data obtained from a large number of borings made to depths varying from 4 to 6 feet.

Glasshouse Sandy Loam.

This soil type is restricted to the higher levels and, consequently, it occurs under conditions of good surface drainage. The surface soil is quite reddish in colour and, while it contains about 40 per cent. of coarse sand, it has rather a loamy texture. Both the characteristic red colour and loamy texture extend to the subsoil. However, examination of a vertical face to a depth of about 3 feet shows that the high sand content of the surface layer does not persist at any great depth. At about 4 inches to 5 inches the soil becomes somewhat heavier. The subsoil commences at about 1 foot from the surface and is always coloured a very deep red. This colour, which is due to the iron content of the soil, is an indication of good drainage since, under conditions of poor drainage, iron is either taken into solution and removed, or converted into a less highly-coloured form.

In its virgin state the Glasshouse Sandy Loam supports a better vegetation cover than any other of the soil types in the Beerburrum-Glasshouse Mountains-Beerwah area. Tree growth is usually well developed and much of the timber is of marketable quality. In contrast to the poorly-drained sands occurring at lower levels, the flora of this soil rarely includes *Banksia* spp., while tea-tree is invariably absent. As might be expected from the type of vegetation which it carries, the Glasshouse Sandy Loam is better suited for agricultural purposes than any other class of soil in this area. Its suitability for pineapple culture has long been recognised, and several plantations at present growing on this class of soil are amongst the best in the State. (Plate 187.)

Glasshouse Sand.

On the lower portions of the ridge slopes the Glasshouse Sandy Loam generally gives way to a lighter type of soil, the Glasshouse Sand, from which it may be distinguished by an examination of the sub-surface and subsoil layers. As its name implies, the surface layer of the latter type of soil is much more sandy in texture and in colour it is not red but brown to greyish-brown. The sub-surface layer is lighter in colour than the surface soil, but still very sandy. In this type the deep red subsoil characteristic of the Glasshouse Sandy Loam does not come

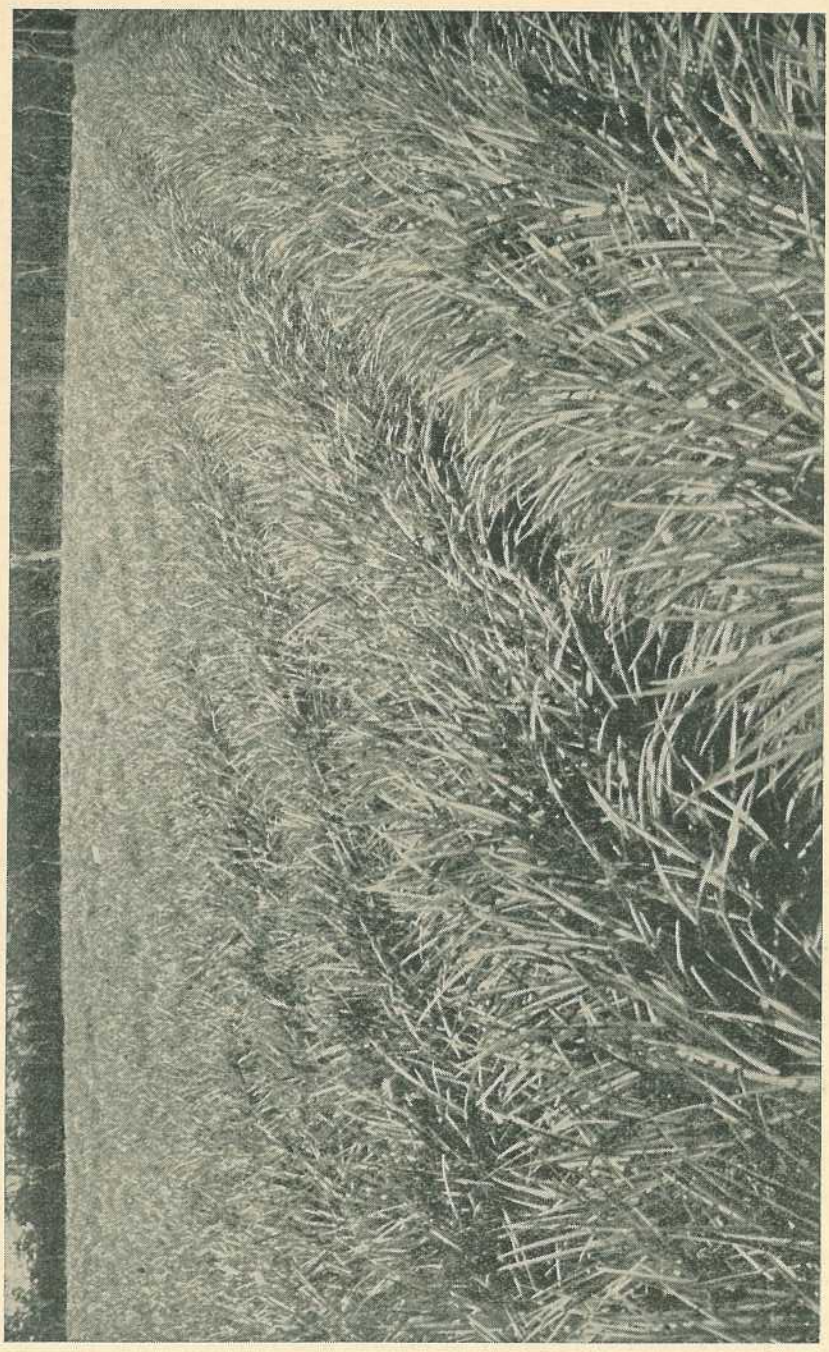

Plate 187.

Four-year-old Smooth Cayenne pineapple field on virgin Glasshouse Sandy Loam, Glasshouse Mountains district.

closer than about 2 feet from the surface. On being brought under cultivation for the first time the surface soil of the Glasshouse Sand may be fairly dark-brown in colour, due to the presence of organic matter, since even a small amount of humus lends a definite colour to a light sandy soil. On examination, however, it will be found that the dark-coloured layer cuts out sharply at about 5 inches to 6 inches from the surface, going straight into the bleached-looking sub-surface soil.

The type and character of the vegetation on the Glasshouse Sand may vary considerably, but tree growth is usually only moderately good. Tea-tree and other swamp vegetation may occur at lower levels and, as the intrusion of such plants denotes poor natural drainage, the areas where they occur should be avoided for pineapples. Provided soils of the Glasshouse Sand type are well drained, however, they may be profitably employed for pineapple culture (Plate 188), although their extremely sandy nature causes them to dry out very quickly unless adequately shaded. This is particularly the case after they have been under cultivation for several years.

Beerburrum Fine Sand.

A characteristic feature of this soil type is the dry, powdery nature of its surface layer. As its name implies, this class of soil is encountered most frequently in the Beerburrum district. The surface and sub-surface layers are greyish-white in colour and very sandy, but, in contrast to the other three types under discussion, the sand content of this soil is made up of very fine particles. At a depth of about 1 foot a band of light-yellow subsoil is encountered, which becomes increasingly clayey in character at greater depths. Underlying the clayey subsoil is a tightly-packed layer of ironstone rubble and clay, which is usually from 2 to 3 feet in thickness. The depth at which this rubble occurs varies considerably, but it is generally encountered at about 2½ to 3 feet from the surface. It may, however, occur at the shallow depth of 18 inches and since the layer presents an almost impenetrable barrier to roots, care should be taken to note its depth from the surface before bringing soils of this type under cultivation.

Soils of the Beerburrum Fine Sand type carry only a poor stand of natural vegetation. Tree growth is usually stunted, while bracken is commonly the dominant feature of the undergrowth. In hollows or depressions, the occurrence of tea-tree thickets is typical, indicating the existence of swamp conditions. In fact, the poor natural drainage of this soil type is its most noteworthy characteristic, and one which limits its usefulness for agricultural purposes to areas where the surface contour and underlying formation is such as will permit of the quick removal of excess moisture. When soils of this type are employed for pineapple culture, especial attention should be given to drainage, since this crop is extremely intolerant of water-logged soil conditions.

Beerwah Sand.

This soil type is confined to low-lying areas and depressions and, consequently, it is frequently encountered under swamp conditions. The surface layer is almost pure sand and is grey-brown in colour. At a foot or less from the surface, however, the colour changes to yellow

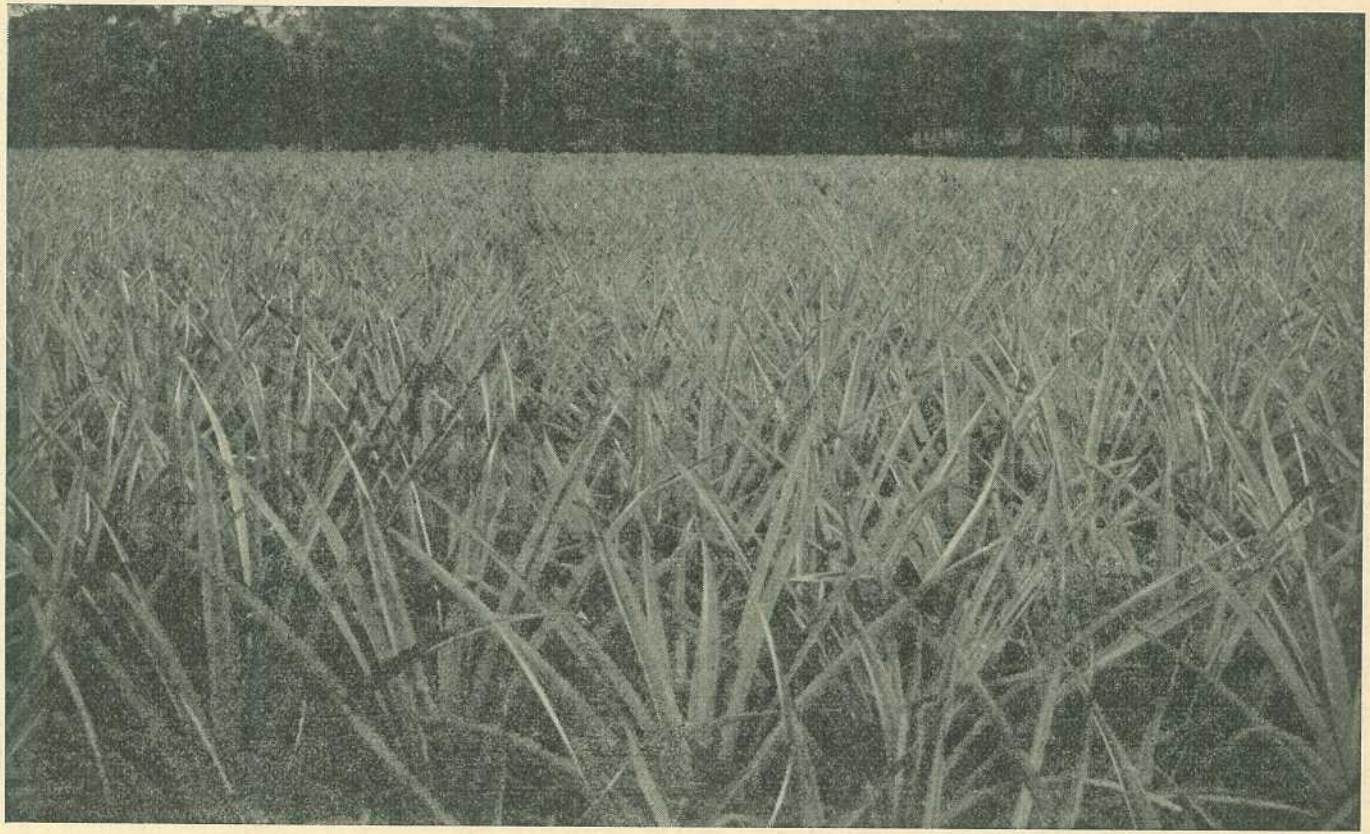

Plate 188.
Twelve-months' old Smooth Cayenne pineapples on virgin Glasshouse Sand, Beerwah district.

and this persists for a great depth, as does also the highly sandy nature of the soil. Analyses show that it may contain 80 per cent. of sand at a depth of 3 feet. On this type of soil, tree growth, if it occurs at all, is characteristically stunted; tea-tree and *Banksia* (honeysuckle) dominate the vegetation on the swampy areas. In every respect, this soil type is the poorest of those occurring in the Beerburrum-Glasshouse Mountains-Beerwah area. It appears to have little or no agricultural value and it is quite unsuited for pineapple culture.

Drainage.

In general, soils of the Beerburrum-Glasshouse Mountains-Beerwah district possess adequate natural drainage if they occur on the crown or upper slopes of one of the low ridges which are typical of this area. The type which is most frequently encountered under these conditions is the Glasshouse Sandy Loam. As previously mentioned, the deep red colour of the subsoil of this type is in itself an indication of good drainage, since under conditions of poor drainage the iron salts which give rise to this red colour are taken into solution and removed. In a few isolated localities, however, a clay-loam layer of low permeability intrudes in this type of soil at about a foot from the surface, and the interference with drainage caused by this layer may result in considerable erosion of the sandy, porous top soil during heavy storms. Where this relatively impermeable layer occurs, and also on slopes of more than usually steep gradient, particular attention should be given to the lay-out of the plantation when the land is planted to pineapples, and open surface drains should be provided in order to ensure a run-off of storm waters with the minimum loss of soil. The Glasshouse Sand, like the more loamy type just referred to, is also usually well drained except towards the bottom of a slope where it may become temporarily waterlogged during wet weather. Under such conditions, pineapple wilt is likely to develop unless adequate provision has been made for draining off surplus water. On ridges and sloping ground the drainage of the Beerburrum Fine Sand type of soil is generally satisfactory, but it should be remembered that the concretionary ironstone layer which underlies the subsoil is relatively impervious to water. Consequently, on this type of soil it is always advisable to lay out the rows in the direction of the slope in order that storm waters may be drained off as quickly as possible. The Beerwah Sand, because of its association with low-lying, swampy country and its fluctuating water-table, is nearly always unsuitable for pineapple culture. Owing to its low natural fertility, the artificial drainage of this type of soil is scarcely likely to prove profitable under existing economic conditions.

Moisture Relationships and the Need for Conserving Organic Matter.

Although the average rainfall of the Beerburrum-Glasshouse Mountains-Beerwah area amounts to between 50 and 65 inches annually, dry spells of fairly lengthy duration are not uncommon, particularly during the winter and spring months. Consequently, crop growth in the soils of this area is limited by their capacity to retain moisture during droughty periods. Unfortunately, the organic matter content of these soils—which is the factor chiefly determining the capacity of a sandy soil to retain moisture—is extremely low. Owing to the

appreciably higher content of both organic matter and fine soil particles in the Glasshouse Sandy Loam, this soil type sustains crop growth better during droughty periods than the more sandy types, because it does not dry out so quickly or to the same extent. In any of the soils, however, root growth is seriously retarded during prolonged dry periods unless steps have been taken to improve its water-holding capacity and to protect its moisture content from evaporation. Improving the water-holding capacity of a sandy soil is usually difficult in practice, as it can be effected only by increasing its content of organic matter. Cover-cropping during the inter-cycle period confers a temporary benefit only, since the dry weight of the organic matter returned to the soil in this way rarely exceeds 1 per cent. of the weight of the topmost foot of soil, and most of this disappears rapidly through decomposition while the land is being prepared for planting. Turning under the old pineapple plants is a far more valuable practice than intermittent cover cropping, since a well-grown crop should yield upwards of 20 tons of dry matter per acre at the end of a four-year cycle, and this contains a much higher percentage of fibrous residue than is usually obtained from the succulent, quick-growing annuals commonly employed as cover crops. Ploughing under old pineapple plants presents practical difficulties, but where these can be satisfactorily overcome the practice is a most beneficial one, particularly in soils with such a low organic matter content and, consequently, such a low water-holding capacity as those now under consideration.

Whether or not is is practicable to increase the water-holding capacity of these soils, however, every effort should be made to reduce evaporation of moisture from the surface layers. Shading the soil is effective in this connection. A simple and highly efficient means of accomplishing this is to space the plants more closely than is normally the practice in Queensland. The drier the locality or the lower the water-holding capacity of the soil, the closer should the plants be spaced, provided that the minimum spacing is not less than 5 feet 6 inches from centre to centre of the double rows nor less than 1 foot between the plants in the rows. Shading of the soil also tends to conserve the organic matter contained in it by slowing down decomposition processes. This is strikingly exemplified in the difference in productivity which usually exists between cleared virgin land and that which has been under cultivation for several years; in the districts under consideration, this difference is almost wholly due to the superior water-holding capacity of virgin soil which, prior to being brought under cultivation, is protected by a cover of natural vegetation.

The use of paper mulch provides a most effective means of conserving surface soil moisture in pineapple plantations, particularly in the early stages of growth before the foliage has grown sufficiently to provide adequate shade. Even soils of very poor water-holding capacity remain moist right to the surface throughout prolonged dry periods when protected by paper mulch. This has been demonstrated in various localities by field trials, particularly by one laid down on replant land at Beerburrum (Beerburrum Fine Sand) early in 1937. (Plate 189.) Prior to planting, the water-holding capacity of this soil was only 21 per cent. but, in spite of the fact that the seasons both preceding and following planting were amongst the driest on record, an excellent rate of growth has been maintained; so much so, in fact, that it

Plate 189.
A nine months' old replant field of Smooth Cayenne pineapples on Beerburrum Fine Sand, Beerburrum District.
Rows on right planted in paper mulch; rows on left unmulched.

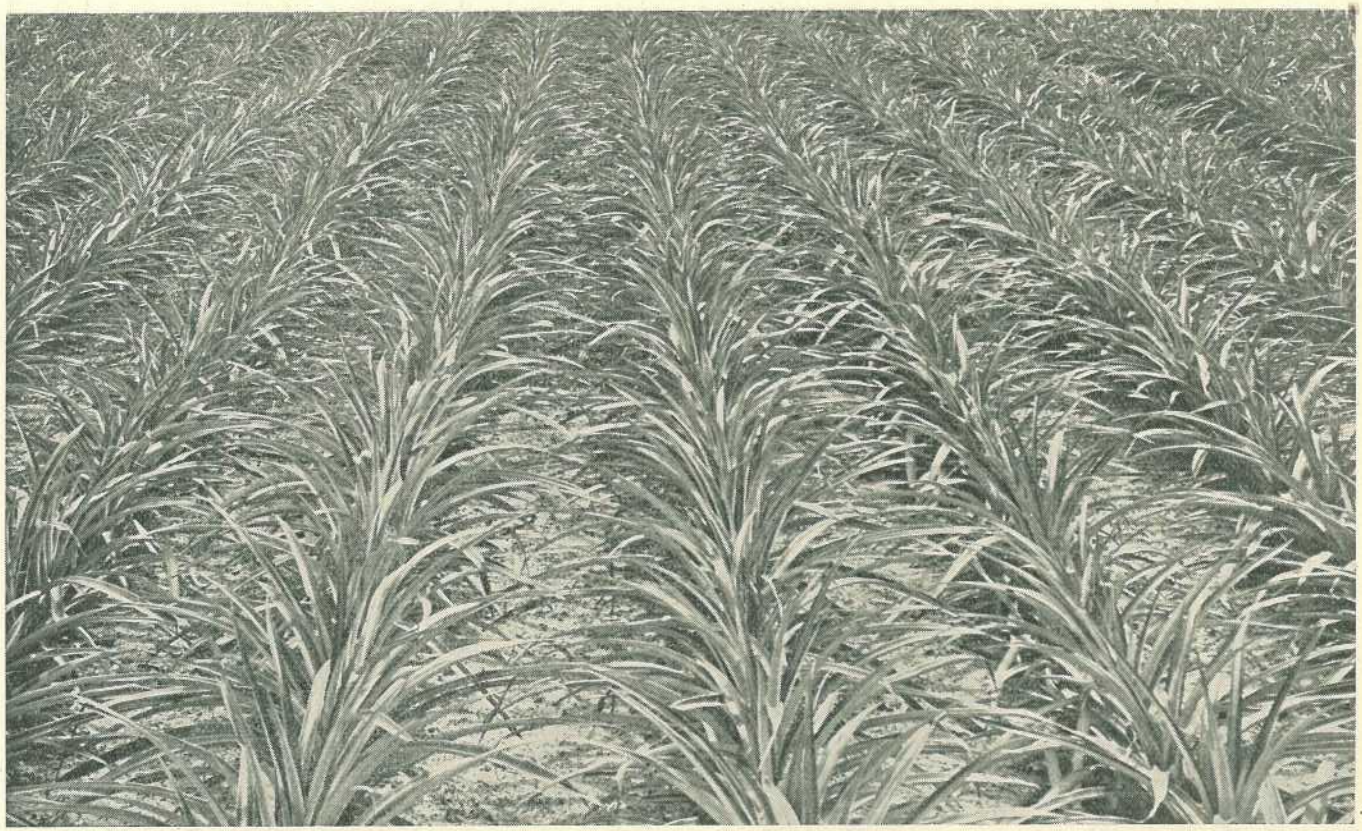

Plate 190.
An unmulched planting of nine months' old Smooth Cayenne pineapples on virgin Glasshouse Sand type of soil at Beerburrum: c.f. Plate 189.

compares favourably with the growth made by a nearby planting of the same age on unmulched virgin soil of the Glasshouse Sand type. (Plate 190.)

Where it is practicable to build up the organic matter content of the soil prior to replanting by shredding up the old pineapple plants, the tilth and water-holding capacity of the Glasshouse Sandy Loam type can be improved by deeper ploughing than is customary, since in this way the loamy sub-surface soil is brought to the surface. A ploughing depth of about 12 inches is recommended in such soils. In the case of the other soil types occurring in the Beerburrum-Glasshouse Mountains-Beerwah area, however, deep cultivation is not likely to improve their condition because of the extremely sandy or rubbly nature of the deeper layers.

Soil Reaction and Sulphur Requirements.

The soil reaction, as indicated by the pH value, exerts a marked influence on the vigour of growth of the pineapple plant since this plant is seldom able to obtain sufficient iron for its requirements in neutral or alkaline soils, and a stunted, narrow-leaved, chlorotic type of growth results. By maintaining the soil reaction between pH 4·5 and 5·0, an adequate supply of soluble iron is ensured unless the functioning of the roots is impaired by diseases or pests, or by unfavourable moisture or temperature conditions. In most soils, adjustment of the reaction to a pH value between the desired limits can be accomplished by an application of powdered sulphur prior to planting. The quantity of sulphur required to effect and maintain this adjustment on any given soil varies with (*a*) its initial reaction, (*b*) its physical and chemical properties, and (*c*) the extent to which it is proposed to use sulphate of ammonia for fertilizing the crop.

Under virgin conditions the reaction or pH value of the soils of the Beerburrum-Glasshouse Mountains-Beerwah area shows a remarkable degree of uniformity. Irrespective of their type, most soils of this area possess a pH value of between 5·5 and 6·0. In such a closely related group of soils variations in the amount of sulphur required to effect a given change in the pH value will be determined very largely by considerations of soil texture. In general, soils possessing the characteristics of the Glasshouse Sandy Loam will require heavier applications of sulphur than the lighter types. The accompanying table indicates the approximate quantities of sulphur required to adjust each of the soil types under consideration from varying initial pH values to a reaction favourable for pineapple growth. Since soils of the Beerwah Sand type are considered to be unsuitable for pineapple culture, no data on their sulphur requirement has been tabulated.

TABLE I.

pH.	6·5—6·1.	6·0—5·6.	5·5—5·3.
	lb. per acre.	lb. per acre.	lb. per acre.
Glasshouse Sandy Loam	500	450	250
Glasshouse Sand	400	350	200
Beerburrum Fine Sand	400	350	200

The acidifying effect of sulphate of ammonia on a soil is theoretically, about one-fifth of that of powdered sulphur. Consequently, the repeated application of sulphate of ammonia to the growing crop in the form of fertilizer may lead ultimately to the development of excessively acid conditions in the soil. At present no data is available on this point for the soils of the surveyed area. Should such conditions develop, however, they may be easily counteracted by the application of light dressings of lime at the end of each crop cycle, but liming of pineapple soils should not be carried out until technical advice has been obtained.

Chemical Characteristics and Fertilizer Requirements.

Chemical analyses show that the soils of the Beerburrum-Glasshouse Mountains-Beerwah area are all exceptionally deficient in mineral plant foods. Consequently, proper and adequate fertilizing of these soils is essential. For most crops, it is necessary to use a "complete" fertilizer mixture—i.e., one containing nitrogen, phosphoric acid, and potash—and for pineapples it is desirable that this mixture should be wholly compounded of water-soluble ingredients—except, possibly, in the case of the fertilizer placed under paper mulch—in order that the deficiency in these elements may be remedied immediately the fertilizer is applied. This is of particular importance in the case of the pineapple, since the vigour of the plant in the early stages of growth determines its productivity throughout the entire crop cycle. Because of the sandy nature and open texture of the soils, it is also preferable to apply the fertilizer mixture in moderate amounts at frequent intervals.

Owing to the extremely low nitrogen content of the Beerburrum-Glasshouse Mountains-Beerwah soils, crops grown on them will generally show an immediate and spectacular response to a dressing of sulphate of ammonia. Since a similar growth response is not usually evident from potassic or phosphatic fertilizers applied singly or in combination, the belief has gained ground that nitrogen is the only element lacking in these soils. Such a belief is entirely erroneous. While the supply of nitrogen is often the limiting nutritional factor for vegetative or leaf growth, the general vitality of a plant is dependent to a very large degree on the availability of other essential plant foods. Under conditions of potash or phosphoric acid deficiency, yields are diminished and the likelihood of losses from disease greatly increased. All of the soils of the Beerburrum-Glasshouse Mountains-Beerwah area exhibit a very marked deficiency in both of these elements, in addition to a shortage of nitrogen. The highest content of readily available phosphate which has been found in any virgin soil from this area to a depth of one foot is equivalent to a dressing of only 60 lb. of superphosphate per acre—i.e., the amount which is contained in one and one-quarter bags of "10-6-10" fertilizer mixture. The content of available (replaceable) potash is also generally much below the quantity required to obtain maximum yields from pineapples, namely, 500 lb. per acre foot. It is evident, therefore, that the profitable exploitation of these soils for pineapple growing entails the frequent application of fertilizers containing not only nitrogen, but phosphoric acid and potash as well.

For pineapples grown on these soils it is recommended that every thousand plants should receive annually at least 100 lb. of sulphate of

Plate 191.

A four months' old replant field of Smooth Cayenne pineapples on Glasshouse Sandy Loam type of soil. Note the vigour of growth which is obtainable on old land by systematic fertilizing combined with the use of paper mulch and close spacing of the plants.

ammonia, 30 lb. of superphosphate, and 20 lb. of sulphate of potash. This quantity of fertilizer should be applied in not less than four dressings, as follows:—50 lb. of "10-6-10" mixture in the spring and autumn and 25 lb. of sulphate of ammonia in midsummer and mid-winter. Even better response may be expected from somewhat lighter applications made at more frequent intervals. Base-leaf placement of the fertilizer will effectively increase its availability during dry periods and minimise losses due to leaching: this is the only satisfactory method of fertilizing pineapples which have been planted through paper mulch. Conservation of surface soil moisture is an important factor with regard to the intake of mineral plant foods by shallow rooting plants such as the pineapple; consequently, maximum results from fertilizing cannot be obtained from these soils unless provision has been made for shading the soil, either by close planting or, preferably, by close planting combined with the use of paper mulch (Plate 191). Where paper mulch is used, a portion of the total amount of fertilizer which is to be supplied to the crop during the cycle should be applied to the soil prior to laying the mulch; a dressing of "10-6-10" at the rate of 10 lb. per 100 feet of mulch is recommended.

Summary.

From an agricultural standpoint, the two most significant features of the soils occurring in the Beerburrum-Glasshouse Mountains-Beerwah area are (1) their low capacity for retaining moisture, and (2) their extreme deficiency in mineral plant foods. Consequently, the profitable exploitation of these lands for pineapple culture depends above all else on (1) the application of measures for conserving soil moisture, and (2) proper and adequate fertilizing of the crop throughout its growth.

Of the four soil types recognised in this area, the one which has been designated the Glasshouse Sandy Loam is markedly superior to the others in both its physical and chemical properties. However, the deficiencies noted above occur even in this soil type, although to a lesser degree than in the lighter types. In the descending order of their agricultural value, these other types are the Glasshouse Sand, the Beerburrum Fine Sand, and the Beerwah Sand. Because of its almost constant association with swampy conditions, the lastnamed is regarded as being entirely unsuitable for pineapple culture.

The Glasshouse Sandy Loam is nearly always characterised by good natural drainage since it occurs almost solely on ridges or slopes. The Glasshouse sand is well-drained where it occurs on slopes, but at low levels it is subject to water-logging. The drainage of the Beerburrum Fine Sand is also usually satisfactory on high ground, but because of the impervious nature of its deeper layers, the layout of the plantation should permit of the rapid "run-off" of storm waters.

Each of the four soil types has a low capacity for retaining moisture, due, in large measure, to the extremely small percentages of organic matter which they contain. Replenishing the organic matter content of these soils at the end of each pineapple cycle by turning under the old crop residues is recommended and also the application of cultural practices designed to minimise surface evaporation. In this connection trials now in progress indicate that profitable yields from replant land

will probably be obtainable only through the use of paper mulch. On the lighter soil types mulching is also recommended on virgin land.

Prior to planting any of the soils of the Beerburrum-Glasshouse Mountains-Beerwah area with pineapples, some adjustment of the soil reaction is generally necessary. In all cases, this can be accomplished by an application of powdered sulphur. The quantity of sulphur required to effect the desired change in reaction varies somewhat according to the type of soil, its pH value prior to treatment, and the type of nitrogenous fertilizer which it is proposed to apply to the crop. The rates of sulphur application recommended for each of the soil types at varying initial reaction values have been tabulated for easy reference.

The extreme deficiency in mineral plant foods of all of the soils under consideration indicates the need for adequate fertilizing. Because of this deficiency and the porous nature of the surface layers, the frequent application of light dressings of water-soluble chemical mixtures is considered preferable to heavy applications of slow-acting, organic base mixtures supplied only at half-yearly or yearly intervals. The use of the latter is not advocated except, possibly, where some portion of the fertilizer is applied under paper mulch prior to planting. Specific recommendations are made with respect to fertilizing pineapples grown on soils of the Beerburrum-Glasshouse Mountains-Beerwah area.

QUEENSLAND SHOW DATES.

June.

Maryborough	31st May to 2nd June
Biloela	2nd to 4th
Lowood	3rd and 4th
Childers	6th and 7th
Boonah	8th and 9th
Bundaberg	9th to 11th
Wowan—	
Show	9th and 10th
Rodeo	11th
Gin Gin	13th and 14th
Gladstone	16th and 17th
Marburg	17th and 18th
Rockhampton	21st to 25th
Mackay	27th to 30th
Kilcoy	30th June and 1st July

July.

Kilcoy	30th June and 1st July
Proserpine	1st and 2nd
Nambour	7th to 9th
Cleveland	8th and 9th
Ayr	8th and 9th

July—continued.

Townsville	11th to 14th
Rosewood	15th and 16th
Esk	15th and 16th
Charters Towers—	
Show and Rodeo	19th to 21st
Laidley	20th and 21st
Maleny	21st and 22nd
Cairns	26th to 28th
Gatton	28th and 29th
Caboolture	29th and 30th

August.

Atherton	2nd and 3rd
Pine Rivers	5th and 6th
Home Hill	5th and 6th
Royal National, Brisbane	15th to 20th

September.

Imbil	2nd and 3rd
Ingham	2nd and 3rd
Pomona	9th and 10th
Tully	9th and 10th
Beenleigh	16th and 17th
Southport	24th

A Soil Survey of the Beerburrum, Glasshouse Mountains and Beerwah Pineapple Districts.*

L. G. VALLANCE, B.Sc., Assistant Research Officer.

1. GENERAL DESCRIPTION OF THE AREA.

Location and Area.

THE area under review consists of approximately 3,500 acres in the parish of Beerwah, county of Canning. The North Coast Railway line, which runs more or less parallel to the coastline and about eight miles distant from it, passes through the townships of Beerburrum, Glasshouse Mountains and Beerwah, about which centres the productive areas are disposed. Beerwah Mountain, Lat. 26° 53′ 55″ S., Long. 152° 53′ 12 ″ 37 E., forms a convenient reference point, being some five miles east by one-half mile south of Glasshouse Mountains railway station.

Physiography.

The southern portion of the area is characterised topographically by the presence of flat low-lying country with tea-tree swamps typically developed. North of Beerburrum low undulating ridges make their appearance, the highest of which would not be more than 200 feet above sea-level. The heights of Beerburrum, Glasshouse Mountains and Beerwah townships are respectively 135, 87 and 103 feet above sea-level. Between these slightly elevated portions occurs a great deal of swampy country which has not been utilised for agricultural purposes. The cultivated areas are mostly confined solely to the ridges, which are usually flat-topped with gentle slopes. The area, therefore, may be referred physiographically to four major features—(*a*) the low flat tea-tree areas south of Beerburrum, (*b*) the plateau-like areas of limited elevation, (*c*) the gentle ridge slopes of these and (*d*) the interspersed tea-tree swamps. These are important, since they practically define the soil types under consideration.

The Glasshouse Mountains, which are briefly described later, form the western boundary. The effect of these igneous peaks on the soil formation of the area is unimportant, and the numerous intrusions associated with them have little significance from a soil point of view in the area surveyed.

Geology.

The country rock consists of Mesozoic sandstones with interbedded shales. The sandstones are ferruginous and coarse-grained, and, in many cases, grade into grits. Fairly large water-worn pebbles sometimes occur, scattered sparsely throughout the soil profile in the lower horizons. The coarseness of the parent material is often reflected in the texture of the Glasshouse Sandy Loam, and in one locality (Portion 92v, 3, 4) the concentration of the fine gravel and coarse sand fraction is most marked. A feature of these sediments is their non-calcareous nature. They belong to the Ipswich Coal Measures, which are regarded as Triassic.

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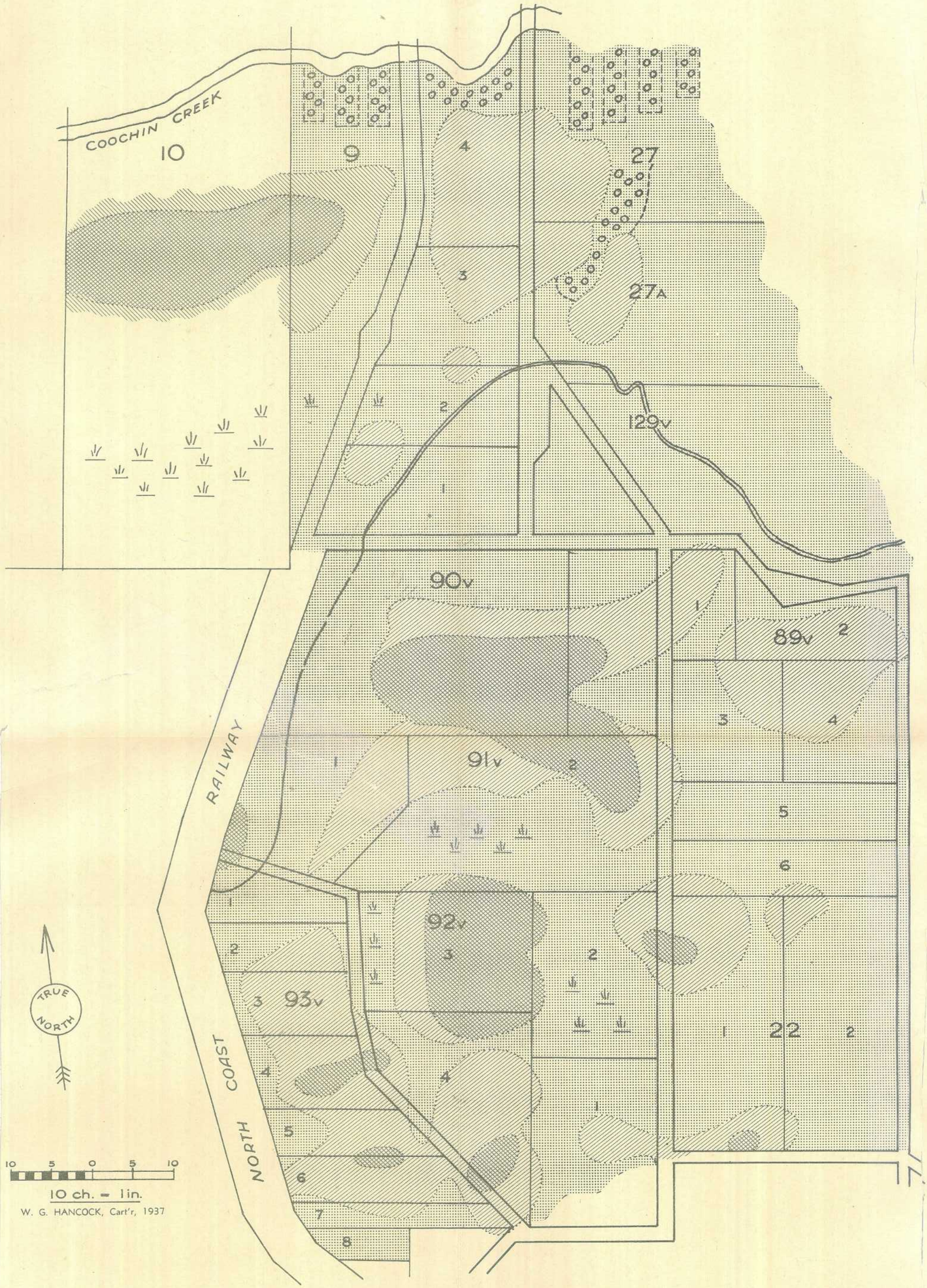
* A non-technical discussion of the data embodied in this paper in its relation to pineapple production in the surveyed area is presented elswhere in this issue, viz., "The soils of the Beerburrum-Glasshouse Mountains-Beerwah area and their suitability for Pineapple Culture."



GENERAL DISTRIBUTION OF SOIL TYPES

PORTION OF

GLASSHOUSE MOUNTAINS– BEERWAH DISTRICT

COOCHIN CREEK

10

9

4

27

3

27A

2

129v

1

90v

1

89v 2

3 4

RAILWAY

91v

1 2

5

6

1

2

92v

3

2

3 93v

4

4

1

5

6

7

8

1 22 2

COAST

NORTH

TRUE NORTH

10 5 0 5 10

10 ch. = 1 in.

W. G. HANCOCK, Cart'r, 1937

GENERAL DISTRIBUTION OF SOIL TYPES

PORTION OF

GLASSHOUSE MOUNTAINS– BEERWAH DISTRICT

PARISH OF BEERWAH

Glasshouse Sandy Loam

Glasshouse Sand

Beerwah Sand

Unnamed Alluvial

The area is flanked on the west by a series of isolated sub-acid lava flows and plugs forming the Glasshouse Mountains which rise to a maximum elevation of 1,814 feet at Mount Beerwah. The outcrops are chiefly trachyte; there is little indication of any pyroclastic material, and flow structure is often in evidence. A characteristic feature is the presence of sanidine felspar and numerous small crystals of ægerine, giving the rock a definite speckled appearance. Comendites, pantellarites, dacite and rhyolite also occur. A full description of these igneous rocks is given by Richards.[1]

Natural Vegetation.

The prevailing vegetation is eucalyptus forest. From general observation there is little correlation between the various species and soil type. It would appear that in these closely related soils the actual growth status of the vegetation is the distinguishing feature, tall timber and good growth being more characteristic of the Glasshouse Sandy Loam and Glasshouse Sand.

The common bracken (*Pteris aquilina*), banksias, and the paperbark (*Melaleuca leucadendron*) are typical of the Beerwah Sand and Beerburrum Fine Sand. The grass tree (*Xanthorrhea* sp.) is common to all types, while the Tallowwood (*Eucalyptus microcorys*) is noticeably associated with the Glasshouse Sandy Loam. A representative list of the eucalypts and other macrovegetation of the area is as follows:—Tallowwood (*E. microcorys*), Yellow Stringybark (*E. acmenioides*), Red Stringybark or Messmate (*E. resinifera*), Grey Gum (*E. propinqua*), Blackbutt (*E. pilularis*), Red Bloodwood (*E. corymbosa*), White Bloodwood (*E. trachyphloia*), Spotted Gum (*E. maculata*), Scribbly Gum (*E. micrantha*), Turpentine (*Syncarpia laurifolia*), Paperbark (*Melaleuca leucadendron*), grasstree, banksia, and bracken.

2. DESCRIPTION AND CLASSIFICATION OF SOIL TYPES.

A feature of the soils of the area, with the possible exception of the Glasshouse Sandy Loam, is the highly leached condition and very sandy nature of the surface horizons. There are no very marked climatic or geologic variations and the soils must be regarded as belonging to one series. Four major types have been recognised and have been named according to the usual nomenclature, the name signifying the location of the major occurrence and also the texture of the surface horizon.

(*a*) Glasshouse Sandy Loam.

(*b*) Glasshouse Sand.

(*c*) Beerwah Sand.

(*d*) Beerburrum Fine Sand.

Since the object of this survey was to provide a basis for agricultural investigational work, certain minor differences in the poorly productive types—e.g., the Beerburrum Fine Sand—have been disregarded. No useful purpose, under present conditions, could be served by attempting to define these variations. From the point of view of pineapple culture the inferiority of this type is obvious. Equally well defined is the relative superiority and drought-resisting capacity of the Glasshouse Sandy Loam. The surface soils of both types, as shown in Part 3, are very low in plant foods. The organic carbon and nitrogen content is also deficient. The significant difference is in the texture,

not only of the surface horizon, but also of the sub-surface. On profile investigation, it is immediately seen that the Glasshouse Sandy Loam possesses a structure retentive of moisture, yet in no way hindering natural drainage. The importance of this fact, having due regard to the climatic characteristics of well-marked wet and dry periods prevailing within the area, cannot be too strongly stressed.

Maps showing the general distribution of each soil type are included in this paper. It is not intended that the boundaries which have been defined should be regarded as the absolute lines of demarcation between the types. There is no abrupt transition in the field and the sequence, Glasshouse Sandy Loam—Glasshouse Sand—Beerwah Sand is the normal one in passing from the higher to the lower levels of the gentle slopes.

(a) Glasshouse Sandy Loam.

This is without doubt the most fertile of all four of the soil types described. It occupies the higher levels, and the major outcrops lie to the west of that portion of the North Coast railway between the stations of Glasshouse Mountains and Beerwah. It is readily recognised by its profile development, which is fairly uniform throughout, and by its colour. A typical profile is illustrated diagrammatically in Plate 193.

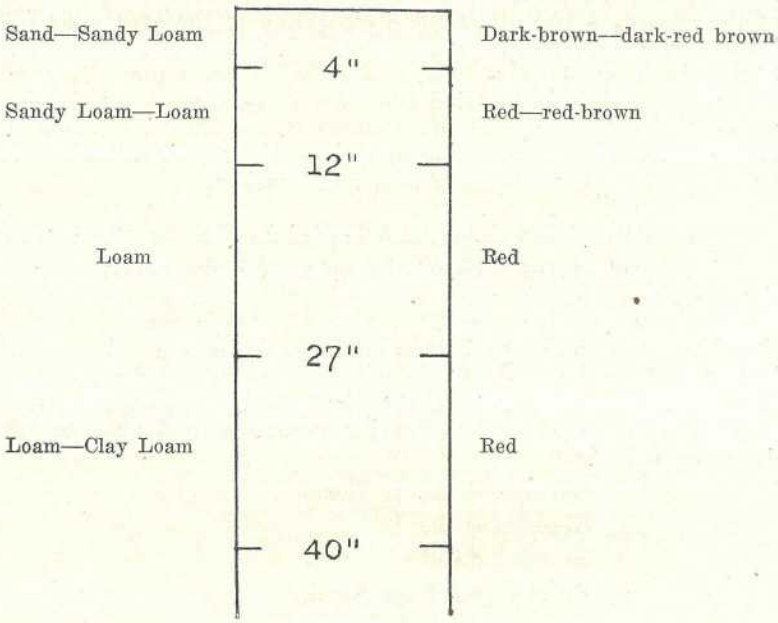
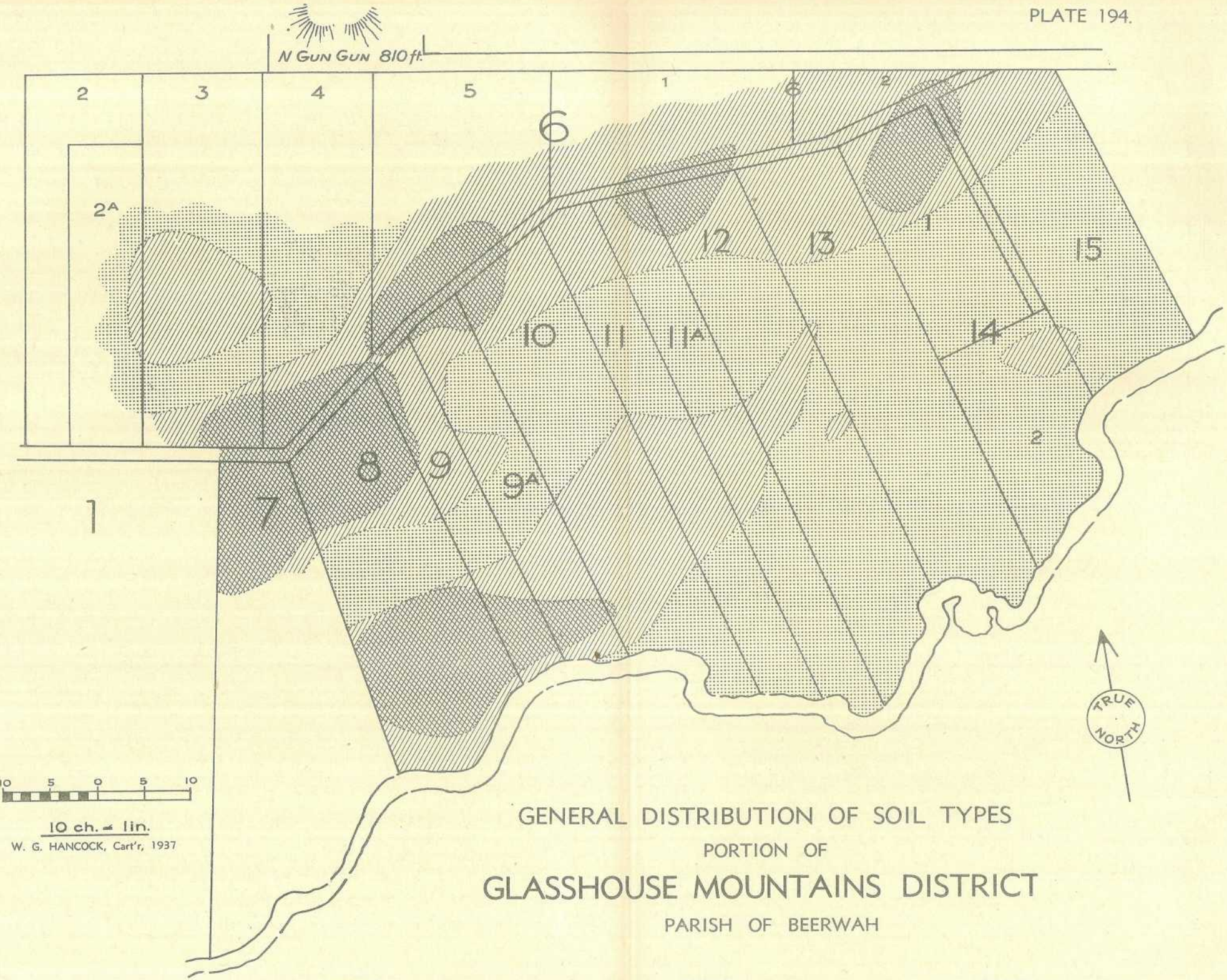


Plate 193.
Profile of Glasshouse Sandy Loam.

A gradual increase in texture and colour with depth is characteristic, there being no abrupt change from one horizon to the other. The surface horizon is perhaps the most clearly defined. In general, this is about 4 inches deep and may vary from dark brown to dark red-brown in colour and sandy to sandy loam in texture. The clay percentage varies from 10 per cent. to 20 per cent. , whilst the coarse sand averages 40 per cent., predominating by about 5 per cent. over the fine sand.



GENERAL DISTRIBUTION OF SOIL TYPES

PORTION OF

GLASSHOUSE MOUNTAINS DISTRICT

PARISH OF BEERWAH

Glasshouse Sandy Loam

Glasshouse Sand

Beerwah Sand

The fact that this coarse sand may be very coarse indeed, approximating to fine gravel, often gives the soil a rather deceptive excessively sandy "feel." This occurs in some localities and appears to be due to variation in grain size of the parent grits. In such cases the coarse texture has allowed a marked mechanical eluviation, and there is a tendency for a compact sandy clay horizon of low permeability to develop about a foot below the surface. Consequently, there is a danger of considerable erosion and wash on such soils during heavy rainfall. This is particularly noticeable on the south-western portion of Portion 90v. The occurrence of these coarse-grained types is patchy and would entail a considerable amount of work to define. It is limited in extent and is not a serious fault providing a little care is exercised by the grower in the layout of the crop rows.

The sub-surface in the type profile is about 8 inches in thickness, and this is fairly general throughout the area. Its texture varies from sandy loam to loam, and its colour from red to red-brown. If this A_2 horizon is turned up during cultivation the sandy texture of the surface soil will be favourably modified, thereby increasing its water-holding capacity. When this soil type is well cultivated a good tilth is obtained which differs markedly from the single-grain nature of the other types.

The subsoil, which occurs at a depth of 12 inches in the type sample, is a deep red loam which is retentive of moisture yet has no tendency towards waterlogging. It will be seen, therefore, that physically this soil may be regarded as good; its ability to continually supply the soil moisture required for root development is a factor which allows a more effective response to quick-acting fertilizers.

TABLE 1.

MECHANICAL ANALYSES AND CHEMICAL DATA OF GLASSHOUSE SANDY LOAM PROFILE.

Sample No.	4464	4465	4466	4467
Depth in inches.	0–4	4–12	12–27	27–48
	%	%	%	%
Coarse Sand	42·40	36·50	33·52	21·52
Fine Sand	34·80	34·25	30·80	21·88
Silt	9·75	7·20	7·00	5·38
Clay	10·12	18·60	26·40	42·02
Loss on Acid	1·20	1·27	..	..
Moisture	2·3	2·25	2·58	7·80
R_2O_3	5·94	9·64	15·11	23·04
Fe_2O_3	2·18	3·62	5·10	8·25
P_2O_5	·03	·01	·02	·02
CaO	·06	·03	·05	·04
MgO	·010	·016	·017	·014
K_2O	·042	·040	·034	·042
Organic C.	1·72	·76	·33	·25
Reaction	6·13	5·6	5·7	5·5

Reference to Table 1 shows that the clay content increases appreciably in the subsoil horizon—i.e., 12 to 48 inches. In the lower portion, the figure of 42 per cent. would imply a heavier nature than is apparent in the field. The same table, however, shows that this horizon is markedly sesquioxidic in character, which factor no doubt contributes

to the permeability and good drainage of the subsoil. The translocation of the Fe and Al within the profile is an indication that this soil has been affected by a process of weak podsolisation. However, the relatively high concentration of sesquioxides still within 12 inches of the surface, and the absence of any bleached A_2 horizon implies that this soil is not so extensively podsolised as the types which are discussed later.

