ANNUAL RATES OF SUBSCRIPTION.

Farmers, Graziers, Horticulturists, and Schools of Arts, **One Shilling.** Members of Agricultural Societies, **Five Shillings,** including postage. General Public, **Ten Shillings,** including postage.

VOL. XXXVII. 1 FEBRUARY, 1932. PART 2.

Event and Comment.

The Pork and Bacon Market.

RECENT advices from Great Britain to the effect that markets for pork products of all descriptions have eased and have receded to levels practically on a par with prices paid locally in Queensland for similar stock make it necessary to review the position in order to ascertain just what the domestic and British markets require, and how best the stock sought can be produced and marketed at a profit. The position created by the easing off of exports, and by increasing production in Queensland, calls for immediate attention to this subject, particularly as all this happens at a time when local pig prices are at a low ebb, and the spending power of consumers is reduced to a level necessitating the purchase of food at a range of values, leaving but a narrow margin of profit to grower, manufacturer, and distributor.

The number of pigs killed at export works in this State for overseas export increased greatly during 1930 and 1931, and it appeared then as if this very valuable outlet for surplus stock would become permanently profitable for Queensland producers. In fact, the trade has already returned considerable sums, for between 80,000 and 100,000 pork carcasses were exported during 1931, though possibly the margin of profit to exporters has been a very narrow and uncertain one, a common experience in most businesses during the early period of development.

The sudden drop in prices in England and in other parts of the world, coupled with increased production in practically every country where pigs are produced along commercial lines, has created a position difficult of analysis, yet even now, producers here will benefit by a review of the position, and by a closer study of marketing problems. Fortunately, those best informed on the subject hold out hopes that the position overseas and locally will improve, but this may not follow immediately, though with more stable conditions in business circles in Great Britain, and the possibility of some definite move being made to establish effective Empire preference, Australian porducers should benefit eventually and to a much greater extent than hitherto.

That there is a potential market for Australian pork and pork products in the United Kingdom goes without saying. Pork valued at £2,486,652 and bacon

valued at £40,348,408 were imported into the United Kingdom during 1928. The imports during 1929 increased by approximately £3,000,000, while in 1930 pork and bacon to a value of £43,890,198 were imported. Denmark supplies the bulk of the bacon, but huge quantities of bacon and ham are also imported from Poland, Sweden, Lithuania, and the Netherlands. Appreciable quantities of bacon and hams are imported from the United States of America and Argentina. The Irish Free State also supplies very large quantities of pork and hams. British imports of pig products during one week in November, 1931, totalled 236,340 cwt. of bacon and 17,809 cwt. of hams, plus fresh and frozen pork.

The position, therefore, is that Great Britain's requirements in bacon, ham, fresh and frozen pork, and lard amount to between £50,000,000 and £60,000,000 annually. Australia gets only a fractional portion of this business. Of the countries supplying Great Britain, Denmark appears to have the best local co-operative organisation, though Canada is moving up and is devoting more time and energy each year to organised marketing, grading, and payment on a quality instead of on a quantity basis.

International Trade.

REPORTING on the overseas position recently, Armour's Live Stock Bureau, United States of America, indicated that the international trade in pork and lard is largely determined by the balance between conditions in the United States and conditions in Europe. The United States leads the world in surplus production of these products above domestic needs. Europe, on the other hand, does not produce them in large enough quantities to supply its own requirements, the United Kingdom and Germany being of outstanding importance as importers. In recent years, certain of the smaller European countries have been developing rapidly as producers of surplus pork and lard, and have been able to supply a considerable portion of the European import requirements in these products. Armour's say that probably the clearest picture of the relative importance of different nations in pig production, from the standpoint of world commerce, can be obtained from the following figures, these being preliminary data supplied by the United States Department of Agriculture during 1930:—

INTERNATIONAL TRADE IN PORK AND PORK PRODUCTS, 1928.

PRINCIPAL EXPORTING COUNTRIES.

	Exports. Lb.
United States of America	1,101,968,000
Denmark	650,462,000
Netherlands	274,177,000
Irish Free State	115,957,000
Canada	53,357,000

PRINCIPAL IMPORTING COUNTRIES.

	Imports. Lb.
United Kingdom	1,416,466,000
Germany	240,873,000
France	102,021,000
Czechoslovakia	71,630,000
Austria	31,093,000
Italy	30,147,000

These figures are not to be taken as conclusive or as current, but they indicate the importance of the industry in countries overseas, and it will be noticed that, as they refer to exports and imports in countries in the Northern Hemisphere, they do not include Australian figures.

It is of interest to observe in passing that the per capita pig population of Denmark is more than twice as great as that of any other nation of importance in commercial swine production. German pig production has now advanced to pre-war levels, while Danish production is more than 80 per cent. above that level. It is because Danish pig production has been rapidly increasing that Denmark's exports of bacon to Great Britain have also increased so largely.

The Position in Queensland.

TO the farmer in Queensland, the matter resolves itself into a broadminded view of the position. That there is an abundant market in Great Britain, and probably also in other parts of the world, has been proved beyond the shadow of doubt, but these markets are so far away from Australia, and are subject to so

many fluctuations, that our oversea trade in pig products is a risky one, unless costs of production and marketing can be reduced, and the position in respect of transport improved. Without doubt, Australia's home markets will always be the most important, though the Danish people appear to view the export market as a far more important and valuable one than the local trade outlet. There are those, too, who believe there will be little or no surplus for export if the farmer will regularly produce pigs of the right type, and market them in the right condition. Similarly, many progressive people believe that there is abundant room for development here, more particularly along the lines of continued improvement in quality and reliability of the finished products.

The Commonwealth Statistician advised recently that, of a total of 244 lb. of meat which every Australian consumed during the year, only 11 lb. consists of bacon and hams, and 7 lb. of pork and lard. In the same year the same Australian consumes 158 lb. of beef and 68 lb. of mutton.

The average Canadian consumes 87 lb. and the American 77 lb. of pork products each year, in addition to other meats. The market for pork products locally is, therefore, capable of considerable expansion, and it has been estimated that, if Australians could be induced to consume between 1 and 2 lb. more of pig products each year, consumption would rapidly overtake production, and there would be no need to worry about the overseas outlets. There are thousands of homes here in which pork and bacon are listed seldom, if ever, on the domestic menu. If all these people could be induced to increase their use of these wholesome products, the farming community would prosper accordingly. Quality dominates every market, hence quality products, attractively served, should be the dominant factor in all efforts at trade expansion. It is quite certain, also, that if the supply of suitable pigs to the several factories and export works were more regular, and of a more fixed and economic type, better values would be obtained.

Economic Phases of the Pig Industry.

THERE are, however, many economic phases associated with the pig industry apart from those having reference to export of surplus products, though the finding of suitable market outlets for the products of an industry constitutes, obviously, one of the most important.

Australia's surplus for export has never been a great one, hence up till within recent years, overseas outlets have not been developed; in fact, Australia's pork production has not at any time been excessive. Denmark, with 3,500,000 people, has 108.56 pigs per cent. of the human population, whereas Queensland has but 21.38, and this is the highest percentage in the Commonwealth. America's percentage is 55.77 and Canada's 50.87. The Irish Free State, New Zealand, Germany, South America, Hungary, Spain, Yugoslavia, all have more pigs per cent. of human population than we have, yet they are not all exporting countries, though the first four named have a large export trade in normal times. No one in his sober senses will for a moment imagine that the farmers of the United States will continue producing 55,000,000 pigs annually with greater regularity—Queensland produces around 200,000—if there is no money in the business, nor will the farmers of Denmark.

The question is: Will Queensland produce pigs at as cheap a rate or a cheaper rate than those countries? We believe, and we say that we can, and a more cheaply produced pig will largely increase the profits, and lead to increased consumption of hams and bacon, which in itself is a most important consideration.

Britain's imports last year were equal to 10,000,000 pigs, or approximately ten times the number of pigs in Australia. Money was either made or lost on all these animals.

The by-products of this industry as with other primary and secondary industries are, of course, not without value, though the pig industry has suffered a heavy blow through serious reduction in values of several important by-products. Pig hair, for instance, that a few years ago was carefully saved and marketed at a profit, is to-day being burnt at most of the factories for the reason that there is no profitable outlet for it. Tallow and lower grades of lard have fallen considerably in value, and on these products it is difficult to show a margin of profit. Sausage casings prepared from the intestines of the pig have similarly been much reduced in value, and many tons of imported casings have been used. These and other by-products all formerly carried good marketable values, which to-day are difficult to obtain. Economic phases of this character call for research and close inquiry if additional profits are to be secured and the industry placed on a permanently sound basis.

THE QUEENSLAND SUGAR INDUSTRY.