There is no accumulation of organic matter in the lower horizons, and there is a decrease in pH with depth.

The lime content is extremely low throughout and, since the distribution of this element is influenced by plant growth, there is evidence of some accumulation at the surface from the deposition of plant residues. The A_2 horizon is the most impoverished in Ca.

Ferruginous concretionary material occurs frequently within the profile, being met with at depths varying from 3 to 7 feet. It is impossible to penetrate this layer with a 4-inch soil augur. The nature and distribution of this material is further discussed on pages 575-577.

(b) Glasshouse Sand.

In close association with the Glasshouse Sandy Loam and topographically related to it, is a well-leached light-coloured sandy soil which has been called the Glasshouse Sand. This type occurs on the ridge slopes, particularly on the lower levels of the slopes occupied by the heavier type. The profile of a typical occurrence is given in Plate 195.

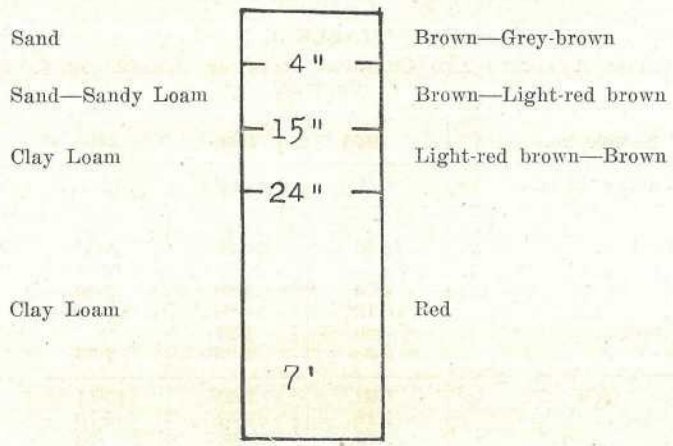


Plate 195.
Profile of Glasshouse Sand.

A feature of the profile is its leached appearance and the sandy texture of the A horizon. The surface is a brown to grey-brown sand containing about 1 per cent. organic carbon, largely undecomposed woody material. This drops off sharply to about 0·5 per cent. in the sub-surface at a depth of about 4 inches. The sub-surface as seen from Table 2 is also sandy and brown to light red-brown in colour. This continues to 15 inches in the type sample, but may be deeper as the bottom of the slope is approached.

Since the A horizon is 15 inches deep, it is the one to which the majority of the roots of the pineapple is confined. From its sandy nature and low organic matter content it is obvious that its field capacity for moisture is very poor, and this is reflected in the relatively poor growth of the natural vegetation cover. In the case of the surface-rooting pineapple, the conservation of the surface soil moisture is an important factor in its response to applied fertilizers; and careful attention must be given to this factor when soils of the Glasshouse Sand type are planted with this crop.

TABLE 2.

MECHANICAL ANALYSES AND CHEMICAL DATA OF GLASSHOUSE SAND PROFILE.

Sample No.	4492	4493	4494	4495
Depth in inches.	0–4	4–15	15–24	24–72
	%	%	%	%
Coarse Sand	41·7	38·8	29·3	22·1
Fine Sand	42·6	40·7	32·6	27·6
Silt	5·2	7·2	7·4	5·0
Clay	5·9	8·6	23·6	38·4
Loss on Acid	nd	nd	1·3	nil
Moisture	1·3	1·9	6·0	7·0
R_2O_3	2·63	4·31	12·22	16·12
Fe_2O_3	1·26	1·92	3·86	6·00
P_2O_5	·013	·021	·020	·018
CaO	·056	·028	·028	·035
MgO	·014	·036	·094	·051
K_2O	0·27	·023	·023	·042
Organic C.	1·0	·51	·52	·18
Reaction	6·0	5·8	6·0	5·8

A comparison of the Fe_2O_3 and R_2O_3 figures as shown in Table 2 with those of Table 1 bear out the more intense nature of the leaching processes which have acted upon this type. The low ferruginous content, even at depths of approximately 2 feet, is a major index in the recognition of this soil in the field. While the lower proportion of bases is not particularly significant in the profile analysis, the lower base status of the type is well borne out in the figures for replaceable base estimations given in Tables 8 and 9.

Concretionary rubble may occur in the profile throughout the area. Its occurrence within 7 feet of the surface is, however, rather infrequent, but may often be observed in cuttings at a greater depth than this. It was not encountered in the type profile.

There is a marked increase in the clay content from 8·6 per cent. at 4 inches to 15 inches to 23·6 per cent. at 15 inches to 2 feet. With its porous surface horizons and greater clay content in the subsoil there is a danger of periodic waterlogging in this type when the topography is disposed to such conditions. Where this has been observed in the field it is marked by a noticeable decline in the health of the pineapple plant and its resistance to wilt.

No accumulation of organic matter in the lower horizons was noted in the large number of field profile studies, and the figures of Table 2 are representative of the decrease in carbon with increasing depth. The pH of the profile remains fairly uniform.

(c) Beerwah Sand.

The Beerwah Sand, which occurs extensively throughout the area, is usually confined to the lower lying portions. It is closely associated with the swamp soils from which no attempt has been made to distinguish it. It is definitely "hungry" country supporting a very poor type of vegetation. A typical profile is illustrated in Plate 196.

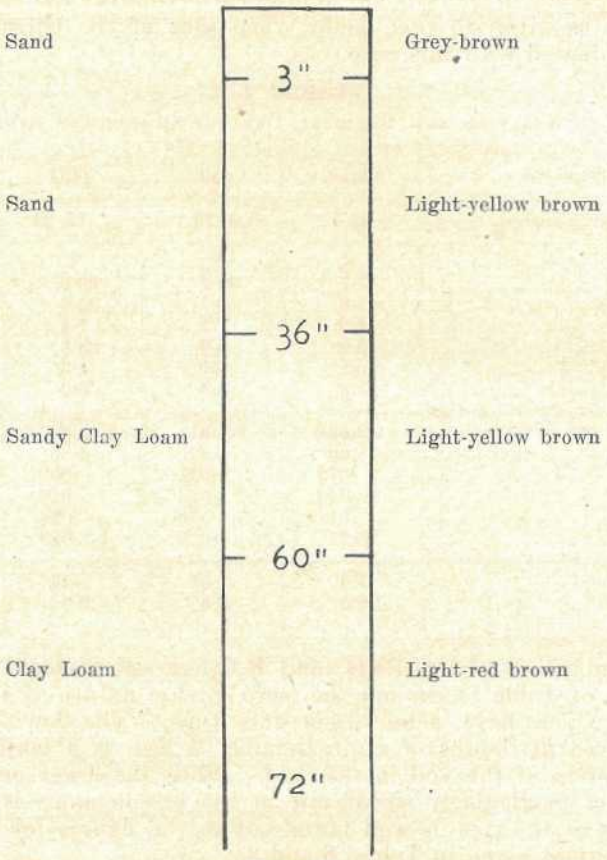
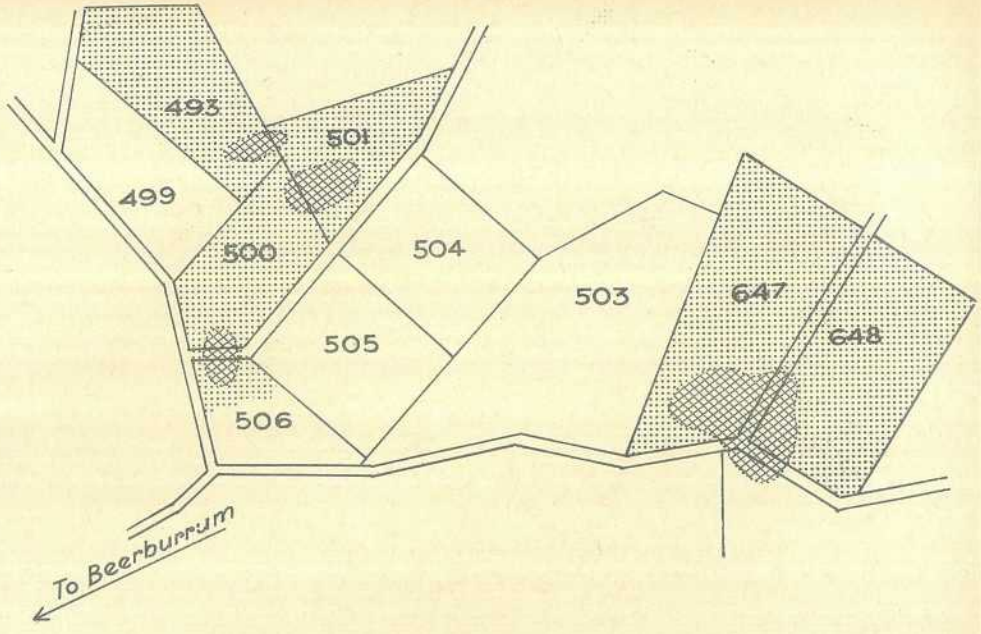


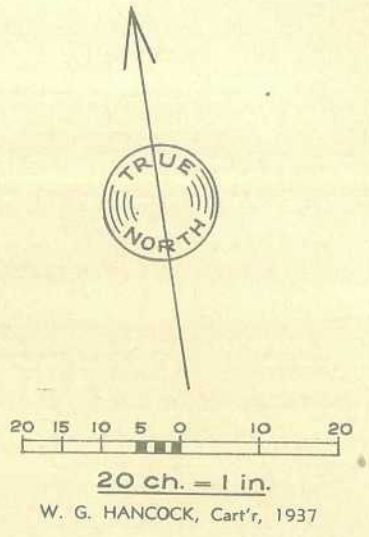
Plate 196.
Profile of Beerwah Sand.

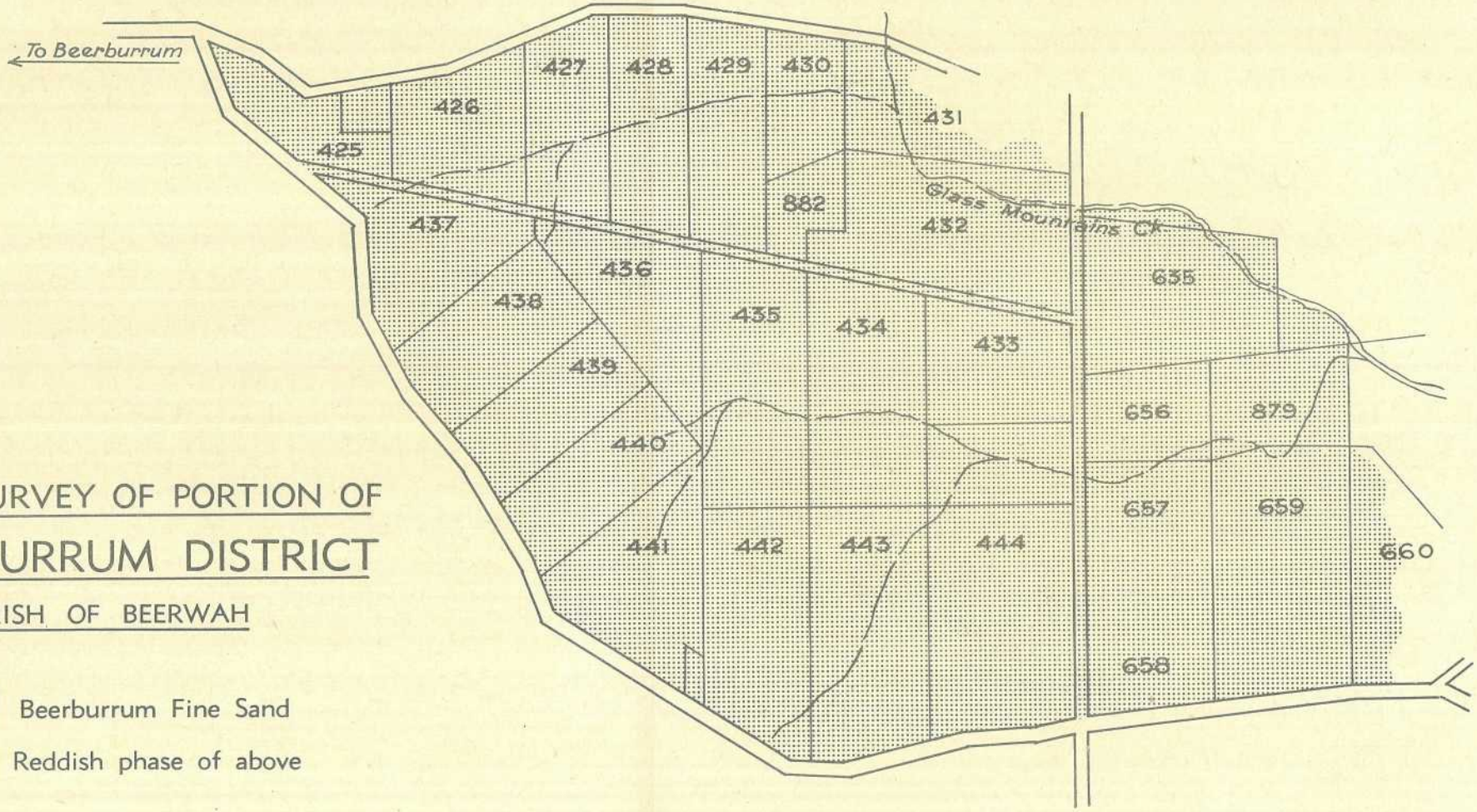
The 3 inches of surface soil contain almost 90 per cent. sand, in which the coarse sand predominates by about 20 per cent., and this high content of sand continues down to 3 feet in the type sample. The depth of this extremely sandy horizon is one of the factors which renders this soil exceptionally poor from an agricultural point of view.

The subsoil is light yellow-brown in the B horizon and the texture is that of a sandy clay loam, the clay content being 22 per cent. and that of sand 66 per cent., the fine and coarse sands being present in approximately equal amounts. Below this the clay further increases to 33 per cent.

In the type areas this soil carries a typical swamp vegetation. In the wet season it may be dangerously waterlogged. The lower horizons are characterised by frequent red and yellow mottling, indicative of bad drainage.







SOIL SURVEY OF PORTION OF
BEERBURRUM DISTRICT
PARISH OF BEERWAH

Beerburrum Fine Sand

Reddish phase of above

The transition point from this soil to the type occupying the higher levels, usually the Glasshouse Sand, is never clearly defined. At the transition stage, the drainage of the Beerwah Sand may be quite good, and any cultivation of this soil should be limited to these areas.

TABLE 3.

MECHANICAL ANALYSES AND CHEMICAL DATA OF BEERWAH SAND PROFILE.

Sample No.	4511	4512	4513	4514
Depth in inches.	0–3	3–36	36–60	60–72
	%	%	%	%
Coarse Sand	54·2	44·2	33·7	31·8
Fine Sand	33·7	43·0	33·0	26·5
Silt	5·6	3·8	9·7	6·0
Clay	4·7	7·8	22·1	33·3
Loss on Acid	·5	·9	·8	·8
Moisture	1·4	·1	1·1	1·5
R_2O_3	..	3·24	12·98	15·76
F_2O_3	..	1·28	4·36	5·62
P_2O_5	..	·009	·024	·015
CaO	..	·035	·035	·028
MgO	..	·063	·051	·030
K_2O	..	·023	·036	·017
Organic C.	1·37	·33	·16	·20
Reaction	5·5	5·7	5·3	5·10

Owing to the many difficulties attendant upon the cultivation of this soil type and its unimportance from an economic standpoint, no good purpose could be served by a detailed study of its features. The tables of analytical data on pages 564-568 further shows its inferiority. The mechanical analyses and chemical data of the type profile are given in Table 3.

(d) Beerburrum Fine Sand.

This soil covers a large area of flat, featureless terrain, of which a large portion is occupied by swampy or badly-drained country, with tea-tree typically developed. Any cultivation is confined to the slight ridges and ridge slopes which begin to appear towards the northern boundary in the vicinity of the Beerburrum township. These low elevated areas are naturally well drained, and the present investigation was confined to them. The typical profile is shown in Plate 198.

The predominating characteristic of the surface horizon of this soil type is its thoroughly leached condition. The fineness of its sandy texture is also well marked. Although the mechanical analysis of the 0-6-inch horizon given in Table 4 shows equal amounts of coarse and fine sand, this coarse sand must be close to the lower limit of ·2 mm., and its fineness is marked in comparison with the coarse sands of the other types. It is noticeable that the relative proportion of the fine sand fraction increases below the surface.

A feature of the profile is the presence of rounded concretions. These occur over a large area of country, and have been observed *in situ* at a point some two miles south of Caboolture, and frequent occurrences are to be noted from there to the type area which is nine miles north of Caboolture. This concretionary horizon occurs at a depth of 2 feet

6 inches to 3 feet, and this depth is remarkably constant, though in a few places it has been noted to outcrop almost on the surface, usually on the ridge tops: for example, on Portion 427 the rubble begins to appear at 18 inches from the surface. The horizon is about 2 feet thick, and is so thickly studded with the concretions that it is impossible to pass through it with a soil augur or spade. The pellets are quite hard, but may be sectioned easily by a pair of stout scissors. Externally they present a yellowish-brown smooth appearance of about 2 or 3 cm.

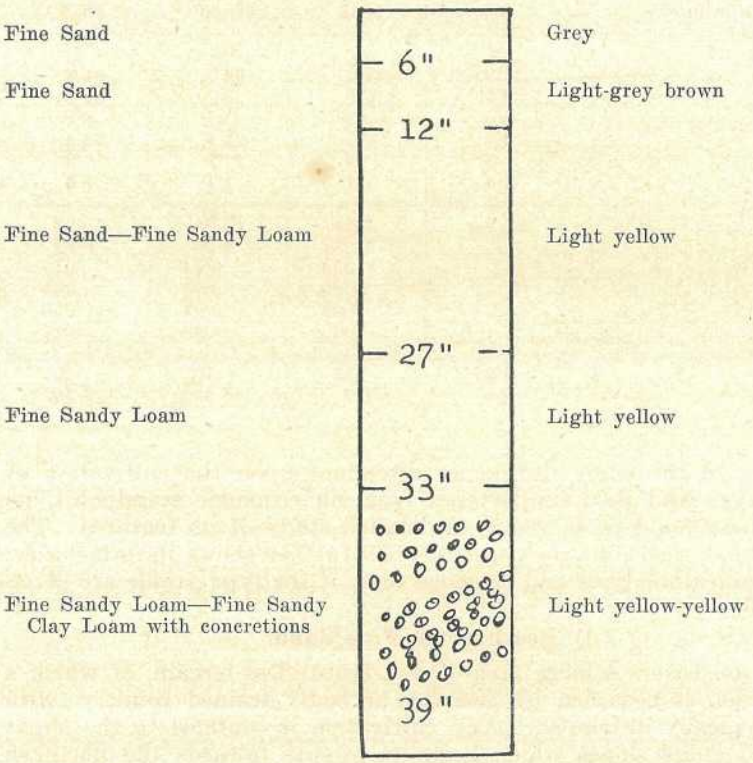


Plate 198.
Profile of Beerburrum Fine Sand.

diameter. When sectioned the compact outer portion is seen to be limited to a thickness of about 1 mm. or less. Internally they consist of fine sand grains cemented by red ferruginous material. Many of them, however, are quite black inside, and this second type is scattered through the topmost portion of the rubble horizon. This dark colour is probably due to manganiferous material, an analysis showing 15·6 per cent. of manganese calculated as Mn_3O_4, plus 15·6 per cent. Fe_2O_3. No P_2O_5 was found. The material in which the rubble is embedded has the texture of a yellow, fine sandy clay loam. In the true swamp areas there is no concretionary horizon, a grey clay with red and yellow mottling being encountered in its stead. The present investigation called for no detailed chemical examination of the rubble layer, but field observations show that the clay increases towards the bottom and the underlying material is, in general, a grey sandy clay to light clay

with red and yellow mottling, the clay becoming heavier with depth. This band of concretions presents an almost impenetrable barrier to root penetration.

TABLE 4. (*a*).

MECHANICAL ANALYSES OF BEERBURRUM FINE SAND PROFILE.

Sample No.	4429	4430	4432	4433
Depth in inches.	0–6	6–12	27–33	33–39
	%	%	%	%
Coarse Sand	46·54	35·92	31·54	30·12
Fine Sand	41·46	48·46	46·40	44·15
Silt	3·63	5·93	7·58	10·12
Clay	4·03	8·38	13·38	14·65
Loss on Acid	2·13	·52	·73	·42
Moisture	·67	·48	·47	·98
Organic C.	1·18	·55	·22	·22
Reaction	6·3	6·1	5·8	5·6

TABLE 4 (*b*).

CHEMICAL DATA OF SUB-SURFACE AND SUBSOIL HORIZON OF BEERBURRUM FINE SAND.

Soil No.	Depth Inches.	R_2O_3.	Fe_2O_3.	P_2O_5.	CaO.	MgO.	K_2O.
		%	%	%	%	%	%
4431 ..	12–27	2·02	·82	·014	·028	·060	·019
4433 ..	33–39	2·26	2·18	·013	·035	·060	·027

Mechanical analyses and chemical data of the Beerburrum Fine Sand are given in Tables 4 (a) and 4 (b). Further chemical data of surface soils are given on pages 564-568. Towards the northern edge of the Beerburrum Fine Sand, in Portions 500-505, a red phase begins to make its appearance, the surface soil of which is slightly browner in colour than the type proper but essentially the same in texture. The subsoil, however, which occurs at a depth varying from 1 to 2 feet, is a light red-brown to red loam, and is remarkably similar to the material underlying the Glasshouse Sandy Loam and Glasshouse Sand, but it was so sporadic in occurrence and so limited in extent as not to warrant detailed investigation.

The figures for the analytical data show the completeness of the leaching of the Beerburrum Fine Sand, and its negligible content of plant food material indicates the necessity for the application of a complete fertilizer.

In common with the Glasshouse Sand, an inherent defect of this type is its inability to withstand droughty periods, and the need for providing some practical means of materially increasing its moisture-holding capacity must be recognised.

3. LABORATORY INVESTIGATIONS.

Ninety samples of surface soils from the area were submitted to laboratory investigation. These were all selected from virgin areas, and each sample represents an average of three samplings. The depth

of sampling was to 9 inches, and this in most cases comprises the A_1 and the topmost portion of the A_2 horizon. This is the portion which is most significant from the point of view of analytical estimation of the nutrient requirement of the shallow-rooting pineapple plant.

All percentages refer to the air-dried material passing a 2 mm. sieve.

(a) Nitrogen, Organic Carbon, and C : N Ratio.

The figures for organic material are strikingly low on all of these soils. This is to be expected from the almost entire absence of surface litter. The eucalyptus forest conditions which prevail are not favourable to the accumulation of humus. Any surface material is predominantly of a woody nature, and the prevalence of bush fires during the hot, dry seasons accounts for the general dearth of nitrogen and the wide carbon-nitrogen ratios.

TABLE 5.

DISTRIBUTION TABLE OF THE % NITROGEN CONTENT OF SURFACE SOILS.

Type.	·021 –·03	·031 –·04	·041 –·05	·051 –·06	·061 –·07	·071 –·08	·081 –·09	·1 –·12
Glasshouse Sandy Loam ..	1	4	6	6	7	1	5	..
Glasshouse Sand	4	7	7	3	2	1	..	..
Beerwah Sand	1	..	10	..	..	..	1	..
Beerburrum Fine Sand ..	1	..	1	..	1	2	1	1
Total	7	11	24	9	10	4	7	1

Reference to Table 5 shows that the N content of the surface soils varies from the extremely low figure of ·02 per cent. to about ·1 per cent., and that the majority do not exced ·05 per cent., which is very deficient. It is not surprising, therefore, to note the very pronounced response to nitrogen fertilizers in the pineapple plantations throughout the area.

While there is a range within the types themselves, the distribution table shows that the nitrogen content of the Glasshouse Sandy Loam is appreciably higher than that of the Glasshouse and Beerwah Sands. The greatest variation is in the Beerburrum Fine Sand, the highest values being from samples taken from cleared land and now under secondary growth.

TABLE 6.

% ORGANIC CARBON. DISTRIBUTION TABLE FOR SURFACE SOILS.

Type.	·5–·75.	·75–1.0	1.0–1·25.	1·25–1·5.	1·5–1·75.	1.75–2·0
Glasshouse Sandy Loam	1	6	9	8	4	2
Glasshouse Sand ..	5	6	7	5	1	..
Beerwah Sand ..	5	4	5	..	..	..
Beerburrum Fine Sand	..	2	3	4	1	..
Total	11	18	24	17	6	2

With regard to organic carbon, the frequency distribution Table 6 shows that the range in all types is from ·5 per cent. to 2 per cent. Considering this in terms of organic matter (Organic C X 1·724), the range is ·8 per cent. to 3·74 per cent. organic matter with the greatest number of estimations falling between 1·72 per cent. and 2·2 per cent.

This must be regarded as low from an agricultural point of view. The Glasshouse Sandy Loam again appears to better advantage in comparison with the other types, the organic C being distributed about a somewhat higher mean.

The extremely wide C : N ratios in the distribution Table 7 is proof that much of the organic matter present consists of undecomposed fibrous woody material, and that "humified" matter occurs only in minor amounts. That this is the case is also evident from a field examination of most of the soils since, with the exception of the Glasshouse Sandy Loam, they are usually light-coloured and the presence of inert charcoal from periodic burns is often noticeable.

TABLE 7.

DISTRIBUTION TABLE OF C : N RATIOS OF SURFACE SOILS.

Type.	10–15.	15–20.	20–25.	25–30.	30–35.	35–40.	40–45.	45–50.
Glasshouse Sandy Loam ..	1	6	16	6	1	..	..	..
Glasshouse Sand	1	6	3	6	1	4	1	1
Beerwah Sand	1	4	2	2	..	1	..	..
Beerburrum Fine Sand ..	..	4	1	..	..	..	1	..
Total	3	20	22	14	2	5	2	1

The range 20-25 is indicative of the average carbon-nitrogen ratio for surface soils of the area under review.

(b) Replaceable Bases.

Since it has been shown[2] that the determination of the replaceable potassium of a soil is a reasonably reliable index of potash availability for pineapples, this determination was made on a number of surface soils from all types.

The frequency distribution in mille equivalents K per 100 gms. air-dried soil is given in Table 8.

TABLE 8.

DISTRIBUTION TABLE REPLACEABLE K (m.e. %) OF SURFACE SOILS.

Type.	·05.	·05–·10.	·11–·15.	·15–·20.	·20–·25.	·25–·30.	·3–·4.	·4–·5.
Glasshouse Sandy Loam ..	..	1	2	6	5	1	1	2
Glasshouse Sand	1	6	6	3	1	2	..	..
Beerwah Sand	..	4	4	1	..	..	..	..
Beerburrum Fine Sand ..	..	2	2	2	..	..	1	..
Total	1	13	14	12	6	3	2	2

It will be seen from the above table that there is a variation in replaceable potash from type to type and also within the types themselves, and that, in general, the values are all low. The Glasshouse Sandy Loam is definitely higher than the rest, the maximum number of estimations falling about the value ·2 m.e. The Beerwah Sand and the Beerburrum Fine Sand are very low indeed, one odd high value of the latter type refers to a sample from a flat running to tea-tree on Portion 441. Magistad[2] has shown that ·5 m.e. of replaceable potash per 100 gms. soil represents the limit beyond which no response to potash fertilizer is obtained in Hawaiian pineapple soils, and applying this figure tentatively to the soils of the area surveyed it is obvious that the present practice of supplying relatively heavy dressings of potash to pineapples grown in these soils is a sound one.

Table 9 shows that the figures for replaceable Ca, Mg, and K are low throughout. This is in keeping with the low clay content of the soils, and is further reflected in the acid nature of the reaction. Again, since the soil organic matter is an important factor in controlling the cationic exchange capacity, it is to be expected that these low humus soils would be very poor in base status.

TABLE 9.

REPLACEABLE K, Ca and Mg (m.e. %) OF SURFACE SOILS.

GLASSHOUSE SANDY LOAM.				GLASSHOUSE SAND.			
No.	Ca.	Mg.	K.	No.	Ca.	Mg.	K.
4434 ..	1·5	1·26	·16	4469	1·75	1·97	·11
4435 ..	2·3	1·80	·51	4470	1·80	1·97	·18
4440 ..	2·0	1·62	·31	4472	1·1	1·49	·07
4442 ..	1·5	1·26	·17	4473	1·8	2·26	·10
4445 ..	1·1	3·32	·16	4479	1·1	1·62	·12
4447 ..	2·4	2·70	·16	4480	1·5	1·53	·13
4450 ..	1·1	1·62	·11	4483	2·4	·99	·28
4452 ..	1·7	2·01	·11	4485	1·2	1·80	·10
4455 ..	1·5	3·49	·17	..	..	..	..
4458 ..	1·9	1·97	·08	..	..	..	..
Mean ..	1·70	1·92	·194	..	1·45	1·70	·136
BEERWAH SAND.				BEERBURRUM FINE SAND.			
4496 ..	1·0	·90	·10	4418	1·2	1·71	·08
4497 ..	0·9	1·44	·10	4420	1·1	2·01	·09
4498 ..	1·1	2·69	·15	4423	2·7	1·16	·17
4500 ..	1·0	1·80	·12	4424	0·8	1·53	·14
4501 ..	1·3	2·15	nd	4425	2·3	1·35	·17
4502 ..	0·8	1·97	·10	4427	5·0	3·20	·12
4503 ..	1·0	2·15	·08	..	..	..	..
4505 ..	0·8	1·62	·13	..	..	..	..
4506 ..	0·7	2·69	·12	..	..	..	..
4507 ..	0·5	1·88	·16	..	..	..	..
Mean ..	0·91	1·92	·118	..	2·2	1·83	·128

The Glasshouse Sandy Loam is the most satisfactory type with regard to replaceable base, and the Beerwah Sand is quite the poorest. In this latter type it is noticeable that the magnesium has not been leached to the same extent as the other bases. There is evidence also, that, throughout the area, magnesium tends to replace calcium as the major exchangeable constituent.

The abnormal value for calcium of Beerburrum Fine Sand No. 4427 increases the mean for this type, but the sample was taken from the red phase which, as previously stated, is of very limited extent in the area surveyed.

(c) Phosphoric Acid.

Some seventy samples of surface soils were examined by means of Truog's method for available phosphoric acid. It was found that in three cases only did the available P_2O_5 exceed the abnormally low figure of 3 parts per million, and these three exceptions gave 6, 7, and 8 p.p.m. Since the figures are so low and since the very small differences were within the limits of experimental error, it is not necessary to tabulate the individual results.

Further evidence of the extreme lack of phosphoric acid is shown by reference to Table 11 (*a*), which sets out the content of P_2O_5 obtained by digestion with constant boiling-point hydrochloric acid of surface soils throughout the area. Out of forty-four estimations, only four are above ·04 per cent., the majority lying between ·01 per cent. and ·02 per cent. The maximum figure is only ·064 per cent., whilst the mean is ·019 per cent. The relation between these low figures and the sparseness of the natural grass cover and lack of organic matter in the profile is a question which suggests itself.

Experimental work has indicated that a content of 20 p.p.m. available P_2O_5 (Truog.) must be present in the soil before the response of pineapple plants to phosphatic fertilizers becomes negligible. Consequently, from the point of view of pineapple culture, these soils must be regarded as exceptionally deficient in phosphoric acid.

(d) Hydrochloric Acid Analysis.

A number of analyses of the standard hydrochloric acid extract were made on surface, sub-surface, and subsoil samples of typical soils from each type. Some of these results have already been given in Tables 1-4, whilst others are included in Table 12.

A large number of hydrochloric analyses of virgin soils from the area under review were also available from the records of the Agricultural Chemist branch of this Department. All these are surface soils. Although the data as to location was not always sufficient to fix definitely the type to which each individual sample belonged, in many cases the block or portion was recorded, and from the classification it was evident that a representative range of textures was included. These results are summarised in Tables 10, 11 (*a*) (*b*).

TABLE 10.

VARIATION TABLE FOR % P_2O_5, K_2O, CaO and MgO IN SURFACE SOILS.

——	Mean.	Minimum.	Maximum.	Number of Samples.
P_2O_5	·019	·001	·064	44
K_2O	·023	<·001	·08	44
CaO	·129	·04	·45	40
MgO	·074	·013	·210	44

Table 10 shows that the mean values for phosphate, potash, lime, and magnesia are extremely low, and that even the maximum values, with the exception of calcium, are still below fertility requirements. The rather high figure of ·45 per cent. calcium is seen from the distribution Table 11 (*b*) to be an abnormal value.

TABLE 11 (*a*).

DISTRIBUTION TABLE FOR % P_2O_5, K_2O FOR SURFACE SOILS.

——	< ·01	·01	·02	·03	·04	·05	·06	·07	·08
P_2O_5 ..	4	19	9	8	1	2	1	..	..
K_2O ..	6	12	12	8	1	1	2	1	1

TABLE 11 (*b*).

DISTRIBUTION TABLE FOR % CaO, MgO FOR SURFACE SOILS.

	<·05.	·05–·1.	·1–·15.	·15–·20.	·20–·25.	·25–·3.	·3–·5.
CaO	2	14	10	8	4	1	1
MgO	12	21	8	2	1	..	..

TABLE 12.

% ANALYSES OF HYDROCHLORIC ACID EXTRACTS OF SURFACE SOILS.

Type.	Sample No.	R_2O_3.	CaO.	MgO.	K_2O.	P_2O_5.
Glasshouse Sandy Loam	4435	6·47	·14	·07	·056	nd
	4468	9·37	·13	·10	·033	nd
	4450	4·72	·13	·08	·036	nd
	4455	8·45	·11	·11	·018	nd
Glasshouse Sand ..	4472	2·90	·13	·08	·025	nd
Beerwah Sand	4504	1·87	·12	·11	·038	nd
Beerburrum Fine Sand	3411	3·30	·08	·16	·01	·03
	3608	3·49	·16	·08	·006	·01
	3609	3·15	·19	·08	·003	·01
	3610	1·96	·22	·07	·03	·02

(e) Mechanical Analysis.

All these soils show a very considerable sand content on mechanical analysis. For the present purposes, an exhaustive texture examination necessitating a large number of analyses was not required. Typical samples from each type were examined, and a reliable check on field descriptions was obtained. The textures of the surface soils are summarised in Plate 199, where the particle sizes are illustrated in the form of summation curves. The predominance of the sand fraction is marked in all types, and with regard to the Beerburrum Fine Sand there is a definite widening of the ratio of fine to coarse sand. In the Beerwah Sand, of the two sand fractions, the coarse is in excess. This is well borne out by a large number of profile observations in the field. There is, in general, a flattening of the lower ends of the curves, indicating a low silt content, particularly in the case of the Glasshouse and Beerwah Sands. Moreover, there is a remarkable uniformity of silt content throughout the area with respect to surface, sub-surface, and subsoil samples, and this is further brought out in the distribution triangle (Plate 200), where all samples are restricted to an area adjacent to the clay-sand axis. The subsoil of the Beerburrum Fine Sand has the highest silt content and this factor, together with the wider fine/coarse sand ratio, has a definite influence on the textural characteristics of the type. The variation in texture in the Glasshouse Sandy Loam surface soils noted in the field is in line with the mechanical analyses results. The variation in clay percentage is from approximately 10 per cent. clay to 20 per cent., and although this range is not very great, the fact that it is accompanied by an increase in fine sand at the expense of the coarse fraction does give a definitely loamier texture in the field. This heavier phase is particularly noticeable on Portions 9, 10, and 90v.

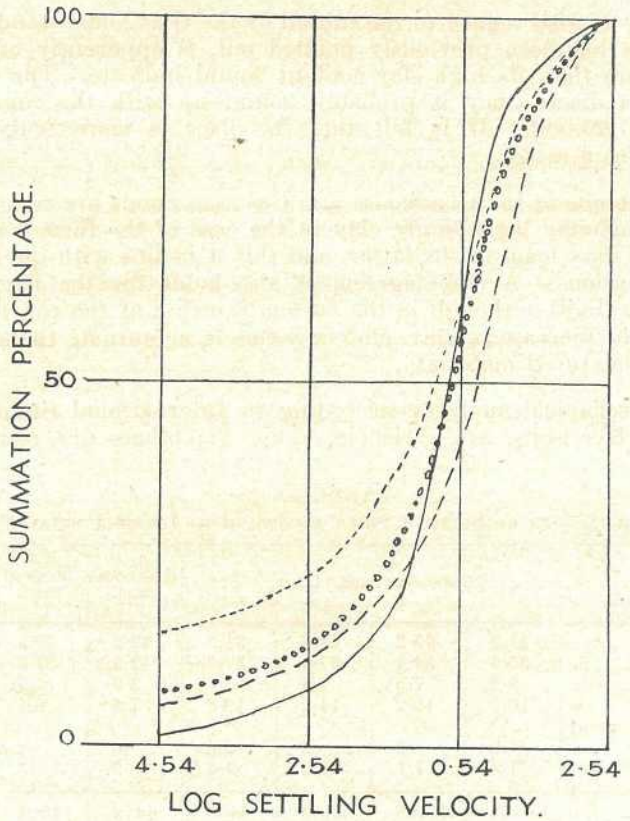


Plate 199.

Summation curves illustrating average mechanical analysis of surface samples of the various soil types.

The shape of the summation curves shows that there is no notable difference between the types, the greatest difference physically lying in the increased clay content of the Glasshouse Sandy Loam.

From Tables 1-4 it is apparent that there is a slight increase with depth in the ratios of fine sand—coarse sand.

Prescott, Taylor, and Marshall[3] have published a schematic diagram showing suggested relationships between textural classes and mechanical composition according to international standards. The portion of this diagram relevant to the soils under review has been superimposed, as a matter of interest, on the distribution triangle (Plate 200). The agreement for surface and sub-surface soils is particularly good. The greatest

discrepancy is with regard to the subsoil of the Glasshouse Sandy Loam, and this, as has been previously pointed out, is apparently of a more loamy nature than its high clay content would indicate. The explanation of this discrepancy is probably bound up with the considerable sesquioxide content. It is felt that its place is more truly in the loam/clay loam range.

The subsoils of the Glasshouse and Beerwah Sands are seen to be on the border of clay loam/sandy clay in the case of the former and clay loam/sandy clay loam in the latter, and this is in line with the recorded field observations. A close agreement also holds for the Beerburrum Fine Sand subsoil, although in the bottom 6 inches of the concretionary layer a slight increase in clay content seems to accentuate the stickiness of this fine-textured material.

The mechanical analyses, according to International Standards of typical surface soils, are given in Table 13; others are recorded in Tables 1-4.

TABLE 13.

MECHANICAL ANALYSES OF SURFACE SOILS ACCORDING TO INTERNATIONAL STANDARDS.

——	Glasshouse Sandy Loam.				Glasshouse Sand.	Beerwah Sand.	Beerburrum Fine Sand.
Coarse Sand ..	41·2	35·2	42·6	31·2	43·2	59·3	39·7
Fine Sand ..	35·5	34·4	37·1	37·6	42·3	27·3	48·6
Silt	9·2	7·5	7·3	5·0	3·9	4·9	7·3
Clay	10·9	19·2	11·2	19·2	7·5	6·1	1·1
Loss on Acid Treatment ..	·9	·3	·3	3·6	·6	·4	·8
Moisture	1·4	1·7	1·5	1·4	·5	·6	·8
Sample No. ..	4435	4468	4450	4455	4472	4504	4418

(f) Reaction, Buffer Capacity.

(i.) Reaction. There is a striking uniformity of pH values for the surface soils of all types. Reference to Table 14 shows that out of eighty-one estimations, sixty-two fall within the short range of pH 5·5 to pH 6·0, whilst there is a variation of just over one unit throughout the area. The arithmetic means given in the last column of the table show practically no difference from type to type with the exception of the Beerwah Sand. This soil, which is the lowest in base status, shows a slightly lower mean reaction value.

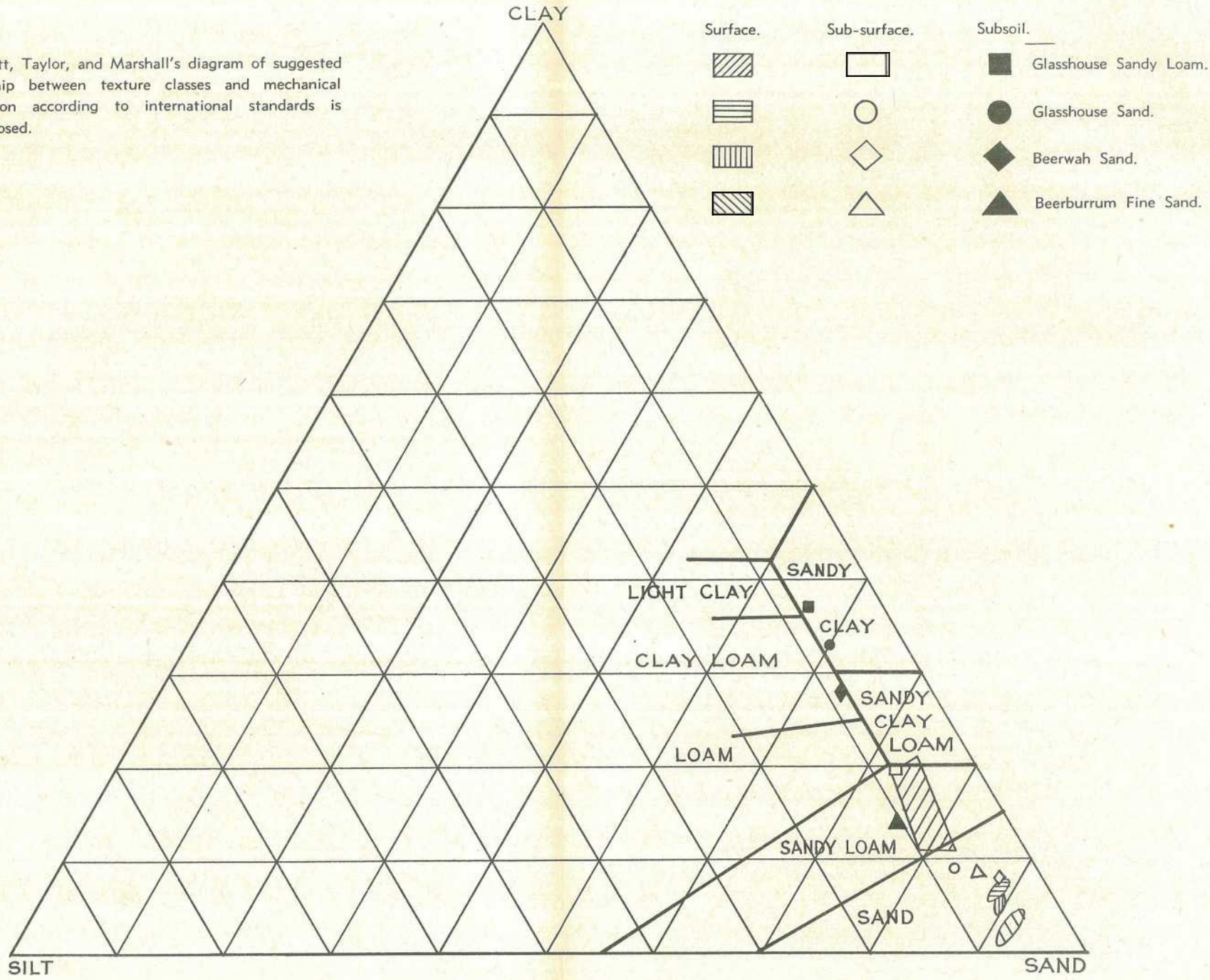
TABLE 14.

DISTRIBUTION TABLE OF pH VALUES OF SURFACE SOILS.

Type.	5·4.	5·5.	5·6.	5·7.	5·8.	5·9.	6·0.	6·1.	6·2.	6·3.	6·4.	6·5.	6·6.	Arith. Mean.
Glasshouse Sandy Loam ..	2	..	4	6	9	3	3	2	..	1	..	..	..	5·83
Glasshouse Sand	2	..	3	2	6	4	2	2	1	1	..	..	..	5·85
Beerwah Sand	2	4	3	..	4	1	1	..	..	..	..	..	..	5·66
Beerburrum Fine Sand ..	3	..	2	1	1	1	2	..	1	..	1	..	1	5·88
Total	9	4	12	9	20	9	8	4	2	2	1	..	1	..

It is interesting to briefly consider these pH values from the point of view of their relationship to the prevailing climatic conditions. Defining the climate in terms of the Meyer precipitation/saturation deficit ratio, the average figure of 290 calculated elsewhere in the text

Prescott, Taylor, and Marshall's diagram of suggested relationship between texture classes and mechanical composition according to international standards is superimposed.



MECHANICAL ANALYSIS DISTRIBUTION TRIANGLE OF SURFACE,

SUB-SURFACE AND SUBSOIL

would indicate sufficient excess of rainfall over evaporation for effective leaching. This has tended towards a removal of the bases, resulting in a greater degree of unsaturation and accentuation of acid properties.

All these pH values fall into line with the relationship between the precipitation/saturation deficit and reaction of a large number of Australian soils as defined by Prescott.[4] The reaction range of 5·5 to 6·0 of the soils from the area in conjunction with a Meyer ratio of 290 is a good fit in the diagram.

(ii.) Buffer capacity. The intimate connection between the availability of iron to the pineapple plant and the reaction of the soil in which it is grown is a vital factor in the successful production of pineapples. In the area under review, the assimilation of iron is a contributing factor in the resistance to pineapple wilt and, consequently, there is a marked correlation between crop production and soil reaction. This is particularly the case in those soils which have been under cultivation for a number of years, and which in consequence have been depleted in humus.

Since an important property of the soil organic matter is its role as a medium for increasing the cationic exchange capacity, it would be expected that soils of such a low humus content as those under consideration would be but weakly buffered. Under these conditions it is further probable that the buffering would be controlled by the colloid content.

That this is the case may be seen from Plates 201, 202, and 203, where some titration curves typical of each type are illustrated.

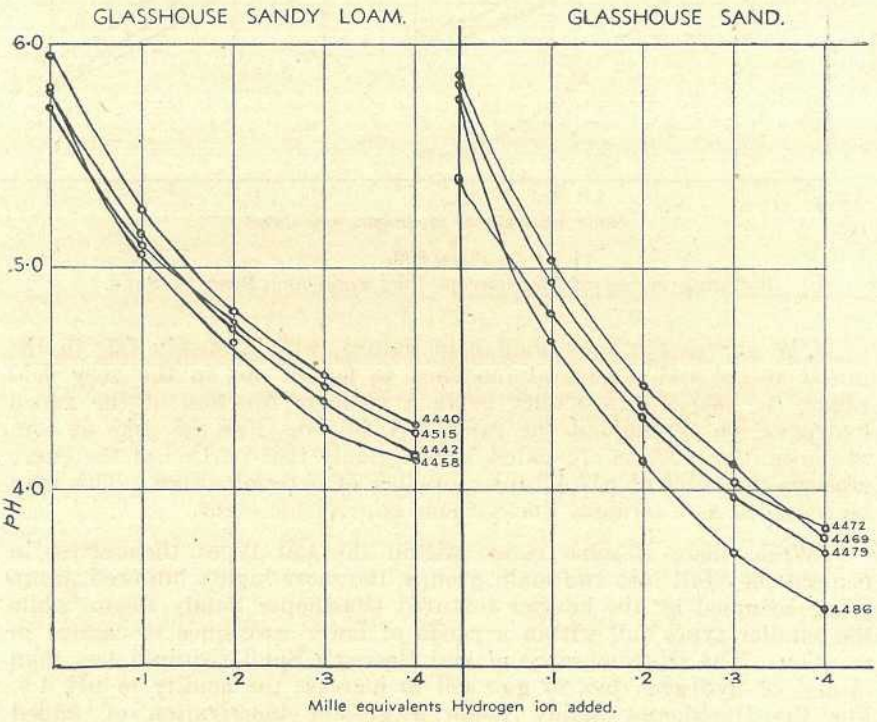


Plate 201.
Buffering curves of Glasshouse Sandy Loam and Glasshouse Sand.

To obtain the curves ·05N H_2SO_4 was added to 20 gm. samples of air-dried surface soil in increments corresponding to ·1 mille equivalent of hydrogen ion. The mixtures in duplicate were stoppered and shaken overnight, when apparent equilibrium was obtained. The pH was determined, using a saturated calomel-glass electrode system in conjunction with a Cambridge electrometer valve pH meter. The duplicates showed good agreement and were always reproducible.

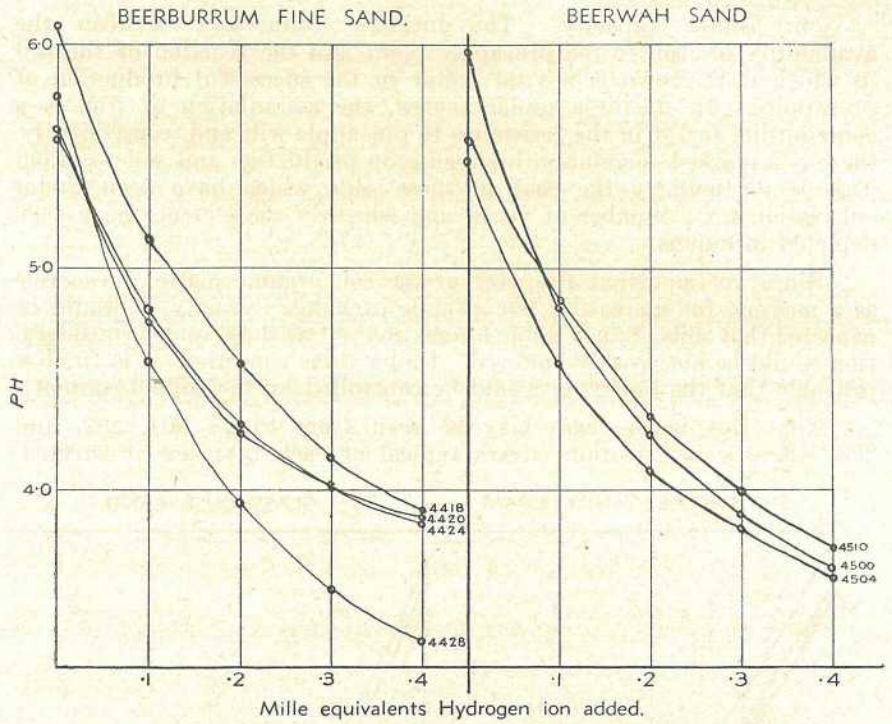


Plate 202.
Buffering curves of Beerburrum Fine Sand and Beerwah Sand.

The curves are very similar in nature, with a steady fall in the initial stages and a general tendency to flatten out in the very acid range, the increase in acidity being a uniform function of the added hydrogen ion throughout the range pH 4·0-6·0. For the sake of convenience, Plate 203 is appended, showing only that portion of the curve crossing the value of pH 4·5 for a number of determinations. This may be regarded as a straight line without appreciable error.