By H. T. EASTERBY, Director of Sugar Experiment Stations.

Part XXIII.

(f) Sugar Prices, &c. (continued).

THE price of sugar in relation to the sugar industry was left in the last article at the time of the extension of the embargo for a further period of three years from 1925, the Australian price to be £27 a ton.

The first large export of sugar was in 1924, when 74,000 tons had to be sent out of Australia. This did not make so much difference to the price of raws, the pooling of the overseas price with the Australian price being £26 per ton, a reduction of only £1. The following year, 1925, however, saw a large increase in the yield, and it became unpleasantly necessary to export 211,000 tons of sugar of the 485,585 tons manufactured, which naturally made a considerable difference to the pooled price received by the industry—viz., £19 10s. 7d. per ton of raw sugar.

The following year 1926 was a dry one, and the yield of cane was much lower—viz., 389,272 tons of 94 n.t. raw sugar, of which 74,777 tons were exported. This gave a price of £24 10s. 10d. to the industry for raws.

In 1927 the manufacture reached 485,745 tons of raw sugar, the export being 152,384 tons, and the price paid by the Sugar Board for raw sugar £22 0s. 4d. per ton.

In 1928 the embargo on the importation of sugar was renewed by the Federal Government for another three years. The Prime Minister of the Commonwealth in making this announcement said the renewal was based upon the primary necessity for the maintenance of a white population in the vulnerable coastal belt of the tropical north of Australia.

The agreement provided that the Government of Queensland would acquire all the raw sugar manufactured during 1928-29, 1929-30, and 1930-31, other than such quantity of raw sugar as might be required for local consumption at the various mills, and refine and sell same at the prices stipulated. The terms of the agreement were very similar to the one made in 1925.

In 1928 the production of raw sugar was the largest to date—namely, 520,620 tons. Of this 186,703 tons were exported, the price for raw sugar being £20 17s. 11½d.; production of raw sugar in 1929 was 515,516 tons, and the export 197,000 tons—price, £20 5s. 10d.

The year 1930 was the last covered by the agreement made in 1928 referred to above. The production of raw sugar was 516,783 tons, and of this 203,605 tons were exported. The price to those mills that did not exceed their "peak year" was £19 13s. 1d.

The term "peak year" was introduced into the sugar industry at a conference of sugar interests in June, 1929, at which it was decided that the highest output of sugar of each mill in Queensland in any one year since 1915 be taken as the limit of any future year's production for that particular mill. All sugar produced by any mill beyond this limit, or any sugar manufactured from cane grown on unassigned lands, should be deemed to be extra surplus, and was to be placed in a

separate export pool, the price payable being the netted price realised for all sugar exported.

The Sugar Board were to be the authority to fix the peak years of all mills in accordance with these resolutions.

In the Proclamation of 5th June, 1930, excess sugar was defined as—

(1) Such portion of the deliveries by each millowner as the Sugar Board shall, in its sole discretion, determine, represents sugar manufactured from sugar-cane grown on lands which are not assigned pursuant to the provisions of section 5 of "*The Regulation of Sugar Cane Prices Acts,* 1915 *to* 1922," the determination of the Sugar Board to be final and not subject to appeal; and

(2) The amount (if any) by which the deliveries made by a millowner, other than deliveries of sugar provided for and described in subclause (i.) of this clause, exceed the quantity of 94 net titre sugar specified opposite the name of such millowner and his mill in the appendix to this schedule.

Appendix.

PEAK AMOUNT OF SUGAR ALLOWED TO EACH MILL IN PROCLAMATION OF 5TH JUNE, 1930, BEFORE SUGAR IS DEEMED EXCESS.

Name of Mill Owner.	Name of Mill.	Quantity of 94 Net Titre Sugar.
A. J. and H. Rehfeldt	Alberton	252
The Babinda Central Mill Company, Limited	Babinda	31,901
Gibson and Howes, Limited	Bingera	17,864
The Cattle Creek Co-operative Sugar Milling Association, Limited	Cattle Creek	8,791
The Colonial Sugar Refining Company, Limited	Childers	16,317
Eagleby Sugar Company	Eagleby	265
Fairymead Sugar Company, Limited	Fairymead	15,882
Fairleigh Co-operative Sugar Milling Association, Limited	Fairleigh	16,993
Gin Gin Co-operative Sugar Milling Association, Limited	Gin Gin	6,000
The Colonial Sugar Refining Company, Limited	Goondi	27,034
The Colonial Sugar Refining Company, Limited	Hambledon	31,836
Pioneer Sugar Mills, Limited	Inkerman	24,207
The Haughton Sugar Company, Limited	Invicta	11,736
Isis Central Sugar Mill Company, Limited	Isis	11,874
The Australian Estates and Mortgage Company, Limited	Kalamia	26,053
The Colonial Sugar Refining Company, Limited	Macknade	30,952
The Marian Central Mill Company, Limited	Marian	18,997
The Maryborough Sugar Factory, Limited	Maryborough	3,862
The Millaquin Sugar Company, Limited	Millaquin	14,443
Moreton Central Sugar Mill Company, Limited	Moreton	11,586
Mossman Central Mill Company, Limited	Mossman	14,972
The Mount Bauple Co-operative Sugar Milling Association, Limited	Mount Bauple	6,231
Australian Sugar Company, Limited	Mourilyan	23,630
The Mulgrave Central Mill Company, Limited	Mulgrave	31,643
North Eton Co-operative Sugar Milling Association, Limited	North Eton	9,319
Pioneer Sugar Mills, Limited	Pioneer	21,391
Plane Creek Central Mill Company, Limited	Plane Creek	18,233
Amalgamated Sugar Mills, Limited	Pleystowe	19,781
The Treasurer of Queensland	Proserpine	16,650

PEAK AMOUNT OF SUGAR ALLOWED TO EACH MILL—*continued.*

Name of Mill Owner.	Name of Mill.	Quantity of 94 Net Titre Sugar.
The Millaquin Sugar Company, Limited	Quanaba	8,940
The Racecourse Co-operative Sugar Association, Limited	Racecourse ..	18,066
W. Heck	Rocky Point ..	1,777
The South Johnstone Co-operative Sugar Milling Association, Limited	South Johnstone..	30,979
The Treasurer of Queensland	Tully	30,930
The Colonial Sugar Refining Company, Limited ..	Victoria	32,221
Totals		611,608

We have now arrived at another fateful period of the sugar industry —viz., 1930-1931. In the month of July, 1930, anxiety began to be felt as to the intention of the Federal Government, for there had been a change in parties since 1928. Strong efforts were made for the renewal of the embargo, and a deputation representative of the industry waited upon the Prime Minister. Considerable hostility to the renewal of the embargo was being fomented in the Southern and Western States. At first it seemed as if the Federal Cabinet would renew the embargo for a short period pending an inquiry into the industry generally, but this understanding, due to pressure by other interests, was suddenly reversed, and the Prime Minister announced after some delay that "the sugar agreement would not be renewed until a Committee of Inquiry had gone fully into the question." He further stated that—

"The Commonwealth Government had given very close attention to representations that had been made to it by various interests regarding the sugar embargo and agreement. Representatives of the Queensland Government and associations of employers and employees representing the sugar industry waited on me, urging that the present sugar agreement be renewed after its expiry on 31st August, 1931, for a period of five years. Other parties have written to the Government in support of the embargo with or without new conditions. On the other hand some State branches of the Housewives' Association, certain fruitgrowers' organisations, and various individuals have urged that the embargo be lifted, and that the present sugar agreement be not renewed. Associations representing the jam, condensed milk, and confectionery manufacturing industries have requested that the present price of sugar be reduced under any extension that may be adopted.

"Taking all the representations into consideration, the Government finds that they comprise a maze, being contradictory and difficult to reconcile. Some of the parties contend that the present price of sugar is an intolerable burden on the fruitgrowers, manufacturers, and householders. The sugar interests, however, point to the gradually increasing efficiency of their industry, their present low returns, and the fact that the price of sugar has increased under the embargo system by less than the price of most other commodities, and also by less than the basic wage, which thus leaves the consumers in a relatively advantageous position as regards sugar. Despite the claims of the sugar industry and the Queensland Government, certain critics claim that the industry is being unsatisfactorily conducted, that land values are inflated, that the methods