While there is some range within the soil types themselves, in general they fall into two main groups, the more highly buffered group being occupied by the heavier textured Glasshouse Sandy Loam, while the sandier types fall within a range of lower resistance to change in reaction. The Glasshouse Sand and Beerwah Sand required less than ·2 m.e. of hydrogen per 20 gm. soil to increase the acidity to pH 4·5, For the Glasshouse Sandy Loam a greater inactivation of added hydrogen ion is evident and a significantly flatter curve is obtained, an amount of ·25 to ·3 m.e. being required to produce the same effect.

The use of powdered sulphur for modifying the reaction of pine-apple soils in Southern Queensland is rapidly being adopted as a standard practice. Previous work (unpublished) on a representative range of these soils has shown that there is a good correlation between the calculated equivalent of sulphur as indicated by the laboratory determination of the buffer capacity and the actual response to sulphur

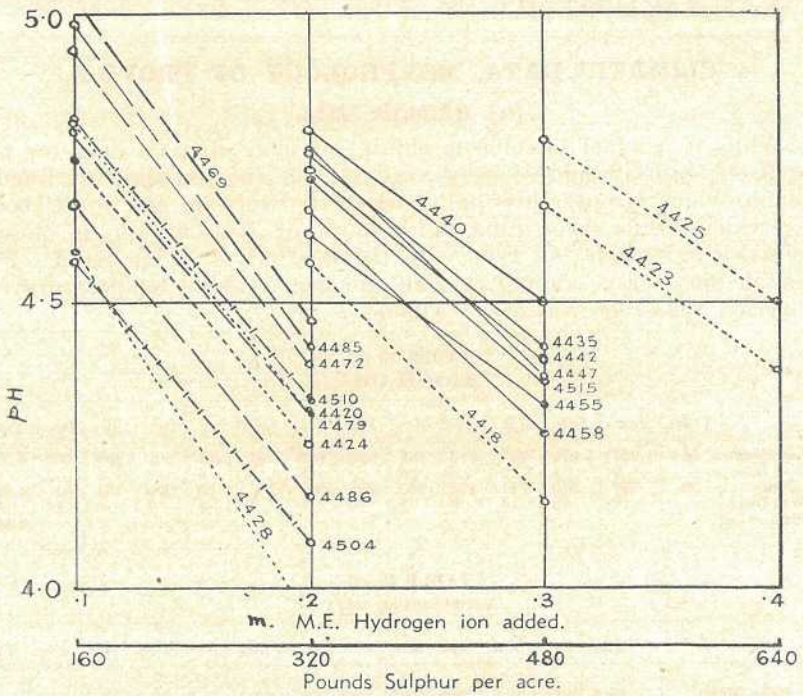


Plate 203.

Showing portion of titration curves and probable sulphur requirement of all soil types.

in the field. The depth to which the sulphur affects the soil reaction has, for the present, been arbitrarily set at 6 inches, and this depth on these sandy types of fairly high specific gravity postulates 2,000,000 lb. of soil per acre. Assuming complete oxidation in the field, the amount of sulphur required for any given area which will bring the reaction within the range, pH 4·5—5 may readily be determined. This range has been adopted as a working hypothesis from the results of a large number of field observations. If the sulphur is applied in a finely powdered condition, free from lumps, and intimately mixed with the soil to a depth of 3 to 4 inches, the desired reaction is reached within a period of four to six weeks in the summer months and slightly longer in the winter.

In these sandy soils of low and uniform organic matter content the sulphur requirement may be determined accurately enough in the field for practical purposes from a knowledge of the initial pH and texture classification.

Two samples, Nos. 4423 and 4425, from the red phase of the Beerburrum Fine Sand show abnormally high buffering power; these are also high in initial pH.

4. CLIMATIC DATA, MORPHOLOGY OF PROFILE.

(a) Climatic Data.

While it was not possible to obtain complete climatic data for the area itself, rainfall figures were available for the township of Landsborough, which is only three miles north of Beerwah, and for Caboolture, which, while some nine miles south of Beerburrum, is closely associated as regards soil type with the Beerburrum Fine Sand. For Beerwah the average annual rainfall and mean annual temperature for the period 1925-1928 was also available.

TABLE 15 (*a*).
RAINFALL DATA.

—	Years.	Jan.	Feb.	Mar.	Apr.	May.	J'ne.	J'ly.	Aug.	Sep.	Oct.	Nov.	Dec.	Year.
Landsborough	44	1,057	1,079	927	616	432	375	238	189	235	300	408	683	6,539
No. Wet Days	..	9	11	12	8	9	5	4	5	6	6	5	7	87
Caboolture ..	50	757	779	744	457	280	268	218	151	186	250	351	525	4,966
No. Wet Days	..	12	13	16	9	8	8	6	7	8	9	8	10	114
Beerwah ..	..	..	..	..	..	..	..	..	..	..	..	..	..	6,333

TABLE 15 (*b*).
TEMPERATURE DATA.

	—	Jan.	Feb.	Mar.	Apr.	May.	J'n..	J'ly.	Aug.	Sep.	Oct.	Nov.	Dec.	Year
BRISBANE	Mean Max. ..	85·4	84·5	82·3	79·0	73·6	69·3	68·5	71·3	75·7	79·7	82·8	85·1	78·1
	Mean Min. ..	68·9	68·6	66·3	61·5	55·3	51·0	48·5	49·9	54·8	60·0	64·2	67·4	59·7
	Rel. Hum. at 9 a.m.	66	69	72	72	73	74	73	69	64	60	60	62	68
GYMPIE	Mean Max. ..	87·6	86·4	84·7	81·7	76·4	71·4	71·4	73·9	78·8	83·5	87·0	88·4	80·9
	Mean Min. ..	66·5	66·4	63·4	57·7	49·8	46·3	42·2	44·4	50·2	56·2	61·4	64·9	55·8
	Rel. Hum at 9 a.m.	74	76	77	77	77	78	75	73	68	65	65	68	73
Beerwah, Mean ..		..	..	..	..	..	..	..	..	..	..	..	..	68·5

It will be seen from Table 15 (*a*) that there is a well-marked seasonal rainfall with a summer maximum. A decrease in mean annual rainfall occurs towards the south. It is unfortunate that there are no figures for intermediate stations, but it is to be expected that the diminution would occur just at the south of Glasshouse Mountains, where there would be a lessening of the influence of the Blackall Range. It was not possible to obtain very satisfactory figures for temperature and relative humidity within the area, but it is probable that the temperature and relative humidity figures of Brisbane may be applied to Caboolture and those of Gympie to Beerwah without a great deal of error. The mean average temperatures of Brisbane, Beerwah, and

Gympie are practically identical, although there is a somewhat greater difference in the 9 a.m. relative humidity figures for Brisbane and Gympie.

Using these figures to calculate Lang's rainfall/temperature factor, there is a variation from 80 at Beerwah to 62 at Caboolture. Meyer's precipitation/saturation deficit ratio is 333 for the former locality and 250 for the latter. Whilst the figures must be regarded as merely tentative, it is noticed that both factors fall just short of their respective limits of indices for podsols.

From a consideration of the rather high figure for precipitation per rainy day, which is ·74 inches in the northern region and ·44 inches towards Caboolture, it would be expected that there would be a marked topographical control affecting the soil types. Such is the case. The nature of the precipitation ensures a relatively lower percentage penetration on the elevated portions, the high run-off decreasing the leaching factor here in those portions, with a consequent concentration of the water at the lower levels. That there is a greater penetration and water movement in these lower levels is shown by the marked increase in the depth of the A horizons and obvious diminution in the sesquioxide content. This is borne out by the analytical data of the profiles, and a feature in the field is the lateral differentiation in colour down the slopes. It is noticeable that, except in small isolated areas occupying limited elevations, the red soils do not persist south of Beerburrum, where the terrain becomes featureless. Moreover, there is a marked drop of ·3 inches in the precipitation figures per wet day in this latter region.

(b) Morphology.

Whilst the nature of the work demanded that this investigation be carried out from an agricultural point of view, it is interesting to briefly consider the pedogenic factors involved.

In the first instance, although these soils are definitely podsolised, they cannot be regarded as true podsols. The low-base status and removal of sesquioxides from the A horizon are indicative of podsolisation, but several factors operate against the application of the term podsol as generally defined. Several of the distinguishing factors are absent, notably the A_0 horizon of peaty material and the humus B_1 layer.

The layer of iron accumulation is always present, either as a subsoil zone of enrichment or a nodular pan, in which the nodules are more commonly discrete ferruginous cemented particles of sand grains, rather than true concretions showing concretionary structure about a nucleus.

Beerburrum Fine Sand.—This type shows the strongest podsolisation of all the types studied. The removal of iron from the A horizon and its light colour is a definite characteristic of the type. As previously described, a concretionary iron pan is uniformly present throughout the area, and this horizon is devoid of organic matter.

An apparently similar ferruginous cementation of sand grains, occurring in the "shot" soils of Western Washington, is described by Wheeting[6], who attributes their formation to the precipitation and dehydration of soluble iron and aluminium compounds during the dry season. However, the Queensland pellets do not contain the high percentage of P_2O_5 recorded in the Washington occurrences.

In the Beerburrum Fine Sand it is significant that the concretionary zone occurs in close proximity to the upper portion of the clayey horizon which would be most subject to alternate water-logging and drying conditions. Periodic fluctuation in the water-table would permit the drying out of the upper sandy layer, with the introduction of oxidising conditions resulting in an irreversible precipitaton of sesquioxides. It is conceivable that such a process would not cause the precipitation of calcium and other bases, and their diffusion and removal would be effected during periods of water movement. A noticeable feature already mentioned is that in present areas of permanent swamp there is no development of a nodular horizon, and this is quite possibly due to the fact that anaerobic conditions are persistent in these areas.

Associated with the normal type of nodule is a smaller variety lustrous in external appearance and black throughout. These are more rare in occurrence, and are usually, but not always, scattered through the topmost portion of the concretionary layer. They are about the size of a pea and contain 15 per cent. Mn. calculated as Mn_3O_4 and no P_2O_5. The normal variety contain slight amounts of P_2O_5, but no trace of manganese was present in an aggregate sample of some typical specimens. The figures quoted in Table 16 show that aluminium has accumulated to an even greater extent than iron.

TABLE 16.

HYDROCHLORIC ANALYSIS OF CONCRETIONARY MATERIAL.

	Beerburrum.		Glasshouse.
	Normal.	Black.	
	%	%	%
Insoluble	44·0	34·1	44·9
Fe_2O_3	17·3	15·6	18·9
Al_2O_3	25·9	11·3	26·0
Mn_3O_4	Nil	15·6	·1
CaO	·35	trace	·5
MgO	·05	trace	·103
K_2O	·05	nd	·07
P_2O_5	·03	nil	·05
Ignition Loss	9·1	nd	9·8

Glasshouse Sandy Loam and Glasshouse Sand.—These two soils, and in particular the Glasshouse Sandy Loam, may be regarded as being but weakly podsolised. There is undoubtedly a marked relation between topography and removal of sesquioxides from the profiles. An obvious lateral diminution in colour is apparent in passing from higher levels to lower levels, the more podsolised Glasshouse Sand being confined to lower limits of slopes and flat country where leaching water remains longer in contact with the soil.

A striking feature is the deep-seated decomposition of the original parent rock. The basal rock consisted of grits and sandstones, and has been observed to occur in a comparatively fresh condition at depths of about 25 feet. Overlying this and reaching to within 9 feet of the surface is a red and white mottled horizon, approximately 15 feet thick. This material is apparently the result of the primary decomposition of

the sedimentary rock, and must be regarded as the parent material of the soil itself. Thus the soil profiles assume a secondary character with regard to the geological structure.

Immediately overlying this red and white mottled horizon and embedded in a red clayey matrix is a layer of concretionary material. This takes the form of thickly-studded, individual pellets 2 to 3 cm. in diameter, or, when not *in situ*, large irregular accretions closely resembling and likely to be mistaken for a ferruginous sandstone. Above this is the soil proper which, in the case of the Glasshouse Sandy Loam, remains red to within 3 to 4 inches of the surface and within about a foot of the surface in the case of Glasshouse Sand. The topographical characteristics of the Beerwah Sand, unfortunately, do not allow an inspection to be made of the deep-seated material.

A significant feature of the mottled horizon is the predominance of the white material in the lower portion with a marked increase in ferruginous colouration towards the top, culminating in the very red concretionary matrix and the concretions themselves. In considering the factors influencing the mobility of this iron, it is interesting to note that the pH of the red and white mottled horizons immediately below the concretions is 4·85. A sample taken from the depth 7 to 9 feet where rubble begins to appear was pH 5·4, and above this, in the concretionary horizon proper, the reaction increased to pH 5·9. Therefore, in this mottled horizon, where reducing conditions must persist, the reaction appears to be below the critical value for the movement of ferrous hydroxide, since this latter value is pH 5·5, and this material must be precipitated when reaching the zone of reaction 5·9. Thus, from a consideration of hydrogen ion concentration, it would appear that, if an upward movement of moisture may be postulated, conditions are such that mobility in the mottled horizon and precipitation in the concretionary layer would be ensured.

It is interesting to compare Glasshouse profile with the "Ilepa" profile described by Doyne and Watson[6] in Southern Nigeria. There appears to be a remarkable similarity with one striking difference, in that the Queensland formation is from sedimentary material, whilst the Nigerian occurrence is developed from acid igneous rocks. Here, intrusive and metamorphic granites are the parent materials of a profile which the authors describe as follows:—(*a*) Brown sandy soil, (*b*) concretion layer, (*c*) red clay, (*d*) mottled red and white clay, (*e*) whitish clay, (*f*) rotting rock. This is almost a word picture of the Glasshouse profile.

SUMMARY.

A soil survey has been made in the Beerburrum-Glasshouse Mountains-Beerwah area with especial reference to pineapple production in these districts.

The rainfall throughout the area varies from 50 to 65 inches per annum. It is sporadic in nature, and the precipitation per rainy day is considerable. A marked climatic feature is the incidence of summer rainfall.

The prevailing vegetation is that of eucalyptus forest. Low ridges of gentle slope and good drainage are definite physiographical features. The lower levels of these slopes and the intervening flat country are characterised by a swamp type of vegetation in which the tea-tree is the dominant species.

Four major soil types have been recognised, and are listed below in the order of their productivity:—

(*a*) Glasshouse Sandy Loam.
(*b*) Glasshouse Sand.
(*c*) Beerburrum Fine Sand.
(*d*) Beerwah Sand.

Topographically, each type is characterised as follows:—(*a*) Plateau-like areas of low elevation; (*b*) the gentle slopes of these plateau ridges; (*c*) low, flat areas south of Beerburrum; (*d*) the swampy areas which occur in the hollows between the ridge plateaux.

A dominant feature of the surface soils of all types is the open texture and high sand content. The clay fraction increases with depth, and the nature of the lower horizons is a distinguishing characteristic of each soil type. The subsoil of the Glasshouse Sandy Loam is physically good, but in the Beerburrum Fine Sand the existence of a concretionary iron layer impedes the percolation of water through the deeper horizons.

The Beerwah Sand may contain over 80 per cent. of sand to a depth of 3 feet, followed by an appreciable increase of clay in the next horizon. This fact, together with the low-lying nature of its occurrences, increases the danger of periodic water-logging in continued wet weather and, consequently, it has little value for agricultural purposes.

A large number of samples, typical of the soil types, has been submitted to laboratory investigation. An outstanding feature is the low content of organic carbon. The figures for nitrogen are grouped about the extremely low value of ·05 per cent., while the majority of the organic carbon estimations range from ·75 per cent. to 1·5 per cent. The C : N ratios are very wide, and indicate that a comparatively large proportion of the organic matter is present as undecomposed woody material and inert charcoal. Because of the sandy texture of these soils, and the paucity of humus in the surface horizons, they are characterised by extremely low water-holding capacities. This fault is further accentuated by the prevailing climatic features of high temperature and evaporation. Since the districts surveyed are frequently subject to prolonged periods of dry weather, the necessity for cultivation practices designed to conserve surface soil moisture is apparent.

The low base status of these soils, resulting from the high degree of leaching to which they have been subjected, is demonstrated by a large number of chemical analyses. There is a marked dearth of phosphoric acid, and in many cases the content of available P_2O_5 is too small to be satisfactorily estimated. The soils are also very deficient in both total and replaceable potash. The mean value for total potash does not exceed the low figure of ·023 per cent., while the majority of estimations of replaceable K lie within the range, ·05 m.e. to ·20 m.e. per 100 gm. of soil. Owing to the extremely low plant food content of all of these soil types, heavy fertilizing is necessary when they are used for agricultural purposes.

A remarkable uniformity in pH values is a feature of the soils of the area, and these values are distributed very closely about the mean pH 5·8. Since this is somewhat greater than the indicated optimum

pH for pineapple growth, the buffer capacities of a number of typical samples have been determined. This determination provides a reliable indication of the amount of sulphur required per acre to increase the acidity of the surface soils to a given pH. It was found that, since the organic matter is uniformly low, the amount of sulphur required varies not only with the value of the initial pH but also with the clay content.

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Plate 204. [*Photo.: L. F. Andersen.*
Farm Buildings on the Ovaltine Estate, England.

Some Aspects of Pest and Disease Control in Tobacco.

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THE question of pest and disease control is one of major importance in all phases of agriculture, and this is especially so in the case of a crop such as tobacco, where the marketable portion of the plant is the leaf. The leaf of the tobacco plant is particularly susceptible to damage by quite a number of organisms which affect it directly, while it may also be indirectly affected by certain organisms which attack other parts of the plant, and, in so doing, derange normal physiological processes. While much may be gained by the prompt application of proved remedial measures when the first signs of attack are in evidence, the losses incurred would be still less were it possible to prevent the attack altogether. It is the aim of these notes to consider such practices as will assist in bringing about some measure of insurance against losses of this nature. For convenience the whole problem may be considered under four main headings—namely, (1) over-wintering of harmful organisms, (2) host resistance, (3) protective measures, and (4) cultural methods.

Over-wintering.

In order that they may survive the winter, some pest and disease organisms require the protection of plant tissues, either living or dead. Others are able to survive in the soil itself for considerable periods, even under unfavourable conditions. It is obviously desirable that conditions on the farm should be made as unfavourable as possible for the survival of harmful organisms and strict attention to field hygiene plays an important part in attaining this condition.

Some organisms which require a living host on which, or in which, to hibernate are restricted to the genus *Nicotiana*—which includes the cultivated tobacco plant—while others have a much wider range of hosts. In most districts where tobacco is grown extensively, the area devoted to other commercial crops is comparatively small. Hence, by restricting the growing of tobacco to that period of the year known to give the best results, several months would remain during which no tobacco would be growing. This practice tends to reduce the survival of harmful organisms from season to season.

As soon as possible after the completion of harvesting in any part of the cultivated area, the old stalks should be uprooted and then burnt later on as soon as they have dried out sufficiently. The longer these stalks remain in the field, the greater will be the risk of some pests, e.g., the leaf miner and the stem borer, completing their development and the greater the risk of contaminating the soil by disease organisms. It has been proved, for instance, that the spores of *Cercospora nicotianæ,* the fungus responsible for "frog-eye" leafspot, may be carried over in this fashion to infect subsequent crops of tobacco. It is provided in "*The Tobacco Industry Protection Act of* 1933" that "every occupier (or where there is no occupier, then the owner) of land used in the growing of tobacco plants shall, within one calendar month after the leaf has been harvested from the plants

growing on such land, uproot the whole of the plants on such land and destroy such plants in a manner to be prescribed," which is by burning. It should be unnecessary to invoke the provisions of this Act in inducing growers to carry out work of this kind which is essential for their own protection.

As mentioned previously, the soil may harbour many of the organisms harmful to tobacco. Fungus spores accumulate in the soil and certain insects pupate in it; if there is no suitable host plant available, nematodes may survive for long periods of time in the soil alone. Under ordinary conditions many of these organisms will be afforded sufficient protection by the soil cover to survive the winter months, though most of them would be destroyed if exposed to the hot rays of the sun for any length of time on the surface of the soil. Besides keeping the land in good tilth, frequent cultivation destroys large numbers of harmful organisms, and regular cultivation is an important factor in reducing losses. The land should therefore be ploughed as soon as practicable after the destruction of the tobacco stalks. If this operation is delayed too long, the soil may have dried and hardened to such an extent that ploughing is both more difficult and less effective. If a crop is to be grown on the land during the next season, it is advisable to follow the first winter ploughing with several further cultivations. The final ploughing should not be carried out until the land has received a fall of rain. Apart from its value in pest and disease control, thorough cultivation assists in reducing weed growth in the crop and, as a consequence, it should be possible to discontinue inter-row cultivations before the crop is too large to permit the use of cultivating implements without injuring the roots.

In most tobacco-growing areas the problem of nematode control is important. These pests possess remarkable powers of survival and their complete eradication in the field is quite impossible. Nematodes are particularly common on light sandy soils and are there found infesting most natural weeds. At the present time no economic chemical treatment is available for their destruction, and recourse must be had to some system of control dependant on starvation, which may be brought about by bare fallowing over a period of several seasons or by growing crops resistant to infestation. Furthermore, tobacco soils in general are very low in humus content, and it is most desirable to replenish the humus of the soil after two or more tobacco crops; otherwise leaf of rather inferior quality is likely to be produced. Some system of crop rotation should be adopted which will serve the dual purpose of assisting in the control of nematodes and adding organic matter to the soil. The range of plants resistant to nematodes is limited and includes most Gramineæ (e.g., Sudan grass, maize, sorghums, millets, and wheat), velvet beans, a few varieties of cowpeas, sunn hemp, and peanuts. Of the legumes, peanuts have proved quite satisfactory in every respect, though rank growth sometimes occurs in the following tobacco crop. However, as a safeguard it is an advantage to follow peanuts with a graminaceous crop such as Sudan grass (or wheat if climatic conditions will permit). This would mean a three-year rotation as follows:—tobacco, peanuts, Sudan grass, tobacco, &c. Such a rotation keeps the land free from cultivated nematode-susceptible hosts for two seasons in a three-year cycle, and the nematode population in the soil should be considerably reduced when the tobacco is subsequently planted.

Host Resistance.

Plant breeding and selection may play an important part in controlling pests and diseases of tobacco. Certain experimental work along these lines has given promising results in the United States of America. There is considerable scope for extensive work in connection with breeding in tobacco, and as time goes on disease-resistant strains and varieties may be evolved. Projects of this kind are particularly difficult, for the quality of the leaf must be maintained in all genetical work aiming at the production of varietal types resistant to pests and diseases. Progress must therefore be relatively slow.

Protective Measures.

The quality of the crop grown in the field is, to a large extent, determined by the health and vigour of the seedlings planted out, and every endeavour should be made to produce seedlings free from disease and insect attacks. The grower should make certain that the seed has been properly sterilized before sowing. Incidentally, tobacco seed supplied by the Department of Agriculture and Stock is always surface-sterilized with silver nitrate prior to distribution. The seedbed soil should be well sterilized by burning and by the application of Cheshunt mixture as an added precaution against the development of "damping-off." As soon as the young seedlings are above ground, care should be taken to see that the mothproof covers are placed in position before dusk each evening as a protection against the moths of the stem-borer and the leaf-miner. Neither "colloidal copper" spray nor benzol vapour has been proved to completely eradicate blue mould once it has appeared in a seedling, and, in any case, by the time outward symptoms are apparent a certain amount of damage has been done to the tissues of the plant. Therefore, the appropriate treatments should be commenced shortly after the plants are established and continued until the time of planting out. When the plants are large enough regular applications of appropriate insecticidal sprays or dusts should be made as often as necessary.

Once the crop is in the field, a routine operation should be that of regular dusting with lead arsenate for the control of stem-borers, leaf-miners, and leaf-eating caterpillars. If necessary, Paris green-bran baits for cutworms should be laid around the plants in the field. Later, when the plants are larger, dusting must be discontinued and replaced by a lead arsenate-pollard dry bait in order to minimise the risk of contaminating the cured leaf by arsenicals. During the earlier stages of growth regular pruning is necessary, and on no account should the primed leaf be thrown on to the ground where it may serve as a continuous source of infection to the growing crop. The primed leaf should be collected into heaps well away from the crop, and, when dry, burnt. Alternatively, the primings should be buried to depths which will prevent subsequent disturbance. It has been claimed by some growers that leaf dropped to the ground rapidly dries out and the organisms are destroyed. However, this would only be true under exceptional circumstances, and spores of parsitic fungi may often be found on uncollected primings after some weeks. Similarly, any insects which have already pupated, or are about to pupate, on primed leaves may survive and eventually reinfest the crop.

One factor in the predisposition of tobacco to disease in the field is that of drainage, and this is a point which is often overlooked by

growers. Provided that the land is not obviously poorly drained, the grower is usually satisfied that the natural drainage is sufficient, and in certain seasons this may be so. However, the risk is too great, and provision should be made for those seasons when heavier rainfalls may be experienced. Under heavy wet conditions where inadequate drainage is provided, the crop is prone to serious losses from blue mould and "frog-eye" leafspot, and under extreme conditions to a condition termed "drowning" or "wet feet."

Cultural Methods.

Since the plant's natural resistance to diseases and pests is considerably modified by its general health and vigour, this aspect of the problem should on no account be overlooked. A weak plant is much more susceptible to disease than one which is making vigorous growth; especially is this the case where one is concerned with a weak parasite —as, for example, the fungus causing "frog-eye" leaf-spot.

The area grown should be commensurate with the facilities for adequate cultivation and harvesting.

Cultivation should be commenced as soon as the young transplants are established in the field in order to promote rapid and extensive root growth, which will fit the plant to withstand dry conditions later. In North Queensland, there is much evidence in favour of early deep cultivation and soil aeration as practised in the United States of America. Cultivation should be continued at regular, frequent intervals until the crop is at least knee-high, though the implements must be set correctly to obviate any damage to the root system.

General Considerations.

In order that tobacco-growing may become an established industry, the element of chance should be reduced to an absolute minimum. Consequently, any measure which will minimise the risk of a failure must be considered worthwhile. No doubt seasonal conditions will always play a part in determining the degree of success attained, but they do not normally explain the whole difference between success and absolute failure, for a good grower is seldom completely at the mercy of the elements, because he practises good farming methods which both offset the effect of adverse seasons and extract the maximum benefit from favourable growing conditions.

Insecticides.*

ROBERT VEITCH, B.Sc.Agr., B.Sc.For., F.R.E.S., Director of Plant Industry (Research).

THE function of insecticides is to kill the insect pest without inflicting appreciable injury to the insect's host, whether it be plant or animal. Insecticides used to eliminate insect infestation in manufactured goods or stored products must also be capable of being employed with a similar degree of safety to the treated article. Furthermore, the cost of the chemical and its mode of application must be such as to render its use economically practicable. It is also essential that the insecticide be applicable with a reasonable degree of safety to the operator, and finally it must not leave spray residues likely to be injurious to the subsequent consumer or user of the treated plant tissue, foodstuff or manufactured article.

Insecticides are usually classified as stomach poisons, contact insecticides, and fumigants. The stomach poisons are employed against insects which bite off and swallow portions of the plant on which they are feeding. Contact insecticides, on the other hand, are used mainly for the control of insects which feed by piercing the skin of the host plant and sucking the sap from the underlying tissue. Fumigants may be employed against both the biting and sucking type of insect.

It is not intended to discuss all the insecticides that are available, but rather to indicate the characteristics and uses of the more generally employed materials.

The manner, time, frequency, and other details of the mode of application of these insecticides, together with the precautions to be observed in using them, are further discussed in various departmental publications dealing with the pests against which they are employed.

Arsenate of Lead.

Arsenate of lead has for many years held pride of place as the most suitable form in which to apply arsenic as a stomach poison for the control of insect pests that feed by chewing. It remains in suspension in a spraying mixture reasonably well; it does not readily burn the foliage of treated plants, and it generally kills quite satisfactorily. It can be used with safety for the control of a number of important insect pests, but it must not be employed in such a manner as to leave injurious quantities of spray residue on the portions of plants intended as food for man or beast, because both the arsenic and the lead in this spray are highly poisonous.

This insecticide can be purchased either as a powder or a paste, and if obtained in the powder form, the purchaser must make sure that every particle of the powder is well moistened before being added to the water when the spray is being prepared. The best procedure is to gradually add small quantities of water to the powder until a thin paste, free from lumps, is obtained. This paste can then be thinned further and finally added to the water required to make up the desired strength of spray, the spray being thoroughly agitated while being applied.

* Reprinted from Vol. III. of "The Queensland Agricultural and Pastoral Handbook," published by the Department of Agriculture and Stock, Queensland, in 1938.

Various strengths of arsenate of lead spray are used, one of the commonest and most satisfactory formulae being arsenate of lead powder 1½ lb. and water 50 gallons. When the arsenate of lead has been purchased in the paste form, then 3 lb. must be used to 50 gallons of water.

Arsenate of lead may be combined with Bordeaux mixture in cases where the grower desires to control chewing insects and certain fungous diseases by a single application of a combination spray. The best procedure in such a case is to prepare the Bordeaux mixture in the usual manner and to add to it the required amount of arsenate of lead, the addition to the Bordeaux mixture taking place in the spray tank, the agitator of which should be kept running while the arsenate of lead is being added. In computing the amount of arsenate of lead required the Bordeaux mixture should be regarded as being the equivalent of an equal number of gallons of water.

Arsenate of lead and nicotine sulphate also form a useful combination in cases where a single application is required for the control of chewing insects and certain species of sucking insects. The soap usually employed in the preparation of a nicotine sulphate spray must, however, be omitted in this case because its presence in the combined spray would lead to the production of water-soluble arsenic with consequent spray injury. As a substitute for the soap, hydrated lime has been recommended at the rate of 2½ lb. to 50 gallons of the spray mixture. The hydrated lime will serve to liberate the nicotine from the nicotine sulphate, a reaction that is so essential to the successful application of a spray containing nicotine sulphate.

A third combination in which arsenate of lead sometimes features is an arsenate of lead and oil spray. This combination possesses certain disadvantages, the chief of which is that the presence of the oil renders an arsenate of lead residue difficult of removal and the spray residue problem in marketed fruit is correspondingly accentuated. Furthermore, the combination in the case of certain oils may lead to the liberation of water-soluble arsenic, the presence of which will cause spray injury.

Lime sulphur and arsenate of lead is a frequent combination for the control of certain fungous diseases and insect pests in deciduous fruit orchards. Spray injury may, however, follow on the production of water-soluble arsenic, formed, presumably, as a result of the interaction between the lime sulphur and arsenate of lead. To obviate such a possibility the addition of hydrated lime has been recommended at the rate of 2 lb. of hydrated lime to each 1 lb. of arsenate of lead, this mixture being worked into a paste with water and added slowly to the lime sulphur in the spray tank, the agitator of which is kept running. It is further recommended that no delay should occur in the application of this spray once it has been prepared. The arsenate of lead and lime sulphur spray is also sometimes used in citrus orchards, generally for the control of Maori mite or red spider and some chewing insect, although occasionally the lime sulphur is included in the combination in order to control certain scale insects.

Arsenate of lead is also used very extensively as a dust, several good proprietary lines, containing the arsenate of lead at strengths ranging from 14 per cent. to 70 per cent. being on the market. A convenient carrier for the dilution of arsenate of lead in the preparation

of a dust is hydrated lime, and any farmer desiring to make up his own dust may do so by thoroughly mixing the correct quantities of the two ingredients; e.g., a 25 per cent arsenate of lead dust may be prepared by mixing one part by weight of arsenate of lead with three parts of hydrated lime. Mixing must be thorough and may be conveniently accomplished by vigorously rotating a sound box or barrel partly filled with the ingredients to which several large round stones have been added.

Calcium Arsenate.

Calcium arsenate is an arsenical which is now frequently employed overseas for dusting purposes, particularly for the control of cotton pests. It is not quite such a stable compound as arsenate of lead, and it is generally considered that it should be used only when fresh supplies are available. It has not yet entered into common use in Queensland, and its further discussion is at present unnecessary; it may, however, become more extensively used in this State in future.

Cutworm Bran Bait.

An excellent form in which to use an arsenical insecticide is obtained by incorporating Paris green in a mixture of bran, molasses, and water. The bait thus prepared is very attractive to cutworms and army worms, and effectively deals with these pests in a wide range of field crops including cotton, tobacco, and tomato.

Paris green was formerly used as an arsenical spray, but for that purpose it has been almost entirely displaced by arsenate of lead, which is not so liable to burn foliage and which, moreover, remains in suspension much better than most commercial grades of Paris green. The latter insecticide, however, is more toxic, and is accordingly used in the preparation of bran bait for cutworm control, because in the case of bait placed on the ground the factors which render Paris green unsatisfactory in a spray are of no consequence.

The bait may be prepared by thoroughly mixing 25 lb. of bran and 1 lb. of Paris green while still dry. Molasses to the extent of 3 or 4 lb. is then mixed with water, and this is added to the dry bran and Paris green, the whole being well mixed, care being taken to ensure that only enough water is used to obtain the right consistency. It will generally be found that only 2 gallons of water is required to produce the desired consistency for the quantity of bran mentioned. The bait should be crumbly and not over-moist, thus permitting it to trickle through the fingers.

It should be scattered in the late afternoon so as to be fresh and attractive when the cutworms emerge from the soil to feed about sunset. It is somewhat difficult to definitely state the amount of bait required per acre, this depending mainly on such factors as the intensity of the infestation, the nature of the attacked crop, and on whether the bait is to be broadcasted or applied in rows. The economics of the crop requiring protection will also frequently determine the amount of bait that can be profitably used. However, as a rough guide to the farmer, it may be stated that 50 lb. dry weight of bran per acre should prepare sufficient bait for a light broadcast, but when the bait is sprinkled in the rows of plants requiring protection half that quantity may suffice if the rows are 4½ feet apart. Much heavier applications may sometimes, however,

be necessary on portions of the baited area where the infestation is abnormally high. There may thus be a very considerable variation in the rate of application, even in a single area.

As a precautionary measure poultry should not have access to a field in which bran bait has recently been scattered; any tendency to danger, however, is largely dependent on the method and density of bait distribution. All domestic animals should be kept away from the containers in which the bait has been prepared until these have been emptied and thoroughly cleansed.

Further details regarding the use of this bait will be found in departmental publications dealing with cutworms and army worms.

Grasshopper Bran Bait.

A different type of bait is employed for the control of grasshoppers, the arsenical in this case being arsenic pentoxide, a favourite in Queensland because of its frequent availability on the station or farm. The formula for this bait is arsenic pentoxide ½ lb., molasses 4 lb., bran 25 lb., water 2½ gallons. The molasses in this formula may be increased to 6 lb. in dry districts particularly if a plentiful supply is available. The arsenical is dissolved in a pint of boiling water in a kerosene tin or other container of suitable size, the molasses being similarly mixed with the same quantity of boiling water in a second container. Both the solutions are thoroughly stirred and half the balance of the water, i.e., 1¼ gallons, is added cold to each container, the solutions being again well stirred. The next step is to add the molasses solution to the arsenical solution, this being accompanied by further stirring. The bran is then spread on a mixing board or sheet of iron and the arsenic and molasses solution is added to the bran, the whole being thoroughly worked up until a moist loose mash is obtained, the consistency of the mash being such as to permit of its trickling readily through the fingers.

The bait prepared according to the directions given is broadcasted somewhat in the same manner as in the hand-sowing of wheat, and is uniformly applied in a very finely divided state wherever the young grasshoppers are present in appreciable numbers. Experience indicates that the amount of bait prepared according to the formula given above is sufficient for the treatment of about two-thirds of an acre of infested ground.

The mixing of this bait should not be done by hand, and tin scoops or other implements should be used for manipulating the arsenic. A wise precaution consists of smearing the hands with petroleum jelly before preparing and broadcasting the bait, the hands being thoroughly washed after the work has been completed. The precautions with respect to domestic animals mentioned in the discussion of the cutworm bran bait should also be observed in the case of the grasshopper bran bait.

Further details regarding the application of this bait for combating grasshoppers will be found in the departmental leaflet on the control of these pests.

Swabbing Mixture.

A swabbing mixture which may be employed in cotton fields for the control of pests such as the corn ear worm and the cotton web-spinner is prepared by mixing 1 lb. of arsenate of lead and 1 gallon of

molasses with 6 gallons of water. Its mode of application will be found discussed in some detail in departmental publications dealing with cotton pests and their control.

Sodium Fluoride.

An insecticide of minor importance is sodium fluoride which acts mainly as a stomach poison although it is believed to possess some slight value as a contact insecticide. It has been suggested as a substitute for arsenicals in baits prepared for the control of cutworms and grasshoppers, but its chief use in insect control is in the destruction of cockroaches. It is somewhat poisonous to human beings and must therefore be used with discretion in dwelling houses. Various proprietary insect powders having sodium fluoride as the active principle are on the market.

Silverfish Bait.

A recently introduced silverfish bait which has proved successful in Australia is prepared according to the formula 1 oz. flour, 1½ oz. sugar, 10 fluid oz. water, ¼ oz. barium fluosilicate or ⅛ oz. zinc borate. The flour, sugar and water are heated to form a warm paste to which the poison is added, the mixture being then spread on small strips of white cardboard. Discretion should be exercised in the use of this bait on account of the poison which it contains.

Barium Carbonate.

Barium carbonate is a poison very frequently employed in the preparation of bait for the control of rats and mice. It is cheap and effective and is generally used in the form of a biscuit prepared by mixing one part by weight of barium carbonate with three parts of flour. These ingredients are mixed together, sufficient water being added to enable a stiff dough to be prepared. This dough is then rolled out to the thickness of a quarter of an inch and is cut up into pieces half an inch square. Finally these small biscuits are dried in the sun or in an oven and are then ready for use. Although much less dangerous than most other poisons employed in rodent bait, barium carbonate biscuits must nevertheless be handled with care and should not be placed within reach of domestic animals or children.

Red Squill.

Another rat poison is obtained from the fleshy bulbs of a wild plant growing on the shores of the Mediterranean Sea. This plant is known as the red squill or sea leek and it provides an efficient rodent poison which is readily eaten by rats and mice. Red squill can be obtained as a powder or as a liquid, such substances as fish, steak, bran, and oatmeal being used in the preparation of the bait. A commonly employed bait is obtained by mixing 1 oz. of powdered red squill with sufficient water to produce a thin paste which is added to and well mixed with 1 lb. of fresh finely chopped up meat. Another formula is 1 oz. of powdered red squill and 1 lb. of oatmeal, bran, or some other cereal meal, the ingredients being mixed dry and then moistened by the addition of a pint of milk or water. A third form of bait is obtained by cutting ½ lb. of bread into ½-inch cubes and mixing it with a pint of liquid red squill. Red squill varies in toxicity, and the formulæ just quoted are based on the assumption that the red

squill used in the preparation of the bait is of high toxicity. Although red squill is the safest material to use in rodent control it should be used with discretion in its application.

Resin-Caustic Soda-Fish Oil.

A departmental spray prepared according to the following formula has recently been evolved for use against the bronze orange bug and other citrus pests, more particularly scale insects:—10 lb. resin, 3 lb. caustic soda of good commercial quality, 1½ lb. herring or other fish oil, and 40 gallons of water.

The resin should be finely ground up before commencing operations, the next step being to dissolve the caustic soda in 2 gallons of water, to which the resin is slowly added while the mixture is boiling quietly. The mixture should be stirred during boiling to prevent solids adhering to the container. A creamy coloured scum forms on the surface of the mixture, the boiling of which should continue until a clear dark solution can be detected beneath the surface scum. The herring oil is added to this solution, and the whole mixture is then boiled for a few more minutes to make sure that no free oil is left. This quantity of concentrate is then available for dilution with 38 gallons of cold water. In preparing the concentrate, it is well to remember that the gently boiling solution expands, and therefore the selected container should be only half full if boiling over is to be avoided.

It will be noticed that a large quantity of solid matter is deposited as the concentrate cools off, hence if the concentrate is being prepared on a large scale necessitating its division into lots for subsequent dilution, it is suggested that the division be made while the concentrate is still hot. If divided into 2-gallon or 3¾-gallon lots, there will be sufficient concentrate in each lot to make up the 40 gallons or 75 gallons respectively, which represent the capacity of most Queensland spray tanks.

This concentrate cannot be kept satisfactorily except in airtight containers, and when such are not available the fish oil should not be added if the grower desires to store the concentrate. In such a case the concentrate should be prepared as directed except that the fish oil should be omitted for the time being. This modified concentrate is then stored and reheated when required, the herring oil being added at reheating and boiled as before for a few minutes to ensure that no free oil is left.

This spray must be carefully prepared, and it is essential that the clear, dark liquid be obtained as described. It can be applied with safety except during very hot weather, and its application should cease when the temperature exceeds 90°F. When the spray is being applied the agitator should be kept running. Smearing the hands with petroleum jelly is a procedure that should be adopted before preparing the resin-caustic soda-fish oil spray.

Oil Sprays.

Oil sprays have practically eliminated such old favourites as kerosene emulsion, and reliable proprietary brands of these sprays are now available at most orcharding centres in Queensland.

The proprietary oil sprays marketed in Queensland are obtained by selecting petroleum oils in various stages of refinement and adding either soap alone or soap in combination with some other substance, the objective

in both cases being to facilitate the formation of a stable emulsion when mixed with water. Earlier spraying oils were known as red oils, but in recent years the so-called white oils have largely displaced the red oils. There is not so much to choose between the red oils and the white oils in so far as the kill of scale insects is concerned, but the white oils, containing oils of a further stage of refinement, can undoubtedly be used with a much greater degree of safety to the tree. The objective aimed at by the manufacturers of these oil sprays is to obtain as high a percentage mortality in the scale insects as is possible without unduly reducing the margin of safety to the tree, and in this respect a reasonable compromise has generally been achieved.

The preparation of an oil spray for application in the orchard commences with the accurate measurement of the oil and water required. The oil is poured into a tin, and twice its volume of water is added, this mixture being forced through a fine nozzle of a bucket pump or poured from one container to another several times until a satisfactory emulsion is obtained. The mixture is then added to the balance of the water which is already in the spray tank. Growers are reminded that the manufacturers' directions should be carefully read before preparing and applying the spray.

Oil sprays should be applied in a well emulsified condition, and the operator should make certain that the spray mixture is kept efficiently agitated while being applied. An accumulation of surplus oil at the base of the tree may cause injury to the lower portion of the trunk and the adjacent portions of the root system, this injury being particularly liable to occur in the case of young trees. It can, however, be obviated by earthing up round the base of the trunk before commencing operations and removing the soil soon after spraying. Trees should not be sprayed with oil when experiencing dry conditions, and in the case of citrus it is not desirable to use oil sprays during the dormant period. Furthermore, the use of these oils during high summer temperatures is attended with danger. Healthy well-watered citrus trees may be sprayed with white oils at a temperature close on 100°F., but, in general, spraying with oils should be confined to cooler weather. It is also well to remember that sickly trees are more liable to spray injury than healthy trees.

Oil and nicotine sulphate may be used as a combination spray, but as stated when discussing arsenate of lead, a mixture of an oil spray and arsenate of lead possesses certain disadvantages and dangers.

For many years lime sulphur and oil were regarded as constituting a dangerous combination, and indeed in the case of many oils this is still so. Certain proprietary oils, however, are now being marketed as safe for mixing with lime sulphur. Such a combination spray is a very useful one but it should be employed with considerable care, and should not be applied while high temperatures are ruling. Experience indicates that the maximum temperature at which this combination spray may be used is in the vicinity of 90°F., but it is better to cease its application before that temperature has been reached.

Oil is now frequently added to Bordeaux mixture when the latter is being used in citrus orchards. The application of Bordeaux mixture for the control of fungous diseases of citrus unfortunately tends to markedly increase scale infestation, and, in order to obviate such an eventuality, 1 per cent. of a good oil spray is frequently added to the mixture. The oil is first well emulsified in double its own volume of

water and is then added to and well stirred into the Bordeaux mixture. Care must be taken to ensure that no free oil is present in the spray while is is being applied.

The application of an oil spray may follow the fumigation of citrus trees within a few days and fumigation may follow an oil spray after a similarly brief interval, but it is better to allow at least two weeks to elapse between each treatment. Normally, however, there should be no necessity whatever for the two treatments to be given at such a brief interval as two weeks. An oil spray should not be used immediately after or before the application of a lime sulphur spray or a sulphur dust, and a period of at least one month should elapse between the two treatments.

Should Bordeaux mixture and oil be applied as separate sprays in citrus orchards at least two months must elapse between the application of the Bordeaux mixture and the subsequent use of an oil spray. When the oil spray is applied before the Bordeaux mixture the interval may be somewhat shorter, but it is seldom necessary to apply these two sprays in that order.

Spraying oils are most commonly used for the control of scale insects on citrus, but they are also similarly used on deciduous fruit trees at certain seasons of the year.

Kerosene Emulsion.

Kerosene emulsion was for many years generally employed for the control of scale insects and aphids, but for such purposes it has now been very largely supplanted by other insecticides. There are, however, still occasions on which growers may desire to use it for it possesses the great merit of being prepared from ingredients obtainable at any country store.

A formula frequently used in its preparation is ½ lb. hard soap, 1 gallon water and 2 gallons kerosene. The soap is added to the water and dissolved therein by boiling. This mixture is then removed some little distance from the fire, and the kerosene is added while the soap solution is still hot. The soap, water, and kerosene are then thoroughly emulsified by churning up for five or ten minutes by means of a small spray pump or syringe. A thorough emulsion must be obtained, otherwise the presence of free oil will cause foliage injury. Although the stock solution prepared in the manner just described may keep for some time, it is generally considered desirable to prepare it as required.

The stock solution has to be diluted prior to use, the proportion of water to be added being determined by the species of plant to be sprayed and the species of pest to be destroyed. Some investigators claim that no greater strength than one part of stock solution to fifteen parts of water should be used, while others consider a one to ten strength reasonably safe.

When discussing oil sprays a suggestion was made as to how an accumulation of potentially injurious spray at the base of a tree can be dealt with. The precaution then mentioned should also be adopted in the case of trees sprayed with kerosene emulsion.

Crude Oil Emulsion.

A crude oil emulsion may be prepared in exactly the same manner as kerosene emulsion except that crude oil is substituted for the kerosene.

The stock solution in this case is diluted by the addition of one part of the stock solution to seven parts of water. This spray has been used against caterpillars in army-worm outbreaks, and for such a purpose it is of value on dairy farms or other grazing holdings on which the owner desires to use a non-arsenical insecticide. The above ground portions of plants with which this spray makes contact are killed together with the insects.

Tar Distillate Washes.

Proprietary tar distillate washes are now employed for the control of a number of pests, and for certain purposes they are quite effective. Their use, however, has to be confined to seasons of the year when the treated trees are completely dormant, and they are employed only in deciduous fruit orchards. They should be applied before the buds begin to swell, otherwise severe injury may be inflicted.

Tar distillate washes can be profitably employed to kill the over-wintering eggs of the green peach aphis. They are also used against San José scale and they can be of assistance in black peach aphis control.

Soap and Washing Soda Mixture.

A soap and washing soda spray has been found very effective for the control of the pink wax scale, for which purpose it has largely displaced the old washing soda wash. The latter spray was sometimes slightly drastic in its effect on treated trees, hence its waning popularity.

The spray is prepared by dissolving twenty-four cakes of Sunlight soap, or an equivalent quantity of similar soap, and 12-14 lb. of clean, fresh washing soda in 75 gallons of water. The washing soda is dissolved in a small quantity of the water which is brought to the boil and the soap, which should be shredded, is then added. The mixture is further heated until the soap has dissolved and is added to the balance of the 75 gallons of water, the spray being agitated during application.

Washing Soda Wash.

Washing soda wash is prepared by dissolving 1½ lb. of clean fresh washing soda in 4 gallons of water. This spray may be used for the control of white wax on citrus against which the soap and washing soda mixture is not so effective. As already indicated, however, the effect of the washing soda wash on the treated trees may be rather severe.

Derris and Cubé.

Insecticides prepared from certain species of Malayan plants belonging to the genus Derris have recently come into favour. These plants are well known as a source of fish poison both in Malaya and in the South Seas, and it has now been demonstrated that several active principles, including rotenone, which are present in derris, are highly toxic to some species of insects. The derris insecticides act both as contact sprays or dusts and as stomach poisons, and they possess the great merit of being safe for application to edible portions of plants due for harvesting at an early date. Insecticides of this type have given good results against the common cabbage caterpillar, the onion thrips, and various species of aphids.

Cubé is the name applied to a group of South American fish poison plants which have also been found to contain these active

principles. They are now a source of insecticides similar to those obtained from the genus Derris.

The derris and cubé insecticides are generally marketed as proprietary lines and the firms selling the various brands usually supply full details as to the strength of application.

Pyrethrum.

Pyrethrum powder, derived mainly from the flower heads of species of Chrysanthemum was formerly used for the control of insects such as the banana rust thrips. Deterioration on exposure and variability in results led to loss of popularity, some measure of which, however, has been restored by its demonstrated value against the red-shouldered leaf beetle.

Recently, standardised extracts have been manufactured, thus eliminating the objectionable feature just mentioned, and extracts of pyrethrum are now used very extensively in the manufacture of fly sprays.

A home-made pyrethrum spray may be prepared by mixing ½ lb. of pyrethrum in 1 gallon of kerosene, the mixture being agitated every now and again during a period of two hours. It is then allowed to settle and the clear liquid is drawn off and used as a fly spray. If water-white kerosene is employed in its preparation this spray can be used in furnished rooms. Stocks of this insecticide should be stored in tightly closed containers.

Lime Sulphur.

Lime sulphur is an excellent dual purpose spray, being a valuable insecticide and an efficient fungicide. It was formerly prepared on the orchard by boiling a mixture of sulphur, lime, and water, but the home-made preparation has largely been displaced by the commercial product which is obtained in concentrated form ready for dilution.

The insecticidal value of lime sulphur is largely dependent on the polysulphide content, a factor capable of determination only by analysis. The old method of discussing the strength of the solution and the effectiveness of lime sulphur in terms of the Baumé hydrometer reading is now generally regarded as unreliable.

Although lime sulphur is a useful insecticide against certain insects, it is more important as a fungicide. For this reason a much fuller account of the method of preparation and dilution of this material is given in the article dealing with fungicides appearing in this issue of the "Agricultural Journal," and to this the reader is referred.

Lime sulphur may be used on citrus at strengths varying between 1 in 10 (2·12 polysulphide) and 1 in 35 (0·61 polysulphide), the stronger sprays being used in the colder months. Lime sulphur is effective against Maori mite and white louse, both important pests of citrus, and it is also used for the control of San José scale on deciduous fruits in the Stanthorpe district, being there applied at a strength of 1 in 10 (2·12 polysulphide) during the winter months when the trees are dormant.

A combination spray of lime sulphur and arsenate of lead and a combination of lime sulphur and oil have been discussed in earlier paragraphs, and the precautions necessary in preparing and applying such combinations have been adequately indicated. Lime sulphur is also sometimes combined with nicotine sulphate to control certain

fungous diseases and soft bodied insects by a single treatment. When such a combination is employed the soap, which is included in the ordinary nicotine sulphate spray, should be omitted because it reacts with lime sulphur. No activator, however, requires to be substituted for the soap because the lime sulphur itself performs that function.

The discussion on oil sprays includes a reference to the period that should elapse between the application of a lime sulphur spray and an oil spray. Lime sulphur following Bordeaux mixture at a brief interval may produce a dark stain on the sprayed surfaces.

Sulphur.

Sulphur is used to control certain pests and diseases, the pests against which it is generally employed being red spiders and other mites.

This insecticide may be obtained in the form of flowers of sulphur or sublimed sulphur, which is produced by the condensation of sulphur vapour. It is also procurable in the form of ground sulphur, which is now available in the degree of fineness essential for application as an insecticidal dust. All ground sulphurs, however, do not necessarily possess the requisite degree of fineness, and this essential should always be specified when ordering this or any other type of sulphur for dusting purposes. Ground sulphur is prepared by grinding lump sulphur, and it should be noted that the grinding imparts a lighter yellow colour than is present in flowers of sulphur. The ground sulphur sometimes tends to become lumpy, while small but injurious quantities of free sulphuric acid may be present in flowers of sulphur.

Hydrated lime may be added to sulphur to the extent of one-third of the sulphur, thereby promoting adherence to the treated foliage, and ease of application while at the same time counteracting the possible presence of injurious quantities of free sulphuric acid.

The attention of the reader is directed to a reference in the discussion on oil sprays to the period that should be allowed to elapse between the application of a sulphur dust and an oil spray.

Sulphur dusting is usually carried out early in the morning when the dew is still present on the foliage, and should not be undertaken on windy days. Sulphur dust is also applied in citrus orchards in the early evening, after sundown, when the dew is falling.

Sulphur may be used as a fumigant for stored products, the sulphur on being burned, combining with the oxygen of the air to form sulphur dioxide. Sulphur may thus be employed for the control of cheese mites.

Colloidal sulphur is another form of this valuable insecticide which has recently come into prominence. The particles in this case are extremely small and the colloidal sulphur mixes readily with water.

Nicotine Sulphate and Nicotine.

Nicotine sulphate has long enjoyed popularity as an effective spray for soft-bodied insects such as aphids and thrips. It acts as a fumigant, and is one of the safest sprays to apply in so far as its effects on the sprayed plants are concerned. Nicotine is liberated relatively slowly from nicotine sulphate under normal conditions, hence in preparing a nicotine sulphate spray it is usual to add a substance as an activator which will

release the essential toxic principle in the spray—namely, the nicotine. For this purpose soap is usually incorporated in a nicotine sulphate spray, a standard formula being nicotine sulphate (40 per cent.) ½ pint, soap 2lb. and water 50 gallons.

Three combination sprays in which nicotine sulphate is combined with arsenate of lead, an oil spray, and lime sulphur, respectively, have already been discussed in earlier paragraphs. Nicotine sulphate may also be combined with Bordeaux mixture in cases where the grower desires to control certain fungous diseases and soft-bodied insects by one and the same spray application. Nicotine sulphate requires no activator in this combination, the Bordeaux mixture supplying all that is required in that respect.

Nicotine sulphate dusts are now largely employed instead of the spray, the nicotine sulphate being mixed with a fine powder which acts as a carrier and also usually functions as an activator to liberate the toxic nicotine from the nicotine sulphate. A good nicotine sulphate dust should be free from lumps, and when discharged from a duster the resultant cloud should float lightly in the air.

A more recent tendency has been to employ nicotine instead of nicotine sulphate in preparing these dusts, a material advantage being that a much more rapid volatilisation is obtained with the nicotine than is the case with nicotine sulphate dusts.

Nicotine and nicotine sulphate dusts deteriorate if exposed, and should accordingly be carefully stored in air-tight containers. Furthermore, it is desirable to purchase only sufficient dust to comfortably do the immediate work, thus leaving little or no surplus to deteriorate in storage.

The sprays are very useful against woolly apple aphis, and the dusts are the most satisfactory insecticide yet evolved for the control of banana rust thrips.

Home-made Tobacco Extracts.

Home-made tobacco extracts have long been out of favour as sources of nicotine sprays, preference now being given to nicotine sulphate sprays and nicotine sulphate or nicotine dusts prepared under carefully controlled conditions permitting standardisation at known strengths. The revival of tobacco growing, however, has created a considerable source of waste tobacco, and frequent inquiries are now received regarding the preparation of extracts from such waste material.

The tobacco plant varies considerably in its nicotine content, and the strength of a home-made extract must of necessity be subject to considerable variation. Some formulæ range from 1 lb. of waste tobacco to 1 gallon of water to 1 lb. of waste tobacco to 2½ gallons of water. It has been suggested that 1 oz. of washing soda be added to each 6 gallons of water.

In preparing the extract by cold soaking, the mixture is left standing for a period of 24 to 48 hours with occasional stirring; the fluid is then drained from the tobacco, and after straining is ready for application as a spray.

The extract may alternatively be prepared by heating the ingredients in a covered container over a fire. Heating continues until the mixture is on the point of boiling, when it is removed from the fire. After cooling the fluid is drained off, strained, and is then ready for use.

These tobacco extracts should be used straight away as they deteriorate on storing. Soap may be added as in the case of proprietary nicotine sulphate sprays.

Wetting, Spreading, and Sticking Properties of Spray Fluids.

As mentioned in an earlier paragraph, the successful application of insecticides depends on their ability to destroy the insect with safety to the treated plant at a cost that can be borne by the product to be marketed.

Success in spraying is, therefore, in large measure dependent on the ability of the operator to obtain a maximum degree of efficiency with a minimum expenditure of spray fluid. This desirable objective will be achieved only when the sprayed surface of the plant or insect is thoroughly, intimately, and evenly covered with a thin film of the spray fluid. In addition, the toxic element of the spray should remain on the sprayed surface for a sufficient period of time to achieve the objective for which it was applied.

Some spray fluids do not in themselves possess satisfactory wetting and spreading properties no matter what plant they are applied to, while such plants as the cabbage and certain insects—*e.g.*, mealy bugs—present decided difficulties in spray application. Nicotine sulphate with soap as an activator and oil sprays require no spreader, but the addition of such a supplementary substance is necessary in the case of arsenate of lead. A lime sulphur spray is also much improved by the addition of a spreader.

Where it has been found impracticable to obtain the desired degree of efficiency in the application of the spray fluid, it has become the practice to add supplementary substances variously known as wetters or spreaders and stickers.

The power of a supplementary substance to wet a surface may depend on its ability to produce chemical changes thereon—*e.g.*, a solvent effect may be produced on the waxy coating of the cabbage leaf or mealy bug. In addition, the wetting power is largely dependent on the physical interactions between the spray fluid and the sprayed surface. From a practical point of view the objective, however, of the supplementary substance is to ensure thorough wetting—*i.e.*, intimate contact between the spray fluid and the sprayed surface.

A further essential in the supplementary substance is its ability to ensure that the sprayed surface is completely covered with a film of spray fluid. The achievement of such an objective means that the spray fluid will not become aggregated in droplets, a development which would leave much of the surface unprotected or many of the insects untreated.

Wetting and spreading are not just one and the same thing, but any one of the commonly used supplementary substances will produce both effects in a spray fluid that is deficient in wetting and spreading properties, and it is generally referred to as a spreader. Soap, saponin, gelatine, and calcium caseinate have been used as spreaders, but before adding a spreader to a spray fluid the operator should satisfy himself that the addition can be made without reducing the toxicity of the spray or rendering the spray fluid more liable to injure the sprayed plants—*e.g.*, soap should not be used as a spreader for arsenate of lead.

Stickers, as their name suggests, are supplementary substances, the addition of which to the spray fluid increases the ability of the toxic substance to adhere to the sprayed surface. Actually the spreader added to a spray fluid functions also as a sticker. While the threefold purpose of a supplementary substance has been outlined so that the reader may appreciate the purpose of the addition, he need concern himself only with the use of one satisfactory agent of this type.

Recently a number of proprietary spreaders have been placed on the market by reputable firms backed in one instance by the claim that the material is "compatible with practically every spraying fluid."

Paradichlorobenzene.

The white crystalline substance known as paradichlorobenzene is now extensively used in Queensland, being employed mainly as a soil fumigant for the control of white grubs in sugar-cane plantations. It can also be used in the control of white ants attacking the roots of trees, and it fills a useful minor role in bookcases for the protection of the books from the ubiquitous cockroaches. It evaporates, rather after the manner of flake naphthalene, to a fumigant gas with a characteristic somewhat sweetish odour. When employed as a soil fumigant paradichlorobenzene should be applied when the soil is in a friable moderately moist condition and not when it is either excessively wet or dry.

Carbon Bisulphide.

Carbon bisulphide is extensively used for the fumigation of insect-infested seeds, cereals, and potatoes, and is also employed for the destruction of ants' nests, being a very satisfactory insecticide for both purposes.

This chemical rapidly evaporates on exposure to the air and forms a highly explosive and inflammable gas. Farmers using it should accordingly make certain that it does not come into contact with a flame or highly-heated pipes. Furthermore, it is essential to refrain from smoking when using carbon bisulphide, and the containers in which it is supplied should not be exposed to strong sunlight. The operator should also make every effort to avoid inhaling quantities of the gas, for serious consequences will ensue if this precaution is not observed.

Satisfactory results with carbon bisulphide fumigation are obtainable only when certain temperatures prevail, and it is generally considered that a temperature of at least 70°F. is desirable. It has been demonstrated that fumigation at less than 60°F. has been productive of disappointing results. For this reason fumigation should not be undertaken in cold weather, and it should start in the morning, so as to obtain the benefit of the higher day temperatures.

The seed to be treated for insect infestation is placed in a suitable container, which should be as air-tight as possible. The carbon bisulphide is then poured into saucers or other suitable dishes placed on top of the seed so that the gas, which is heavier than air, will diffuse throughout the container, which should be immediately tightly closed.

The general practice is to allow 4 or 5 lb. of the carbon bisulphide to each 1,000 cubic feet of the container, and to leave the seed exposed to the gas for thirty-six hours. Cowpea and allied seed, however, should be fumigated for twenty-four hours only. The fumigated seed should

then be aired to remove the gas. The germination of mature seed is not affected if dry when treated and if the precaution of airing the seed after treatment is observed.

Reinfestation of fumigated seed will take place if steps are not taken to prevent it, hence the usual procedure is to store the treated seed in tightly closed containers giving little chance of reinfestation.

Cereals and potatoes are fumigated in a rather similar manner except that, in the case of the latter, the weaker dosage of carbon bisulphide is used.

Hydrocyanic Acid Gas.

Another extremely useful fumigant is hydrocyanic acid gas, which is extensively employed for the fumigation of ships, buildings, imported raw materials, dormant nursery stock, and citrus orchards.

This colourless gas is lighter than air and diffuses rapidly, a smell of bitter almonds being the only means whereby its presence can be readily detected. It is extremely poisonous to insects, animals, and man, and must therefore be handled with great care. It is a highly-efficient insecticide for the fumigation of scale-infested citrus trees, and produces no appreciable injury in such trees if the requisite precautions are observed in its application.

The discussion of hydrocyanic acid gas fumigation will be confined to its application to insect-infested citrus orchards, and the first point to note in connection therewith is the fact that the gas may be effectively generated in any one of several ways.

The method originally employed is still frequently used in Queensland, and is known as the pot system, in which the gas is generated under a sheet by the interaction of potassium cyanide, sulphuric acid, and water. The tree to be fumigated is completely enclosed by pulling a sheet over it by means of poles not less than 18 feet in length for average size trees. The poles should, in general, be about 2 feet longer than the height of the trees to be fumigated. The height and diameter of the enclosed space are then obtained by comparison with a pole plainly marked in feet, and by reference to Table I. the operator ascertains the quantity of materials required for the fumigation of the tree he has just covered and measured. The requisite quantities of these materials are accurately weighed or measured, and the water is poured into an earthenware jar. The sulphuric acid is then carefully and slowly added to the water, and the jar is placed under the fumigating sheet covering the tree. The potassium cyanide is immediately dropped into the mixture of water and sulphuric acid, and the portion of the sheet that has been raised to permit the charging of the pot is promptly closed. A word of warning must be issued with respect to the addition of the sulphuric acid to the water, because if care is not exercised in doing so some of the acid may splash on to the operator and inflict very severe burns.

The proportion of water, sulphuric acid, and potassium cyanide is 3:1:1, the amount of water and sulphuric acid being expressed in fluid ounces and the potassium cyanide in ounces avoirdupois. It is desirable at this stage to mention the fact that the so-called potassium cyanide is generally a mixture of potassium cyanide, sodium cyanide, and a little inert matter. However, its equivalent value in pure potassium cyanide has to be declared on the labels. The requisite amounts of potassium cyanide necessary for the fumigation of various sizes of citrus trees

TABLE I.

POTASSIUM CYANIDE.

45 Minutes Exposure.

Diameter of Tree (feet).

Height of Tree (feet).

	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	
4	1	1	1	1																4
5	1	1	1	1½	2															5
6		1½	1½	2	2	2½	3	4	4											6
7		1½	1½	2	2½	3	4	4	4	5										7
8				2½	3	3	4	4	5	6	6	6	7							8
9				2½	3	3	4	4	5	5	6	6	7	7						9
10				3	3	4	4	4	5	5	6	6	7	8	9					10
11					4	5	5	5	6	6	7	7	8	9	10					11
12						5	5	6	6	6	7	8	8	10	11	12	13	15	17	12
13						6	6	7	7	7	8	9	9	12	13	14	15	16	18	13
14							6	7	7	8	9	10	11	13	14	15	17	18	18	14
15								7	8	8	10	11	12	14	14	16	18	20	20	15
16									9	10	12	12	13	14	15	17	18	20	21	16
17										12	13	13	14	15	16	18	20	22	22	17
18											13	13	15	16	18	20	22	23	24	18
19												15	16	18	19	21	23	25	25	19
20													17	19	21	23	24	25	26	20
21													19	19	21	23	25	26	27	21
22														21	22	24	25	26	27	22
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	

Doses in Ounces.

Proportion: Water, 3; Sulphuric Acid, 1; Potassium Cyanide, 1.

are shown in Table I. Once the requisite quantity of potassium cyanide is known for any particular tree, the quantities of sulphuric acid and water required in the fumigation of that tree are readily ascertainable according to the proportion mentioned earlier in this paragraph.

The duration of the fumigation is generally forty-five minutes, at the end of which period the sheet or tent is transferred to the next tree. The materials used for tents and their handling and measurement are discussed later in these notes on hydrocyanic acid gas.

TABLE II.

CYANOGAS DUST.

45 Minutes Exposure.

Diameter of Tree (feet).

Height of Tree (feet).

	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	
4	1	1	1	1½																4
5	1	1	1½	1½																5
6	1	1½	1½	1½	2	2½	3	4	4											6
7	1	1½	1½	2	2½	2½	3½	4	5	5½										7
8		1½	1½	2	2½	3	4	4½	5½	6½	7½	8½	10							8
9			2	2½	2½	4	4½	5	6	7	8½	9½	11	12½						9
10				2½	3	4	4½	6	7	8	9½	10½	12	14	15½					10
11					3½	4½	5	6½	7½	9	10	12	13½	15	17	19				11
12					3½	4½	6	7	8	10	11	13	14½	16½	18½	20½	23	25	27½	12
13							6	7½	9	10½	12	14	16	18	20	22	24½	27	30	13
14							7	8	9½	11	13	15	17	19	21½	24	26½	29	32	14
15								8½	10	12	14	16	18	20½	23	25½	28½	31	34	15
16								9	11	13	15	17	19½	22	24½	27½	30½	33½	36½	16
17									11½	13½	16	18	20½	23	26	29	32	35½	39	17
18									12½	14½	17	19	22	24½	27½	31	34	37½	41	18
19									13	15½	18	20½	23	25	29	32½	36	39½	43½	19
20									13½	16	18½	21½	24½	27½	30½	34	38	42	46	20
21												22½	25½	29	32½	36	39½	44	48	21
22												23½	26½	30	34	37½	41½	46	50½	22
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	

Doses in Ounces.

Table recommended by manufacturer. Modifications may be made in this table by the manufacturer, and citrus growers should accordingly obtain the latest table when purchasing their supplies of this fumigant.

Fumigation by the pot method, which can be carried out only during the night, necessitates the handling of a very corrosive acid and a highly poisonous chemical. Hence the pot system is by no means an ideal one, and it has recently been largely displaced by other methods of generating the gas.

TABLE III.

CALCID BRIQUETTES.

40 Minutes Exposure.

Diameter of Tree (feet).

Height of Tree (feet).	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	
4	1	1	1½	1½																4
5	1	1	1½	2																5
6	1	1½	1½	2	2½	2½	3	3½	4											6
7	1	1½	2	2	2½	3	3½	4	4½	5										7
8		1½	2	2½	2½	3	3½	4½	5	5½	5½	6	7							8
9			2	2½	3	3½	4	5	5½	5½	6	7	8	9						9
10				2½	3	3½	4½	5	5	6	7	8	9	10	11					10
11					3½	4	4½	5	6	7	8	9	10	11	12	13				11
12					3½	4	5	5	6	7	8	10	11	12	13	14	16	17	19	12
13							6	6	6	7	9	10	11	13	14	16	18	20	22	13
14							6	6	7	8	9	11	12	14	16	17	19	21	23	14
15								6	7	8	10	11	13	15	17	19	21	23	25	15
16								7	8	9	11	12	14	16	18	20	22	24	27	16
17									8	10	11	13	15	17	19	21	24	26	29	17
18									9	10	12	14	16	18	20	22	25	28	30	18
19									10	11	13	15	17	19	21	24	26	29	32	19
20									10	11	13	15	18	20	22	25	28	31	34	20
21												16	19	21	24	26	29	32	35	21
22												17	19	22	25	28	31	34	37	22
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	

Doses in Number of Briquettes.

Table recommended by manufacturer. Modifications may be made in this table by the manufacturer, and citrus growers should accordingly obtain the latest table when purchasing their supplies of this fumigant.

The most generally used alternative to the pot system is the generation of the gas by the use of calcium cyanide, which is obtainable in Queensland in the form of Cyanogas and Calcid Briquettes. The calcium cyanide in a finely divided condition interacts with the water

vapour in the atmosphere, and hydrocyanic acid gas is evolved. In practice, the Cyanogas "A" dust, which is the form of Cyanogas generally employed in this State, is blown under the sheet by means of a forge type blower, although some growers, in order to obviate the cost of the blower, place the necessary amount of dust in a saucer and throw it under the sheet, using a sweeping motion in order to obtain a good distribution of the dust. Application by the special blower is to be preferred to the use of the saucer. A special machine grinds the Calcid Briquettes and blows the resultant powder under the sheet.

The number of ounces of Cyanogas dust and the number of Calcid Briquettes required for the fumigation of various sizes of citrus trees will be found in Tables II. and III., respectively.

Fumigation by means of calcium cyanide possesses many advantages over the old pot system, the principal of which are the simplicity of the operation, the elimination of the highly-corrosive sulphuric acid, the fact that calcium cyanide, although itself a very strong poison, is safer to handle than potassium cyanide, the fact that the fumigation can be done in the day time under widely varying climatic conditions, and the further fact that calcium cyanide is more effective for most purposes on a citrus orchard.

Liquid hydrocyanic acid gas has also been employed elsewhere as a substitute for the pot system, but it has not been used in Queensland.

Fumigation can be effectively carried out without any appreciable undesirable consequences to the fumigated trees, but to ensure safe and successful treatment certain precautions must be observed.

The dimensions of the tree must be correctly ascertained, the appropriate quantity of chemical or chemicals and water definitely determined, and then accurately measured out. Trees should not be fumigated when wet, and if the work is being carried out at night the incidence of a heavy dew renders the continuance of fumigation undesirable. Furthermore, wet sheets should not be used in fumigation.

Fumigation by the pot system is inadvisable when the temperature exceeds 75° F. on the coast or 80° F. in inland citrus areas. With calcium cyanide, however, the safe temperatures are generally 10°F. to 15°F. higher when normally healthy trees are being fumigated under average good conditions. However, special care should be exercised when fumigating near the temperature limit of safety, and on hot summer days operations should cease between 12.30 p.m. and 3 p.m.

Trees on soil that is very wet, either as a result of rain or irrigation, should not be fumigated, but, on the other hand, drought-stricken trees are more susceptible to injury than those enjoying normal moisture conditions. Fumigation may cause excessive injury to trees carrying a large amount of tender young growth, and in such cases treatment should be delayed as long as is practicable. Young fruit is also susceptible to injury, and trees bearing fruit of a smaller diameter than three-quarters of an inch should not be fumigated. Finally, growers should remember that trees with a Bordeaux mixture residue may be very seriously injured by fumigation. Hence a tree that has been sprayed with Bordeaux mixture should not be fumigated until at least six months have elapsed, and, indeed, nine or twelve months is a safer interval. Reference has been made in an earlier paragraph to the interval that should elapse between fumigation and the application of an oil spray, and the reader's attention is directed thereto.

Before leaving the subject of fumigation, some mention must be made of the tent equipment required for the purpose. The tents or sheets are usually made of duck or drill, and must be sufficiently closely-woven to prevent the rapid escape of the gas and to stand the rough usage to which they will be subjected without being unduly heavy. It is generally considered that 8-oz. army duck is better than drill and is the best material than can be employed. Recent departmental experiments, however, have shown that a medium-weight, closely-woven calico gives satisfactory results. It is considerably cheaper than duck, but its life would not be so long. The sheets are usually eight-sided, and their diameter varies from 30 to as much as 80 feet, depending on the size of the trees to be covered. A well-shaped tree 12 feet in height can usually be covered by a 36-foot sheet.

BOTFLIES IN HORSES.

At about this time of the year all horses should be drenched for bots. In determining the period of the year when drenching for these parasites will give best results, their life history must be taken into consideration.

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 larvæ 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 at this time of the year.

The most effective drug is carbondi-sulphide. The animals are starved for twenty-four hours before and for four 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.

—Dr. F. H. S. Roberts.

Fungicides.*

J. H. SIMMONDS, M.Sc., Senior Research Officer.

THE term fungicide usually refers to an agent of a chemical nature employed to control a fungous disease. It is usually applied as a spray or dust so as to give a protective covering over the whole plant. Spraying is seldom resorted to for the control of physiological and virus diseases, although in the former case a few diseases which are due to a lack of certain chemicals in the plant's food supply can be remedied by applying this chemical in the form of a spray. Thus, citrus exanthema is cured by applying copper salts to the tree and iron chlorosis of the pineapple by spraying the crop with iron sulphate. Virus diseases are sometimes kept in check and prevented from spreading by spraying with an insecticide which controls the insect vector. Spraying has no effect on the virus within the plant and, once infected, a plant cannot be cured of a virus disease by this means.

It must be remembered that the application of a fungicide should not be relied upon as the sole means of keeping diseases in check. Much can be done by employing cultural methods which ensure strong vigorous growth and by avoiding unsuitable or badly drained soil. Attention to sanitation is also important. The remains of a diseased crop should be removed and burnt as soon as possible and when a disease is known to be present it is advisable not to grow the same or allied crops successively on the same land. Where possible resistant varieties should be sown. These and suchlike precautions should become part of the normal routine of the farm.

TYPES AND METHODS OF APPLICATION.

The control of plant diseases by means of fungicides depends on the fact that it is possible to obtain certain chemicals which will kill the fungus or bacterial parasite on the surface without causing injury to the plant itself. This condition is not an easy one to satisfy—hence it is found that the range of fungicides in use at the present day is comparatively limited. The common ones have as their active constituents one or other of the two elements—sulphur or copper, and may therefore be classed as belonging to either a sulphur group or a copper group. Speaking generally, each of these groups has its special use, which it is important for the grower to note.

The sulphur fungicides are used mainly against the ectoparasites, such as the powdery mildews, and for the control of the rust fungi. They are also required as a summer spray for certain stone fruit trees, such as the plum and peach, whose foliage would be injured by a copper spray at this time of the year.

The copper fungicides are usually favoured for the control of the non-superficial type of plant parasite, owing to the toxic action which they have on the germinating spore, and also to the fact that they possess greater permanency. When properly used the copper sprays will not injure the plant, nor are they sufficiently poisonous to human beings to render their preparation and proper use objectionable.

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Fungicides are used either in the form of a liquid or dust. If a wet spray is used, it should be applied at a high pressure by means of a satisfactory type of pump. This will result in a more thorough distribution of the spray on the plant and a quicker operation. A barrel pump delivering the spray at about 200-lb. pressure is a suitable outfit for most purposes. The knapsack spray is not economical except for small areas, or when initial cost is a serious consideration.

Dusting, in so far as the use of sulphur is concerned, has been in vogue for many years, and sulphur applied as a dust is usually effective for the use to which it is put. The application of copper fungicides in the form of a dust has come into practice comparatively recently. This method has the advantage over spraying in the ease and rapidity with which a dust may be applied. There are, however, certain disadvantages. The results obtained from dusting are not always equal to those obtained with a wet spray. To obtain satisfactory covering, it is essential to dust when the air is still, and if the surface of the plant is shiny, moisture should be present to ensure adherence. These are conditions often lacking when required. A dust does not remain on a plant as long as a spray, with the result that more applications are needed, and consequently the cost is somewhat greater. Careful consideration has, therefore, to be given to the merits and demerits of each particular case before deciding on the best form in which to apply the fungicide.

Spreaders.

To be satisfactory a spray must completely cover and wet the surface of the plant which it is to protect. For this reason it is often necessary to add a spreader. The function of the spreader is to lower the surface tension of the spray so that the drops of liquid flatten out and form a complete and uniform film over the surface. This results in a more complete protection, and in less unsightly stain. A number of different substances are available for this purpose. The choice is based on several considerations, such as cost and availability, efficiency with the particular spray to be used, and the avoidance of combinations which might bring about harmful reactions between chemical constituents of spray and spreader. Several of the more common spreaders are discussed in connection with the preparation of Bordeaux mixture and other sprays.

Hints for Spraying.

The following hints may be of some help to those who have not had much experience in the application of fungicides:—

(1) Take care of the spraying machine. See that the pump will deliver a fine spray at a satisfactory pressure.

(2) Always use a strainer in the spray tank and clean out the pump and nozzle well after use as this will help prevent stoppages during operation.

(3) Do not mix a spray in a rough and ready manner. Weigh out the materials carefully.

(4) Do not wait until a disease becomes well established before applying a fungicide. It is then usually a waste of time and material to attempt remedial measures.

(5) In general, it is necessary to spray thoroughly and sufficiently often to keep the plant surfaces, both upper and lower, covered with a film of spray during the whole of the susceptible period.

(6) The crop should be well protected during moist weather, as at such times most fungous diseases spread rapidly, the conditions being suited to both spore production and germination. Hot, dry days usually serve as a check to disease for the opposite reason.

(7) If possible avoid spraying on exceptionally hot days or when the plants are in a wilted or weakened condition as some spray injury may result.

The number of different specifics which have been advocated from time to time for the control of various plant diseases is considerable. Of these some have a wider scope and have stood the test of long usage. Details of the preparation of the more useful of these are given below. Of recent years a number of new fungicides have been suggested for use in the control of certain diseases. In most cases it is too early to be able to predict how effective these substances will be under Queensland conditions, but it is advisable to keep in touch with any developments along these lines.

BORDEAUX MIXTURE.

Bordeaux mixture is probably the most widely used fungicide at the present day. It consists of a somewhat indefinite mixture of copper compounds which are precipitated in a fine gelatinous suspension when a solution of bluestone (copper sulphate) is mixed with one of lime (calcium hydroxide). The method of preparation ensures that the copper compounds are in an insoluble state and since they are not then absorbed into the tissues of the plant the spray is harmless to the crop.

This spray exerts its fundicidal action by reason of the fact that on the surface of the plant minute quantities of copper are dissolved out of the spray film by secretions from the host cells, the fungus hyphae and by other means, and this is sufficiently poisonous to destroy the spores or germ tubes of the fungus parasite without harming the plant itself.

Briefly, the preparation of the spray, using one of the commonly accepted formulæ, is as follows:—

1. Dissolve 4 lb. bluestone in 20 gallons of water in a wooden cask.
2. Slake 4 lb. burnt lime with a small quantity of water and add the paste formed to 20 gallons of water in a second vessel.
3. Stir the two solutions and pour them simultaneously through a strainer into a third vessel or the spraying tank.
4. Test the mixture for acidity.

Formulæ.

Mixing the spray with suitable proportions of bluestone and lime ensures that practically all of the copper is converted into the insoluble form. On the other hand, should there be insufficient lime to precipate all the bluestone, the copper salts remaining in solution may be absorbed by the plant in sufficient quantity to cause injury.

The proportions of bluestone and lime recommended for preparing Bordeaux mixture vary considerably with the circumstances. Generally speaking, even when using a pure sample of burnt lime, the weight of this must be at least one-quarter the weight of copper sulphate, as otherwise some of the copper may still remain free in solution and cause burning. In practice, in order to avoid this risk, the lime content is rarely less than two thirds that of the bluestone.

It is generally considered that the lower the lime content is below equality in weight with the bluestone the more rapid is the action of

the spray and the greater is the fungicidal activity since under these conditions the copper is more readily available. On the other hand, when equal quantities of lime and bluestone or a greater weight of lime than bluestone is used, the copper will be more insoluble, and the spray will therefore adhere longer and be less liable to injure tender plants. The greater the proportion of lime the greater will be the deposit left on the plant, and this may be an important consideration when fruit are to be sprayed. Also, an excessive amount of lime on its own account, is harmful to some plants.

When first used the ingredients of Bordeaux mixture were much more concentrated than at the present day, when the tendency is still towards weaker sprays with improvements in spreading and sticking qualities. The formulæ in the following table are amongst those commonly used:—

	Bluestone. lb.	Burnt Lime. lb.	Water. gal.
Maximum strength. Grape vines and deciduous fruit trees at bud burst ..	6	4	40
Normal strength. Tomato, potato, and most small crops	4	4	40
Citrus	3	2	40
Cucurbits	3	4	40
Pear, plum, and apricot foliage. Seedlings and plants subject to spray injury..	2	3	40

It is common practice to refer to a spray containing 6 lb. bluestone, 4 lb. burnt lime, and 40 gallons of water, as a 6-4-40 mixture, the amounts of bluestone, lime and water always following in that order.

Materials.

Bluestone may be obtained in three forms—large crystals, smaller crystals known as bluestone fines, and powder. For the sake of ease in dissolving the fines are to be preferred. Powdered bluestone is more expensive, and therefore uneconomical to use.

The lime used may be in the form of burnt (quick) lime or hydrated lime.

Burnt lime possesses the disadvantage that it cannot always be obtained in a pure state and, moreover, if not kept in a tight container may become air-slaked, when its value for spray purposes is lost. The latter difficulty may be overcome by slaking the burnt lime when fresh and storing under water. For convenience when in use later, store a known amount in a known volume of water. It is then only necessary to make up any water that has evaporated, stir well, and take out the volume calculated to contain the required amount of lime.

Hydrated lime is obtained from burnt lime by slaking it with water under controlled conditions. It is more expensive, but as it has not the disadvantages of burnt lime, its use considerably simplifies the mixing of the Bordeaux. It must be noted that it takes one and one-third parts by weight of hydrated lime to be equivalent to one part of burnt lime It is usually found that the weaker nature of the hydrated lime is largely compensated for by its greater purity. Hence in formulæ containing a high proportion of lime such as the 4-4-40 mixture the same amount of hydrated lime as burnt lime may be used. In other cases it is necessary to use about one-third as much again of the hydrated as specified for the burnt lime. Do not confuse hydrated lime with burnt lime which has

become crumbled with contact with air, and is therefore air-slaked lime. This latter, although somewhat the same as the former in appearance, consists of a different compound, and is useless for the purpose of preparing Bordeaux mixture.

Details of Preparation.

Dissolve the bluestone in half the required amount of water in a wooden or copper vessel. To do this it is best to tie the bluestone in a piece of sacking and leave it suspended in the top of the water for a few hours or overnight. Only wooden, earthenware, or copper vessels can be used to contain bluestone solution, as this chemical will quickly eat through iron. Wooden casks form convenient receptacles, and for mixing small quantities a kerosene tin or iron drum well covered with tar or pitch may be used.

Slake the lime in another vessel by the gradual addition of small quantities of water, allowing the heat generated to aid the reaction. If using hydrated lime, form a thin paste in the same manner. Then add water to make up the remaining half of the total required.

Pour the two solutions, bluestone and lime, simultaneously through a fine strainer into a third container or the spraying vessel and stir well. This method gives a fine gelatinous precipitate which does not readily settle out. In case of necessity one dilute solution may be poured directly into the other or a fairly concentrated lime solution may be poured with constant agitation into the diluted bluestone containing the rest of the total water needed, without unduly altering the satisfactory nature of the resulting mixture. Two concentrated solutions must never be mixed before dilution, as the precipitate then tends to be of a granular formation and its spreading and adhesive properties are poor. For the same reason the two solutions should be quite cold before mixing. Much labour is saved by providing a convenient permanent mixing platform.

Testing for Acidity.

It sometimes happens that the lime used is of poor quality, and the finished spray may then contain a certain amount of free bluestone not precipitated. This must be corrected if spray injury is to be avoided. It is therefore always best to test the spray before using with blue litmus paper, small packets of which may be obtained from a chemist. Dip a strip of the paper into the layer of clear liquid on top of the spray. If the colour changes to red an excess of bluestone is present, and more lime must be added until the paper remains blue. A rough test is given by allowing a clean knife blade or bright iron nail to remain in the mixture for a few minutes. If, on removal, this shows a brown coating of copper, more lime is required.

Hints for Using Bordeaux Mixture.

(1) The spray should be used as soon as possible after preparation, as it loses its gelatinous nature after several hours standing and settles out.

(2) Do not apply a Bordeaux spray during showery weather, as some spray injury may follow.

(3) Spraying on an exceptionally hot day or when the plants are wilted or weakened by drought may also result in burning.

Stock Solutions.

It is sometimes found convenient to make up stock solutions of bluestone and lime. Dissolve 40 lb. of bluestone in 40 gallons of water in a wooden vessel. Slake 40 lb. of quicklime and add water to make up to 40 gallons. The solutions will keep well if protected from evaporation. One gallon of each will contain 1 lb. of bluestone or lime respectively. It is therefore only necessary to stir well and take out 1 gallon for every pound of lime or bluestone required. It is advisable to mark the height of the solution in the barrel each time some concentrate is removed in order that water may be added to this mark to make up for any loss by evaporation.

Proprietary Bordeaux Mixtures.

Certain proprietary mixtures, usually in the form of a paste or powder, are now on the market, which, it is claimed, will form Bordeaux mixture on addition of the required amount of water, thus doing away with the trouble of preparing the home-made article. Some of these ready prepared materials are mixtures of bluestone and lime with or without a spreader. Others are mixtures of bluestone and soda, and are therefore more akin to a Burgundy spray. There are, however, some disadvantages in the use of these mixtures—

(1) They are usually more expensive than the home-made spray.

(2) The exact composition varies with the different makes, and it is therefore sometimes difficult to prepare a mixture of definite strength.

(3) It is found that some of the ready-mixed powders do not give such a fine suspension as the home-made mixtures, so that their spreading and adhesive properties are poorer.

However, if a reliable brand is obtained, these mixtures serve a useful purpose for the treatment of a crop for which it is not desired to acquire the apparatus necessary for home mixing. Best results are obtained if the dilution is calculated on the actual copper content of the mixture, so that the final spray will contain the same amount of metallic copper as would a home-made Bordeaux of the correct strength. It is useful to remember that 1 lb. of metallic copper is contained in approximately 4 lb. of bluestone (crystalline copper sulphate), 3 lb. of dehydrated copper sulphate (monohydrate) and 2 lb. of copper carbonate (basic).

Combination Sprays.

Lead arsenate may be combined with Bordeaux mixture for combating both fungus diseases and chewing insects. The lead arsenate should be mixed to a cream with water and added to the prepared Bordeaux.

Nicotine sulphate may be added to Bordeaux mixture for the control of soft-bodied sucking insects. With this combination it is not necessary to add soap to liberate the nicotine.

Cyanide fumigation should not follow a Bordeaux spray until six months or longer have elapsed, otherwise there is risk of serious injury.

Lime sulphur applied shortly after a Bordeaux spray may leave a black stain on the sprayed plants.

The application of an oil spray prior to or following Bordeaux mixture may lead to injury under certain circumstances, and the notes on this subject in the article on insecticides appearing in this issue of the "Agricultural Journal" should be consulted.

Spreaders.

Properly made Bordeaux mixture when freshly prepared spreads sufficiently well on easily wetted surfaces to give a good cover. In certain circumstances, however, when the plant to be sprayed has a shiny or waxy surface, or needs special attention, it is an advantage to use a spreader. Several common substances as well as some excellent proprietary preparations are available for use.

Although discussed for convenience at this stage, many of the spreaders may be used to advantage with other sprays, and will be referred to in connection with them.

Soft Soap.—Use a genuine potash soft soap at the rate of 2 to 4 lb. to 40 gallons of spray. Dissolve the soap in a small portion of the original volume of water saved for the purpose using heat if necessary. Then pour into the main bulk of spray and stir well until a good lather is obtained.

Soap must not be used if the Bordeaux is to be combined with lead arsenate in a dual purpose spray.

Molasses.—Molasses may be stirred directly into the mixed spray, using it at the rate of 4 lb. to 40 gallons. A slight precipitate follows the addition of both molasses and soft soap to Bordeaux mixture, but apparently this has no detrimental effects on the spray.

Oil Emulsion.—The addition of an emulsified oil increases both the spreading and adhesive properties of a spray. Bordeaux and oil emulsion has been used as a spray for citrus. Beside acting as a spreader the oil is reported to reduce the amount of scale infestation which often follows the use of a Bordeaux spray. However, it is possible that colloidal copper will supersede Bordeaux and oil for use in this connection.

Take of a good brand of spraying oil an amount equal to 1 per cent. of the total volume of the spray (approximately ½ gallon spraying oil to 40 gallons spray). Emulsify this thoroughly in twice its own volume of water by shaking or stirring, or if a bucket pump is available by pumping it back into itself. Then stir well into the Bordeaux mixture. The oil should be well emulsified before adding to the Bordeaux.

Used with a higher percentage of oil this combination has been used as a dual purpose spray on certain deciduous fruit trees.

Casein.—Casein is a white powder derived from milk and in commercial spreaders is usually mixed with various proportions of lime to increase its solubility. A casein spreader does not appear to markedly improve the spreading properties of a good Bordeaux mixture. On the other hand when used with lime sulphur a decidedly better cover is obtained. It has been stated by some workers that the addition of casein renders a spray less permanent on the plant.

Proprietary Spreaders.—A number of proprietary spreaders of varying chemical composition are now on the market. One known as Agral is available locally. While these spreaders are usually more

expensive than the older materials, the good brands are decidedly more efficient and can be recommended for use with all sprays where the subject to be treated is difficult to wet or a particularly good cover is required.

BORDEAUX PAINT.

This mixture is often useful for painting pruning cuts, wounds, and other injuries to prevent the invasion of rot-producing fungi.

Mix 1 lb. of burnt lime or 1½ lb. hydrated lime in 1 quart of water. Dissolve ½ lb. of bluestone in another quart in a wooden, glass, or earthenware vessel. Mix equal quantities of the two solutions to give the amount of paint required. If a thicker mixture or paste is required reduce the amount of water.

BURGUNDY MIXTURE.

Burgundy mixture is very similar in fungicidal value to Bordeaux, and can be used as a substitute for the latter when good quick lime and hydrated lime are not available. Now that good quality hydrated lime is so easily obtained it is doubtful whether this spray possesses any advantage over Bordeaux.

Formula:—

Bluestone	6 lb.
Washing soda	8 lb.
Water	40 gallons.

This can be reduced when spraying is to be frequent to a 4-5½-40 formula. The preparation is essentially the same as in the case of Bordeaux, except that washing soda is used instead of lime.

The washing soda may contain impurities, and it is therefore necessary to test for excess bluestone as in the case of Bordeaux. Also, as excess soda, unlike lime, may cause injury in some instances, it is advisable to test the mixture with red as well as blue litmus paper. If the red paper quickly turns a definite blue too much soda has been used, and more bluestone solution should be stirred in slowly until there is a distinct but slow change to a blue colour.

Lead arsenate must not be added to Burgundy mixture. The same spreaders can be used as for Bordeaux.

AMMONIACAL COPPER CARBONATE.

As a fungicide this spray is definitely inferior to Bordeaux and Burgundy mixtures, but possesses the advantage that it can be used on fruit approaching maturity or on ornamental shrubs since it is a clear solution leaving no stain. Further work will probably demonstrate that colloidal copper can be substituted for this spray to advantage in many cases.

Formula:—

Copper carbonate	5 oz.
Strong ammonia	3 pints.
Water	40 gallons.

Make the carbonate of copper into a paste by the addition of a pint or two of water. Add the 3 pints of concentrated ammonia to about 2 gallons of water in order to make the solution easier to handle. Stir

the copper carbonate paste into the ammonia water until no more will go into solution. It is advisable to have a little excess copper carbonate left undissolved at this stage. Add water to make up to 40 gallons.

COLLOIDAL COPPER.

Home made colloidal copper has only recently been employed in Queensland, but already it has been shown to possess certain advantages in the control of blue mould of tobacco and as a citrus fungicide It possesses the advantage that a stock solution is prepared, and this can be stored and drawn upon when required for dilution with water and so provide spray for more than one application. Colloidal copper also leaves little stain and is therefore useful for applying to fruit that is approaching maturity. When used on citrus the possibility of increased scale infestation is less than with Bordeaux.

Formula for 1 gallon of Stock Solution.

A.	Bluestone	1 lb.
	Molasses	1 pint.
	Water	4 pints.
B.	Caustic soda	5 oz.
	Water	3 pints.

Preparation of Stock Solution.—A. Dissolve the bluestone in the required amount of water by suspending the crystals in a piece of sacking in the top of the liquid. Some little time is required for this process. Next add the moasses, stirring well. Use a wooden, copper, or non-metallic vessel to hold the bluestone solution since this chemical will eat through iron. Tin vessels thoroughly coated with pitch will last temporarily. B. In a second vessel carefully dissolve the caustic soda in the water required for it.

The solution of bluestone and molasses (A) is next made slightly alkaline by adding to it the caustic soda solution (B) very slowly and with constant stirring.

The stock solution should be stored in some non-metallic container such as a closed wooden barrel, where it will remain in a good condition for from two to three months. It should not be used until it is at least a week old, when the colour will have changed from green to slightly yellow.

Dilution for Spraying.—Owing to the short time that colloidal copper has been in use in this State, the various strengths at which to use the spray have not been fully worked out. The recommendations given here are therefore of a provisional nature. Before removing part of the stock solution replace any water evaporated and stir vigorously.

For seedlings ..	3 pints stock solution to 10 gallons water
As a general spray ..	3 gallons stock solution to 40 gallons water

Spreaders.—Genuine potash soft soap at the rate of 2 lb. to 40 gallons may be added as a spreader. The soap should be dissolved separately in a small portion of the water retained for the purpose and heated if necessary. It is then added to the rest of the spray, and the whole briskly stirred, or, better still, the spray is pumped back into itself until a good froth is obtained. The proprietary spreaders mentioned for use with Bordeaux mixture may also be used with this spray.

LIME SULPHUR.

As has been pointed out in the discussion on page 604 sulphur compounds are used mainly for the destruction of the powdery mildews and the rust fungi. Of the different forms in which sulphur is used lime sulphur is probably the most important. It is the usual experience that this spray is more effective than sulphur dust or the common sulphur-water mixtures. Colloidal sulphur, however, on account of its extremely fine state of division, may prove a suitable substitute for lime sulphur in some instances. Lime sulphur is not usually as efficient as Bordeaux mixture for the numerous diseases in which the parasite has an internal existence. Weighing against this disadvantage is the fact that lime sulphur has considerable insecticidal value in the destruction of scale and mites. It can also be used as a summer spray for certain deciduous fruit trees which would be injured by Bordeaux.

Lime sulphur can be bought in concentrated form ready prepared, or can be made in the orchard. The latter procedure is more economical, but is seldom practised on account of the trouble involved. Also since the strength of the product is uncertain, it is necessary, for satisfactory results, to submit a sample for analysis and advice regarding the strength at which it should be used.

Formula for home-made lime sulphur:—

Flowers of sulphur ..	100 lb.
Good burnt lime	50 lb.
Water	50 gallons.

Preparation.—Place half the water in an iron vessel and bring to the boil. While this is heating stir in the lime. Mix the sulphur into a paste and add to the vessel, stirring until the lime is slaked and the contents well mixed. Add the rest of the water and boil for three-quarters of an hour to an hour, but not longer. Strain the orange-red liquid free from any sediment, and store in an air-tight container.

Dilution of Concentrates.—Lime sulphur concentrates both home made and commercial contain a number of different compounds of sulphur and calcium but owe their fungicidal value very largely to the sulphur which is present in what is known technically as the polysulphide form. The quantity of polysulphide present is also an important factor in determining the strength at which a particular brand of lime sulphur is likely to cause spray injury. For these two reasons a knowledge of the amount of polysulphide sulphur available is necessary when determining the dilution required to make up a suitable spray.

For the reason that the Baumé test does not give a definite indication of the quantity of polysulphide sulphur present the Baumé hydrometer and dilution table are not as extensively used as formerly. It is found advantageous to express the strength of the spray in the more exact terms of the final polysulphide content. A 1 in 20 lime sulphur spray made from a concentrate containing 20 per cent. of polysulphide sulphur would then have a 1 per cent. polysulphide content.

Regulations now require that the polysulphide sulphur content of any brand of lime sulphur shall be shown on the label. For the sake of uniformity this is expressed in terms of weight in weight of solution. Knowing the poysulphide content of the concentrated lime sulphur the amount of this concentrate required to make up any given spray may then be obtained by reference to the accompanying table (Table I). In

TABLE I.—QUANTITY OF LIME SULPHUR REQUIRED TO MAKE 40 GALLONS OF SPRAY FROM A CONCENTRATE OF GIVEN COMPOSITION.

Dilution based on standard concentrate (*see* text)	1 in 10.	1 in 12.	1 in 15.	1 in 25.	1 in 30.	1 in 35.	1 in 50.	1 in 80.	1 in 120.	1 in 240.
Polysulphide content of spray	2·12	1·77	1·42	0·86	0·71	0·61	0·43	0·27	0·18	0·09
Polysulphide content of the commercial concentrate—	Gal. Pt. Oz.	Gal. Pt. Oz.	Gal. Pt. Oz.	Gal. Pt. Oz.	Gal. Pt. Oz.	Gal. Pt. Oz.	Gal. Pt. Oz.	Gal. Pt. Oz.	Gal. Pt. Oz.	Gal. Pt. Oz.
14	5 1 0	4 2 0	3 3 10	2 0 10	1 5 10	1 3 10	1 0 0	0 5 3	0 3 8	0 1 14
15	4 6 10	4 0 0	3 1 10	1 7 10	1 5 0	1 3 0	0 7 14	0 4 16	0 3 4	0 1 12
16	4 4 0	3 6 0	3 0 0	1 6 10	1 4 0	1 2 0	0 7 4	0 4 10	0 3 0	0 1 10
17	4 2 0	3 4 0	2 6 10	1 5 10	1 3 10	1 1 10	0 6 16	0 4 5	0 2 16	0 1 8
18	4 0 0	3 2 10	2 5 10	1 5 0	1 2 10	1 1 0	0 6 8	0 4 0	0 2 13	0 1 6
19	3 6 10	3 1 10	2 4 0	1 4 0	1 2 0	1 0 10	0 6 0	0 3 16	0 2 10	0 1 5
20	3 5 0	3 0 0	2 3 0	1 3 10	1 1 10	1 0 0	0 5 15	0 3 12	0 2 8	0 1 4

N.B.—Amounts of 1 gallon and over given to the nearest half pint. Calculations based on an average specific gravity for lime sulphur of 1·2.

order to enable the user to become familiar with the new method of expression, this table gives the desired strength of spray both in the old manner as standard dilutions such as 1 in 12, and as percentage of polysulphide sulphur.

In calculating the quantity of lime sulphur required for the various dilutions, a concentrate having an 18 per cent polysulphide content has been taken as the standard. Since a well-prepared lime sulphur concentrate of 33° Baumé (the old standard) is approximately equivalent to this new standard in fungicidal properties, the strengths 1 in 12, 1 in 15, and so on, will have the same value in the new table as in the older Baumé one. To make a spray containing 1·42 per cent. polysulphide (in the older way of expressing it, a 1 in 15 dilution) from a brand of lime sulphur containing 16 per cent. polysulphide look to the vertical column of the table headed by "1·42" and "1 in 15," and then the figure in this column and also lying in the horizontal line referring to the 16 per cent. polysulphide concentrates, gives the gallons, pints, and ounces necessary to include in 40 gallons of spray.

Spreaders.—The spreading qualities of lime sulphur may be increased by the addition of a casein spreader or one of the proprietary lines, such as Agral. Soap cannot be used with this spray.

SULPHUR.

Generally speaking sulphur dust is somewhat less effective as a fungicide than lime sulphur, but on account of the ease in application it is extensively used for the control of the powdery mildews and for some of the rust diseases. Sulphur may usually be obtained in two forms—ground sulphur consisting of lump sulphur ground to a powder, or flowers of sulphur formed by the condensation of the vapour of burning sulphur. Exactly in what way the sulphur acts is not known with certainty, but it has been shown that the finer the particles the greater the fungicidal value of the dust. Fine division also confers on the sample greater covering power and better adhering properties.

Finely-powdered lime is sometimes added to the sulphur to the extent of 25 to 50 per cent. for dusting purposes. This enables a more thorough application to be made than would otherwise be economically possible. It also reduces the chance of burning should the sulphur contain, as it sometimes does, a trace of free acid produced during the manufacturing process.

A still, warm day should be chosen for sulphuring, and if the dust is applied while the dew is on the leaves better adherence will be obtained.

Sulphur-water Mixtures.

It is sometimes more convenient and effective to apply sulphur as a wet spray. Sulphur dust alone will not mix well with water, but a number of proprietary lines such as those mentioned below have been developed to overcome this difficulty.

Wettable and Dry Mix Sulphurs.—These usually consist of sulphur powder, together with a wetting compound, such as casein or gelatine, which enables the sulphur particles to go into suspension.

Precipitated Sulphur.—This form is obtained by a chemical precipitation from certain sulphur compounds in solution. The size of the constituent particles is somewhat smaller than those of the wettable sulphurs, but it possesses little advantage over them as a fungicide.

Colloidal Sulphur.—Several trade preparations have recently been put on the market which are known collectively as colloidal sulphurs. In these the sulphur particles are of extremely minute size, the state of division being much finer than any of the forms of sulphur already mentioned. For this reason colloidal sulphur has proved an effcient fungicide, and can be recommended for use when a substitute for lime sulphur or sulphur dust is required. When colloidal sulphur is added to lime sulphur it is said to form a combination having greater fungicidal value than the lime sulphur alone.

SHIRLAN.

Shirlan AG is a fungicide recently placed on the market for use in the control of powdery mildews and other fungi. It consists of 25 per cent. salicylanilide together with a spreading agent. The value of this material as a general spray has not been fully tested out, but it has proved an excellent disinfectant for controlling squirter disease in bananas. It is also of value for preventing mould growth on certain stored commodities.

Soaking calico or duck in water to which 1 per cent. of Shirlan has been added greatly increases its resistance to mildew, and accordingly this treatment can be suggested for tobacco seed-bed covers, tents and similar material.

SEED DISINFECTION.

Many serious diseases are seed borne. Bacteria or the spores and vegetative threads of a parasitic fungus may contaminate the seed before or after harvesting, with the result that, if such seed is planted without treatment to destroy these organisms, the resulting crop is likely to develop the disease. Hence, whenever the source of the seed supply is unknown, or when the crop it was obtained from is suspected to have been diseased, seed disinfection should be practised. Especially is this advisable when the seed is to be planted on virgin land or in a field which has been rotated for some time to other crops. Starting off with seed and field clean a reasonably disease-free crop should result.

The need for disinfection also applies to the vegetative parts of plants commonly used for planting purposes, such as tubers, bulbs, suckers, and cuttings.

Several different methods are available for seed disinfection. An important consideration in determining which is to be used is whether the parasite is merely contaminating the outside of the seed or whether it has actually penetrated within the seed coat. In the former case corrosive sublimate or formalin is commonly used, while in the latter a hot water treatment is often necessary. A summary of the treatments necessary in the case of certain crops for which seed disinfection has become an established practise is given in Table II. The method of applying the disinfectants will now be described. Special modifications necessary in certain cases such as with cereals and potatoes are more fully discussed in other Departmental publications.

CORROSIVE SUBLIMATE.

This chemical, also known as mercuric chloride, is the most commonly-used substance for disinfecting vegetable and flower seeds. It may be obtained in either the powder or tablet form. The latter is

by far the more convenient form to use when small quantities of solution are required. The tablets, together with directions for making the necessary dilutions, may be obtained from a chemist. The solution should be made up in glass, crockery, or wooden containers. A metal vessel must not be used, as the chemical will eventually eat through such material.

Corrosive sublimate is a deadly poison, and certain precautions must be observed when handling it. Bottles used to contain either the pure chemical or its dilutions should be plainly labelled POISON and kept away from household articles. The solution should be got rid of by pouring it into a hole in the ground immediately after use.

Corrosive sublimate to a less extent is toxic also to plant life, and, consequently, may injure seed if improperly and carelessly used. Special attention must be paid to strength and time of immersion, as both of these vary with the particular seed treated. Table II. on page 618 gives recommendations for a number of the treatments commonly used. It will be seen that the strength chiefly used is 1 of corrosive sublimate in 1,000 parts by weight of water.

After treatment the seed should always be washed for five or ten minutes in several changes of clean water, so as to avoid prolonging the action of the poison. The temperature of the disinfecting solution is also important, and for ordinary vegetable and flower seeds should be between 60 degrees and 70 degrees F.

The procedure of seed disinfection is therefore as follows:—Enclose the seed loosely in a bag made of muslin or similar open material. Immerse in corrosive sublimate solution of the required strength for the necessary time, agitating the bag meanwhile to dislodge any air bubbles. Wash for ten minutes in running water, or in half a dozen changes of clean water. Spread out on clean paper in the shade to dry. Sow as soon as possible, as delay may result in loss in germination.

Do not replace treated seed in the old bags, but take precautions that reinfection does not take place. Corrosive sublimate loses its strength with use, and it is advisable to use a solution only once.

Corrosive sublimate is also used on a larger scale for the disinfection of seed potatoes and bulbs. In the case of the former the tubers are washed but not cut and then immersed for five minutes in a solution consisting of $\frac{1}{4}$ lb. corrosive sublimate and $1\frac{1}{4}$ lb. hydrochloric acid (spirits of salts) to $12\frac{1}{2}$ gallons of water. In the case of bulbs the usual procedure is to immerse them in a 1 in 1,000 solution of corrosive sublimate for 1 hour.

PROPRIETARY MERCURY COMPOUNDS.

Several proprietary mixtures containing mercury in different chemical combinations are now being placed on the market for use in seed treatment. Some of these are applied in solution but the more useful ones are in the form of a dust. Many of these have proved efficient substitutes for the materials previously employed and as they are in general easier to apply and are less liable to cause seed injury they will no doubt find an important place in the agricultural practices of this State as soon as their local application is more fully known. The use of certain of these, such as Agrosan and Ceresan, is already replacing older methods for the control of some cereal diseases.

TABLE II.—SUMMARY OF SEED TREATMENT FOR THE PREVENTION OF DISEASE.

Crop.	Disease.	Material.	Rate or Temperature.	Method.
Cabbage and cauliflower	Black rot (*Pseudomonas campestris*)	Corrosive sublimate ..	1 in 1,000	Soak for 30 minutes
	Black leg (*Phoma lingam*)..	Hot water	122°F.	Soak for 30 minutes
Cucumber, watermelon, and pumpkin	Various	Corrosive sublimate ..	1 in 1,000	Soak for 5 to 7 minutes
Potato	Scab (*Actinomyces scabies*) and black scurf (*Corticium solani*)	(*a*) Hot formalin	1 pint in 15 gallons at 125°F.	Immerse 2½ minutes, drain and cover one hour
		(*b*) Acid corrosive sublimate	Corrosive sublimate ¼lb., hydrochloric acid 1¼ lb., water 12½ gallons	Soak 5 minutes
Tobacco	Various	Silver nitrate	1 in 1,000	Soak for 15 minutes
Tomato	Various	Corrosive sublimate ..	1 in 3,000	Soak for 5 minutes and rinse thoroughly
Barley	Covered smut (*Ustilago hordei*)	(*a*) Formalin	1 pint to 40 gallons ..	Moisten by sprinkling and cover overnight
		(*b*) Approved mercury dusts	2 oz. per bushel	Apply by dry mixing.
	Loose smut (*Ustilago nuda*)	Hot water	129°F.	Immerse for 10 minutes
Maize	Seedling blight	Approved mercury dusts ..	2 oz. per bushel	Apply by dry mixing.
Oats	Loose smut (*Ustilago avenae*) and covered smut (*U. levis*)	(*a*) Formalin	1 pint in 40 gallons ..	Moisten by sprinkling and cover overnight
		(*b*) Approved mercury dusts	2 oz. per bushel	Apply by dry mixing.
Wheat	Bunt (*Tilletia tritici* and *T. laevis*)	(*a*) Copper carbonate ..	2 oz. per bushel	Apply by dry mixing.
		(*b*) Approved mercury dusts	2 oz. per bushel ..	Apply by dry mixing.
	Loose smut (*Ustilago tritici*)	Hot water	129°F.	Immerse for 10 minutes
	Flag smut (*Urocystis tritici*)	Bluestone	1½ lb. to 10 gallons ..	Soak for 3 minutes

If desired the mercury dusts may be applied some time before planting and will then have some insecticidal value. It is preferable, however, to make the interval between treating and planting a short one, as a reduction in germination does sometimes occur if this interval extends for several months. Where a large quantity of seed is to be treated it should be rotated in a suitably designed box or barrel fitted with baffle boards.

It must be remembered that these materials are poisonous and treated seed must be labelled and kept away from birds and stock. It is dangerous to inhale the dust and it is necessary to avoid handling it with wet hands or a broken skin.

FORMALIN.

Commercial formalin is a 40 per cent. solution of formaldehyde gas. It is an important preventive for certain cereal diseases and is also sometimes used in place of corrosive sublimate, as, for example, in the treatment of potatoes for scab. Before use, formalin has to be diluted with water and, as the recommended strength and time of immersion varies for different purposes, reference should be made to Table II. on page 618 for a summary of the quantities and methods employed.

The procedure employed is similar to that already described for corrosive sublimate except that modifications are necessary when large quantities of material have to be treated, as for example, in the case of cereals where a sprinkling method is adopted. Unlike corrosive sublimate, formalin solution may be held in iron vessels. Take care that the seed is not recontaminated before sowing by the use of old bags or the proximity of other sources of infection, as it is no longer protected once the formalin has evaporated. To avoid losses in germination, treated seed should be planted as soon as it is dry.

HOT WATER.

A treatment with hot water has sometimes to be substituted for chemical steeps when the parasite causing a particular disease is able to penetrate to within the tissue of the seed. Ordinary disinfectants would cause serious injury if they were to be used at a strength sufficient to destroy the organisms in this position. The hot water treatment can be used in those cases in which it has been found that the parasite is killed at a lower temperature than is injurious to the host.

The method necessitates considerable care as there is usually only a small range of temperature at which the fungus or bacterium is killed and the plant remains uninjured. It is necessary to obtain a thermometer in order that the correct temperature can be determined.

As large a volume of water as can be conveniently handled should be used as it will retain a more constant temperature. The method of keeping the heat constant will depend on the amount of seed to be treated and the apparatus available. In the case of small samples of vegetable seeds when about half a kerosene tin of water is all that is required, a carefully adjusted kerosene lamp is useful. Another method is to heat the water to the required temperature and then add small amounts of boiling water from time to time to make up for the heat lost. The seed is inclosed in a loose open bag and immersed for the required time, seed and water being stirred continuously. It is then spread out to dry in a clean place and planted as soon as possible.

When bulky quantities of seed are to be treated, specially adapted apparatus may be necessary. In the case of cereals the seed is first soaked for four to five hours in cold water. Immediately prior to the heat treatment it is prewarmed by immersing it for a few seconds in water heated to about 120 degs. F., and after treatment it is cooled rapidly by plunging into cold water. By this means is made possible effective treatment with less risk of injury.

COPPER CARBONATE.

Copper carbonate in the form of a dust is extensively used for preventing smut in wheat. The dust has to be intimately mixed with the seed by rotating the two together in a box or other suitably constructed vessel. This treatment has the advantage that the germination of the seed is not affected and the seed may be treated some time before planting.

BLUESTONE.

Bluestone (copper sulphate) is also used as a preventive against certain cereal smuts. It is used in solution for which a wooden or copper vessel has to be available. The seed is immersed for the required time and then dried and sown as soon as possible. If germination is delayed some injury may result.

SOIL STERILIZATION.

It is of little or no use to go to the trouble of disinfecting seed if the seed-bed already harbours the disease-producing organism. The rapidity with which a disease may spread in the seed-bed and the risk of severe loss from damping off fungi make it specially important that attention should be given to seed-bed hygiene.

Whenever possible the seed-bed should be located on virgin land situated some distance from cultivated fields, from which it must not receive the wash. When this cannot be done, consideration should be given to sterilising the soil of the bed.

In a district where wood is abundant, sterilising by fire is a cheap and effective method. Brushwood and branches should be laid evenly over the bed and the surrounding margin. The amount of wood required can be reckoned as the equivalent of a solid layer of about 3 inches thick. The soil should be moist and neither dry nor excessively wet when firing takes place.

Sterilising by steam is by far the best method, but quite impracticable for the average grower in this State. Failing this, chemical means may be employed. Formalin, bluestone, and Cheshunt mixture are each used for this purpose.

Care should be taken that disinfected beds are not recontaminated by the introduction of foreign soil on boots and cultivation implements. The latter should be sterilized by washing in formalin solution or heating in a fire before use in the seed-bed.

FORMALIN.

The beds are prepared ready for planting and preferably should be moist but not wet. If the soil is dry use a 1 per cent. solution of formalin (1 gallon of commercial formalin in 100 gallons of water) and apply with a watering can at the rate of 10 gallons to the square yard.

If the soil is moist use a 2 per cent. solution of formalin watered on at the rate of not less than 5 gallons per square yard. The beds, as soon as treated, are covered with sacking for two or three days to keep in the fumes. They are then aired for a further ten days or until the odour of formalin can no longer be detected, after which they are ready for use.

Formalin is also useful for disinfecting tools, packing sheds, and so forth. For this purpose a 5 per cent. solution (1 pint formalin in 2½ gallons water) can be used and applied as a spray or wash.

BLUESTONE.

A solution of bluestone (copper sulphate) made by dissolving 1 lb. bluestone in 7 gallons of water has been found useful in eradicating the common soil-frequenting fungus, *Sclerotium rolfsii*, from garden beds. This is watered on the soil at the rate of 2 gallons per square yard or until the soil is wet to a depth of six or more inches. This solution, like formalin, can not be applied to the ground in which plants are actually growing without risk of serious injury, and a few weeks should elapse before planting up a treated bed. As has been mentioned before, bluestone solution can not be held for any length of time in unpainted iron vessels without corrosion taking place.

CHESHUNT MIXTURE.

This preparation is specially useful for treating a bed of seedlings in which damping-off has appeared, since, unlike formalin and bluestone, it has no detrimental effect on growing plants with which it may come in contact. It can also be used to check soil-frequenting organisms causing root and crown rots in the flower and vegetable garden.

Formula:—

Powdered bluestone (copper sulphate)	2 parts
Fresh powdered rock ammonia (ammonium carbonate)	11 parts

If necessary crush the bluestone and rock ammonia to a fine powder. Thoroughly mix the two together in the correct proportions and keep in a tightly stoppered glass or earthenware vessel for at least twenty-four hours before using.

For use dissolve the dry mixture in water at the rate of 1 oz. to 2 gallons. Water this solution on the soil suspected to be harbouring the parasite so as to wet it thoroughly.

Wash out the can after use, since the solution will corrode metals.

How Animals Acquire Disease.

J. LEGG, D.V.Sc., Senior Veterinary Officer, Department of Agriculture and Stock.

NOT infrequently outbreaks of disease occur among farm stock and the owner is completely baffled as to the origin. He may have built up a herd or flock by careful selection and breeding over a long period of years; and he may have fed and tended them in a way which is in accordance with the best practice. Yet, without warning, disease may suddenly appear among them and superficially there has been no evidence as to entry or origin—no outbreaks in adjacent flocks or herds, no acquisition of new animals, and no change in the method of feeding and handling. In such cases, the owner is inclined to assign his trouble to various origins, often failing to detect the correct one.

Since the discovery that many diseases are caused by small parasites, our knowledge has very greatly increased. Some of these parasites are so small as to be beyond the powers of the best microscopes. Such an organism is spoken of as a "virus." Others may be visible microscopically, but appear only as small rods or rings, and are referred to by the man in the street as "microbes." Others, such as many intestinal worms, again, are quite large and at least big enough for much detail of their structure to be visible to the naked eye.

During the last few years particularly, we have made an intensive study of many of these organisms both inside and outside the animal's body. By this means we have gained a wealth of information, though there are still some very serious gaps in our knowledge.

Microbes are certainly responsible for many of the diseases which occur to-day among domestic animals.

Disease Carriers.—If an animal became violently ill and died when it contracted a disease, there would be no trouble, as a rule, in detecting the cause, for many of the common diseases produce characteristic symptoms and changes which are then seen at post-mortem. These are often so characteristic as to leave little doubt in one's mind as to the cause.

Acquirement of a disease, however, is not always noticed by the owner. An animal may contract a disease in a mild form and remain affected over a long period without any visible change in its outward appearance. All this time, however, it may have a diseased centre or focus somewhere within its body. From this centre the microbes may be leaving the animal by one or other of the natural openings. Contamination of the surroundings thus occurs and so other animals are affected. One of the best known examples in Queensland is pleuro-pneumonia. This is particularly bad in some of the northern pastoral areas where control of the cattle is difficult and therefore not thorough. Here we occasionally find animals which outwardly show no illness but are often in an advanced stage of the disease. Yet they may live in such a state for months, and even years, and during this period infect many other animals. Such animals are known as "carriers." Contagious abortion and swine fever are two other examples of such diseases.

The "carrier" may be the animal which looks one of the best in the herd, and is one of the last to be suspected as having been in any way responsible. Prime cattle killed in the abattoirs are occasionally found in an advanced stage of tuberculosis.

Diseases which are Spread Directly.—In many microbial diseases, the microbes cannot live for any great length of time outside the animal body. If not taken in by a new animal shortly after leaving the first one, they quickly perish. The sun, which is a powerful disinfectant, soon kills them in the outer air. Pleuro-pneumonia is a good example. In this case, the organism is so fragile that infection probably takes place by the one animal being close enough to the other to inhale the organism in its breath. Possibly tuberculosis spreads in some cases in a similar way.

Diseases which are Spread Indirectly.—The great majority of diseases are spread indirectly. By this we mean that the microbe or larger parasite leaves the body of the first animal and lives for a certain period in the water, soil, or pasture, and awaits its opportunity to infect a new animal. In some cases, the disease-producing organism may not multiply outside the body of the animal; others, particularly the larger parasites, are obliged to pass through definite stages of their life history in another animal, usually of a different species.

The group, however, falls naturally into a number of sub-groups.

Diseases Contracted from Soil, Water, Pasture, &c.—In the case of diseases like anthrax and blackleg, when death of the infected animal takes place, there are enormous numbers of microbes in the body. These are very resistant. Disintegration of the body is followed by these organisms becoming widely distributed. Water, cultivation, earthworms, and wind all contribute, and so a wide area around the spot where the animal died is soon contaminated. The chance of another animal becoming infected will largely depend on the number of visits it pays to the infected piece of ground; hence we hear of certain paddocks on a farm being associated with anthrax or blackleg.

Pastures and soils frequently become infected in a varying degree with microbes, and often according to the concentration of animals. Large numbers of disease carriers discharging on a restricted area lead to heavy infection. Thus piggeries, calf and sheep pens, and fowlyards may become badly contaminated. Infectious material may be discharged into feeding troughs, drinking places, or over wounds. Many of the larger internal parasites spend part of their life period in the soil, and concentration of animals in small areas often means a high degree of infection of such soil with these parasites.

Tuberculosis, calf scours, pig scours, strangles, contagious pneumonia of pigs, swine fever, and contagious abortion of cattle are all good examples.

Improved pasture and heavier carrying capacity have greatly facilitated the spread of some of the larger sheep parasites in parts of Australia.

Diseases Transmitted by Human Beings.—Human beings frequently transmit animal diseases indirectly. Mastitis of cows is no doubt greatly assisted in its spread by the milkers' hands.

Another example is cow pox. Swine fever may be spread on one's boots from an infected to a non-infected sty. Infection by means of instruments is not uncommon. Infected dehorning instruments have been responsible for outbreaks of anaplasmosis (a form of tick-fever in cattle). Men engaged in the control of animal diseases are obliged to be particularly careful to prevent the unwilling transmission of disease from infected to healthy herds.

Strangles can be spread by the hands or infected watering places, while lice, fleas, mange parasites, &c., are spread by the use of infected rugs and bedding.

Diseases transmitted by "intermediate hosts" (ticks, insects, &c.).—A very large number of diseases are spread through the intermediary of ticks, lice, biting flies, or other external parasites. The best known examples in this State are the tick-fevers of cattle which do not occur outside the tick areas. Spirochætosis (tick fever of fowls) is spread by the fowl tick. The heart worm of the dog, so common in North Queensland, is spread by the mosquito.

With all these insect-transmitted diseases, the microbe or larger parasite is taken up directly or indirectly by the external parasite from an infected animal and then spread to a non-infected one at a later period. In these diseases the insect or transmitting agent is known as the "intermediate host"—the host in which the microbe sojourns for a while when being transmitted from one animal to another.

There are very many offending agents which cause diseases and which require intermediate hosts. The young sheep fluke cannot develop beyond a definite stage unless it reaches the body of a certain type of snail, hence, fluke disease only occurs in areas where these snails occur, and destruction of these snails causes fluke disease to disappear. The hydatid cyst of sheep and cattle is the intermediate stage of the tape worm of the dog.

Possibly three-day sickness of cattle is also spread by means of an intermediate host, also the beef nodule of the brisket and flank of cattle in Queensland.

The number of diseases which depend entirely on intermediate hosts for their natural spread is enormous. Incidentally, their control can be attempted indirectly by destruction of the intermediate host where this is practicable. Thus destruction of the common fowl tick, which lives during the day in the cracks of the woodwork of fowl-houses and only attacks the bird at night when on the perch, removes the danger of fowl spirochætosis (tick fever).

Non-transmissible diseases.—These constitute a large group and can be naturally divided into a number of smaller groups of which we can consider two.

Nutritional diseases.—The body is a very complicated organism consisting of many parts or organs which require certain elements in the foodstuffs for their proper maintenance. Whenever any of these elements are lacking, disease may make its appearance. The food eaten by the average ruminant covers a wide range, so that any possible deficiency in one plant may be compensated by another. However, where there is a definite deficiency in the soil of certain essential elements these may be lacking in the plant food.

In many large areas throughout the whole world almost, phosphorus is deficient in the soil. There is, therefore, a corresponding deficiency in the plant. But the body of the animal consuming the plant demands a large quantity of phosphorus. In the growing animal, much of it is used in bone building, some is required in the ordinary processes of digestion, and the demand becomes more intense as milk production is increased.

Phosphorus deficiency leads to the production of brittle bone or "pegleg," as it is commonly called in Queensland. Bone chewing is often seen associated with this disease. This is merely a symptom which shows that the animal is trying to replace the deficiency in its food by chewing bones.

It has recently been shown in parts of South Australia and West Australia that the absence of the mineral called cobalt in the foodstuff causes a serious disease of cattle and sheep. The chief symptom is wasting and stunted growth. By feeding relatively minute amounts of cobalt, the disease is cured.

Although all the necessary elements may be present in a ration, yet their proportions may be so unbalanced that they lead to an improper functioning of the digestive organs, so that disease of one or other parts of the body may follow. Most dairymen are aware that their cows must receive a certain amount of roughage to give the food bulk.

When there are faults in the internal organs due to lack of proper diet, the weakness that develops allows the entrance of disease-producing agents, which would not otherwise have gained a footing. A complication of several factors may, therefore, be necessary for the outbreak of a disease. Thus, during drought periods, when the animals are reduced in condition and not infrequently greatly weakened, the disease-producing parasite may assert itself. A common example is hookworm in calves in certain of the coastal districts of Queensland. In drought years the infection has been noticed to be frequently more severe than in good seasons.

We might also add that vitamin deficiency is now recognised as a factor in nutritional diseases. Vitamins are substances which occur in a large number of plant foods, and are essential to health. Most of them are of complex chemical structure, and much is yet to be learnt concerning their exact action on the animal body.

Poisonous plants and poisons.—There are many poisonous plants which cause serious stock losses. It is unnecessary to enumerate these, for even the list of the more common ones would be too long. Most of them contain poisonous substances which are unknown; others contain hydrocyanic (prussic) acid. Many of the unknown poisons produce marked gastro-intestinal disturbances such as diarrhœa, &c. In these cases the disease usually runs an acute course and death or recovery quickly follows. There are a few, however, which produce a more chronic type of disease, such as the well-known Zamia poisoning of the north coast districts. Another well-known example is Walkabout disease of horses of the gulf district, which is caused by the eating of Whitewood. Experiments have shown, however, that considerable quantities of the plant can be eaten over long periods of time before any symptoms are shown. However, when this stage has been attained, the poison has produced such extensive changes in some of the organs that recovery is practically hopeless.

Poisonous substances such as arsenic account for many deaths among stock in Queensland. This is often due to carelessness in leaving tins or vessels containing this substance in places where cattle have access. The sludge thrown out when dips are cleaned is often left to contaminate the adjacent ground.

Strychnine has been known to cause deaths in sheep where dried pieces of meat containing strychnine have been left to poison wild dogs.

New waterpipes are sometimes responsible for lead poisoning in stock, and zinc poisoning has been seen where new tubs and buckets have been used for feeding skim milk to calves.

The careless mixing of some poisons when used for purposes of treatment accounts for occasional losses of stock. Too high a concentrate of arsenic in dipping solutions for ticks, and the careless weighing and preparation of nicotine or arsenic in sheep drenches, are sometimes followed by disastrous results.

ANTISEPTICS.

Antiseptics are useful in the treatment of a wound and may be applied in two ways:—

1. As a weak solution to wash out the interior of the wound.
2. As dressings impregnated with the antiseptic to absorb any discharge and prevent the further growth of germs. They also prevent contamination from outside sources.

Stockowners frequently use antiseptics at too great a strength, and do more harm than good. Some tissues are very susceptible to injury, and solutions should not, therefore, be used at more than the recommended strength.

Antiseptics are particularly valuable for cleansing the hands before touching a wound, and in concentrated form some can be used to sterilise instruments when boiling water is not available.

After shaving off the hair surrounding a wound, the skin requires treatment with an antiseptic solution before any surgical operation.

In emergencies, a wound should first be cleaned, then treated with an antiseptic, and protected from contamination.

Some common antiseptics are:—

Tincture of iodine—invaluable for immediate application to cuts and scratches.

Methylated spirits—used in undiluted form causes smarting, but has no ill effect on the tissues.

Permanganate of potash (commonly, though not correctly, known as Condy's fluid) can be added to boiled rain water to make a deep pink antiseptic fluid which is mild in its action.

Boric acid—a saturated solution is made by adding two teaspoonfuls to each pint of boiled rain water, and allowing the undissolved material to settle. A useful eye lotion can be prepared by mixing equal parts of the saturated solution and water.

Peroxide of hydrogen—an antiseptic and a deodorant. It is usually used at a 3 per cent. strength, and may be purchased as such. The stronger 30 per cent. solution must first be broken down to a milder form by adding nine parts of water to one of the solution.

—W. Dixon.

The Farmer visits the Soil Chemist.*

H. W. KERR.

IT is unfortunate that the farmer is generally too busy ploughing, or harrowing, or destroying weeds, to be able to study the wonders of the soil with which he is occupied. But to-day, let us imagine that the farmer is taking a holiday from the farm, and is able to spend a brief hour or two in a visit to the soil chemist's laboratory, and see what the chemist can show him of the wonders of the soil. As it is not convenient for us all to visit the actual laboratory we have done the next best thing and have attempted to bring the laboratory to our meeting place.

Our first question is, what is soil? It is quite obviously composed of minerals of various kinds and sizes; and if we should visit a suitable road cutting, we can generally study the transition from surface soil, through various stages of decomposition, to the original unchanged rock. Furthermore, we notice that different rocks give rise to different kinds of soil; and these differences exist in respect both of appearance and agricultural value. It is apparent, then, that the parent rock has an important bearing on the question. Let us therefore examine the rock more closely and see what we can discover. We have before us two important soil-forming rocks of coastal Queensland: the first, a *granite,* which gives rise to large tracts of alluvial canelands in the far North; and the second, a sample of *basalt,* the parent rock of the well-known red volcanic loam of the Woongarra scrub lands.

Let us examine the granite. We do not even need a magnifying glass to show us that it is composed of at least three distinct types of substance "welded" together: firstly, we observe a greasy looking semi-transparent material, which we know to be *quartz*: secondly, a rather dull, white material, which is known as *feldspar*; and finally, a shiny black material, which we can flake off with a pen-knife, and which is called *mica.* We also have before us larger specimens of these three *minerals,* as they are known to the geologist, so that they can be studied with greater ease. On exposure, over many thousands of years, these apparently permanent and resistant minerals undergo changes due to seemingly insignificant but persistent forces of nature which act on all exposed rocks. In the first place, heating and cooling cause the mineral grains to expand and shrink repeatedly, and the rock is caused to crack and shatter due to the different properties of the three minerals in this respect. The effects of rain and flowing water are to cause some of the minerals to change their character and turn into other minerals. In the case of quartz, we find that the only result of the weather—or *weathering* processes, as they are known—is to cause the larger grains to break up into smaller ones: these small grains are called

* Address to the Queensland Society of Sugar Cane Technologists, Bundaberg Conference, 25th February, 1938, and reprinted from the *Canegrowers' Quarterly Bulletin* (Bureau of Sugar Experiment Stations, Department of Agriculture and Stock).

sand, and they are identical with the sands which we find on the seashore and elsewhere. Our second mineral, the feldspar, does not withstand the weathering process nearly so well: for it changes into a new mineral called *kaolin*—which is a Chinese word—or to give it its popular name, pipe-clay, which we see here. In the process it loses certain of its original substance, and we shall see the importance of this in a few minutes time. The third mineral—the mica—does not rot away so rapidly as the feldspar, but is certainly not so permanent as the quartz: consequently, we often find mica flakes in a granite soil, but eventually they also lose their identity, to yield up some of their substance and give rise to further types of new mineral.

Consider now the manner in which our basalt rock behaves under the influence of the weather. This rock is totally different in its make-up from the granite we have just studied: firstly, it contains no quartz, and therefore a soil formed from basalt contains no sand grains; secondly, it is composed mainly of black minerals, which are not flaky like mica, but which in large masses look like the mineral specimens we see here; but it also contains feldspar minerals, though these differ somewhat in make-up from those existing in the granite. The main feature of the basalt is that it rots away much more readily than granite, and therefore the characteristic red volcanic soil which results is generally much deeper than the light-coloured sandy type of soil which exists in association with granite.

Now let us see if these soils exhibit any evidence of the processes which I have described, or resemblance to the rocks from which they have come. The chemist employs in his laboratory methods by which the soil can be separated into the individual grains, of different sizes, of which it is composed. Such methods have been applied to a granitic and a basaltic soil, with the result we see before us (Plate 205). The granitic soil has quite a large proportion of sand grains, but also a reasonable amount of finer grains—called by the soil chemist "silt"—and finally, a percentage of still finer grains, known as "clay." Similar methods applied to the red volcanic soil show us that there is a small proportion of grains which are similar in size to the sand grains of the granitic soil, but these are grains of ironstone, and of the "rotting" products of basalt. The bulk of this soil, however, consists of silt and clay particles. The chemist will tell us, moreover, that these samples of sand, silt and clay from different soils are also very different in makeup, and these differences are very important in their influence on the fertility of the soil.

To make a long story short, the fact is that in the process of rock and mineral decay lies the clue to the value of the rock and the soil in nourishing our plants and crops: as minerals decompose we have seen that they give up portions of their substance, which can be dissolved in water: these we speak of as "plantfoods." And if the process of rotting which commences with the fresh rock minerals did not continue in the soil after it is formed, it would be quite incapable of supporting crops.

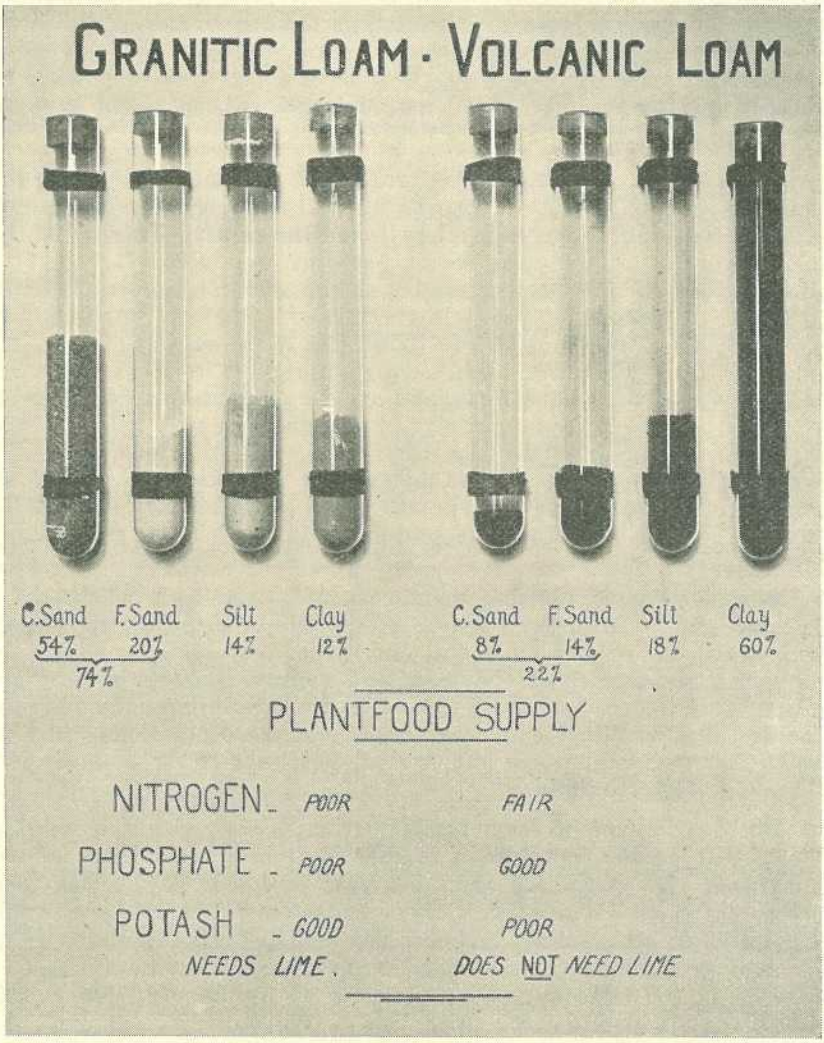


Plate 205.

Chart showing the relative amounts of coarse sand, fine sand, silt and clay in—(*a*) Granitic loam and (*b*) Red Volcanic loam. The way in which the parent rock and soil-forming processes affect the plantfood supply is also shown.

Actually, there are six such distinct mineral plantfoods which result from mineral decomposition and which are essential to crop growth: one of these is *potash,* which is yielded by some of the feldspars and mica: *calcium* (or more familiarly, lime) is yielded by other feldspars: *iron* comes largely from the black coloured rock minerals, in which we saw the basalt was so rich; and so on for the other plantfoods—*phosphate, magnesium* and *sulphur,* which make up the six.

It should now be quite a simple matter to understand why it is that certain soils contain different proportions of the individual plantfoods. Thus basalt rots readily, and as it contains several minerals rich

in lime and but few yielding potash, it usually gives a soil well supplied with lime but poor in potash. Granite, on the other hand, contains few lime-bearing minerals, but has quite a liberal supply of potash-yielding substances. It therefore is likely to give us a soil rich in potash, but probably lacking in lime. Later our chemist will carry out tests for us which will show that this is actually the case.

When the farmer grasps this truth, he will realise why it is that some soils do not yield the crops he might reasonably anticipate, even though he has cultivated the land well, and the rainfall distribution has not been unfavourable. The secret probably lies in the fact that the soil is not able to provide the crop with the correct proportions of the individual plantfoods, and it is in the farmer's interests to supplement any deficiency of supply. This introduces us to the subject of fertilizers and their use. Fertilizers are simply substances which contain soil plantfoods in concentrated form, and a small amount applied to the soil provides a relatively large quantity of plantfood in such a form that it can readily be absorbed by the crop roots. But the farmer must be careful that he uses the correct balance of plantfoods which the soil demands, or he may be piling potash on to a soil already rich in that plantfood, while neglecting the phosphate for which the crop may be starving.

The business of advising the farmer as to the food deficiencies of his land is, of course, the business of the Sugar Experiment Stations. First of all our officers must find out by fertility trials, conducted on the farms, the nature of the plantfood supply characteristic of each soil type, and then base their advice on the results actually obtained. You are all acquainted with these trials and the conclusions which are drawn from them: they are summarised each year in the January issue of the Quarterly Bulletin.

But the project of farm fertility trials is altogether too slow and laborious to enable the Bureau to give each individual block of each canegrower the specialised attention that is desirable. It was therefore necessary to devise other simpler and more rapid methods for this purpose, if at all possible. After many years of patient study we are now able to announce that we possess proven chemical tests which can be made in the laboratory, and which agree in their indications with what we actually find from farm trials. We will now call upon our chemist to demonstrate to us how he tests a soil to determine whether it is lacking in phosphate or potash (or both): while he is preparing the material for these tests, I will explain also another test which is always made on all samples received. The farmer is generally acquainted with the importance of applying lime to those soils which are sour, in order to improve their quality for crop production. Now whereas a modest lime application would never be harmful to any Queensland cane soil, it is obviously uneconomical, if not wasteful, to apply lime to soils which do not require it. We have therefore devised a very simple test which will also be demonstrated to show how we find out whether soils are sour or not. We ask our farmer friends to note carefully what we mean by "sour" soils; we refer to soils formed from rocks poorly supplied with lime, and which under conditions of high rainfall readily lose their supply; and in consequence the soil acids so released are so strong as to be harmful to the crop roots. There is another class of soil,

usually clayey in nature, which is wet and lacking in "sweetness," and which is frequently very difficult to cultivate; such soils, we know, are often improved in character by the addition of lime. But the lime in this case is for quite another purpose than neutralizing soil acids, and the farmer should formulate his own judgment in this respect; our acidity tests have no direct bearing on this phase of the problem.

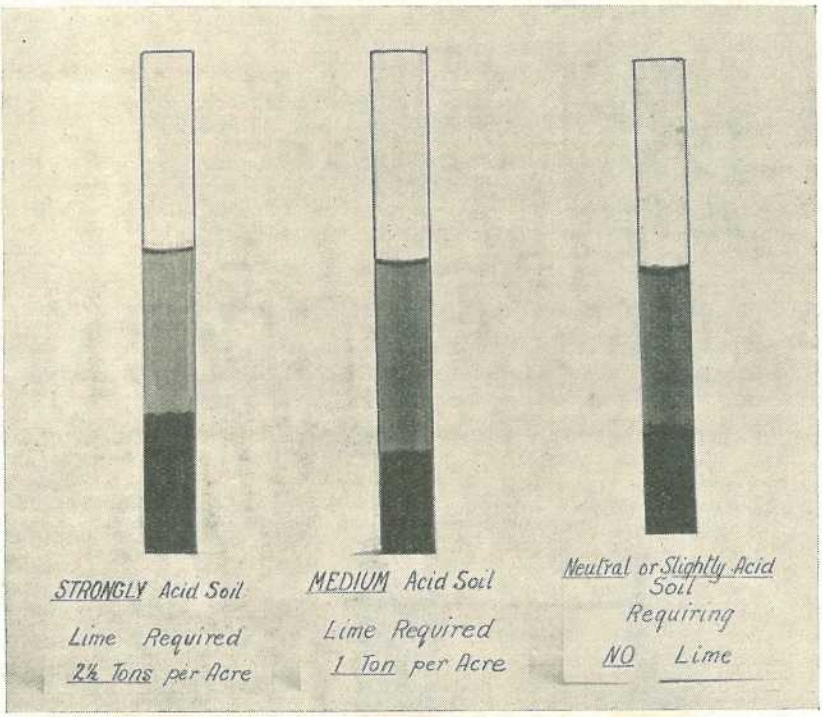


Plate 206.

Illustrating the Soil Acidity Test. The *yellow* colour of the dye solution, in the left-hand tube, showed strong acidity and the need for heavy liming; the central tube indicated medium acidity, by showing a *green* colour; while that on the right showed a strong *blue* colour, which means that no lime is required.

So far I have purposely refrained from mentioning a seventh plant-food material which is of very great importance to Queensland canegrowers. This is *nitrogen*, which comes not from the soil minerals, but from that portion of the soil which is derived from quite a different origin. From what has been discussed hitherto, one might imagine that the soil is simply a mixture of decomposed and undecomposed minerals, which are quite lifeless and inert. Actually this is far from the truth: for the soil is the inevitable receptacle for the vegetable remains of the entire plant life which it supports, and for the residues of the animal life which dwells on and in it. Such materials—known as organic matter—are also the natural food materials of the myriads of minute life—known as bacteria and fungi—which consequently occupy the soil as their natural habitat. Thus we have in the soil very distinct constituents which invest the soil with life, and which are composed of the by-products of life processes. One of these is our valuable plantfood

nitrogen. No plant or animal can exist without a supply of nitrogen, which it builds into its tissues. After it has perished, the nitrogen is once again converted, through the agency of minute soil organisms, to a state in which it is again available for further plant growth. That fraction of the soil which comprises the decomposed vegetable and animal remains is called by the soil scientist *humus,* and is one of the most important constituents of the soil from many points of view. This is one phase of the soil which is not very obvious to the farmer, though he probably is aware of its existence. A well decomposed mass of farmyard manure approaches very closely to humus in appearance and properties. But we will also ask our soil chemist to show us how the humus content of a soil may be demonstrated. (Plate 207.)

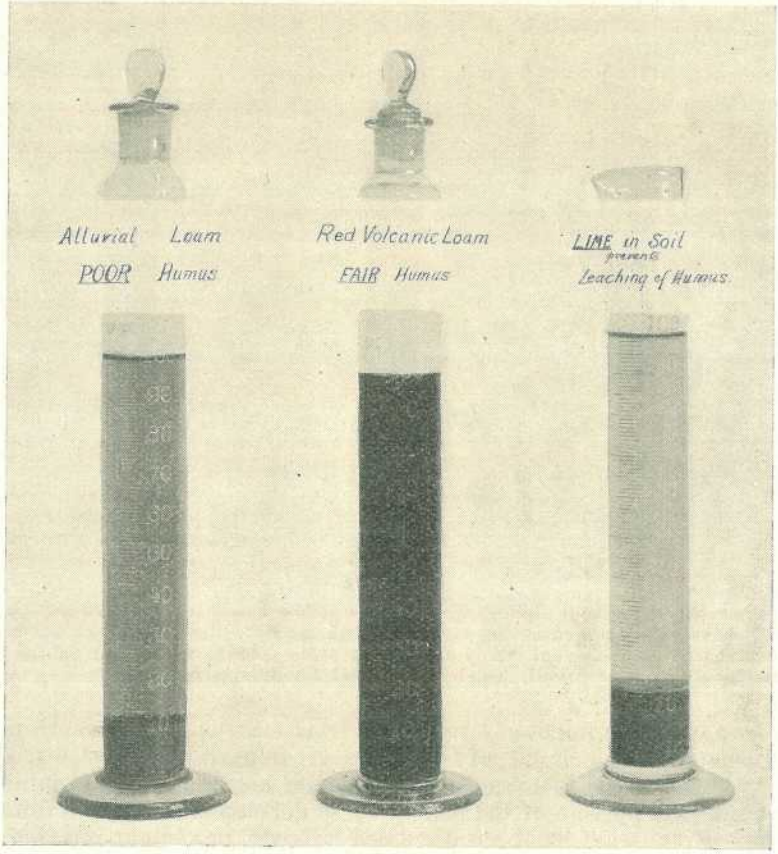


Plate 207.

Illustrating the Humus Test. The depth of colour of the liquid is a guide to the humus content of the soil; the alluvial loam is thus seen to contain less humus than the red volcanic loam. To the tube on the right, burnt lime was added; this completely removed the humus, to give a dark sediment and a clear water layer. In the soil, lime is thus instrumental in preventing the leaching of humus.

In general, the more humus the soil contains, the better is its supply of nitrogen for the purposes of plant nutrition. But unfortunately those soil conditions of high temperature and abundant

moisture, which make for rapid cane growth, are just those conditions which make also for rapid decomposition and loss of humus from the land. Hence it is that our cane soils require a supplement of available nitrogen, if they are to continue to produce profitable crops. This may be applied in the form of dried blood or meatworks offal, or as sulphate of ammonia and nitrate of soda. But such a policy is costly, and moreover, there are at the disposal of the farmer other and cheaper methods by which this process may be achieved, at least to some extent, while conferring other benefits on the soil as well.

So we finalise a rather hurried discussion of soil forming processes and their relationship to crop growth. But in addition to food, the crop must also have water, as Bundaberg canegrowers are all too frequently reminded, in the many drought periods which they experience. With your permission, I will therefore discuss briefly this phase of plant nutrition, and attempt to indicate those features of the soil which bear on the question.

It is a well-known fact that crops on clayey soils withstand droughty spells to much better advantage than do those on sandy loams. Why is this?

To provide the full story, we must go back to the constituent particles of our soil. We have seen that a sandy soil—such as is usually obtained from a granite rock—is rather rich in coarse sand particles and poor in the finer silt and clay portions. Now when a soil is wetted, the water does not actually pass "into" the soil: what really happens is that a fine film of water is formed around each of the individual grains of soil, whether they be large or small; and the quantity of water which a soil holds when wetted is largely a measure of the total area of all the surfaces of all the individual grains of the soil. To illustrate this point more clearly, suppose we take a piece of basalt rock in the form of a cube, 1 cubic inch in volume. It is seen that the surface area of such a cube is 6 square inches. If this be dipped into water and allowed to drain it is obvious that the piece of rock has merely become wetted on the surface and is not "saturated" with water. If we could now split our cube into eight smaller cubes, each $\frac{1}{2}$ inch on the side, we will have increased the total surface area from 6 to 12 square inches; for the surface area of each of the small cubes is $1\frac{1}{2}$ square inches, and there are eight such cubes. The surfaces of the smaller cubes will therefore retain, on wetting, twice as much water as the original cube. As we subdivide the cubes still further, the surface area of the original piece of rock becomes greater and greater: and it has been calculated that the total surface of a weight of clay particles, equal to that of the original inch cube of basalt, would actually be some hundreds of square yards. It would therefore appear that the greater the proportion of fine particles in a given weight of soil, the greater will be its capacity to take up and retain water during periods of rainfall, or when irrigation water is applied. (Plate 208.)

Again our story would not be complete if we were not to stress once more the importance of soil humus or organic matter in this connection. Whereas, in a well-drained soil, sand can hold in the form of surface

films about one-seventh of its weight of moisture, silt will hold one-quarter, and clay about one-half: but humus possesses the virtue of retaining almost *twice* its weight of moisture, to be made available to the growing crop in dry times. And so we can understand why even the modest 3 or 4 per cent. of humus which a good soil contains is so important also from the point of view of the moisture holding capacity of the soil.

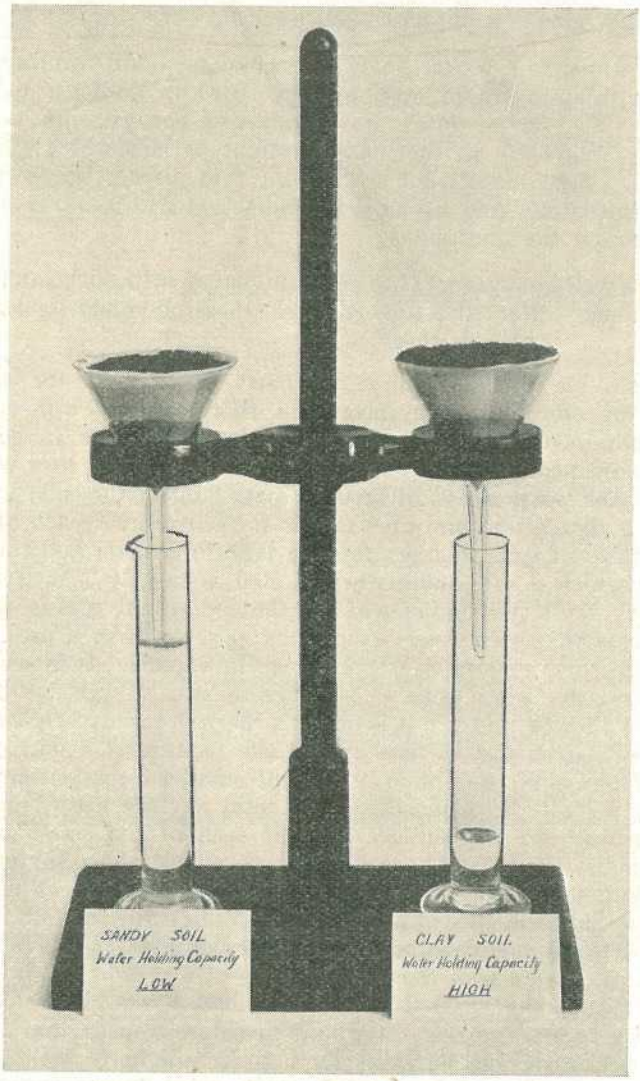


Plate 208.

Illustrating the influence of soil type on water holding capacity. Equal weights of soil received equal volumes of water; it will be observed that whereas there was little surplus for drainage, with the clay soil, there was a substantial excess with the sandy soil.

Clay soils therefore hold more moisture and are more drought-resistant than sandy soils.

Finally we should point out that the individual soil grains—whether sand, silt, clay or humus—do not exist simply as a mechanical mixture, in a good agricultural soil. This condition does indeed exist in some soils which are difficult to cultivate, and when an attempt is made to bring them to a condition of good tilth, they become as fine as dust: when wetted they run together, and on drying once more become compacted to a concrete-like mass. But a first class agricultural soil is found to consist of an aggregation of small irregular crumbs which readily separate one from another when at the most desirable condition of moistness; these crumbs or granules actually consist of loose aggregates of soil grains of all dimensions, in which the sand and silt particles form a matrix which is loosely bound together by the very fine clay and humus particles. Again the humus is most important in maintaining this desirable condition in the soil. The process of intensive cultivation with implements, on the other hand, tends to destroy the granules, and the process of ploughing a soil when too wet readily provides merely an exaggerated effect of this influence.

In conclusion, let us briefly summarise what we have learned from our visit to the soil chemist's laboratory. We saw that soils were the products of rock disintegration and decomposition, whereby many of the original minerals are slowly changed to new forms, and plantfoods are liberated in the process. We learned also that different rocks decompose at different rates—some giving shallow and some deep soils. Moreover, the kinds and amounts of plant-foods yielded by any rock depended very much on the kind of minerals contained in the parent rock: and while a soil of one origin might give just the supply of plantfoods which our particular crop desires, others do not provide the "balanced diet," and the farmer must take a hand in supplementing any nutrient deficiencies, by the use of a suitable fertilizer mixture. With soils from high rainfall areas the chemist showed us that the lime is often washed away just as quickly as it is released by mineral decomposition, and under these conditions the farmer must supply lime to correct the objectionable and harmful acids which are thus produced. The chemist has also shown us the methods he employs to provide him with the intimate details of the chemical conditions of the soil.

Then we were given a demonstration of the presence of the black waxy substance present in all soils, in greater or less amounts, which we called Humus. We learned that humus is the sole source of that important plantfood nitrogen, so essential for vigorous crop growth, and so generally deficient in amount in our Queensland soil, because of the great rate at which heat and moisture combined with intensive cultivation, cause it to decompose.

And lastly, we were shown how the amount of moisture which a soil will hold after rain is governed by the coarseness or fineness of the individual mineral grains of which the soil is composed, and above all, the value of the sponge-like organic matter or humus in its ability to hold moisture.

So we come to the end of our brief excursion into the realms of soil science, though we have done nothing more than visit the outskirts. I can only wish it were practicable to venture more boldly with you and discover more of the inner secrets of the wonderful thing which we call soil, and which is the foundation of every phase of life and civilization.

Banana Growing in Queensland.

H. J. FREEMAN, Senior Instructor in Fruit Culture and Chief Inspector, Banana Industry Protection Board.

(*Continued from page* 442, *May issue,* 1938.)

WIRE TRANSPORT SYSTEMS.

A CONVEYOR system is necessary in steep and broken hillside country for the rapid transport of bunches from the plantation to the packing shed. Aerial wiring systems range from a single wire stretched from a stump within the plantation to another stump near the packing shed, along which run loose pulleys bearing short rope slings by which the bunch is suspended, to most elaborate wire rope installations.

The chief thing to do is to put these wires up as strongly as possible. For the lighter systems, special "banana wire" may be purchased for this purpose. This wire is oval in section, of high tensile steel and is in unwelded lengths of up to 1,200 yards with a breaking strain of 2,500 lb., and sold at, approximately, 50s. per coil. A lighter wire known as 10X 12 gauge has a breaking strain of 2,140 lb., is 1,200 yards in length, and costs, approximately, 30s. per coil. Both these wires are suitable for carrying the weight, but where the wire is set at too steep a grade to allow for reasonable speed of carriage, a tail wire also should be used, and for this purpose plain galvanised wire of 12 gauge is recommended at, approximately, 25s. per cwt. coil. Smaller coils are obtainable, if desired.

As a general principle, carrying wires are strung in pairs, spaced about 3 feet apart. As many wires as are desired may be strung within a plantation, but all should lead to a central landing stage within or close to the packing shed.

If no natural anchorage is available, one must be built. For this purpose, two hardwood posts 10 or 12 feet in length and from 6 to 10 inches in diameter are erected and stayed very securely. If necessary, a small landing stage may be built on to this anchorage to allow for loading the bunches, so that they will easily clear the ground when starting off on their rapid downhill flight. Holes should be bored through the top of each post and the wires passed through and made fast. A similar anchorage and platform should be made at the packing shed end, except that the anchorage should be much stronger and, with the posts spaced wider apart, as the grower may desire to bring four or even six pairs of carrying wires on to the landing. The tighter the carrying wire, the more rapid is the transit of fruit. To prevent or minimise sagging, each wire should be passed through the post or connecting cross beam and also through a round wooden roller to which it is fastened. This roller should be arranged so as to make it a really strong wire strainer and, used as such, it is an easy matter to bring each wire up to the required tension periodically. At approximately 18 inches below these carrying wires, an endless tow wire is strung by passing a 12 gauge galvanised wire round a flanged wheel of any diameter from 12 inches to 2 feet and placed horizontally by means of a bolted axle to a very substantial cross-bar, bolted to the main supports especially for this purpose. This tail or tow wire is only used

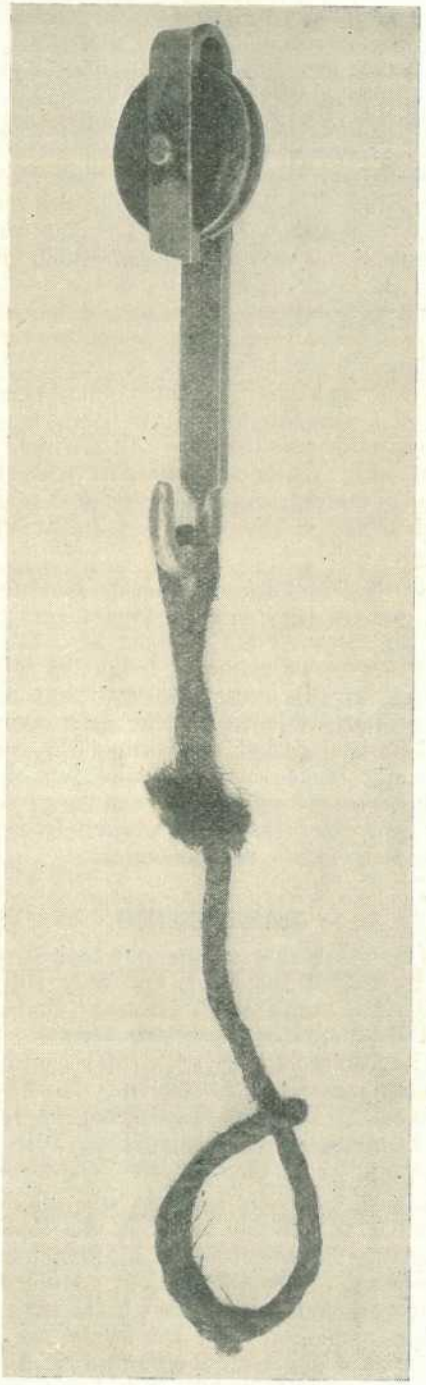


Plate 209.

BANANA WIRE PULLEY AND ROPE SLING.

The pulley is made of malleable cast steel, and is of the following dimensions:—Diameter 3 inches, width $\frac{5}{16}$ inch; depth of flange $\frac{5}{16}$ inch; rivet $\frac{5}{16}$ inch iron; frame 1 inch by $\frac{1}{4}$ inch mild steel, 14 inches long. Made up, these pulleys are 9 inches in length.

The rope sling is $\frac{3}{8}$ inch by 18 inches long, spliced at each end for preference.

as a brake, and does not need tightening beyond a reasonable degree. Loose pulleys specially riveted to short light steel frames, so well known to most Queensland growers, are used to carry the bunches. A light rope sling 18 inches long is attached to each pulley. The pulley is placed on the carrying wire, the sling twisted twice round the tail wire and half-hitched on to the bunch stem. From one to twenty bunches can be loaded on the one wire, 3 feet spacing between each bunch, in this way, then steadied as it progresses downwards, by some form of improvised brake operated by a man at the top landing applying some pressure to the wheel round which the tail wire passes. The rope slings grip the tail wire firmly, so the operator can steady up or quicken the load as required. The second load may be sent down on the opposite wire thus necessitating a similar, but reverse action of both wheels at either end of the endless tail wire. From then on, each wire may be used alternatively, or only one carrying wire may be used, in which case a continuation of bunches may be lowered at a speed, regulated only by the rapidity with which these are handled at the packing shed end. When only one wire is used, no reverse action of the tail wire is necessary, and an occasional sugar bag containing spare pulleys and slings is the only cargo sent up the second wire to the wiring head.

Some of these systems are very fast, moving as many as 250 bunches an hour. Where very long distances over broken country are necessary, a form of intermediate support is required. This is given by the erection of a post of required height to which a cross arm is bolted. On the ends of this cross arm, two iron supports are bolted. One end of this support is bolted to the cross arm, and the other is riveted to a small flanged rocker over which the carrying wire passes. Any blacksmith could make these and the job of the rockers is to prevent the carrying wire springing from the flange while under pressure of a heavy load. For this reason, an absolutely rigid support on the ends of these cross-arms is not recommended.

HARVESTING.

Harvesting is the work that all growers look forward to. One must not be too eager to market the fruit, and only fully matured bunches should be cut. By fully matured, it is meant that the fruit should be well rounded and the bunch even in appearance. Fruit intended for a local sale could be allowed to mature a little more than that intended for a distant market—such as Melbourne. But, as all bananas are now ripened artificially, bunches should not be left uncut until the stage of maturity immediately approaching full ripeness has been attained.

In some periods of the year bananas will fill out much more than at other times, and it is only by knowing the local conditions within a district that a grower is able to select his bunches to the best advantage from week to week, or from cut to cut. Much has been said about methods of making such a selection. With the experienced grower, one look at the bunch is sufficient. For those who are not so experienced, a fair guide is to break a finger off the bottom hand of the bunch. Hold this banana curve downwards in the left hand and gently press the blade of the cutting knife into the skin near the bud end of the fruit. If the skin cracks above this knife cut, the fruit is ready to market. Another test is to cut this particular banana in halves and if the pulp

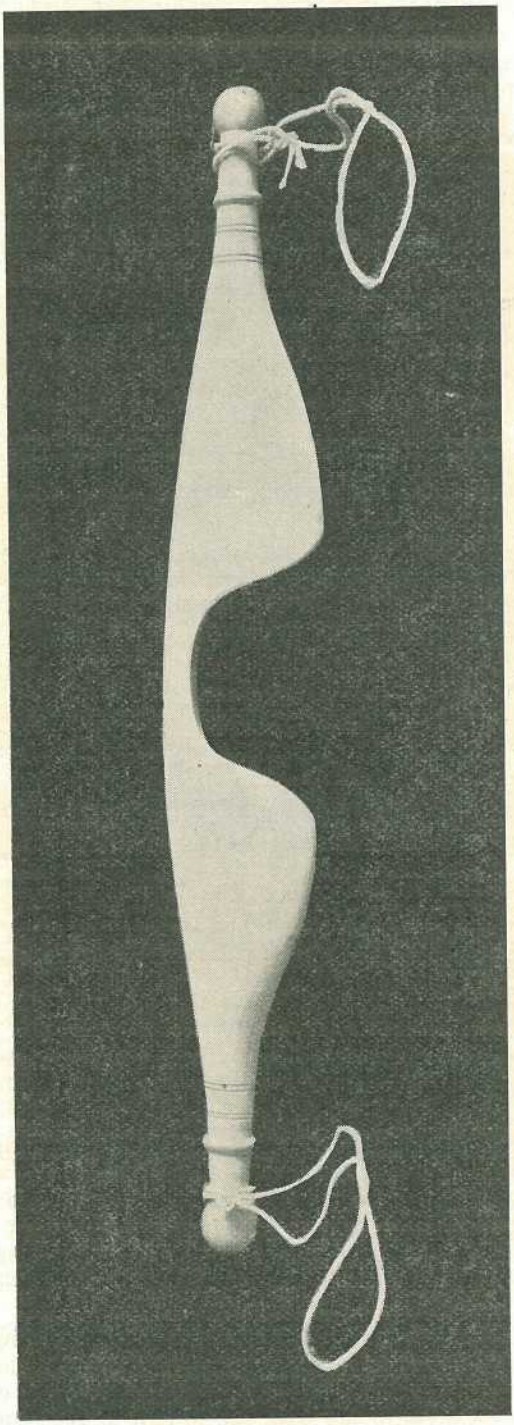


Plate 210.
Yoke for carrying bunches of bananas to the wireway or packing shed.

is slightly yellow the fruit is matured. On the other hand, if the skin refuses to crack open and the fruit itself is almost white in colour, the bunch should certainly be left to hang for another week or two. Angular thin fruit should not be harvested in any circumstances.

Plate 211.

CUTTING AND CARRYING.—A cane knife is best for cutting the bunch. Under-arm carrying, as illustrated, is a wrong practice, and causes bruising.

A sharp cane knife is one of the best tools for cutting the bunches. With the first cut, several leaves are severed and fall to the ground, usually straight beneath the bunch. The second cut should sever the bunch, which may be laid conveniently on the leaves cut previously for this purpose.

With Cavendish bananas the correct method of cutting the bunch is to place the left hand firmly round the bunch stem and the left leg in against the lower portion of the bunch. Using the right hand, sever the bunch by one clean cut, leaving plenty of stem for convenience in handling later. The bunch will then rest on the left knee, and with the other hand can be laid gently on the leaves already cut and lying on the ground.

The Mons Marie variety with its lofty habit of growth requires somewhat different handling. With the cane knife, a small V-shaped cut is made about 6 feet from the ground at the front of the plant stem. This allows the stem to sag with the weight of the bunch, which is severed similarly to the Cavendish once it comes within reach of the cutter's hands.

Plate 212.

WINTER FRUIT.—Note objectionable angular formation. Summer fruit should be filled more roundly.

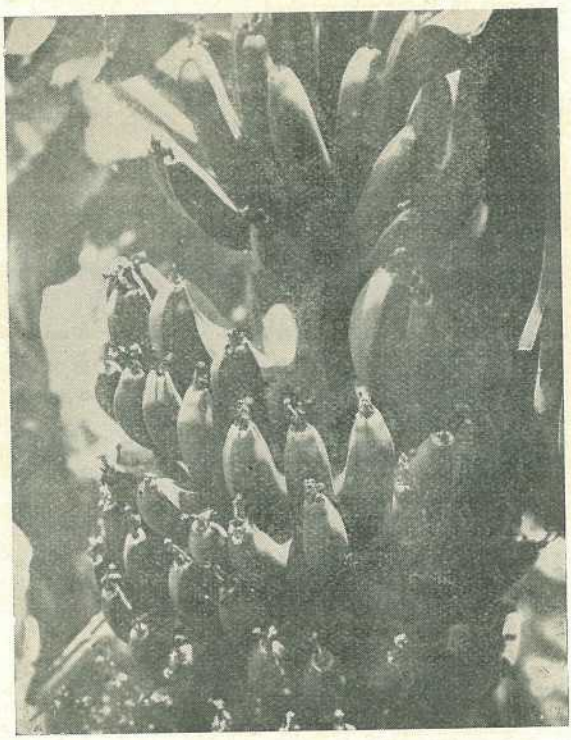


Plate 213.

Well-matured winter fruit of the Cavendish variety.

Plate 214.

LOADING SLIDE.—Some bag or hessian lining along the sides and ends of the frame and an armful of banana leaves on the floor of the slide prevents damage to the fruit in transit to the packing shed.

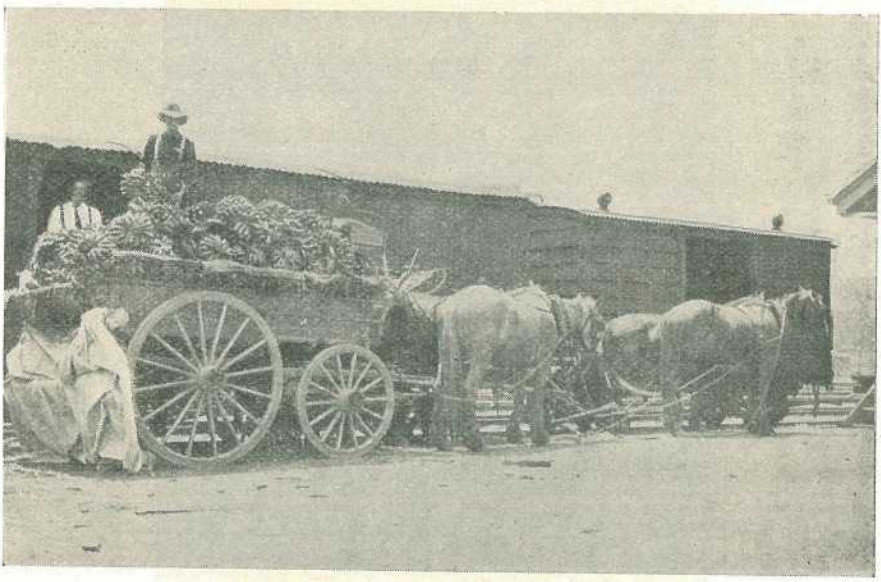


Plate 215.

BANANAS IN THE BUNCH FOR THE DOMESTIC MARKET.

In consigning fruit to local selling centres, careful handling is necessary to prevent bruising. In many districts the fruit is conveyed to the railway in utility trucks, but where bananas are grown in mountainous country and road grades are steep and the going difficult, horse transport is still the vogue.

Lady Finger and Sugar varieties are harvested in similar way, and with all varieties the plant stem must be removed by cutting off at about 12 to 15 inches from ground level and further cutting into several pieces, thus allowing for more rapid rotting. The cutting up of the plant stem may be done at the same time as the bunches are cut, or, if more monvenient, the grower may allot a special time for removing the spent stems within, say, a fortnight following the cutting of the fruit.

After cutting, the bunches are usually carried into every fourth or fifth row of plants, a few leaves being carried with each bunch on which to place it gently. This enables the grower to collect the bunches much quicker than if the fruit were laid between every row of the plantation. The importance of special care in handling bananas cannot be stressed too strongly. The use of carrying wires wherever possible is recommended. Where a horse-drawn slide is used, slide tracks should be made through the plantation, thus providing for more even and smoother running of the slide. Some hessian packing round the insides of the carrying frame of the slide is an advantage and an armful of leaves on the floor of the slide to protect the fruit from bruising is necessary. Carrying by hand in the course of harvesting is always necessary, and nothing is better for this job than the yoke used usually on banana plantations in Queensland. This allows a man of average physique to carry two bunches at a time without damaging the fruit. Carrying one bunch at a time on one's shoulders is too slow, but with care it is possible to handle the bunch in this way without damaging the fruit.

The packing shed floor should be clean and covered with an abundance of banana leaves to prevent bruising. As against hessian, or similar material, green banana leaves are best for this purpose.

The packing shed need not be elaborate in construction. If the area of the plantation does not warrant the expense of sawn timber, round bush timber, iron roof, bag sides, and a smooth, hard, earthen floor is quite suitable, but a wooden floor is of course preferable. In any case, what really is important is the cleanliness of the shed. All refuse should be swept away after each consignment has been despatched, as fungus spores may develop in rotting banana refuse and infect clean fruit. The resultant damage may not become noticeable until the fruit is in transit to the market or in the ripening rooms. The use of green banana leaves, not dry trash, is commended specially because of this risk of loss of quality in the consignment.

To pack and grade well and quickly, reasonable working space is necessary. Made up cases, already stencilled with the grower's and agent's names, should be stacked in a convenient place. A stoutly built casemaking bench should be provided inside the shed to allow for casemaking during wet weather.

Bananas are graded by measurement. When the bunches are brought in they should be dehanded and the hands stacked right side upwards, as nearly as possible according to grade, in heaps on the floor—a practice favoured by many successful growers. Some growers, however, contend that to have waist-high packing benches on which to stack the fruit is a better method. Theoretically, it may be so, but in practice it has many disadvantages, chief of which is loss of valuable time. Any damaged fruit should be discarded at once. This will speed up the actual packing considerably.

A departmental publication—"Packing Bananas for Market"—is available free on application to the Under Secretary, Department of Agriculture and Stock, Brisbane.

Cattle Dip Concentrates.

F. B. COLEMAN, Officer in Charge, Seeds, Fertilizers, Veterinary Medicines, Pest Destroyers, and Stock Foods Investigation Branch.

SECTION 3 of the Pest Destroyers Act requires all pest destroyers—which includes cattle dips—to be registered with the Department of Agriculture and Stock annually on or before the 31st January.

Standards are laid down by the Regulations under the Act, and labelling particulars are also prescribed. With respect to cattle dip concentrates, it is necessary to state on the label the percentage of arsenic by weight in the concentrate and the dilution required to give a resultant solution containing 2 lb. arsenic per 100 gallons (0·2 per cent.).

The following list sets out the cattle dips registered for the current year, the dilutions required, and the names and addresses of the persons responsible for putting them on the Queensland market.

LIST OF CATTLE DIPS REGISTERED UNDER SECTION 3, "PEST DESTROYERS ACT," FOR THE YEAR ENDING 31ST DECEMBER, 1938. LIST COMPILED 30TH APRIL, 1938.

Name of Dip.	Dilution.	Name of Queensland Wholesale Dealer.
LIQUID—		
Dilution 1 in 200 or less.	Concentrate. Water.	
Alco Liquid Cattle Dip	1 gal. to 160 gal.	Australasian Laboratories Pty. Ltd., Brisbane
Australian Liquid Dip	ditto	Australian Disinfectant Co., Brisbane
Coopers Improved Cattle Dip	1 gal. to 125 gal.	New Zealand Loan and Mercantile Agency Co. Ltd., Brisbane
Dalco No. 2 Single Strength Cattle Dip	1 gal. to 160 gal.	Dalgety & Co. Ltd., Brisbane
Effecto Improved Liquid Cattle Dip	ditto	Queensland Primary Producers Co-operative Association, Ltd., Brisbane
Kiltic Liquid Cattle Dip	ditto	G. Horsburgh & Co. Pty. Ltd., Maryborough
Kiltic Liquid Cattle Dip	ditto	Surgical Supplies Ltd., Brisbane
Kreeola Liquid Cattle Dip	ditto	Australian Chemical Co. Ltd., Brisbane
Littles Cattle Dip	ditto	Wilcox, Mofflin, Ltd., Brisbane
Mactaggarts Improved Liquid Cattle Dip	ditto	Mactaggarts Primary Producers' Co-operative Association Ltd., Brisbane
Non-Ox Liquid Cattle Dip	ditto	Australian Chemical Co. Ltd., Brisbane
Queensland Cattle Dip (Homogenous)	ditto	Australian Machinery Co. Ltd., Brisbane
Royal Cattle Dip (Homogenous)	ditto	Australian Machinery Co. Ltd., Brisbane
Sidolia Liquid Cattle Dip	ditto	Norris Agencies Pty. Ltd., Brisbane
Standard Non-Oxidising Liquid Cattle Dip	ditto	Queensland Chemical Distributing Co., Brisbane
Tickstroy Cattle Dip	ditto	J. H. Eden & Co., Brisbane
United Cattle Dip	ditto	United Chemical Co. Ltd., Brisbane
BAR—		
Kiltic Cattle Dip	2½ lb. to 50 gal.	Surgical Supplies Ltd., Brisbane
PASTE—		
Thomas' Carbolised Cattle Wash	10 lb. to 175 gal.	James Campbell & Sons Ltd., Brisbane
POWDER—		
Vallo Powder Cattle Dip	10 lb. to 200 gal.	A. Victor Leggo & Co. Ltd., Brisbane
LIQUID—		
Dilution greater than 1 in 200.		
Acco 1–300 Liquid Cattle Dip	1 gal. to 300 gal.	Australian Chemical Co. Ltd., Brisbane
Alco 1–320 Liquid Cattle Dip	1 gal. to 320 gal.	Australian Laboratories Pty. Ltd., Brisbane
Austral Liquid Cattle Dip	ditto	Taylors Elliotts and Australian Drug Pty. Ltd., Brisbane
Australian Double Strength Liquid Dip	ditto	Australian Disinfectant Co., Brisbane
Campbells Liquid Cattle Dip	ditto	Campbell Bros. Ltd., Brisbane
Concentrated Kiltic Liquid Cattle Dip	1 gal. to 300 gal.	Surgical Supplies Ltd., Brisbane
Coopers Tixol	1 gal. to 320 gal.	New Zealand Loan and Mercantile Agency Co. Ltd., Brisbane
Dalco No. 1 Double Strength Cattle Dip	ditto	Dalgety & Co. Ltd., Brisbane
Harton Cattle Dip	ditto	Chemical and Tar Products Ltd., Brisbane
Hayes Cattle Dip	1 gal. to 300 gal.	Hayes Veterinary Co., Brisbane
Hibiscus Cattle Dip Fluid	ditto	Queensland Pastoral Supplies Ltd., Brisbane
Kreeola Liquid Cattle Dip	ditto	Australian Chemical Co. Ltd., Brisbane
Littles Cattle Dip (Concentrated)	ditto	Wilcox, Mofflin, Ltd., Brisbane
Maxdip Double Strength Cattle Dip	1 gal. to 320 gal.	Mactaggarts Primary Producers' Co-operative Association Ltd., Brisbane
Royal Cattle Dip (Concentrated)	1 gal. to 300 gal.	Australian Machinery Co. Ltd., Brisbane
Sidolia Liquid Cattle Dip	ditto	Norris Agencies Pty. Ltd., Brisbane
Standard Non-Oxidising Liquid Cattle Dip	ditto	Queensland Chemical Distributing Co., Brisbane
Uccol Cattle Dip	1 gal. to 320 gal.	United Chemical Co. Ltd., Brisbane
Vallo Improved Fluid Cattle Dip	ditto	A. Victor Leggo & Co. Ltd., Brisbane
Youngs Improved Cattle Dip	ditto	Sturmfels Primary Producers' Co-operative Association Ltd., Brisbane

Australian Export Pig Competition.

THE first All Australian Export Pig Competition conducted by the Australian Meat Board was completed when the pig carcases were judged in London last January.

Competitors have been supplied with reports on their pig carcases, and now, for the information of the Queensland pig industry as a whole, this summarised report, with extracts from the comments submitted by the judges, has been prepared by the Pig Raising Branch of this Department.

The competition required entries of three carcases of porker or baconer pigs which were treated at Australian meatworks and exported to London, where the judging was carried out by Messrs. H. R. Davidson and Jos. B. Swain, using the recently-adopted system of carcase appraisal which was described in detail in the "Queensland Agricultural Journal" in August, 1937.

Thirteen entries of baconers and nine entries of porkers were received, all the States excepting Tasmania being represented. Unfortunately several carcases were lost in transit and this precluded several entries from participating in the awards, the entries affected included one of baconers and four of porkers, all of which were from Queensland.

Baconers.

The average marks awarded for all the entries in the baconer competition were 66·7 per cent., which is considered fairly satisfactory, as the method of marking is very severe and sets a very high standard of excellence.

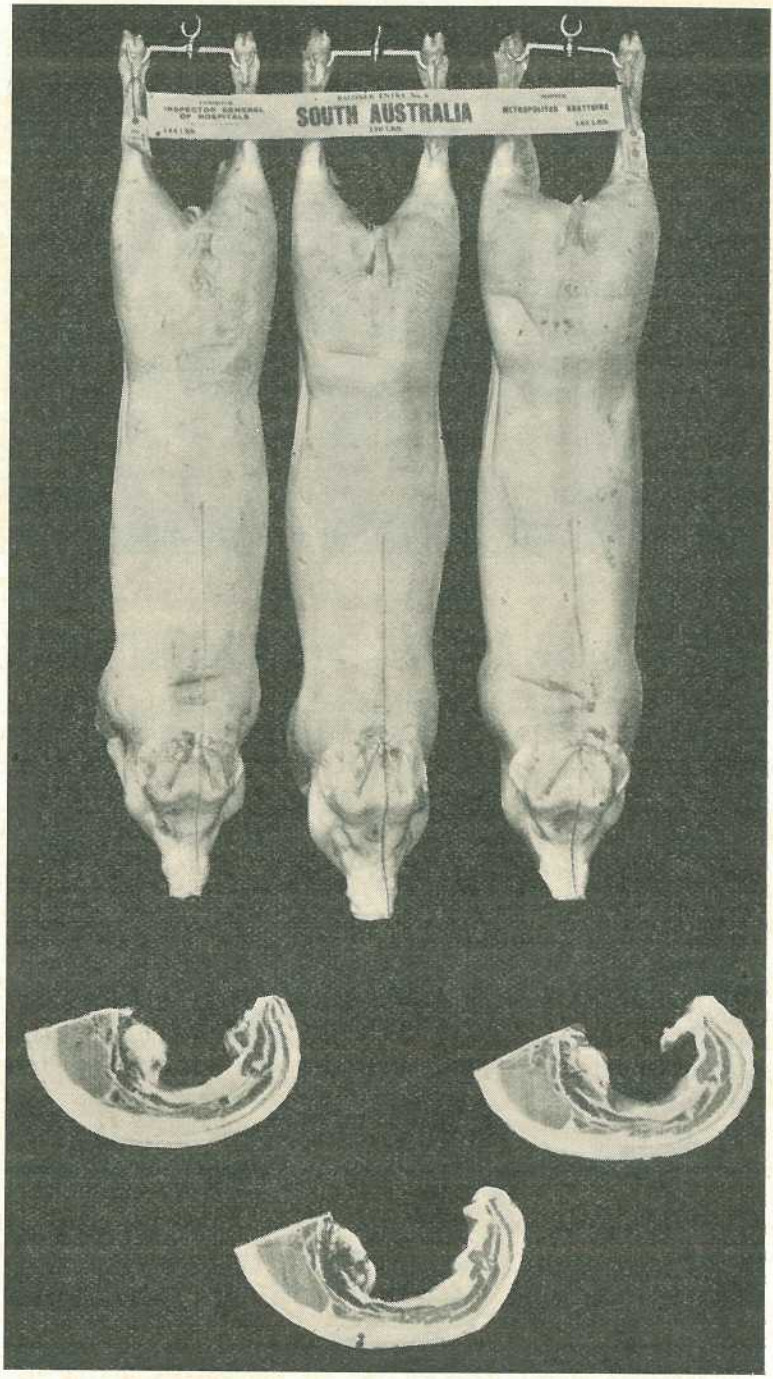


Plate 216.
EXPORT CARCASE COMPETITION.—Winning entry of baconers.

AWARD CARD.

BACONER

BREED Large White — **Inspector General of Hospitals** — Entry No. 6

A. Inspection	Maximum Marks	Actual	Marks	Ideal	Actual	Marks	Ideal	Actual	Marks	Ideal	Percentage
Skin Colour	5		5			5			5		100%
Dressing	5		5			5			5		100%
Hams	8		5			4			6		62.5%
Shoulders	7		4			5			4		61.9%
Streak	12		7			7			7		58.3%
B. By Measurement											
Eye Muscle	28	46	20	54	44	19	53	47	21	54	71.4%
Fat Thickness	20	22	18	20	16	17	19	17	17	20	86.6%
Body Length	20	745	8	805	770	15	795	780	13	815	60%
Leg Length	5	580	2	559	585	1	554	560	5	564	53.3%
Wgt. Suitability	15		15			15			15		100%
Total			89			93			98		
Total (3 Carcases)						280					74.6%

AUSTRALIAN MEAT BOARD PIG COMPETITION DEC. 1937
Judges: H. R. DAVIDSON and JOS. B. SWAIN

The following extracts from the judges' report give the headings under which the carcases were valued, together with the possible number of marks allotted for each feature, and the average marks awarded for all the entries.

"It will be noted from the judge's report following that the most serious fault with the carcases as a whole was the deficiency in body length, for which the average marks awarded were only 45·6 per cent.; this point should receive the serious consideration of breeders, as it is one of the most important features of the pig, both from the breeders' and the trade's point of view.

Skin and Colour (5 marks).—It is necessary for successful marketing that the carcase should retain its natural bloom and be free of bruise marks, scratches, bites, &c. Even though there may be some doubt as to the cause of these faults by the time they arrive at Smithfield, it is important to draw attention to them. In this direction both the Nankival and Hawtin entries were reddish in colour and lost one mark each, while the Kingston Farm Pig Co.'s exhibits lost marks for a dull, blotchy appearance which is not shown in the photographs. The Dawkins' entry was bruise marked, while the Crosby entry was slightly marked by wrinkles on the skin. The Western Australian entry only received one mark out of five, as these pigs were extremely dirty in the skin.

Dressing (5 marks).—All entries scored 100 per cent. of marks, so that this point calls for no comment.

Hams (8 marks).—The average marks for all entries are 72·3 per cent. of the possible total, and indicate that the hams are very good.

Shoulders (7 marks).—With 68 per cent. this point is not quite so good as hams, though if the Burgess entry, with only 47·6 per cent., is omitted, the other entries are very good. It is to be expected that where hams are good shoulders will not be quite so good, and vice versa.

In illustration of this the Large Whites have the lowest marks for hams and highest for shoulders. The Canadian Berkshires, with the highest marks for hams, have the lowest for shoulders.

Streaks (12 marks).—Although this point only scores 60 per cent. of possible marks the streaks must be regarded as very good and potentially better than is shown by the marking. They mostly lose marks because they are not thick enough rather than because there is not sufficient lean in them. Had there been a little more fat between the muscles many of the streaks would have earned full marks.

"Eye Muscle" of Loin (28 marks).—The standard set for this point is a severe one, as it is most important to encourage its development. An average of 59·3 per cent. of possible marks is accordingly considered to be a good result. Some of the entries, such as those from Aldridge with 75 per cent., Inspector-General of Hospitals with 71·4 per cent., and Logie with 69 per cent., deserve special mention. In some cases where the marks for the whole entry are not so good, it will be found that one poor carcase out of the three is responsible, the others being good.

Back Fat Thickness (20 marks).—The results under this heading are very good and are even better than suggested by the average of 66·1 per cent. of possible marks. Although entries Nos. 1 and 2 from the Kingston Farm Pig Co. only averaged 48 per cent. of marks, this was not due to too much fat, but to too little. A little more finish would probably have enabled these entries to equal No. 6 from the Inspector-General of Hospitals (which scored 86·6 per cent.) or No. 2 from Logie, which at 96·6 per cent. is the best score we have ever recorded under this system from any pen of three pigs.

Body Length (20 marks).—It is in respect of this point, on which the average marks of all entries only reach 45·6 per cent. of the possible, that the entries as a whole are deficient. There is, however, great variation, the difference between the best and worst being 39·7 per cent. Even within one breed, the Large Whites, there is a variation of from 48·3 per cent. to 75 per cent., which brings into prominence the two entries from the Kingston Farm Pig Co., with 71·6 per cent. and 75 per cent., respectively. At the other end of the scale the Canadian Berkshires at 13·3 per cent. do not do themselves or the breed justice.

Leg Length (5 marks).—At 72·6 per cent. of the possible this point is very good indeed, particularly considering the preponderance of Large White influence.

Suitability of Carcase Weight (15 marks).—Loss of marks in this section is entirely under the control of exhibitors, as the optimum marks for the most suitable bacon market weights, viz., 135-154 lb., have been published on several occasions and should be well known."

TABLE I.

BACONERS.

ANALYSIS OF RESULTS FOR INDIVIDUALS ON A PERCENTAGE BASIS.

—	Individual Competitors' Results.	Principal Feeds, &c.	Breeds.	Marks Awarded.	Per-centage.
South Australia ..	Inspector-General of Hospitals (Entry No. 6)	Crushed Barley, Crushed Wheat, Crushed Peas, Skim Milk	Large White	280	74·6
Victoria	W. Logie (Entry No. 2)	Barley and Boiled Potatoes	Large White x Large White x Middle White	269	71·7
Queensland ..	Kingston Farm Pig Co. (Entry No. 2)	Butter Milk, Maize, Pollard, Oatmeal. Paddock reared. Finished last six weeks in pens	Large White	261	69·6
South Australia ..	J. W. Aldridge (Entry No. 2) ..	Peas, Barley, and Meat Meal ..	Large White	258	68·8
South Australia ..	Inspector-General of Hospitals (Entry No. 5)	Crushed Barley, Crushed Wheat, Crushed Peas, Skim Milk	Large White x Berkshire ..	257	68·5
South Australia ..	W. H. E. Crosby (Entry No. 3) ..	Mixed Corn, Skim Milk, Pollard. Free range	Large White x Tamworth x Berkshire	250	66·6
Victoria	H. C. Nankivell (Entry No. 1) ..	Pastured Skim Milk, Boiled Potatoes, finished with Barley, Peas, and Skim Milk	Large White	249	66·4
Victoria	F. Hawtin, (Entry No. 1)	Milk, Pollard, Crushed Barley, Yard Feed	Large White	246	65·6
South Australia ..	J. W. Aldridge (Entry No. 4) ..	Peas, Barley, and Meat Meal ..	Large White x Berkshire ..	246	65·6
Victoria	Nestle Anglo Swiss Milk Co. (Entry No. 1)	Butter Milk, Whey, and Crushed Barley. Indoors from time of birth	Tamworth x Berkshire ..	240	64·0
South Australia ..	J. H. Dawkins (Entry No. 1) ..	Crushed Barley and Meat Meal ..	Large White x Middle White x Large White	225	60·0
Western Australia	W. G. Burgess (Entry No. 1) ..	Wheat	Canadian Berkshire ..	218	58·1
Queensland ..	Kingston Farm Pig Co. (Entry No. 1) (Not in competition), 2 carcases only	Butter Milk, Maize, Pollard, Oatmeal. Paddock reared. Finished last six weeks in pens	Large White	172	68·8

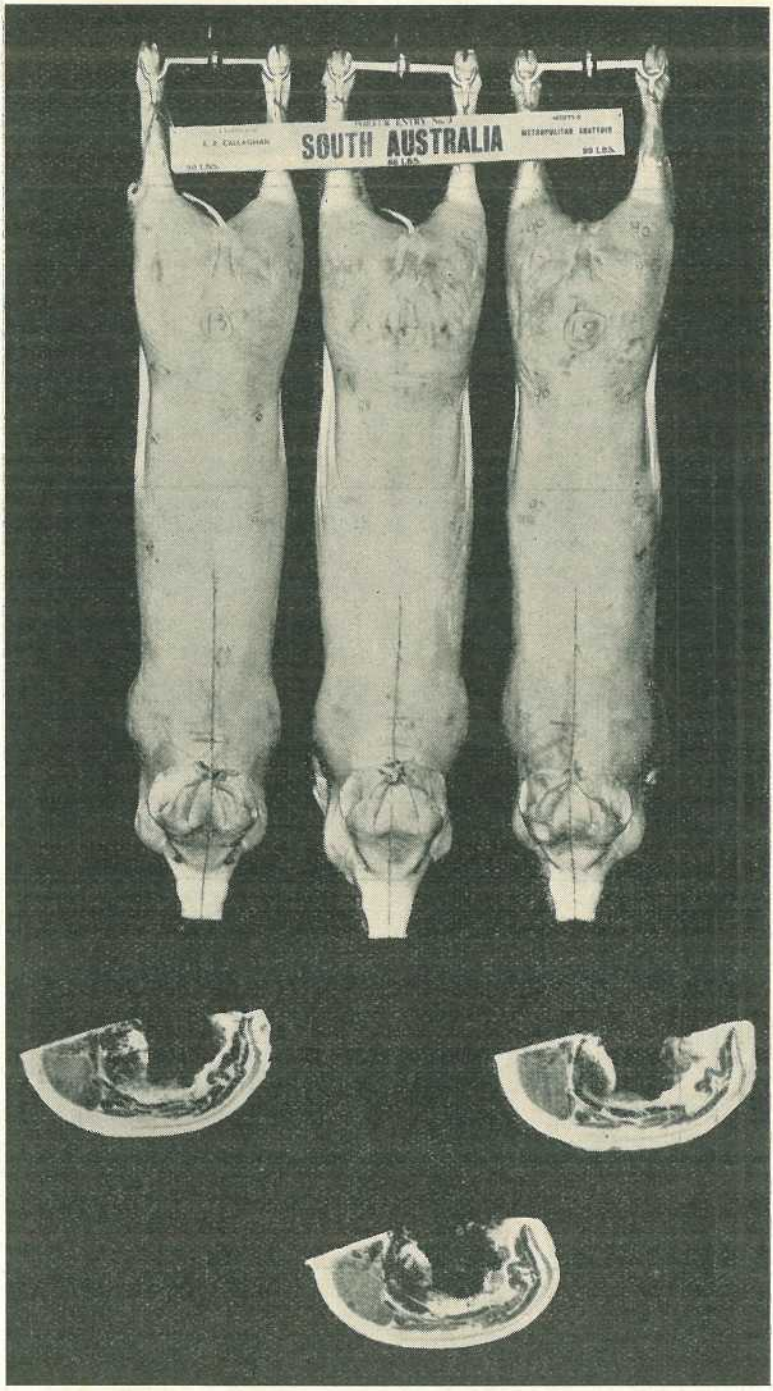


Plate 217.
EXPORT CARCASE COMPETITION.—Winning entry of porkers.

AWARD CARD.

PORKER

BREED Can. Berk. X Large White — **A. H. CALLAGHAN** — Entry No. 3

	Maximum Marks	Actual	Marks	Ideal	Actual	Marks	Ideal	Actual	Marks	Ideal	Percentage
A. Inspection											
Skin	5		4			4			4		80%
Colour	5		4			4			4		80%
Dressing	5		5			5			5		100%
Hams	8		6			5			5		66.6%
Shoulders	7		5			5			5		71.4%
Streak	12		9			9			6		66.6%
B. By Measurement											
Eye Muscle	28	42	20	50	42	21	50	43	21	50	73.8%
Fat Thickness	20	14	18	12	13	19	11	15	16	12	88.3%
Body Length	20	655	10	705	662	13	695	660	11	705	56.6%
Leg Length	5	485	4	479	485	3	469	475	5	479	80%
Total			85			88			82		
Total (3 Carcases)						255					73.9%

AUSTRALIAN MEAT BOARD PIG COMPETITION DEC. 1937

Judges: H. R. DAVIDSON and JOS. B. SWAIN

Porkers.

The porkers were judged by the same method as the baconers. The average marks awarded were 66·9 per cent., and the pigs were described by the judges as being of good marketable quality.

The following are extracts from the judges' reports.

Skin and Colour.—The results of 89·5 per cent. and 87·6 per cent. respectively are very good and losses are accounted for by slight bruises, scratches, bites, and a few carcases coming up a bad colour.

Dressing shows an award of 97·1 per cent., all States getting 100 per cent. except New South Wales, one mark being deducted on each carcase because the hands (forefeet) were incorrectly tied up, which tends to throw the shoulders out of shape and possibly helped to cause the low marks on shoulders.

Hams, with a result of 69·4 per cent., is quite up to standard and would have been better but for the poor result of Victoria with only 50 per cent.

Shoulders show a considerable variation in the States, the average of 63·2 per cent. being quite good, New South Wales, however, with 39 per cent., making a poor showing.

Streaks, with an average of 59·1 per cent., is possibly better than it appears, many marks being lost by thinness, not sufficient fat between the meat.

"Eye Muscle" of Loin.—The result of 65·9 per cent. is good, although there is very wide difference in many of the carcases. Special mention must be made of A. H. Callaghan, Entry No. 3, with such level results of 20-21-21 m.ms. with 73·8 per cent. award.

Back Fat, with 74 per cent., is very good and indicates that the Australian farmer realises that the British public want lean meat.

Body Length is not good, although the average of 50 per cent. is pulled down by the Queensland entries, which gain only 31·6 per cent. It is interesting to note that these entries are all crossbred Middle Whites.

Leg Length, at 61·9 per cent., is only spoilt by the Victoria entry with 40 per cent.

TABLE II.

PORKERS.

ANALYSIS OF RESULTS OF INDIVIDUAL COMPETITORS.

—	Competitors' Results.	Principal Feeds and Husbandry.	Breeds.	Marks Awarded.	Per-centage.
South Australia ..	A. Callaghan (Entry No. 3)	Mixture of Barley, Wheat, and Peas. Mainly outside feeding	Canadian Berkshire x Large White	255	73·9
South Australia ..	Inspector-General of Hospitals (Entry No. 4)	Crushed Barley, Crushed Wheat, Crushed Peas, Skim Milk	Large White x Berkshire ..	244	70·7
New South Wales	Australian Chilling and Freezing Co. (Entry No. 1)	Wheat, Butter Milk, Lime Water, Offal, and Green Feed	Large White x Tamworth ..	227	65·7
South Australia ..	E. A. Farr (Entry No. 5)	Skim Milk and Crushed Barley ..	Large White x Large White x Berkshire	225	65·2
Victoria	W. Logie (Entry No. 1)	Barley and Boiled Potatoes	Large White x Large White x Middle White	210	60·8
Queensland ..	Wallace and Son (Entry No. 1) .. (1 pig only, 80 lb.)	Kitchen Refuse with Meat Meal and Maize Meal	Tamworth x Middle White	81	70·4
Queensland ..	Wallace and Son (Entry No. 2) .. (1 pig only, 72 lb.)	Kitchen Refuse with Meat Meal and Maize Meal	Middle White x Tamworth	79	68·6
Queensland ..	G. W. Winch (Entry No. 3) .. .. (2 pigs, 64 and 66 lb.)	Table Scraps, Red Comb Pig Meal, Borthwick's Mebo, No Milk, Housing Intensive System	Middle White x Berkshire ..	137	59·5
Queensland ..	G. W. Winch (Entry No. 4) .. .. (2 pigs, 79 and 85 lb.)	Table Scraps, Red Comb Pig Meal, No Milk	Middle White x Tamworth ..	160	69·5

OBJECT OF REGISTRATION.

THE registration of hatcheries has for an object the distribution of healthy chickens, the progeny of parent stock of good type and production ability.

The following clauses of Regulation 29 of "*The Diseases in Poultry Acts,* 1923 *to* 1937," will indicate the obligations of owners of Registered Hatcheries:—

(iv.) He shall have all poultry at or upon or kept at or upon such hatchery tested for pullorum disease at the times and in the manner from time to time required by the Chief Poultry Expert. He shall pay to the Minister the cost of every such test.

(v.) He shall not place, permit, suffer, or allow to be placed in any incubator at such hatchery for the purpose of incubation, any egg which shall be less than 2 oz. in weight.

(vi.) He shall not sell or offer for sale any chickens other than chickens which are healthy and normal, and shall not sell or offer for sale any chickens which are deformed or injured in any way, or which have weak navels.

(vii.) He shall at all reasonable times permit the Chief Poultry Expert, any inspector, or any officer to enter into or upon such hatchery and inspect the same.

Following is a list, giving the name of the owner, of the hatcheries registered up to and including 31st May, 1938.

Name and Address.	Name of Hatchery.	Breeds kept.
G. Adler, Tinana	Nevertire ..	White Leghorns, Australorps, Rhode Island Reds, and White Wyandottes
F. J. Akers, Eight Mile Plains ..	Elmsdale ..	White Leghorns and Australorps
J. Cameron, Oxley Central ..	Cameron's ..	Australorps and White Leghorns
M. H. Campbell, Albany Creek, Aspley	Mahaca Poultry Farm and Hatchery	White Leghorns and Australorps

Name and Address.	Name of Hatchery.	Breeds kept.
R. B. Corbett, Woombye ..	Labrena ..	White Leghorns and Australorps
N. Cooper, Zillmere road, Zillmere	Graceville ..	White Leghorns
Rev. E. Eckert, Head street, Laidley	Laidley ..	Australorps, White Leghorns, and Langshans
Elks and Sudlow, Beerwah ..	Woodlands ..	Australorps and White Leghorns
Gisler Bros., Wynnum	Gisler Bros. ..	White Leghorns
J. W. Grice, Loch Lomond ..	Quarrington ..	White Leghorns
C. and C. E. Gustafson, Tannymorel	Bellevue ..	Australorps and White Leghorns
J. McCulloch, White's road, Manly	Hindes' Stud Poultry Farm	White Leghorns, Brown Leghorns, and Australorps
A. Malvine, junr., The Gap, Ashgrove	Alva ..	White Leghorns and Australorps
H. L. Marshall, Kenmore ..	Stonehenge ..	White Leghorns and Australorps
W. J. Martin, Pullenvale ..	Pennington Stud Poultry Farm	Australorps, White Leghorns, and Black Leghorns
F. S. Morrison, Kenmore ..	Dunglass ..	Australorps, Brown Leghorns, and White Leghorns
F. J. Mottram, Ibis Avenue, Deagon	Kenwood ..	White Leghorns
G. Pitt, Box 132, Bundaberg ..	Pitt's Poultry Breeding Farm	White Leghorns, Australorps, Langshans, White Wyandottes, Sussex, Rhode Island Reds, and Brown Leghorns
C. L. Schlencker, Handford road, Zillmere	Windyridge ..	White Leghorns
E. E. Smith, Beerwah	Endcliffe ..	Australorps and White Leghorns
T. Smith, Isis Junction ..	Fairview ..	White Leghorns
H. A. Springall, Progress street, Tingalpa	Springfield ..	White Leghorns
W. J. B. Tonkin, Parkhurst, North Rockhampton	Tonkin's Poultry Farm	White Leghorns and Australorps
T. Westerman, Handford road, Zillmere	Zillmere ..	Australorps and White Leghorns

Following is a list of persons who have applied for registration:

Name and Address.	Name of Hatchery.	Breeds kept.
J. L. Carrick and Son, Manly road, Tingalpa	Craigard ..	White Leghorns
T. G. Crawford, Stratford, via Cairns	Rho-Island ..	Rhode Island Reds
Mrs. A. Dvorik, Box 572, Innisfail	Coquette ..	Australorps and White Leghorns
F. J. Lambert, Acacia Vale, Townsville	Lamberts ..	Australorps and White Leghorns
J. W. Moule, Kureen	Kureen ..	White Leghorns and Australorps
J. A. Miller, Charters Towers ..	Hillview ..	White Leghorns
E. K. Pennefather, Oxley Central	..	Australorps and White Leghorns
R. H. Young, Box 18, P.O. Babinda	Reg. Young's ..	White Leghorns, Brown Leghorns, and Australorps

EFFECT OF CLIMATIC CONDITIONS ON DIFFERENT CLASSES OF POULTRY.

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

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

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

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

—*P. Rumball.*

MARKING EARLY LAYING PULLETS.

The marking of early laying pullets provides a practical method of selection where the trap nest is not used.

Records obtained by trap nesting in various parts of the world show that—

(1) Early laying pullets are, as a rule, the highest producers;

(2) Birds that lay late into the autumn and are late in moulting are also high producers.

As the early layers and late moulters are high producers, a marking system will assist in distinguishing between profitable and unprofitable fowls.

In one convenient system of marking, a coloured leg band is placed on the left shank of all pullets that start to lay before six months of age. A band of another colour is attached to the left shank of pullets starting to lay when six and seven months of age, and a third coloured band is used for fowls which commence to lay in the eighth month. Pullets that do not lay until after the eighth month should be eliminated from the flock, or kept in a pen by themselves, and forced for egg production.

Pullets which are early layers show the following characteristics:—

(1) A large red comb;

(2) An active disposition and a ravenous appetite;

(3) Roominess between the keel and pelvic bones;

(4) An occasional disappearance of the yellow coloration round the vent in some yellow shanked varieties.

In small flocks, individuals showing the above characteristics may be caught in the nests and then marked.

During the following season, all fowls that were marked as late maturing the previous autumn and moult in December, January, and February can be culled. All the early laying birds and those that moult after 1st March may be kept for layers or placed in a special breeding pen and mated to a male known to have come from a high laying hen that has been trap nested. In this way the egg production of the offspring may be raised.

The method outlined is simple and, if properly employed, will raise the level of production in a flock.

—*P. Rumball.*

A HOME-MADE BRUSH.

The following simply constructed brush will be found useful for numerous purposes in workshop, cow shed or house. The bristles of the brush are made by winding a bunch of horsehair around the fingers and tying tightly in the middle with string. The ferrule or handle, tapered to one end, is cut from a piece of

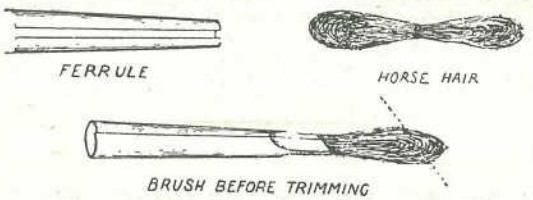


Plate 218.

galvanised iron and hammered into shape over a suitable block, the join being for the time left open. The horsehair is then inserted, the ferrule closed and the end pinched in a vice. A better job will be made if a little sealing or cobbler's wax is dropped into the ferrule before the hair is inserted, as this will help to bind it. The string can now be removed and the bristles cut to the desired shape.

A HANDY PIPE WRENCH.

A simple and efficient pipe wrench can be made as follows:—Take a piece of ordinary fencing wire 2 or 3 feet long and make a loop of it by joining the ends. Wrap this loop around the pipe and push through each end a piece of very strong

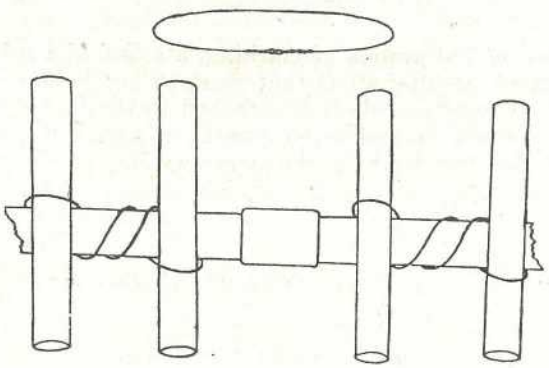
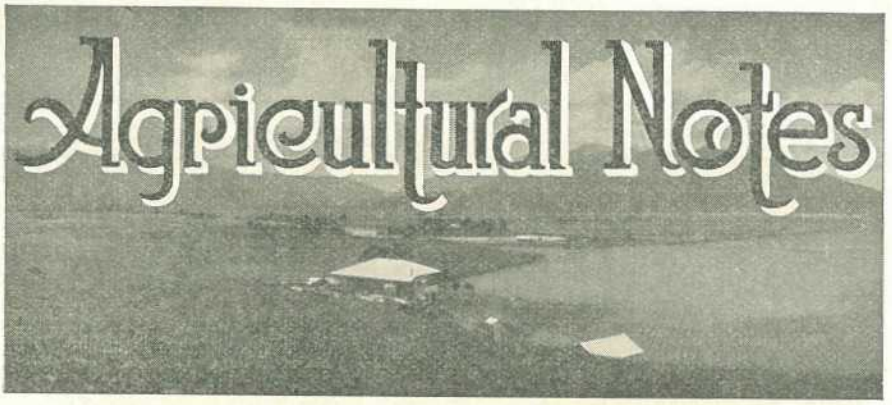


Plate 219.

wood (as shown in sketch). Turn the sticks in opposite directions and the wire will tighten on the pipe. To use apply pressure to both sticks and the pipe will screw or unscrew as the case may be.



Fodder Conservation in Central Queensland.

N. E. GOODCHILD, Instructor in Agriculture.

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 lends itself particularly to grazing and hay making, but the first cut or two from a new lucerne patch are often used in conjunction 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 in conjunction 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, at least, a limited extent.

CROPS FOR WINTER AND SPRING FEED.

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

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

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

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

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

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

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

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

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

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

—H. W. Ball.

WHEAT VARIETIES.

The census of wheat varieties sown in Queensland during 1937, compiled by the State Wheat Board, Toowoomba, from growers' returns, discloses many points of interest, the most important being the elevation of "Flora" to the premier position with 55,813 acres sown as against 41,160 acres during the previous season.

"Flora" is a medium early, moderately short-strawed grain wheat, of high quality, which has won many honours at Queensland shows, and is now attracting some attention in New South Wales. A sample of "Flora" grown at Gilgandra (yield 11 bushels per acre, with rainfall only 2 inches 10 points during growing period) was successful in winning the Commonwealth champion prize in the medium-strong white class at the recent Sydney Royal Show.

The combined area of "Three Seas" and "Seafoam," which are somewhat similar varieties, being bearded and rust resistant, was given as 67,332 acres, which is of particular significance in view of the good yields obtained, in spite of the heavy infestation of rust experienced late in the season. The area sown with "Seafoam" alone increased from 18,229 to 32,539 acres.

An area of 200,432 acres—approximately half the total area sown —was placed under twenty varieties evolved by the Department of Agriculture and Stock at Roma, and introduced into general cultivation through the medium of trial plots established throughout the Darling Downs wheat areas. The chief of these varieties, in order of present day preference, were "Flora," "Three Seas," "Seafoam," "Cedric," and "Novo."

The acreage sown of the recently introduced crossbreds, "Pusa" (C.C.C.), "Pusa-Warren" (Warput), "Pusa-Flora" (Puora), "Pusa-Gluyas" and "C.C.C. 2704" (Seaspray), also has consistently increased —the first named selection to the extent of 9,094 acres.

Unfortunately, 40,163 acres, a big proportion of the total area, was sown with unnamed varieties. Growers are strongly advised to procure pure seed of approved varieties and to maintain the purity of their seed from year to year by "rogueing" out impurities from the areas selected for seed.

The total area sown, 405,967 acres, is a gratifying increase over the previous year when 349,765 acres were cropped. A large proportion of the increased area is in the Dalby and Western Downs districts, where the greatest general expansion of grain growing is taking place. With a continuation of the present rate of expansion, Queensland growers will soon be in a position to supply State requirements regularly.

—*H. W. Ball.*

ROTATION OF CROPS.

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, soybean, 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-beed, 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.

—*H. W. Ball.*

Selecting New Banana Areas.

WITH the approach of winter, intending banana-growers would be well advised to give serious consideration to the selection of the areas shortly to be felled for the 1938 planting.

Of late years, bananas have been grown extensively and fairly successfully on inferior forest country, but, in most instances, a suitable aspect, assisted by good cultural methods, has been the chief factor in success.

The best aspect, of course, is the north-east or northerly slope, with standing timber on all four sides to give the necessary shelter from strong winds, and these aspects ensure the maximum amount of winter sunshine.

With sites facing any further into the east than north-east, great care should be taken that, as far as possible, the area is sheltered from the cold south-east winds. An efficient windbreak on the south side of an easterly patch should, therefore, be provided for in the clearing plan. The site chosen should be so situated that tall timber or hills at the top of the proposed area will not shut out the winter sun at an early hour.

A north-westerly slope is preferable to south-east, south, or south-westerly slopes if heavy belts of timber block the strong westerly winds. Many good bananas have been grown on westerly slopes of this description, chiefly because the areas in question receive the sun during the whole of the afternoon.

All southerly slopes should be definitely avoided, more particularly if there is open country for any distance around the proposed area. Much more timber will have to be felled than actually required for planting, to obviate the long shadows which standing timber at all close to the patch throw over the plantation. The limited period during which they are exposed to the sun is the chief objection to all southerly slopes.

When one considers that a good warm-slope plantation will produce from two to three bunches to every one on the cold-slope areas, production costs, particularly to the grower on leased ground, enter so largely into the picture that intending growers with a choice of ground should always choose a warm situation to gain the best results for their work.

—*J. R. Horsley.*

PACKING SHEDS AND EQUIPMENT.

In many deciduous fruit districts marketing activities are now at a minimum and it is now possible to overhaul, repair, replace, and add to the existing packing shed equipment. Many growers carry on, season after season, with makeshift equipment, when, for a little time and a small expenditure of money, a properly-equipped packing shed could be furnished.

Packing stands, nailing-down presses and benches, sizing machines, hammers, stencils, and other equipment should all be gone over and restored to a high state of efficiency. Simple designs for packing stands, nailing-down presses, and case-making benches can be procured, and are not hard to follow by anyone who is useful with a hammer and saw. Simple forms of sizing machines can also be made at home, while those growers who have commercial machines should overhaul them thoroughly, tightening up all screws and bearings, and, if necessary, renewing the padding in the bins and feed channels. Broken parts should be replaced and power plants overhauled. Broken handles in working tools should be renewed. Case end scrapers and packing needles should be sharpened and greased and packed away until required next season.

Complete sets of new stencils can be cut. A sheet of thin zinc, a small chisel, round and flat fine-grained files, a hammer, and a piece of end-grain hardwood are the necessary tools. The designs of the letters to be cut can easily be made by obtaining stencils, and copying them on to the zinc in the design wanted. The stencilled letters are then cut out of the sheet of zinc with hammer and chisel, and, in that way, an excellent stencil is made. Stencils are easily obtained, and there is no need to use blue crayon for marking cases.

When the overhauling of plant has been completed, growers should turn their attention to the cleanliness of the packing shed. Old cases and picking boxes should be repaired or burned, a close inspection of the cracks and crevices being made for pupating insects, such as codling moths. Any shed-stored fruit, which has rotted in the cases, should be removed and destroyed and the cases thoroughly sterilized by completely immersing them in a 5 per cent. solution of formalin for at least one minute. Floors and other parts of the building affected by juice from rotted fruit should also be treated.

Close attention to these details will enable growers to make a clear start at the next harvesting period.

—*Jas. H. Gregory.*

PLANTING THE AUSTRALIAN NUT.

J. McG. WILLS, Fruit Branch.

WHERE it is proposed to plant an area of the Australian Nuts on open or forest ground, the land should now be got ready for planting time in August. Thorough deep ploughing of the area will be necessary to give the young trees a sufficient depth of a free soil in which to make a good root system. Subsoiling, if practicable, is also desirable.

When planting the young trees, a good hole, at least 2 ft. across and 18 in. in depth, should be dug so that the tap root—which is comparatively long—can be properly set vertically into the ground, and the secondary roots distributed evenly around the plant.

In digging the trees from a seed-bed, care must be taken to remove them as carefully as possible, and to get a good length of the tap root with the plant. If the tap root is injured during digging, care should be taken to cleanly prune off the injured portion above the point of mutilation. If the tap root is too long, it can be pruned back about 8 in.

It is advisable to soak the bed thoroughly the day before lifting the young trees, as this will make it easier to extract them from the ground without breaking the roots. Loosening the soil, by making a trench, 15 to 18 in. deep, alongside the rows, will simplify digging.

The trees should be planted in the ground at the same level as they were in the nursery bed, or perhaps a little deeper. Excessively deep planting should, however, be avoided.

The young trees should be well watered at the time of planting, and also subsequently, should the weather be dry.

On open land, shade should be provided by driving sufficient stakes into the ground around them to support a light hessian or bag cover.

Very often the main stem of the tree is allowed to grow too high before the top is pruned off. This will result in an ungainly, lanky tree. With the Australian Nut, as with fruit trees, pruning should aim at producing a sturdy set tree, well-balanced and fairly open.

The young trees should not be allowed to grow beyond 2 ft. in height on a single stem before the top is pruned back. Three side-shoots nicely placed are later trained to make the framework of the tree.

Many young trees do not come away well on a single stem, this failure being due to a variety of causes, and a cluster of base shoots may arise as a consequence. It will then become necessary to select the strongest and best-situated shoot to form the tree, the others being cleanly cut away.

No matter whether the trees be planted amongst bananas, pine-apples, or other fruits, or in the open, a good stake should be driven alongside each tree, both to protect and support it. Many young trees are destroyed or permanently misshapen by injuries caused during cultural operations, and some protection is clearly necessary.

Where young trees have grown very densely through too many low shoots having been permitted to grow, a certain amount of thinning out of surplus main branches, or of the secondary growths, will be necessary to open up the trees to light and air.

The Fruit Market.

J. H. GREGORY, Instructor in Fruit Packing.

FOR most fruits market conditions in Brisbane during May were in a depressed condition because, mainly, of continuous dull and wet weather. In many fruit districts rivers were in high flood. In the course of a recent visit to Sydney many inspections of Queensland fruits were made. A few notes on the condition of the various fruits may be helpful to growers supplying Southern markets. These inspections provided much food for thought as to the various methods used in packing different fruits for distant markets.

PINEAPPLES.

During April, pineapple deliveries in Sydney were most unsatisfactory, a very high percentage of "water-blister" affected fruit being observed. One consignment examined immediately on delivery from the railway showed all fruit affected and unsaleable. Fruit supplied for the Queensland State exhibit, harvested and packed in Queensland on a Monday and opened on the following Thursday evening showed 75 per cent. fruit affected. The affected fruit broke down from the sides in these consignments, although some specimens in the consignment mentioned were affected down the heart, the tops pulling out easily. Fruit packed in grass appeared to be in a worse condition than that packed in woodwool. The oft-repeated suggestion that pineapples should be wrapped for distant transit is well worthy of consideration. This method is in use with Hawaiian fresh-packed pineapples for despatch to far-away markets. The material used may be either corrugated cardboard or plain paper. Bearing in mind the successful results obtained with fruit sent to Western Australia at the same time as the "Elgin" experimental shipment to England, the use of a single-layer box may also be considered. It would be necessary to experiment on a large scale to achieve definite results. It is, obviously, very important that unfavourable market reactions should be avoided.

BANANAS.

The quality of bananas seen during the period of inspections was excellent in appearance. Various types of single packs were examined. The best pack examined, in so far as lack of blemishes and solidity of pack were concerned, was the reverse pack with the fruit placed flat in each layer instead of concave side down. This pack has been recommended, but never adopted to any extent—the agents appearing to prefer the concave side down method. With this pack, it is not possible to obtain the large bulge as in the more common form of pack used. This factor may possibly assist in making the pack unpopular.

PAPAWS.

Wet weather during summer also tends to cause the same reactions as those mentioned in respect of pineapples with many lines of papaws. Papaws from Townsville, Sunnybank, and Yarwun inspected contained a high percentage of waste. Much of the fruit was mushy and soft, being only fit for fruit salad. Other consignments were green and hard, going

"specky" before ripening. Some of this fruit inspected twelve days after its arrival was still in an unsaleable condition, being still green and hard. With the coming of cold weather, growers should let the colour develop in the fruit before harvesting. Fruit will not ripen satisfactorily under the colder climatic conditions of Melbourne and Sydney. There is not a doubt that at present consignments of unsuitable papaws are being sent to Sydney, retarding the development of a constant demand for tropical fruit. As Queensland has practically a monopoly in the supply of tropical fruits, the advantage of the sound development of this trade are obvious.

CUSTARD APPLES.

Many excellent consignments of custard apples were seen in Sydney during April. The weather was unseasonably warm, with the result that the fruit ripened quickly. From some trains fruit already ripened was unloaded, and the spectacle of barrow-men selling piles of custard apples was common. No difficulty was experienced by the salesmen in making sales at 2d. to 6d. each for fruit which would pack eighteen to thirty to the case, the fruit selling readily.

The over-supply of good-quality fruit possibly will have quite a beneficial effect from an advertising point of view, enabling, as it did, Sydney people to buy custard apples at their best and cheaply. It is unfortunate that many immature custard apples are sent South, and they must often influence prospective consumers against the fruit. The packing was quite satisfactory.

CITRUS.

Some excellently packed quality grapefruit from Gayndah was noticed. Palestine and United States of America Sunkist were still on the market, providing a definite offset to the demand for Queensland fruit. Some Queensland navels also appeared during the third week of April. This fruit looked well, but tended to cut on the dry side. There should be a good market for good-quality early lines of navels, as the oranges seen in the shops were practically all old season Valencias.

Prices during the last week of May:—

The following were the ruling market prices during the last week of the month of May, 1938:—

TROPICAL FRUITS.

Bananas.

Brisbane.—Cavendish: Nines and eights, 8s. to 17s. 6d.; sevens, 8s. to 15s. 6d.; sixes, 6s. to 13s.

Sydney.—Cavendish: Nines and eights, 23s. to 26s.; sevens, 19s. to 23s.; sixes, 16s. to 19s.

Melbourne.—Cavendish: Nines and eights, 20s. to 27s.; sevens, 18s. to 22s.; sixes, 15s. to 18s.

Adelaide.—Cavendish: 23s. to 25s., all sizes.

Owing to the flooded condition of the creeks in the banana districts supplies have been short. Growers are advised not to attempt to rush extra supplies to the market by cutting fruit too closely. It is only by sending full and well-matured fruit that prices will be maintained.

Lady's Finger, 4½d. to 11d. per dozen.

Pineapples.

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

Sydney.—Smoothleaf, 6s. to 10s. per tropical case.

Melbourne.—Smoothleaf, 8s. to 10s. per tropical case.

Extra care needs to be taken when handling after heavy rain, as "water blister" appears to develop to a greater extent during these periods. Growers are advised to select fruit for distant markets from the older portions of their plantations.

Papaws.

Brisbane.—Yarwun, 4s. to 6s. tropical case; Gunalda, 3s. to 3s. 6d. bushel case; Locals, 2s. to 2s. 6d. bushel case.

Sydney.—8s. to 12s. tropical case.

Melbourne.—10s. to 14s. tropical case.

Fruit should now show two-thirds colour before harvesting.

Custard Apples.

Brisbane.—2s. to 2s. 6d. Market fully supplied.

Sydney.—3s. to 6s.

Melbourne.—5s. to 8s.

Avocados.

Brisbane.—9s. to 12s.

Melbourne.—12s. to 14s.

OTHER TROPICAL FRUITS.

Rosellas.

1s. 6d. to 2s. per sugar bag.

CITRUS FRUITS.

Oranges.

Brisbane.—Commons, 5s. to 6s. per bushel case; navels to 8s.; few Gayndah specials to 10s.

Mandarins.

Brisbane.—Glens, 6s. to 10s.; Fewtrells, 3s. to 4s.; Scarlets, 5s. to 9s.; Emperors, 5s. to 8s.

Sydney.—8s. to 12s. bushel case.

Melbourne.—8s. to 10s.; specials higher.

Grapefruit.

Brisbane.—Locals, 3s. to 6s.; Gayndah, 11s. to 13s. bushel case.

Sydney.—6s. to 9s.; specials higher.

Lemons.

Brisbane.—Gayndah, 5s. to 10s.; Locals, 3s. to 6s.

DECIDUOUS FRUITS.

Apples.

Brisbane.—Jonathan, 4s. to 8s.; Granny Smith (Stanthorpe), 7s. to 9s.; Delicious, 6s. to 8s.; Tasmanian blues, 6s. to 7s.

Pears.

Brisbane.—Winter Cole, 10s. to 14s.; Kieffir, 5s. to 8s.; Beurre Bose, 6s. to 9s.; Packham's Triumph, 7s. to 9s.

Quinces.

7s. 6d. to 8s. bushel case.

OTHER FRUITS.

Tomatoes.

Brisbane.—Ripe, 3s. to 6s. half-bushel case; green, 2s. to 5s.; coloured, 3s. to 7s.; special higher.

Sydney.—Bowen tomatoes, 6s. to 8s.; Southern Queensland, 4s. to 6s.

Passion Fruit.

Brisbane.—Seconds, 7s. to 9s.; first grade, 10s. to 12s.

MISCELLANEOUS, VEGETABLES, &c.

Beetroot.—4d. to 9d. bundle.

Cucumbers.—9s. to 10s. bushel case.

Pumpkins.—4s. to 6s. bag.

Marrows.—1s. 6d. to 4s. dozen.

Lettuce.—1s. 6d. to 3s. dozen.

Cabbages.—1s. 6d. to 6s. dozen.

Beans.—*Sydney.*—4s. to 7s. per bushel case; *Melbourne.*—4d. to 7d. per lb.

Chokos.—3d. to 6d. dozen.

Cauliflowers.—2s. to 11s. dozen.

The Need of a Tree Consciousness.

Soil erosion has increased alarmingly in many of our grazing and farming areas, and the position calls for a change of attitude towards trees. Pioneering in Australia has repeatedly involved a grim struggle against trees which resulted in settlers recognising all the handicaps and few of the advantages of the native vegetation. This attitude still persists, unfortunately, in some districts, and to see gums and wattles cultivated to greatest advantage for beauty and profit one must go to New Zealand, California, Mediterranean countries, or South Africa. The attitude of the farmer is summed up frequently in the phrase— "You cannot have trees and grass too." This is true only up to a point. We are learning that it is impossible to have either crops or grass without some trees.

Many of our native trees—kurrajong, for instance—can be grown easiest from seed.

Sugar Levies—1938 Season.

Regulations under "*The Primary Producers' Organisation and Marketing Acts*, 1926 *to* 1935," have been approved, providing for levies on suppliers of cane to sugar-mills at the following rates for the season 1938 [the figures for 1936 and 1937 are given for comparison purposes]—

Name of Mill.	General Levy by Queensland Canegrowers' Council.	Administrative Levy by District Executive.	Administrative Levy by Mill Suppliers' Committee.	Special Levy by Mill Suppliers' Committee.	Total Levies for 1938.	Total Levies for 1937, given for comparison.	Total Levies for 1936, given for comparison.
	d.	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*
Mossman Central	¾	1¼	..	..	2	2	2¼
Hambledon	¾	¼	¼	..	1½	1½	1⅜
Babinda Central	¾	¼	1/16	..	1 1/16	1 3/16	1¼
Mulgrave Central	¾	¼	..	..	1	1	1⅛
South Johnstone Central	¾	1½	..	..	2¼	2¼	2⅜
Goondi	¾	1½	..	..	2¼	2⅜	2⅜
Mourilyan	¾	1½	..	..	2¼	2¼	2¼
Tully River Central	¾	1¾	..	..	2½	2½	2⅜
Macknade	¾	½	½	..	1¾	1¾	1¾
Victoria	¾	½	½	..	1¾	1¾	1¾
Kalamia	¾	..	½	½	1¾	2¼	2¼
Pioneer	¾	..	1	½	2¼	2⅜	1¾
Inkerman	¾	..	½	..	1¼	1⅛	1
Invicta	¾	..	1½	..	2¼	2¼	1¾
Proserpine Central	¾	1	..	..	1¾	1¾	1¾
Cattle Creek Central	¾	½	½	..	1¾	1½	1½
Plane Creek Central	¾	½	⅜	..	1⅝	1¾	1¾
Marian Central	¾	½	¼	¼	1½	2¼	2
North Eton Central	¾	½	..	..	1¼	1¼	1¾
Pleystowe	¾	½	¼	½	2	2¼	2¼
Racecourse Central	¾	½	½	..	1¾	1¾	1¾
Farleigh	¾	½	½	..	1¾	1¾	1¾
Qunaba	¾	1½	½	..	2¾	1¾	1⅜
Bingera	¾	1½	½	..	2¾	1¾	1½
Fairymead	¾	1½	¾	..	3	2	1¾
Gin Gin Central	¾	1½	¾	..	3	2¼	1½
Millaquin	¾	1½	¼	..	2½	1½	1¼
Isis Central	¾	½	..	..	1¼	1¼	1
Maryborough	¾	¾	..	..	1½	1⅜	1¼
Mount Bauple Central	¾	¾	..	..	1½	1½	1¼
Moreton Central	¾	¼	1	¾	2¾	2¼	2¼
Rocky Point	¾	¼	¾	..	1¾	1½	1½
Eagleby	¾	¼	..	..	1	¾	¾

No poll will be taken in respect of the General Levy of ¾d. per ton (first column) for the Queensland Cane Growers' Council, or for the administrative levies by District Executives or Mill Suppliers' Committees (second and third columns).

In the fourth column, the levies on cane supplied to the Kalamia, Pioneer, Marian Central, and Pleystowe Mills will be used in defraying the costs of employing farmers' representatives at those mills for the current season. In the case of the Moreton Central Mill, ½d. will be

used in defraying the costs of employing a farmers' representative at the mill and ¼d. in controlling the spread of Fiji disease. In the case of these levies, growers may petition for a poll, and the petition must be signed by at least 100 or 50 per cent. (whichever shall be the less) of the cane suppilers to the five mills concerned.

In addition to the foregoing levies, the undermentioned Mill Suppliers' Committees are empowered to make particular levies on growers within each of the following districts, at the following rates :—

Name of Mill Suppliers' Committee and Mill to which Cane is Supplied.	Description of District upon the Growers wherein Levies will be made and description of Cane upon the Growers whereof Levies will be made.	Amount of Levy per ton of Cane Supplied.	Purposes of Levy.
		d.	
Isis Central ..	Pialba district within the boundaries of the parishes of Urangan, Vernon, and Bingham, county March	1¼	To be used for administrative purposes by Pialba Branch of Isis Central Mill Suppliers' Committee.
Isis Central ..	All cane consigned on the railway by Government trucks from Booyal, Junien, and Marule Sidings on the Dallarnil Railway	¼	To be used for administrative purposes by Booyal Branch of Isis Central Mill Suppliers' Committee.
Mount Bauple Central	Mount Bauple district within the boundaries of the parishes of Gundiah, Tiaro, Gootchie, Curra, and St. Mary	½	To be used for administrative purposes by Mount Bauple Branch of Mount Bauple Mill Suppliers' Committee.
Maryborough ..	Pialba district within the boundaries of the parishes of Vernon, Urangan, and Bingham, county March	¾	To be used for administrative purposes by Pialba District Branch of Maryborough Mill Suppliers' Committee.
Maryborough ..	Maryborough district within the boundaries of the parishes of Tinana, Maryborough, Bidwell, Elliott, Young, and Walliebum, county March	½	To be used for administrative purposes by Maryborough District Branch of Maryborough Mill Suppliers' Committee.
Racecourse Central	All cane hauled over Silent Grove tramline	2	To defray the costs of employing a farmers' representative of the section of growers concerned at the Racecourse Mill for the current season.
Gin Gin Central ..	All cane delivered at Morganville Railway Station	1	To defray the costs of maintaining a loading derrick at Morganville Railway Station by the section of growers concerned.
Marian Central ..	All cane loaded at Dow's Creek and Langdon Siding	¾	To be used for insurance and weighbridge maintenance by the Dow's Creek and Langdon Branch of the Marian Central Mill Suppliers' Committee.

Growers are given the opportunity of petitioning for a poll to decide whether or not the above levies shall be made. The petition must be signed by at least 100 or 50 per cent. (whichever shall be the less) of the cane suppliers within any of the areas concerned.

All petitions must reach the Secretary for Agriculture and Stock, Department of Agriculture and Stock, Brisbane, on or before the 4th July, 1938.

Full particulars of these Regulations appear in the *Government Gazette* of the 26th May, 1938, or may be obtained on application to the managers of the various sugar-mills in Queensland or to the undersigned—

R. WILSON, Acting Under Secretary,
Department of Agriculture and Stock,
Brisbane.

In Memoriam.

The Honourable WILLIAM LENNON

Plate 220.

BY the death of the Hon. William Lennon on 5th May, Queensland lost a great citizen and one of her foremost public men. He was successively a public servant, banker, business director, Cabinet Minister, Speaker of the Legislative Assembly, President of the Legislative Council, Lieutenant-Governor and Deputy Governor.

The late Mr. Lennon was born in Dublin in 1849. He arrived in Australia with his parents in 1855. From 1870 to 1874 he was an officer of the Mines Department of Victoria and resigned to enter the service of the Bank of Australasia, in which he passed through various offices of responsibility to the important position of Inspector. As manager, he opened the Townsville branch of the Bank in January, 1881. In 1886, mercantile pursuits attracted him and he became manager for Burns, Philp and Co., Ltd., at Townsville. Ten years later, he established his own business in the northern city. In 1907 he stood for the Herbert seat against the late Sir Alfred Cowley, and was elected to the State Parliament by a substantial majority. He continued to represent the Herbert Electorate until 1920, when he was appointed President of the Upper House and Lieutenant-Governor of the State.

While in the Legislative Assembly he was sometime Leader of the Opposition, and was Minister for Agriculture and Stock in the Ryan Government from 1915 to 1919. In the latter year, he was elected Speaker. When the Legislative Council was abolished in 1922, he retained the Lieutenant-Governorship—an office which he adorned—until his retirement in 1929. He was twice—in 1919-20 and 1925-27—Deputy Governor of Queensland.

The late Mr. Lennon was a very able man of outstanding personality, great courage, strength of character, fidelity to high principle, and the last word in old world courtesy. Of him, a biographer has said: "He was ever faithful, a true man—a gentleman in every sense of the term."

As Lieutenant-Governor of the State, Mr. Lennon, during their visits to Queensland, had the unique distinction of acting as host to two sons of His Majesty King George V.—Edward VIII., then Prince of Wales, and the present King, then Duke of York—both of whom afterwards ascended the throne; and also Queen Elizabeth, then H.R.H. the Duchess of York.

As Minister for Agriculture and Stock, Mr. Lennon is remembered as an administrator of broad vision, a wide knowledge of the requirements of rural industry and a sympathetic understanding of the problems of the farmer and the pastoralist, and especially of the difficulties of struggling settlers.

The Government had offered a State funeral, but in accordance with his own wish, expressed long ago, he was interred privately with only members of his family in attendance. In the words of a former colleague: "Simplicity, allied to natural dignity, had been a keynote of his private and public career, and the quiet funeral at Toowong Cemetery was fully in accord with William Lennon's way when he had lived."

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, and the Jersey Cattle Society, production charts for which were compiled during the month of March, 1938 (273 days unless otherwise stated).

Name of Cow.	Owner.	Milk Production.	Butter Fat.	Sire.
		Lb.	Lb.	
AUSTRALIAN ILLAWARRA SHORTHORNS.				
Mature Cow (Standard 350 lb.).				
Model II. of Alfa Vale	W. H. Thompson, Nanango	16,820·85	785·321	Reward of Fairfield
Yuruga Gentle	F. Hansen, Goodger	10,732·2	429·078	Werona Vale Handsome Boy
Novar Caprice 2nd	C. Roberts, Toowoomba	10,116·4	375·314	Statesman of Kurrawong
Senior, 4 Years (Standard 330 lb.).				
Kia Ora Violet 5th	G. A. Meyers, Barwin, Imbil	9,176·35	349·921	Principal of Blacklands
Junior, 4 Years (Standard 310 lb.)				
Radford Ida 4th	E. O. Jeynes, Raceview	7,946·54	350·101	Madam's President of Avonel
Senior, 3 Years (Standard 290 lb.).				
Folkestone Heather	N. Bidstrup, Ehlma, *via* Warra	10,187·37	380·922	Dinkum of Thorndale
Mabreen Plum	F. G. Haldane, Hazelbrook, Wolvi	7,319·65	297·33	Numbawarra Headlight
Junior, 2 Years (Standard 230 lb.).				
Laguna Model	F. G. Lamkin, Moola, Dalby	8,160·46	356·814	Morden Marcus
Laguna Princess	F. G. Lamkin, Moola, Dalby	7,736·73	333·467	Morden Marcus
Folkestone Lemon	N. Bidstrup, Warra	9,152·89	307·629	Glenore Monarch
JERSEY.				
Mature Cow (Standard 350 lb.).				
Kathleigh Thorn's Daphne	F. W. Kath, Malakoff, Dalby	6,984·18	401·243	Retford King's Thorn
Hampstead Babette	J. H. C. Roberts, Herries street, Toowoomba	7,214·0	353·411	Kelvinside Favourite Raleigh
Senior, 3 Years (Standard 290 lb.).				
Kathleigh Silvie	F. W. Kath, Malakoff, Dalby	7,467·64	444·184	Retford King's Thorn
Glenview Baroness	G. Harley, Childers	6,704·66	352·353	Glenview Goldfinder

SENIOR, 2 YEARS (STANDARD 250 LB.)				
Bellgarth Lucky Girl II.	D. R. Hutton, Bellgarth, Cunningham	5,316·45	321·241	Bellgarth Lucky Boy
Glenview Chrissie	F. P. Fowler and Sons, Glenview, Coalstoun Lakes	5,849·1	290·934	Trinity Governor's Hope
Glenview Nightingale	F. P. Fowler and Sons, Glenview, Coalstoun Lakes	5,425·8	289·68	Trinity Governor's Hope
Maud of Woodbine	J. Williams, Wondai	4,880·5	261·047	Brookland's Royal Gift
JUNIOR, 2 YEARS (STANDARD 230 LB.).				
Brooklands Royal Chimes	N. Webb, Beaudesert	7,656·8	430·011	Retford Earl Victor
Brooklands Royal Babette..	N. Webb, Beaudesert	7,442·25	372·741	Retford Earl Victor
Brooklands Royal Nettie	N. Webb, Beaudesert	7487·79	353·342	Retford Earl Victor
Glenmore Island Fern	L. J. Comiskey, Warra	5,697·06	265·512	Glenmore Island King
Bellegarth Bonzanette III.	G. F. Smith, Leslie, *via* Warwick	3,926·86	243·309	Trecarne Renown II.

The Tropics and Man

Some Effects upon European Communities in Tropical Areas of Co-Existent Native Populations.

DOUGLAS H. K. LEE, Professor of Physiology, University of Queensland.

1. Introductory.

AUSTRALIA was first settled by that somewhat mysterious race we speak of as the aboriginals, whose real origin and mode of advent are cloaked in obscurity. Beyond a very small infiltration of the northernmost edges by the residents of the neighbouring archipelago, these inhabitants remained undisturbed until the advent of the white man a little more than one hundred and fifty years ago. Any invasion by the Mongolian races prior to that time must have been entirely insignificant. Soon after the advent of the Caucasian, however, the attention of the other races of the Far East was turned to this continent, and immigration of their subjects commenced. At first this was tolerated and even welcomed in some quarters as a source of labour to replace the recently-abolished convict source of supply. Public sentiment and political expediency, however, soon swung the other way and the foundations of a White Australia policy were laid. This was not complete, however, as various Indian races and South Sea Islanders were granted entrance and even imported for the purpose. It was not until Federation was achieved that the complete future reservation of Australian territory and employment to Caucasian stock was affirmed. Apart from these temporary departures, however, Australian settlement has been dominantly Caucasian from its outset. This imposes upon Australian relationship with Eastern peoples, a situation which does not exist elsewhere in the tropics, and renders arguments based upon comparability of such situations futile. I do not believe that, from a broad viewpoint of the problem as a whole, the White Australia policy should be radically altered. I might summarise my conception of Australia's correct policy in this regard to be that of preserving the essential Caucasian unity of this country with admission of other races only in individual cases in which it can be clearly demonstrated that no medical, economic, or social disturbance is entailed. When, if ever, the time comes that the general populace of other races is on an equal footing with Australians in these respects, then such a policy would automatically admit such subjects, and to such a procedure no just opposition could be made.

Although I agree in essence with the "White Australia" policy, which protects Australians from immediate contact with the problems raised by racial co-existence, I do feel that it is important that Australians should understand its implications as seen in neighbouring countries. It is necessary because Australians are of a mobile disposition and travel a good deal in other countries, and unless they are acquainted with some of the aspects of racial inter-relationship beforehand, they are apt to be trapped into hasty opinions upon such subjects without being cognisant of adequate evidence. It is necessary

also because in our Mandated Territory and in Papua such conditions exist, and it particularly behoves us to avoid insularity of thought in dealing with countries so closely bound to us. It is also essential that we have a reasonable knowledge of conditions existing in neighbouring non-Australian countries with which we do trade. When I first went home to England I used to be quite annoyed by the person who, without knowing the first thing about it, stated dogmatically that he would not like to live in Australia. I now find myself reacting similarly to the Australian who confidently asserts that to live in Singapore must be a terrible existence. In commenting upon the proverbial insularity of thought of English residents, it appears we should examine our own attitude towards other countries a little more critically. If international amity is to be more than a pipe-dream, international knowledge and tolerance must first be established.

2. Medical.

Such is the volume of published work on tropical medicine and tropical hygiene, that I intend to give here only the briefest consideration to these aspects, purely for the purpose of reminding non-medical members of the salient features. That an extensive native population living under poor housing conditions, exposed to the ravages of infection through under-nourishment, cursed with traditional and religious taboos obstructing hygienic administration, constitutes a severe menace to a co-existing white population has long been recognised. Attempts to remove these disabilities or to localise their influence upon the spread of disease have met with varying success in different areas. India, in all probability, presents the most difficult problem by virtue of the enormous numbers of native subjects, the low living conditions of the great majority, and the incredible multiplicity and intricacy of traditional and religious inhibitions. It speaks volumes for the wisdom and pertinacity of the administrators that so much has been done, but the problem there is far from being solved. China presents an even more wretched picture, but here the European population is not as extensive, and a reasonable check is kept upon diseases in the great cities like Shanghai and Peiping. Malaya presents one of the brightest results. Apart from malaria, the white man is exposed to very little more risk of disease there than in our own country. The reasons for this success are numerous and owe their influence to happy coincidence. A territory of limited extent, abundance of money, enlightened native rulers accepting British advice while retaining their dignity, abundant non-seasonal rainfall, and an essentially docile and happy indigenous population all contribute their quota to ensuring success for what has been, in general, a very sound and wise European administration.

There is a reverse side to the picture of health hazards propagated by native populations, and that is the abundance of labour available for the carrying out of the extensive engineering propositions necessary for the maintenance of sanitary conditions. While it is true that more labourers are required when natives are employed, the cheapness of their hire (under existing conditions) more than compensates for this. Construction which is essential in our northern areas for adequate sanitation and development of living amenities cannot be carried out to anything like its full extent because of the excessive cost, but in a non-European country most extensive works of this nature are very often developed in areas supporting the most meagre white population. When

you consider the developments existing for European health and convenience in Singapore in terms of a white population the size of that in Mackay the contrast is astounding (excluding the harbour!).

3. Social.

It must be admitted that European interest in the lands occupied by other races has been concerned primarily with the exploitation of the natural resources of the land, a legitimate procedure, and where possible, the exploitation of the natives themselves as a source of cheap labour, a proceeding not quite so legitimate. The only argument extensively used against the White Australia policy was the possibility of obtaining cheap labour by inflation of Eastern subjects. That the native races in occupied lands have benefited by our suzerainty in matters of health, domestic peace, and living standards might constitute mitigating circumstances but does not abolish the nature of our primary interest. This attitude, of course, was very easily rationalised by obvious comparisons between European and native capacities and thus mental conflicts were avoided. It yet remains to be proved, however, how far, if at all, the different non-Caucasian races are genuinely inferior in capacity to the European, when inequality of opportunity is taken into proper consideration. This attitude, although everywhere modified from Victorian smug self-satisfaction, and in some areas almost defunct, still largely determines our individual and collective behaviour towards native races. The average native remains the beast of burden, not so much because he cannot or will not rise to a higher level, as is the case with our own labourers, as because he is not given the opportunity. In all communities, of course, there are grades of remuneration and corresponding grades of living conditions, but nowhere are the grades so immutable as in these mixed populations. The difference in living standards consequent upon this demarcation is enormous, although as an offset to this a good deal of artificial regulation of prices is attempted. (For example, the price of an article often depends upon the nationality and status of the purchaser.) Two small rooms each 10 feet square, and one narrow veranda are considered (by both parties) as quite excellent quarters for the syce and the kebun, complete with families, which may run to any number. Apart from rice, which, of course, is the staple item, the food consumed by the Chinese servants consists largely of fish heads, inferior fruit, and such items as can be withdrawn from the household supplies without undue complaint from the mem or tuan.

The rigid maintenance of such contrasts cannot but have its effect upon the European. Men in positions which would barely suffice in the home countries for the maintenance of respectability, find themselves not only vested with the necessary rights and means, but guided by pressure of public opinion into quite expansive living. To cut expenditure and save money is anti-social and vaguely damaging to the white man's prestige, unless, perchance it can be done at the expense of a native. (The same person who will go to all lengths to outshine the neighbours in the matter of domestic display will haggle over 5 cents in the market, and justify the parsimony as frustrating the cunning attempt of a native at defrauding the European!) Extravagance and thriftlessness are, under the best conditions, extraordinarily easy vices to cultivate, so that one can picture the mushroom-like growth in a forcing house such as this. (I trust I shall not be accused as a Pharisee for these remarks; I can now detect many indications of my ultimate

surrender to prevailing practice had I stayed in the East.) To such an extent does the superficial integrity of the white man determine procedure, that it is not at all an uncommon occurrence for a young man, who has been brought out by a local firm, and who has involved himself beyond recovery in debt by reckless extravagance, to have his debts settled and return passage paid by his employers, without further liability being incurred by him.

The fact that menial and routine work is very largely relegated to a subject class is apt to have an insidious effect upon the liberated individual European. It is quite true that the essence of large-scale enterprise and direction in all modern countries depends upon a similar relegation of routine and unskilled labour to dependent and lower-salaried workers, but the criterion of such partition is different and so are the surrounding circumstances. Organisation demands such differentiation in modern progress in order that the more highly-skilled person shall have his time free for employment in those tasks for which he is better fitted by reason of his peculiar skill. That he should be more highly paid is a secondary consequence of his skill, not of his liberation. That he sometimes, though by no means always, has less official working time is not germane to the discussion, as such work is usually more exhaustive of the critical mental aptitude responsible for the skill, than routine work is of unskilled ability. Specialisation, particularly in such a democratic State as this, is very much a matter of individual achievement; in mixed populations on the other hand it is very largely referable to the accident of race. Because of this arbitrary differentiation, in mixed populations, the situation is entirely different. A person thus arbitrarily lifted to a ruling plane can find in his own mind by logical search no real reason for his justification. There are simple amiable souls to whom such a conflict never presents itself, of them I have no complaint to make, though of them few are sufficiently dissatisfied to forsake their native land and migrate to the Colonies (and that is another tale!). For the rest, there is often an unresolved conflict, subconsciously demanding justification for the position, and seeking vent only in arrogance. Far be it from me to suggest that there are no people in such areas whose personal attainments justify their position. I merely wish to point out that, in the nature of things, the existence of a high minimum status for the European implies a certain amount of artificial status which could easily account for the well-recognised appearance of undue arrogance amongst the "synthetic sahibs" of such countries. The moral damage done in this way is easily extended by the indulgence made possible by the accompanying leisure time and financial facilities. I should point out again, that my remarks are directed not at all Europeans in the non-European countries, for the first-class man will be worthy of his position anywhere, and will continue to do his duty and preserve his character, and of these there are a considerable number who constitute the backbone of this Commonwealth of Nations. The man of proverbial bucolic temperament will also remain largely unspoilt. It is the mediocrities who suffer, and of these, for various reasons, there is apt to be an undue proportion in Colonial settlements.

An inevitable tendency towards laziness must be expected from an abundance of native labour supplied on a basis of social distinction rather than productive requirement, a tendency reinforced by the climate in tropical non-European countries. Actually this is not as

evident as one might imagine, at least amongst the commercial and professional population. The reason for its curtailment is not clear, but a contributory factor might easily be the continued and careful supervision of native labour required for the adequate completion of most tasks. Financial matters, particularly, call for elaborate cross-checking devices and repeated verification. The focal point of this particular attack upon white morale is the female of the species. Released from the multitudinous minor worries of maternal care by the ubiquitous amah and ayah and prevented by the white man's prestige from performing any work to be classed as menial such as cooking, fetching and carrying, &c., she has the alternative of sleeping, reading, club life, and the pursuit of some art to fill in the time between matutinal shopping and nocturnal gaiety. To few is given the power of constructive activity, and Heaven forbid that amateur effort should exceed its rightful bounds of occasional relaxation and domestic colouring. In such a plight, laziness is the least harmful result that can befall a woman.

Alcoholism has rightfully been classed as the second most prevalent tropical disease, but one should dismiss as highly exaggerated the colourful pictures beloved of the writer (and presumably reader) of "best-sellers." If there are more thorough-going drunkards in the Colonies than in the older civilisations, which I doubt, it is largely because more of the type congregate (or segregate) there. The point is that the average person drinks much more there than at home, not enough to render him obvious, even in a normal environment, but enough in many cases to undermine his health in the course of years. There is little harm in strictly limited "sundown" refreshment if no further critical work is contemplated, but social customs render it fatally easy regularly to exceed the limitation. Climate and a certain degree of isolation play an important part in encouragement of alcoholism, but I think it is also in part an indirect result of circumstances produced by native labour, as with the disabilities mentioned previously.

4. Possible Improvements and their Limitation.

So long as the races concerned remain separated by the present abyss of religious, traditional, and economic differences, so long will the position of racial co-existence remain in its present highly unsatisfactory position. Any real progress in bridging this gulf can only be achieved by very long labourious and patient work by far-seeing and quietly active workers. Only by evolutionary means can we hope for a measure of success. Blatantly advertised schemes can only evoke useless and dangerous dissatisfaction at lack of achievement within the limited space of a few years. At times a Lawrence can in a few months gain complete mastery of the non-European mind and weld the forces of the East into a solid matrix having a tangible contact with the methods of the West, but the world in general moves too slowly for use to be made of such opportunities and the inspired race must sink back again with an added sense of futility.

Equalisation of living standards, increased responsibility for the native, fundamental instead of superficial Westernisation, reciprocal understanding, may all be regarded as units in the ultimate goal, but countless years of continued effort aided by constantly revised and intensive primary education for the native masses must gradually pave the way for progress towards the ideal.

There is one feature which seems to me worthy of much greater study than it at present receives, and that is the consideration of more permanent settlement of Colonial possessions by Europeans. It is the custom for colonial residents to be taken home every three or four years for a number of months and for them to be repatriated at a comparatively early retiring age. Furthermore, it is the almost universal practice in British Colonies for the children to be sent home to school at the age of six. For the periodical long leave the stock excuse of climatic disability is put forward. Except in a very few specialised areas I cannot subscribe to the belief that climatic influence alone and dispossessed of the many evils discussed above justifies the contention. Improved adventitious conditions would undoubtedly remove a very large part of the so-called "climatic" disabilities, that would render the European more of a settler than a sojourner, and that in turn would stabilise his interest in his surroundings and lead to the creation of a less artificial existence. It is in this very respect that settlement of our own tropical areas differs so much from that of our tropical colonies, and this difference of attitude is largely bound up with the question of native labour. Once the principle of permanent residence is established adequate schools would spring up as they became freed from the prohibitive expense of long leaves for the staff, and then the very important problem of family separation would largely be solved. In the case of the child, again it is the adventitious factors which are, in general, deleterious and not the pure climatic factor.

CONVENIENT, DURABLE MILK CAN RACK.

The accompanying diagram shows a convenient and durable rack for drying and airing milk cans after washing and scalding. This rack is inexpensive and easy to build, requiring a few pieces of two by fours, and four lengths of ¾-inch

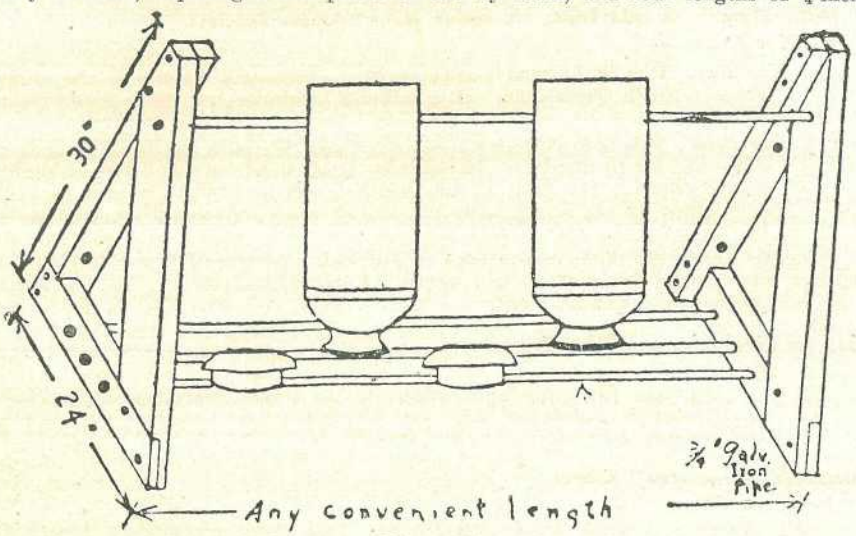


Plate 221.

galvanised iron pipe. The diagram shows the details of construction. The size may vary depending on the number of cans to be accommodated, and whether 20-quart or 40-quart cans are used. The rack fastens to the side of the dairy shed or milk house either inside or outside as preferred.

—*New Zealand Farmer.*

Answers to Correspondents

BOTANY.

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

"Gomphrena Weed."

M.McD. (Bald Hills)—

Your specimen is *Gomphrena decumbens*, a plant of the Amaranth family, for which we have not heard a common name. On this account, it is frequently spoken of as the "Gomphrena weed." It is a native of tropical America, and first made its appearance in Queensland about ten years ago. It has now become more widely spread, particularly in sandy soils. We have no definite information about its fodder value, but it belongs to a wholesome family, and should say is quite good feed.

Two Grasses from the Downs.

"Inquirer" (Toowoomba)—

The tall grass specimen is *Eleusine indica*. This grass is spread very widely over the warm temperate regions of the world. It is very common in Queensland, and mostly grows as a weed of cultivation. It is extremely strong-growing, with a very tenacious hold of the ground. Like some of the sorghums it produces prussic acid yielding glucocide, especially in its more luxuriant forms. Very little trouble, however, has been experienced with it in Queensland. It is most commonly known as crowsfoot grass, but is not to be confused, of course, with the common herbage of that name on the Darling Downs.

The other grass is *Urochloa panicoides*, the species of which are excellent fodder. They are native grasses, but, unlike most native grasses, prefer ground that has been broken or disturbed, such as cultivation paddocks. They are rarely found in the ordinary pasture. We have not heard a suitable popular name for this grass.

"Milky Plum." A wild fruit. A native plant (Ginger Species).

S. (Townsville)—

1. *The Nut:* This is *Lucuma castanospermum*, commonly known as the milky plum in North Queensland. It is rather a handsome tree, with glossy green foliage.
2. *The Fruit:* This is *Siphonodon membranaceum*. We have not heard a common name applied to this tree. In Southern Queensland, an allied tree is known as ivorywood. The fruit of the North Queensland plant is said to have been eaten by the aboriginals, but, as far as we have observed, it is much too woody in texture to be edible.
3. *The Leaf:* We think this belongs to *Curcuma australasica*, a native plant of the ginger family. It has rather an ornamental flower, and is worth growing as a garden plant.

Soil for Pineapples and Other Fruit.

A.J. (Petrie)—

If you send your full name and address to the Under Secretary, Department of Agriculture and Stock, Brisbane, information on pineapple culture and soil analysis will be sent to you direct.

Brazilian or Mexican "Clover."

INQUIRER (Townsville)—

The specimen is *Richardsonia brasiliensis*. This plant is commonly known as Brazilian or Mexican clover. It is, however, not a member of the clover family, and is in no way related to the legumes. It has been highly spoken of as a fodder, but our experience with it in Queensland is simply as a bad weed of cultivation, particularly on fruit farms, where it grows between pineapple rows and is extremely difficult to eradicate. So far as we have observed, stock do not take very readily to it.

Forest Blue Grass. Wild Millet.

E.G.N. (Rannes)—

The tall-growing specimen with the fluffy top is *Bothriochloa intermedia*, forest blue grass, a very widely spread grass in Queensland, being very abundant in the Callide Valley and parts of Central Queensland. It is generally regarded as quite a good stock feed, but we have never heard of its cultivation. It would be an interesting experiment.

The smaller grass is *Echinochloa colona*, commonly known as wild millet. This grass is very closely allied to such well-known cultivated fodders as Japanese millet and white panicum.

Trees Suitable for the Taroom District.

S.C. (Taroom)—

Following is a list of trees worth a trial in your district:—

Chinese Celtis (*Celtis sinensis*).—This, we think, is one of the most satisfactory trees. It is being grown in some of the western towns with great success. The tree is sometimes called Portuguese elm, although this name belongs more correctly to an allied species.

Bottle Tree (*Sterculia rupestris*).—This tree transplants fairly well when well grown. Young trees may be taken from the scrub. This was done successfully at Roma a few years ago.

Kurrajong (*Sterculia diversifolia*), White Cedar (*Melia dubia*).—Both are kept in stock by most nurserymen.

Jacaranda (*Jacaranda mimosæfolia*), Silky Oak (*Grevillea robusta*), Camphor Laurel (*Cinnamomum camphora*).—All are worthy of a trial. Without local knowledge we would not advise planting them on a large scale. All are stocked by most nurserymen.

Native Bauhinia (*Bauhinia Hookeri*).—A very handsome tree but rather slow growing. It should do very well in your district.

Carob Bean (*Ceratonia siliqua*).—Worthy of trial.

Honey Locust (*Gleditschia triacanthos*).—This tree has been grown fairly extensively on parts of the Downs and does quite well as a street tree. Objections to it are its large thorns and its susceptibility to borer attack.

Bindweed.

L.K. (Warwick)—

The specimen is the bindweed, *Convolvulus arvensis*, a very aggressive weed in the Southern States. It has been established in Queensland for only a few years, and seems to be definitely on the increase, although it does not spread here, apparently, to the same extent that it does in New South Wales and Victoria. It is one of the worst weed pests so far introduced to the Downs. It produces a large number of underground runners. Any part of these cut with a spade or plough forms a new plant. A weak arsenical solution poured into the patch may be tried, but would probably have to be done several times before eradication would be complete. A Downs farmer has informed us that pigs, being very fond of the underground parts of the plant, are useful in keeping it in check if not eradicating it entirely.

Fanflower Weed.

H.T.B. (Jandowae East)—

The specimen is fanflower weed, *Scævola æmula*. The local name comes from the spreading habit of the flower, something like a small fan. It is a native plant with a wide distribution in the Eastern States from Central Queensland to Victoria. Like some other plants with a well-developed underground root system, it has the power of forming fresh plants from small underground parts when they happen to be cut with a hoe or plough. This type of weed is rather difficult to get rid of, and if ordinary cultural methods fail, they may be sprayed with a very weak arsenical solution or with ordinary waste salt, such as butcher's salt. The former method is impracticable where stock are running, and the latter, although harmless to stock, has the disadvantage of making the ground sterile for about a season, or perhaps longer if the weather is dry.

Trees for St. George District.

Inquirer (St. George)—

The following trees are likely to do well in the country around St. George:—

Bottle Tree (*Sterculia rupestris*).
Kurrajong (*Sterculia diversifolia*).
Bauhinia Hookeri (Queensland Bauhinia).
Celtis sinensis (Portuguese Elm).
Privet (*Ligustrum lucidum*).
Pepper Tree (*Schinus molle*).
White Cedar (*Melia dubia*).
Torulosa Pine (*Cupressus torulosa*).
Jacaranda (*Jacaranda mimosæfolia*).
Phytolacca or Bella Sombra Tree (*Phytolacca dioica*).
Cape Chestnut (*Calodendron capense*).

Plane Tree.—This is worth trying. Sometimes it does not seem to succeed in localities where one would think it had every chance of success. Are there any well-grown plane trees about St. George? You could, of course, try a few to see how they turn out.

Tamarind.—We think the winters at St. George would be too severe for the tamarind.

Li-chee.—See tamarind.

Grevillea.—We presume you mean the red flowering variety, *Grevillea Forsterii*. We think there is every chance of this succeeding at St. George. It is at most, however, only a small tree, and is frequently grown as a shrub. Another species of Grevillea, the Silky Oak (*Grevillea robusta*) is a fair-sized tree and should do quite well in your district.

Shrubs—

Brunfelsia latifolia.
Hibiscus (Syriacus or deciduous type).
Hibiscus (*Rosa sinensis* or evergreen type).
Oleander (*Nerium oleander*).
Spiræa Reevesiana (May).
Tamarix (*Tamarix gallica*).
Tecoma capensis.
Tagasaste (*Cytisus proliferus*).
Indian Hawthorn (*Rhaphiolepis indica*).
Laurustinus (*Viburnum tinus*).

Bougainvilleæ also may be grown as a shrub. Some of the hardier sorts would probably do quite well. One of the best is *Traillii magnifica.*

Lawn Grasses.—You have a choice of buffalo grass, couch grass, and kikuyu. If you have a good water supply we think it likely that you will find buffalo the most satisfactory; although if your lawns are too big to water, probably the common couch would be the best.

We have kept the list to plants usually obtainable from ordinary nurseries, but some of the trees—bottle, Portuguese elm, and Queensland bauhinia—might be difficult to procure.

Eriochloa Grasses.

W.G.S. (Ambrose)—

The grass is a species of *Eriochloa*. Several species of *Eriochloa* grow in Queensland, but the genus is at present under review, and we are not able to give you the specific name. All species of *Eriochloa*, however, generally go under the name of early spring grass, although this name is not particularly appropriate, as they are essentially summer grasses and do not respond to spring rains more than most of the other grasses of their type. They are all good fodders, nutritious and much relished by stock. They are commonly seen in the ordinary pasture, but, on the whole, prefer ground that has been broken up or disturbed in some way, such as around cowyards or old cultivation paddocks. The seeds of these grasses are not stocked by nurserymen. They mostly spread naturally when once introduced into a locality.

General Notes

Staff Changes and Appointments.

The following members of the Farleigh Mill Suppliers' Committee have been appointed honorary protectors under the Fauna Protection Act:—

Messrs. J. J. Hand (Reliance Creek, Mackay), H. G. Mulherin (Cameron's Pocket, via Calen), A. Fordyce (Eimeo Road, Mackay), S. Hamilton (Glenella, Mackay), A. P. Donnelly (Farleigh), P. Kirwan (Dumbleton, Mackay), J. Trevaskis (Farleigh), and H. C. J. Hansen (Pioneer).

Messrs. F. C. Jorss (Maryborough), R. J. Rollston (Greenslopes), and H. Lambert (Acacia Ridge) have been appointed assistant inspecting cane testers for the forthcoming sugar season, with headquarters at Cairns, Mackay, and Bundaberg, respectively.

Messrs. H. Sbresnie (Oyster Creek, via Rosedale) and A. W. W. Rothan (Palmwoods) have been appointed honorary protectors under the Fauna Protection Act, and Mr. P. E. Bell, of Mutarnee, Ingham line, has been appointed an honorary protector under the Fauna Protection Act and an honorary ranger under the Native Plants Protection Act.

Mr. D. R. L. Steindl, assistant to pathologists, has been appointed assistant pathologist, Bureau of Sugar Experiment Stations.

Alderman R. Turnbull, of the Toowoomba City Council, has been appointed an honorary protector under the Fauna Protection Act.

Messrs. F. C. Jorss, R. J. Rollston, and H. Lambert, assistant inspecting cane testers at Cairns, Mackay, and Bundaberg, respectively, have been appointed also cane testers at each of the sugar mills in their respective districts.

The following have been appointed cane testers for the forthcoming sugar season at the mills specified:—Mr. G. Becker (Inkerman), Mr. C. J. Boast (Moreton), Miss D. Bowder (Babinda), Mr. T. Breen (Pioneer), Mr. L. Chadwick (Plane Creek), Miss E. Christsen (Maryborough), Mr. P. H. Compton (Pleystowe), Mr. T. F. Corbett (Kalamia), Mr. T. D. Cullen (Millaquin), Mr. L. G. F. Helbach (Bingera), Mr. T. Herbert (South Johnstone), Mr. L. C. Home (Invicta), Mr J. Howard (Rocky Point), Mr. C. H. Humphreys (Tully), Mr. H. C. Jorgensen (Marian), Miss A. L. Levy (Farleigh), Mr. J. McFie (Mount Bauple), Mr. S. McRostie (North Eton), Miss M. A. Morris (Gin Gin), Miss J. O'Flynn (Mossman), Miss J. Orr (Racecourse), Miss I. Palmer (Proserpine), Mr. W. Richardson (Isis), Miss M. T. Smith (Qunaba), Mr. G. Tait (Mulgrave), Mr. F. W. Trulson (Cattle Creek), Mr. R. D. Woolcock (Mourilyan), and Mr. V. F. Worthington (Fairymead).

The following have been appointed assistant cane testers for the forthcoming sugar season at the mills specified:—Miss D. Aldridge (Bingera), Miss A. Anderson (South Johnstone), Mr. R. Anderson (North Eton), Miss K. Backhouse (Plane Creek), Mr. P. C. Boettcher (Tully), Mr. C. Boone (Pleystowe), Mr. A. Byrne (Racecourse), Mr. L. C. J. Clifton (Pleystowe), Mr. D. M. Corbett (Pioneer), Miss E. A. Crees (Invicta), Mr. E. J. Delaney (Isis), Miss P. G. Eadie (Proserpine), Miss F. Foubister (Racecourse), Mr. H. J. Heidke (Fairymead), Mr. V. W. Keating (Marian), Mr. J. D. Kinnon (Kalamia), Mr. G. R. Kronk (Farleigh), Miss M. A. Lyle (Inkerman), Mr. J. Mackenzie (Bingera), Mr. R. A. Mahoney (Kalamia), Miss M. H. Makings (Marian), Mr. C. M. Martin (Plane Creek), Mr. V. B. Martin (Cattle Creek), Mr. J. H. Murtagh (Proserpine), Mrs. M. E. Nally (Qunaba), Mr. R. D. R. Rex (Maryborough), Miss E. M. Rowe (Fairymead), Mr. W. P. Snewin (Isis), Miss P. Southwick (Pioneer), Mr. C. W. Steley (Invicta), Mr. R. A. Stephenson (Millaquin), Miss M. Thorburn (Millaquin), Mr. J. Y. Taylor (Moreton), Mr. P. A. Van Lith (Moreton), Mr. D. Walton (Babinda), Miss M. E. L. Wassell (Farleigh), and Miss S. Wilkinson (Tully).

Wild Life Preservation.

Approval has been given for the deletion from the North Queensland Coast and Atherton Tableland bird and animal sanctuary of the Shire of Cardwell and that portion of the Shire of Hinchinbrook hitherto included within that sanctuary.

THE LATE Mr. GRAHAM—FINE TRIBUTES.

"Countryman," of the Australian Broadcasting Commission, made this graceful reference to the passing of Mr. Graham in the course of the Countryman's Session broadcast over the State network of national and regional radio stations:—

"With a strong faith in the principle of farmers' co-operation, Mr. Graham lived to see a sound system of orderly marketing established in Queensland. His ability, courtesy, tact, balanced judgment, wide knowledge of rural enterprise in all its branches and a sympathetic understanding of the producer and his problems were factors in the success of a notable career. A practical dairy farmer, he could select a cow, grow feed for her, milk her and manufacture the product into high-grade butter and cheese. The scientific side of agriculture had for him the strongest attraction, and few men were more widely read in its literature.

"In every district throughout the Queensland countryside, sincere regret is felt for Mr. Graham's untimely passing. Literally, he died in harness after labouring long and faithfully to the limit of a great capacity—and, towards the end, with magnificent courage in the gathering shadow of death—for the betterment of the conditions of the primary producers."

At meetings of the Queensland Butter Board, the Queensland Cheese Board and the Queensland Dairy Products Stabilisation Board, highly commendatory remarks were made by speakers on the work Mr. Graham had done for the dairy industry. Other associations of producers also have recorded their appreciation of Mr. Graham's work and guiding influence in the realm of agricultural economics.

Referring to the passing of the late Under Secretary and Director of Marketing of the Department of Agriculture and Stock, the "Queensland Producer" paid this fine tribute to a man who gave great service to the farmers of Queensland:—

"From the very outset a firm believer in the principle of grower-controlled co-operative marketing, Mr. Graham lived to see the patient work of years towards this laudable objective crowned with ultimate success. And it is fitting that a generous tribute be paid for the active part he played in bringing about the consummation of such ideals and hopes during the early stages when doubts were freely expressed and opposition was by no means absent.

"Later, as Government representative on the various commodity boards and as Director of Marketing, he rendered signal service in promoting a spirit of unity and assisting to overcome many problems which cropped up from time to time. His singleness of purpose and unselfish labours in helping to place Queensland co-operative marketing on the map as an example worthy of many other countries to follow will ever remain a monument to his memory. The ranks of the pioneers are becoming thinned with the march of time, but, in common with others who have earned well from the community, he will not be forgotten.

"Mr. Graham's innate courtesy and tact were important factors contributing to his successful career and steady advancement in the Department of Agriculture and Stock, and made him a wide circle of friends amongst the primary producers of Queensland. Moreover, his unassuming manner and realistic understanding of the difficulties of the man on the land were largely responsible for the esteem in which he was held in the rural community. Pre-eminently a man of wide human sympathies, his role of kindly mentor and guide came natural to him.

"There was probably no officer connected with the Department of which he occupied the important position of Under Secretary whose helpful and practical advice was more valued by primary producers, and there is no doubt that sincere regret will be felt at his passing. He laboured long and faithfully in the cause of agriculture and for the betterment of conditions of the toilers on the land. The directors and editorial staff of the 'Queensland Producer' join in tendering their sincere sympathy to his sorrowing family."

Rural Topics

A Satisfied Scotsman.

A Galloway farmer, now farming in Victoria (Australia), wrote recently as follows to "The Scottish Farmer: "If Scotsmen at home had any idea at all (which they haven't) of what a magnificent country this is—the finest land and the finest climate in all the world—they wouldn't stay at home and 'tramp red' farms on the market to let, and offer rents extortionate to get a farm and a living under very adverse conditions. Victoria is all good, but Gippsland is the garden of Victoria, with good land and an assured rainfall. There is no housing for stock, no byres (an Australian would wonder what a byre was); run your eighty or one hundred cows into a milking shed, eleven or twelve stalls (single); a good milking machine; do your cows fifty in the hour (a five-unit plant)—and there you are. Gallop in your draught horses on a 'stock hack'—a thoroughbred pony (Australians don't walk; it is said they would walk a mile to catch a horse to ride half a mile); and get your teams agoing. Australian girls are all splendid riders, and can gallop and 'stock ride' with the best men. I have a girl whom I employ for droving and she is more reliable than any man."

"Save Our Soil"—the Farmer's S.O.S.

Grass anchors soil against erosion. Its decaying remains make the soil absorbent, roots bind the soil and open tiny conduits into the earth, and blades and stalks impede the downward flow of water. Slow water does little damage, and grass makes running water creep. Soil conservation makes extensive use of grass. Good pastures shed little water and lose very little soil. Trees place a roof over the soil, cover it with a carpet, and tie it with grasping roots. Rain strikes gently beneath a tree, and running water is obstructed by countless twigs and leaves which form the carpet covering of the soil. Furrows up and down a slope are really gutters that concentrate and speed the rain run-off with its burden of top soil. Furrows around a slope are really dams that hold the rainfall and store it in the vast reservoir, the soil.

—H. A. Wallace, of the United States Soil Conservation Service.

The Management of the Bull.

The bull should be kept away from the rest of the herd in a separate run securely fenced and provided with water and shelter. A small service yard and a crush to facilitate the handling of the bull when necessary, should also be provided.

The advantages gained by keeping the bull away from the herd are:—

1. Calving can be regulated.
2. It is easier to decide whether or not the cow is in calf.
3. The bull's services are controlled and not wasted.
4. There is less likelihood of the cows having to return to the bull.

If the run is placed well away from a public road any annoyance caused by a neighbour's cows breaking into the bull or the bull breaking out is avoided.

Top-dressing Pastures.

The best way of ensuring evenness of sward in a grass paddock and consequent pasture efficiency is to make good use of harrows for the spreading of animal manure, in addition to sound grazing practice and regular top dressing. The spreading of the stock manure serves a double purpose, since it not only makes use of stock nitrogen but keeps the pastures clean and even.

Because of lack of minerals in their food dairy cows chew bones and swallow all kinds of junk—nails, wire, rusty tins, and other mineral substances. Eaten-out pastures are the chief cause of this deficiency, and that can be rectified only by better pasture management or the provision of the necessary minerals in the stock food.

Some farmers are quite willing to grow 10 acres or more of crops for dairy cattle, but often jib at spending less on the cultivation of their biggest and best crop—grass.

De-horning Cattle.

There is every reason for favouring the practice of dehorning cattle while the animals are in the calf stage. One of the best methods is the application of caustic soda to the horn buttons, which are easily felt when the calves are a few days old. The skin around each button should be protected by smearing it with vaseline and the button itself carefully rubbed with the caustic pencil, the operator being very careful not to let the caustic touch the skin itself. For the same reason, the caustic must not be handled with the fingers, but slipped for use into a metal holder, such as an ordinary pencil holder. Four applications are generally sufficient, when the buttons will peel off. This operation is said to give no pain to the calf so treated.

Is Disease Spread by Starlings?

Evidence available in England supports the view that foot-and-mouth disease was conveyed to that country from Europe by migrating starlings. The disease is still prevalent in the Old Country, although by its policy of slaughter and isolation of infected animals, the Government veterinary officers have succeeded in stopping the spread of the disease from farm to farm. The trouble seems to be severe in dairying districts, and the interesting theory in explanation of this is that the modern dairy cow has lost resistance to disease through being bred intensively for high milk yields.

Livestock Standards.

In setting up beef and mutton and pork standards the United States Department of Agriculture has reduced grade factors to three—conformation, finish, and quality.

Conformation is regarded as a question of proportion, and not of size. As a rule the animal or carcase that shows the best proportion possesses the highest degree of conformation.

Finish is fat. It involves not only the quantity of fat but also the character, quality, and distribution of the fat. A carcase to rank high in finish must possess an approved proportion of fat to lean, and the fat must be of high quality and must be smooth and evenly distributed within the limits set by nature.

Quality is perhaps the most comprehensive of all grade factors and the hardest to define. A high-quality animal must possess refined bone, a mellow hide, and relatively thick muscles.

The Menace of Soil Erosion.

Evidences of the progress of soil erosion are to be seen in every farming district. If definite cases are to be quoted, plenty of examples come to mind. Yields of fruit from many orchards on the Blackall Range and around Gosford (New South Wales) have decreased both in quality and quantity in recent years. In other places orchards have had to be abandoned from this cause. Cases can be quoted of wheat farms in New South Wales where yields have decreased by half as the top soils have been washed away and gullies developed. Hundreds of paddocks have had to be taken out of cultivation because of erosion, and are now carrying only second-grade pastures. Failure to control soil erosion must result in decreased production in the near future, and in many cases so soon that the financial position of the farmers concerned will be seriously weakened.

Production from the Land.

Comparative figures are doubtless interesting and helpful at times, but I think it was Andrew Lang who said that many people use them as a drunken man uses a lamp post—for support rather than for illumination. If a 20 per cent. gross increase of agricultural production, as reported, has been attained during the past six or seven years without being noticeable, it only emphasises what can be done with a little encouragement, and how great the possibilities are for further progress.

—*"Blythe," in The Farmer and Stock Breeder (England).*

An M.P.'s Evidence.

Speaking at a Farmers' Union dinner in England, Captain Beaumont, of the British House of Commons, remarked: "The principal evidence of success to agriculture that I can give you is that I am going in for farming myself."

Orchard Notes

JULY.

THE COASTAL DISTRICTS.

THE marketing of citrus fruits will continue to occupy the attention of growers. The same care in the handling, grading, and packing of the fruit which has been so strongly recommended in these monthly notes must be continued if satisfactory returns are to be expected. It is pleasing to note that citrus fruits coming on to the Brisbane market continue to show quality in grading, packing, and colouring.

Where the crop has been gathered, the trees may be given winter pruning if necessary—such as the removal of broken or diseased limbs or branches, and the pruning of any superfluous wood from the centre of the tree. Where gumming of any kind is seen it should be at once attended to. If at the collar of the tree and attacking the main roots, the earth should be removed from around the trunk and main roots—all diseased wood, bark, and roots should be cut away, and the whole of the exposed parts painted with Bordeaux paste. When treated, do not fill in the soil around the main roots, but allow them to remain exposed to the air for some time, as this tends to check any further gumming. When the gum is on the trunk or main limbs of the tree cut away all diseased bark and wood until a healthy growth is met with, and cover the wounds with Bordeaux paste.

Towards the end of the month all young trees should be carefully examined for the presence of elephant beetles, which, in addition to eating the leaves and young bark, lay their eggs in the fork of the tree. When the young hatch out they eat their way through to the wood and then work between the wood and the bark, eventually ringbarking one or more of the main limbs, or even the trunk. A dressing of strong lime sulphur to the trunk and fork of the tree, if applied before the beetles lay their eggs, will act as a preventive. In the warmer localities a careful watch should also be kept for the first appearance of sucking bugs, and to destroy any that may be found. If this is done systematically by all growers, damage by this pest will be much reduced.

Citrus trees may be planted throughout the month. All worn-out trees should be taken out, if the root system is too far gone to be renovated; but when the root system is still good the top of the tree should be removed until sound, healthy wood is met with, and the portion left should be painted with a strong solution of lime sulphur. If this is done the tree will make a clean, healthy growth in spring.

The inclusion of a wide range of varieties in citrus orchards is not recommended. Far too much consideration is given to the vendor's description for the purchaser's appreciation of a particular variety or varieties. Individual tastes should be subordinated to market requirements, and the selection of varieties restricted to the best available kind of early, medium, and late fruits. Among oranges, Joppa should be placed first, Sabina for early fruit, and Valencia for late markets.

With mandarins, local conditions influence several varieties, and since the introduction of the fungus known as "scab" the inclusion, particularly on volcanic soil, of the Glen Retreat and Emperor types is risky. In alluvial lands, Emperor and Sovereign (an improved Glen Retreat) are the most profitable, although Scarlet in many places is worth including, with King of Siam as a late fruit.

Land intended for bananas and pineapples may be got ready, and existing plantations should be kept in a well-cultivated condition.

Bananas intended for Southern markets may be allowed to become fully developed, but not coloured, as they carry well during the colder months of the year.

The winter crop of smoothleaf pines will commence to ripen towards the end of the month, and when free from blackheart (the result of a cold winter) or from fruitlet core rot, they are good for canning, as they are of firm texture and stand handling. Where there is any danger of frost or even of cold winds, it pays to cover pines and also the bunches of bananas. Bush hay is used for the former and sacking for the latter.

Strawberries should be plentiful during the month. Like all other fruits, strawberries pay well for careful handling, grading, and packing. Well-packed boxes always realise a much higher price than those packed carelessly.

When custard apples do not ripen when gathered, try the effect of placing them in the banana-ripening rooms, and they will soon soften instead of turning black.

THE GRANITE BELT, SOUTHERN AND CENTRAL TABLELANDS.

JULY is a busy month for the growers of deciduous fruits, as the important work of winter pruning should, if possible, be completed before the end of the month, so as to give plenty of time for spraying and getting the orchard into proper trim before the spring growth starts.

Pruning is one of the most important orchard operations, as the following and succeeding seasons' crops depend very largely on the way in which it is done. It regulates the growth as well as the number and size of the fruit, for if too much bearing wood is left there is a chance of the tree setting many more fruits than it can properly mature, with a result that unless it is rigorously thinned out the fruit is under-sized and unsaleable. On the other hand, it is not advisable to unduly reduce the quantity of bearing wood, or a small crop of overgrown fruit may be the result. Apples, pears, and European varieties of plums produce their fruits on spurs that are formed on wood of two years' growth or more; apricots and Japanese plums on new growth and on spurs; but peaches and nectarines always on wood of the previous season's growth. Once peachwood has fruited it will not produce any more from the same season's wood, though it may develop spurs having a new growth or new laterals which will produce fruit. The pruning of the peaches and nectarines, therefore, necessitates the leaving of sufficient new wood on the tree each season to carry a full crop, as well as the leaving of buds from which to grow new wood for the succeeding year's crop. In other words, one not only prunes for the immediately succeeding crop, but also for that of the following season. All prunings should be gathered and burnt. When pruned, the trees are ready for their winter spraying.

All kinds of deciduous trees may be planted during the month, provided the ground is in proper state to plant them. If not, it is better to delay planting until August, and carry out the necessary work in the interval. The preparation of new land for planting may be continued, although it is somewhat late in the season, as new land is always the better for being given a chance to mellow and sweeten before being planted. Do not prune vines yet on the Granite Belt; they can, however, be pruned on the Downs and in the western districts.

Trees of all kinds, including citrus, may also be planted in suitable situations on the Downs and western districts, and the pruning of deciduous trees should be concluded there.

TO KEEP A WIRE FENCE STRAINED.

This device will be found useful for preventing wire fences becoming slack as they tend to do in the course of time.

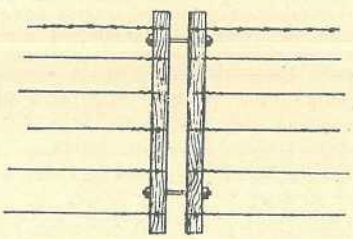


Plate 222.

The materials required are two battens 4 in. x 2 in. and two stout bolts with thread cut at each end. Drill holes in the battens to take the bolts, attach the fence wires securely and then insert the bolts, when the whole fence can be strained by tightening the nuts with a spanner.

This apparatus can be used on an ordinary strained fence and one is required for every twenty chains.

Farm Notes

JULY.

FIELD.—Practically the whole of the work on the land for this month will be restricted to the cultivation of winter crops—which should be now making good growth—and to the preparation of land for the large variety of crops which can be sown next month. Early maturing varieties of wheat may be sown during the month. Sow late maturing varieties early and early maturing varieties late.

The harvesting of late-sown maize will be nearing completion, and all old stalks should be ploughed in and allowed to rot.

Clean up all headlands of weeds and rubbish, and for this purpose nothing equals a good fire.

Mangels, swedes, and other root crops should be now well away, and should be ready for thinning out. Frosts, which can be expected almost for a certainty this month, will do much towards ridding the land of insect pests and checking weed growth.

Cotton-picking should be now practically finished and the land under preparation for the next crop.

The young lucerne should be becoming well established; the first cutting should be effected before the young plants reach the flowering stage, as, although such an early mowing is seldom worth gathering, it has the effect of stimulating root growth, to the benefit of subsequent cuttings, which are usually made when approximately one-third of the plants have reached the flowering stage. If weed growth is prevelant during the spring months, frequent cutting is often necessary as a control to prevent seeding.

DISINFECTION.

The object of disinfection is to destroy organisms and ultra-visible viruses which cause disease. It is a job which should certainly be done after the occurrence of one or more cases of contagious disease—such as tuberculosis, contagious abortion, swine fever, and influenza.

Periodical disinfection of stables, byres, piggeries, and poultry runs is highly commendable as a measure of disease prevention.

The extent and thoroughness of the work would depend on the nature of the disease which had occurred, and would not need to be so extensive or intensive when merely carried out as a routine measure.

A common error in disinfecting premises is to first remove accumulations of excreta, discharges, dirt, and dust. Otherwise, the causal organisms and viruses contained in the accumulations are disseminated throughout the building, and may lodge in places which cannot be easily covered by the disinfecting solution afterwards.

The proper way is first to apply liberally to all parts of the premises a suitable disinfectant in solution, and to leave it in contact for twenty-four hours.

After the disinfectant has been allowed to act for that period, the walls and floors should be scraped (or scrubbed), and the scrapings soaked with kerosene and burnt.

Suitable solutions are phenol or other coal tar preparation (1 pint to 4 gallons water), chloride of lime (1 lb. to each gallon of water), or crude carbolic acid (1½ pints to 4 gallons water), to be sprayed on all surfaces.

If shearing sheds and yards are disinfected before shearing commences, losses of stock through infection of wounds may be avoided.

Our Babies.

Under this heading a series of short articles, by the Medical and Nursing Staffs of the Queensland Baby Clinics, dealing with the care and general welfare of babies has been planned in the hope of maintaining their health, increasing their happiness, and decreasing the number of avoidable deaths.

THE NEW-BORN BABE.

Natural Feeding.

During the nine months before birth the mother, through her blood, is providing the food which is necessary for the development of the young child. If the child is to be strong and well at birth the mother must be in good health herself. The importance of this has been stressed in a previous article.

Within the mother's body the child lies doubled up suspended in a comfortably warm fluid, everything is done for him, he does not require either to eat or to breathe. From this comfortable state of dependence he is suddenly born into the world. With his first cry a new order of things begins. A new type of circulation is established, his oxygen is now obtained from the air instead of through the mother's blood, he has to do his own work of digestion and to get rid of his waste products through his own excretory organs. In other words, he has to become self-supporting.

In this land of ours most babies are born healthy, and it is within the mother's power to keep them healthy. Why is it that a number of our infants, during the first two or three months of their lives, do not make satisfactory progress? In most cases it is the result of wrong methods of feeding, and particularly of the failure of the mother to feed her baby naturally. If mothers realised the value of breast milk very few would be unable to feed their infants either fully or partly. Nature has evolved a wonderful plan whereby the stomach is gradually

educated to digest food. For the first few days there is found in the breasts a thin watery-looking fluid—a most valuable food containing a large percentage of one of the constituents of blood. This can be absorbed with comparatively little effort by the stomach whose function is slowly becoming established. Gradually this fluid is changed into milk, and in this way Nature provides a perfect transitional food for the infant.

The child who is denied his birthright—his own mother's milk—receives early in life a food of an unnatural sort. However, it may be modified, cow's milk can never be made into anything approaching human milk. Further, the exercise of sucking the breast promotes a good supply of blood to the jaws whose development is assisted and good spacing of sound teeth encouraged. In nursing her baby the mother tends to improve her own health by aiding the natural physiological changes occurring in her body. The importance of a right start for both mother and infant cannot be over-emphasised.

It is unfortunate that in so many instances the decision to discontinue the efforts to establish natural feeding is so readily made. Artificial feeding often has its origin in the small bottle of diluted milk solution given when the child is a day or two days old, by a nurse who may not have the time or in some cases the experience necessary to overcome certain difficulties which may arise in connection with feeding. The nurse who has not had experience in infant welfare work is handicapped in handling such babies. In some cases the flow of milk may be delayed beyond the usual few days, or the child may be slow in learning to suck. If this occurs attempts to train the infant to suck should be continued for some weeks, as it often happens that natural feeding is established ultimately. The best stimulus to the flow of milk is the regular sucking by the baby. In certain cases where it has been necessary to separate the child and the mother, as in the case of sickness of one or other, natural feeding has been re-established after an interval of several weeks.

Natural feeding is the baby's best protection against disease; it prevents certain diseases and protects against others. Persevere in your efforts to establish natural feeding, and when you are in difficulties, seek the assistance of a nurse who can help you.

IN THE FARM KITCHEN.

VEGETABLES ON THE MENU.

Stuffed Marrow.

Take 1 medium-sized vegetable marrow, 2 cupfuls breadcrumbs, 1 egg, ½ pint cheese sauce, 2 tablespoonfuls butter, 1 tablespoonful chopped parsley, 1 medium-sized onion, ½ cupful chopped cooked ham, stock or milk to moisten, pepper and salt.

Cut off a slice from either end of marrow. Remove seeds and membrane, then peel. Parboil in salted water for five minutes. Heat butter in a saucepan. Add chopped onion, breadcrumbs, parsley, and ham, then the beaten egg and stock or milk to moisten. Season to taste with salt and pepper. Drain marrow, and fill shell with the mixture. Cover with the sauce. Bake in a moderate oven for about forty-five minutes or till brown and tender. Serve with potatoes (boiled) as the main dish for dinner.

Vegetable Marrow a l'Espagnole.

Take 1 vegetable marrow, 3 tomatoes, 1 onion, 2 oz. butter, ¾ pint stock, salt, pepper.

Peel the onion and slice it. Melt the butter in a saucepan, put in the onion and fry without browning, slice the tomatoes, add them to the onion, and cook a little. Peel the marrow, cut it in quarters, take out the seeds, and slice it into pieces about 2 inches square; add these to the onion and tomatoes, season with pepper and salt, add the stock, and stew gently until the marrow is tender. When the marrow is sufficiently cooked, turn it on to a hot dish, place the onion and tomato over it, and serve.

Little Moulds of Carrots.

Take 8 large carrots, 1 whole egg, 1 egg-yolk, butter, stock, salt, pepper, 1 hard-boiled egg-white, white sauce.

Wash the carrots and slice off the red part of them. Melt some butter in a saucepan, put in the pieces of carrot, and cook them in it for about ten minutes, stirring constantly; add some white stock, and cook until tender. Drain well, and rub through a fine sieve. Return the puree to the saucepan, add the whole egg and the yolk, stir over the fire until thoroughly mixed. Butter some small dariole moulds and decorate the bottom of each with a star of hard-boiled egg-white, fill up with the carrot mixture, and cook in a slow oven in a baking tin containing water for fifteen to twenty minutes. Before putting them in the oven, cover with a buttered paper. When done, turn out on to a hot dish, pour hot white sauce round, and serve.

Beetroot with Cream.

Take 1 large cooked beetroot, ½ pint stock, 1 egg-yolk, 1 gill cream, pepper and salt.

Take a large beetroot, peel it and cut in slices; put it into a stew-pan with the stock and seasoning, stew it gently until quite hot. Strain off the stock. Dress the beetroot on a hot dish; put stock back into the saucepan. Whip the egg-yolk with the cream. Add this to the stock, place it on the gas, and bring to the boil, but it must not actually boil. Pour this sauce over the beetroot and serve.

Baked Cauliflower.

Take 1 large cauliflower, 1½ oz. butter, ¾ oz. flour, ½ pint milk, 1½ oz. grated cheese, breadcrumbs, salt and pepper.

Boil the cauliflower in salted boiling water, taking care not to over-cook it. When ready, lift it out of the saucepan carefully, drain it thoroughly, and place on a well-buttered fireproof dish. Melt 1 oz. of butter in a saucepan, stir in the flour, add the milk, and bring to the boil, stirring all the time; simmer for five minutes, then season with salt and pepper, and add 1 oz. of cheese; pour this sauce carefully over the cauliflower, sprinkle with grated cheese and a few breadcrumbs, put a few bits of butter on top, and place in a hot oven for about ten minutes. Serve very hot.

Croquettes of Parsnips.

Take 4 parsnips, 1 oz. butter, breadcrumbs, 1 tablespoonful cream, lemon juice, 2 eggs, salt, pepper, fried parsley.

Wash, peel, and boil the parsnips in water seasoned with salt and a little lemon juice. When tender, drain and mash them, put them into a saucepan with the butter, stir over the heat until quite hot; season with pepper and salt. Draw the pan off the gas and add one well-beaten egg and the cream; stir over the gas to bind, then turn the mixture on to a plate, and put aside to cool. Divide the mixture into equal portions, make each into a ball or cutlet shape. Dip these into beaten egg, toss in breadcrumbs, place them in a frying basket, and fry in very hot fat. When nicely browned, drain them, arrange on a hot dish, garnish the dish with fried parsley, and serve very hot.

Baskets of Peas.

Take ½ lb. short pastry, 1 oz. butter, ½ pint peas, parsley.

Roll the pastry out thinly, line some small, fluted patty-tins with it, fill them with raw rice, and bake in a quick oven until a pale brown. Remove the rice as soon as the pastry is cooked. Roll out the remainder of the pastry. Cut it out with a round fluted pastry-cutter about 3 inches across; cut the centre out of each round with a cutter one size smaller than the first one used. Divide the rings in halves and bake them a light brown. Boil the peas in the usual way; drain them, and toss in 1 oz. of melted butter. Fill the pastry basket with the peas, put one of the handles in each, and place in the oven for a few minutes. Serve as a separate course. Dish them on a hot dish on a paper d'oyley; garnish with parsley, and serve hot.

The Genius of John Frederick Bailey.

This beautiful tribute to the late Jack Bailey—sometime Government Botanist and a son of the late F. M. Bailey, also a former Government Botanist of Queensland—and his work was paid by the Rev. J. P. Parker, rector of St. Paul's, East Brisbane, who conducted the funeral service.

The world has sustained a loss in the passing of Mr. Bailey. This statement will go unchallenged in Australia, for his memorials are scattered throughout the Commonwealth. To take a piece of practically waste land, especially after it has been further spoiled by man—and turn it into health-giving beauty—requires a genius of no mean order. Such a genius was John Frederick Bailey—and there will always be historians able to tell people what indifferent pieces of land their great gardens were till Mr. Bailey made them beautiful and famous. He had the true characteristic of genius inasmuch as he was able to impart information from his vast knowledge to the ignorant. We believe he is happy with God, who once planted a garden in Eden and put man there to tend it. I am sure we should all be better and happier if we did more of this work as opportunity offers, remembering it is the only manual labour that God definitely decreed for man.

THE ROSE GARDEN.

Roses will never flourish unless the soil in which they are grown is rich in plant foods and well cultivated.

Points to be considered when preparing soil for roses are: The soil may be too retentive of moisture and too cold; or it may be entirely the reverse. Roses of the hardiest group will do well on a great variety of soils. The hybrid perpetuals do best in a cool, but well-drained clay loam, while the tea roses should have a warmer soil, a sandy loam being preferable. However, where it is possible an intermediate type of soil should be chosen which will suit all groups. A soil then should be chosen which is naturally cool and cool soils are usually those with considerable humus and with good moisture-retaining capacity. Clay loams are, generally, naturally richer than sandy loams, and as the rose requires plenty of plant food, the heavier soils also have the advantage in this respect. Shallow soils should not be chosen for roses, as they are liable to become very dry and warm during rainless periods.

Soils where water lies within 3 feet of the surface should not be chosen, as such soils are cold and roses will not bloom well in them. The soil besides being cool should be well-drained, deep, and rich. If the soil is composed of strong clay, it should be trenched to a depth of about four spades and the bottom filled for 6 inches with broken rubble to act as drainage. Unless some material which will rot is incorporated into the full depth of the digging in clay soil, the effect of the water will be to reset the ground, after one thorough soaking, so that it becomes as hard as before. For this reason it is a good thing to incorporate, as the trench is dug, all the aerating matter which can be added—leaves, straw, wood chips, litter, and garden refuse—keeping the finest of this mixture for the top spit. The rougher matter below

will gradually rot and add humus to the lower soil and in its decay give air space where formerly all was compact and airless soil. This is an excellent way of aerating the ground and providing a free root-run, which is one of the essentials to good rose growing. Lastly, unless heavy clay land slopes downwards, it will become waterlogged, hence the rubble footing must have an outlet through a ditch or drain to carry away the water which would otherwise remain.

An ordinary clay soil is favoured by many growers, and if it is treated in the way described, or lightened by the addition of sand, road grit, soot, and other such materials, and dug over early and allowed to lie fallow and exposed to the rigours of the weather and so become thoroughly pulverised, it will grow magnificent roses.

Where the soil is too light it will require the addition of some "body." Clay or heavy clay-loam may be added to light sandy soil to the extent of one-half, and worked to the depth of about 2 feet 6 inches.

The best soil for rose culture is a deep rich loam, sufficiently heavy to retain moisture during the dry season, but so well-drained that it will not become cold and clammy at other seasons. It should be deeply trenched to the depth of at least 2 and preferably 3 feet, forking up the soil at the bottom of the trench. It should be the *aim of every rose grower to bring his soil as near to this ideal as is possible.*

The Principles of Rose Pruning.

A few simple rules govern all rose pruning:—

Cut out all dead and diseased wood, making the cut as close to the base as possible.

Cut immediately above a bud pointing away from the centre of the bush so that the growth may not develop inwards, but outwards, where there is light and air.

Cut in an upward, outward, slanting direction, using a sharp knife which will cut clean, in preference to secateurs which often make a jagged cut and crush the end of the shoot; the cut should be neither too close nor too slanting.

Cut off each growth above the second or third bud counting from the base, provided that: the rose is of normal growth; the bud left is pointing outwards, if not, the cut must be made above the next bud that is.

Cut back hard and well-ripened shoots from 3 to 6 eyes according to variety or wish; cut back weak shoots to fewer eyes.

Where new growths have sprung from the ground-line, cut these back to from 4 to 6 inches high.

Prune hard for weak growth, less severely for medium, and still less for vigorous growth.

Always cut back to dormant eyes.

Pruning should be timed according to the weather, and should not be done if heavy frosts are expected. The operation should always be carefully and properly performed, it will then cause the bushes to bear a wealth of blossoms; indifferently done or without knowledge it will spoil the shape of the tree and cause it to bear second rate blooms. Where the cut is not clean decay is likely to set in; dying back also follows when the cut is not made close to the bud.

The golden rule as regards rose-pruning is that the stronger the growth of the shoot,, the greater number of buds may be left for future development.

NATIONAL RADIO TALKS.

The following programme of national talks, supplied by courtesy of the Australian Broadcasting Commission, will be given over the national network of broadcasting stations, including 2BL, 2NR, 2CO, 3AR, 3GI, 4QR, 4RK, 4QN, 5AN, 5CK, 7ZL, 7NT.

National talks for Mondays and Wednesdays, 7.40 to 7.55 p.m., are arranged for three or four months in advance. For other days and at other times, they are arranged from month to month.

All times stated are *Eastern Standard Time.*

SUNDAYS.

9.10 to 9.30 a.m.

Countryman's Session each Sunday.

(Queensland Listeners tune in to 4QG, 4RK, or 4QN.)

9.15 to 9.30 a.m.

Special National Talk on the First Sunday in every Month.

(For this Session South-Eastern Queensland must tune in to 4QG instead of 4QR.)

6.30 to 6.45 p.m.

JULY.

3rd—

"AN AUSTRALIAN CREED" (Series). *"Drifting or Steering."* (First Talk in this Series.) By Professor Walter Murdoch.

10th—

"Science in the News." By Professor W. J. Dakin (Sydney).

17th—

"The Enemies of Progress." (Second Talk in the series "An Australian Creed.") By Professor Walter Murdoch.

24th—

"Science in the News." By Professor W. J. Dakin (Sydney).

31st—

"Wanted—A Common Platform." (Third Talk in the series "An Australian Creed.") By Professor Walter Murdoch.

AUGUST.

7th—

"Science in the News." By Professor W. J. Dakin (Sydney).

8.30 to 8.50 p.m. every Sunday.

"INTERNATIONAL AFFAIRS."

MAY.

15th—

Dr. E. R. Walker.

22nd—

Dr. G. L. Wood.

MONDAYS.

7.40 to 7.55 p.m.

4th— **JULY.**

"Religion." By Mr. F. W. Coaldrake (Brisbane). (To be broadcast from Sydney.)

11th—

"AMERICA TO-DAY" (Series). By Mr. C. Hartley Grattan. *"A Chat on America's Economy."*

18th—

"A Chat on America's Cultural Life."

25th—

"NEW ZEALAND'S NEW DEAL" (Series). By Mr. N. M. Richmond (Brisbane). *"New Zealand's New Deal"*—Part I.

AUGUST.

1st—

"New Zealand's New Deal"—Part II.

8th—

"An American's Views on New Zealand's New Deal." By Mr. C. Hartley Grattan.

TUESDAYS.

A National Talk will be arranged somewhere between 9.30 and 10.0 p.m. each Tuesday.

WEDNESDAYS.

7.40 to 7.55 p.m.

JULY.

6th—

"Why not an Australian Culture?—Another View." By Mr. J. I. M. Stewart (Adelaide).

13th—

"SOME 'OUT OF THE WAY' BOOKS." *"The Saga Spirit."* By Mr. Ian Maxwell (Sydney).

20th—

"Folly in Old France."

27th—

"THIS, CHANGED THE WORLD" (Series). *"Discoveries by Stone Age Man."* By Mr. F. S. Shaw (of Hobart). (Broadcast from Melbourne.)

AUGUST.

3rd—

"Gunpowder." By Professor E. J. Hartung (Melbourne).

10th—

"Coal." By Professor E. J. Hartung (Melbourne).

17th—

"Vaccination." By Professor W. A. Osborne (Melbourne).

24th—

"Bacteria." By Professor W. A. Osborne (Melbourne).

31st—

"The Engineer through the Ages." By Sir Henry Barraclough (Sydney).

SEPTEMBER.

7th—

"Steam." By Sir Henry Barraclough (Sydney).

14th—

"Electricity." By Sir Henry Barraclough (Sydney).

THURSDAYS.

7.40 to 7.55 p.m.

As from 5th June, the National Book Review will be broadcast on Sundays at 10.15 a.m.

FRIDAYS.

7.40 to 7.55 p.m.

A National Talk will be arranged every Friday evening at this hour.

WEDNESDAYS AND FRIDAYS.

2BL, 2NR, 2CO, 3AR, 3GI, 4QR, 4RK, 4QN.

6.0 p.m.

"A FORUM FOR TEACHERS AND STUDENTS."

National Talks on Wednesdays and Fridays are arranged specially to interest young people. Usually these Talks will be broadcast by young people themselves.

RAINFALL IN THE AGRICULTURAL DISTRICTS.

TABLE SHOWING THE AVERAGE RAINFALL FOR THE MONTH OF APRIL, IN THE AGRICULTURAL DISTRICTS, TOGETHER WITH TOTAL RAINFALL DURING 1938 AND 1937, FOR COMPARISON.

Divisions and Stations.	Average Rainfall.		Total Rainfall.		Divisions and Stations.	Average Rainfall.		Total Rainfall.	
	April.	No. of years' records.	April, 1938.	April, 1937.		April.	No. of years' records.	April, 1938.	April, 1937.
North Coast.	In.		In.	In.	*Central Highlands.*	In.		In.	In.
Atherton	4·24	37	0·79	1·63	Clermont ..	1·58	67	0·34	0·94
Cairns	11·27	56	1·12	6·57	Gindie	1·14	39	..	0·66
Cardwell	8·75	66	0·12	0·76	Springsure ..	1·53	69	0·46	0·51
Cooktown ..	8·77	62	1·38	2·12					
Herberton ..	3·77	52	0·47	0·35					
Ingham	7·48	46	0 43	0·59					
Innisfail	19·95	57	2·41	12·47					
Mossman Mill ..	8·11	25	0·62	3·92	*Darling Downs.*				
Townsville ..	3·33	67	0·09	0·15					
					Dalby	1·40	68	0·60	0·88
Central Coast.					Emu Vale ..	1·39	42	0·81	0·57
					Hermitage ..	1·40	32	..	0·38
Ayr	2·46	51	..	0·60	Jimbour ..	1·38	50	1·05	0·78
Bowen	2·67	67	0·76	1·21	Miles	1·45	53	2·05	0·77
Charters Towers ..	1·48	56	0·13	0·03	Stanthorpe ..	1·77	65	0·24	1·44
Mackay	6·10	67	0·40	1·02	Toowoomba ..	2·62	66	1·39	0·86
Proserpine ..	5·67	35	0·04	1·22	Warwick ..	1·64	73	1·10	0·31
St. Lawrence ..	2·76	67	0·62	3·04					
South Coast.									
Biggenden ..	2·15	39	2·15	0·58	*Maranoa.*				
Bundaberg ..	3·27	55	3·06	0·60					
Brisbane	3·78	86	1·01	0·92	Roma	1·29	64	..	0·32
Caboolture ..	4·51	51	1·60	1·45					
Childers	2·82	43	4·10	0·28					
Crohamhurst ..	6·71	45	0·98	2·47					
Esk	3·01	51	1·19	1·31					
Gayndah	1·44	67	2·92	0·47					
Gympie	3·45	68	1·01	0·54	*State Farms, &c.*				
Kilkivan	2·26	59	0·77	0·80					
Maryborough ..	3·87	67	2·92	3·03	Bungeworgorai ..	1·11	24	..	0·30
Nambour	6·21	42	1·02	1·97	Gatton College ..	1·90	39	..	1·21
Nanango	1·95	56	0·57	0·27	Kairi	..	..	..	..
Rockhampton ..	2·53	67	3·37	1·58	Mackay Sugar Experiment Station	4·63	41	..	1·28
Woodford ..	4·65	51	1·45	1·83					

A. S. RICHARDS, Divisional Meteorologist.

CLIMATOLOGICAL TABLE—APRIL, 1938.

COMPILED FROM TELEGRAPHIC REPORTS.

Districts and Stations.	Mean Atmospheric Pressure at 9 a.m.	Shade Temperature.						Rainfall.	
		Means.		Extremes.				Total.	Wet Days.
		Max.	Min.	Max.	Date.	Min.	Date.		
Coastal.	In.	Deg.	Deg.	Deg.		Deg.		Points.	
Cooktown	29·82	86	76	91	14	68	13	138	7
Herberton	..	81	59	89	13, 14	51	12	47	2
Rockhampton	29·94	86	67	96	1, 2	50	28	337	6
Brisbane	29·99	81	63	94	1	50	28	101	8
Darling Downs.									
Dalby	29·99	82	55	93	1	36	27	60	4
Stanthorpe	..	75	47	86	1	28	28	24	4
Toowoomba	..	76	55	86	2	38	28	141	7
Mid-Interior.									
Georgetown	29·88	94	64	99	2	55	13	25	1
Longreach	29·93	92	60	100	1, 2, 12	43	27	..	..
Mitchell	29·98	84	52	94	1	35	27	63	1
Western.									
Burketown	29·87	95	69	102	1, 2	57	28	..	..
Boulia	29·97	91	61	101	3	47	27	..	..
Thargomindah	29·96	85	59	98	16	45	28	2	1

ASTRONOMICAL DATA FOR QUEENSLAND.

TIMES COMPUTED BY A. C. EGLINTON.

TIMES OF SUNRISE, SUNSET, AND MOONRISE.

AT WARWICK.

	June. 1938.		July. 1938.		June. 1938.	July. 1938.
	Rises.	Sets.	Rises.	Sets.	Rises.	Rises.
					a.m.	a.m.
1	6·36	5·2	6·46	5·6	8·58	9·7
2	6·37	5·2	6·46	5·6	9·46	9·50
3	6·37	5·2	6·46	5·7	10·32	10·22
4	6·38	5·2	6·46	5·7	11·12	11·7
5	6·38	5·2	6·45	5·8	11·51	11·43
					p.m.	p.m.
6	6·39	5·2	6·45	5·8	12·30	12·22
7	6·39	5·2	6·45	5·8	1·7	1·2
8	6·40	5·2	6·45	5·9	1·42	1·45
9	6·40	5·3	6·44	5·9	2·21	2·30
10	6·41	5·3	6·44	5·9	3·5	3·16
11	6·41	5·3	6·44	5·10	3·44	4·7
12	6·41	5·3	6·44	5·10	4·30	4·59
13	6·42	5·3	6·43	5·11	5·21	5·53
14	6·42	5·3	6·43	5·11	6·10	6·43
15	6·42	5·3	6·43	5·12	7·5	7·36
16	6·43	5·4	6·43	5·12	7·56	8·28
17	6·43	5·4	6·42	5·13	8·48	9·21
18	6·43	5·4	6·42	5·13	9·40	10·17
19	6·43	5·4	6·42	5·14	10·34	11·11
20	6·44	5·4	6·41	5·14	11·27	..
						a.m.
21	6·44	5·5	6·41	5·15	..	12·12
					a.m.	
22	6·44	5·5	6·41	5·15	12·22	1·11
23	6·44	5·5	6·40	5·16	1·22	2.14
24	6·44	5·5	6·40	5·17	2·22	3·10
25	6·45	5·5	6·39	5·17	3·28	4·19
26	6·45	5·5	6·39	5·18	4·26	5·17
27	6·45	5·6	6·38	5·18	5·37	6·10
28	6·45	5·6	6·37	5·19	6·38	6·59
29	6·45	5·6	6·37	5·20	7·33	7·42
30	6·45	5·6	6·36	5·20	8·23	8·23
31			6·35	5·21		9·1

Phases of the Moon, Occultations, &c.

5th June	☽	First Quarter	2	32 p.m.
13th „	○	Full Moon	9	47 a.m.
21st „	☾	Last Quarter	11	52 a.m.
28th „	●	New Moon	7	10 a.m.

Apogee, 15th June, at 4.0 a.m
Perigee, 28th June, at 11.0 a.m.

Jupiter, on the same day, will be stationary, which means that the Earth, as seen from the planet, has reached its furthest distance east of it, in this instance, and for a short time will travel directly towards Jupiter. After this period the planet will apparently move with retrograde motion until it reaches its next stationary point, three months hence.

The third and most important event which occurs on the 22nd June is our Winter Solstice. The Sun, in its apparent journey on the ecliptic, the path of the planets, has reached its extreme northern latitude, and will seem to halt in its course, after which, very slowly at first, it will be seen to turn southward.

Venus and a very narrow crescent of the Moon will be seen above the western horizon on the 30th. Their nearest approach will occur after they have set, at midnight.

Mercury rises at 4.54 a.m., 1 hour 42 minutes before the Sun, and sets at 3.50 p.m., 1 hour 12 minutes before it, on the 1st; on the 15th it rises at 5.58 a.m., 44 minutes before the Sun, and sets at 4.23 p.m., 40 minutes before it.

Venus rises at 8.47 a.m., 2 hours 11 minutes after the Sun, and sets at 7.3 p.m., 2 hours 1 minute after it, on the 1st; on the 15th it rises at 9.2 a.m., 2 hours 20 minutes after the Sun, and sets at 7.25 p.m., 2 hours 22 minutes before it.

Mars rises at 7.51 a.m. and sets at 6.5 p.m. on the 1st; on the 15th it rises at 7.32 a.m., and sets at 5.57 p.m.

Jupiter rises at 10.57 p.m. on the 1st, and sets at 12.7 p.m. on the 2nd; on the 15th it rises at 10.3 p.m., and sets at 11.16 a.m. on the 2nd.

Saturn rises at 2.22 a.m. and sets at 2.8 p.m. on the 1st; on the 15th it rises at 1.33 a.m., and sets at 1.18 p.m.

From south-east to south-west the sky is luminous with the constellations Sagittarius, Scorpio, Centaurus, and Argo Navis. About 9 o'clock the brilliant Arcturus in Bootes is almost due north, and in the north-west the two first magnitude stars, Regulus and Spica lie close to the ecliptic. About 8 o'clock the Southern Cross will be upright.

4th July	☽	First Quarter	11	47 p.m.
13th July	○	Full Moon	1	5 a.m.
20th July	☾	Last Quarter	10	19 p.m.
27th July	●	New Moon	1	54 p.m.

Apogee, 12th July, at 7.0 a.m.
Perigee, 26th July, at 9.0 p.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.