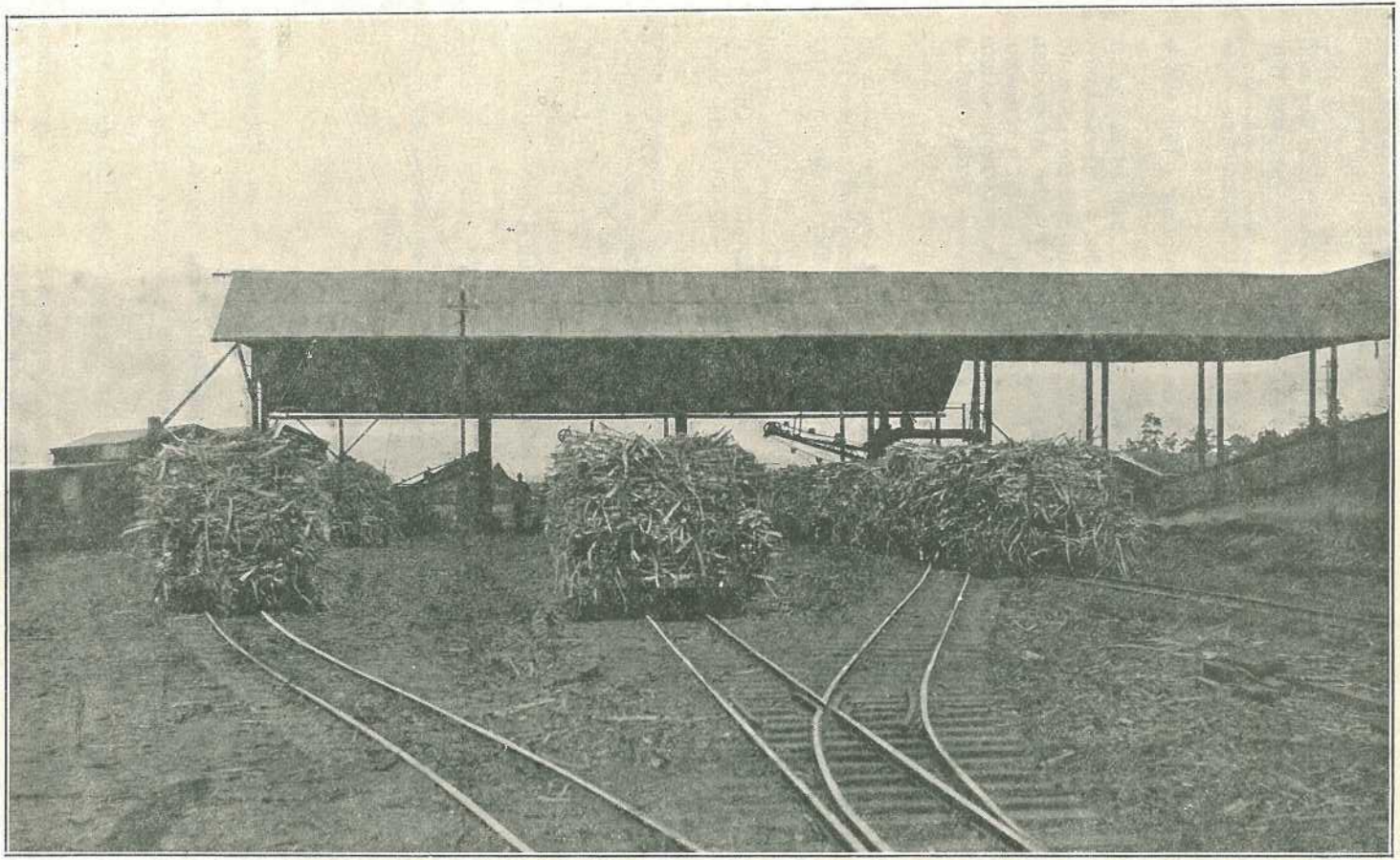

PLATE 25.—SUGAR CANE AT THE CARRIER, SOUTH JOHNSTONE MILL.

can be improved, that the industry is uneconomic, and that the control is rapidly passing from the British race. In view of the diversity of the many issues raised, the Government has arrived at the conclusion that there is a need for full inquiry into the Australian sugar industry and the operation of the sugar embargo and agreement. It has also concluded that it is not advisable that the sugar agreement should be renewed until a comprehensive report on all its aspects has been carefully considered by the Government.

"Accordingly, the Government has decided to appoint a Committee of Inquiry which would consist of not more than seven persons, with the Commonwealth Director of Development as chairman, and including an accountant of the Department of Trade and Customs, a representative of the sugar employers to be nominated by the Queensland Government, a representative of the employees to be nominated by the Australian Workers' Union, a representative of the manufacturers, and a representative of the fruitgrowers. The Government would receive nominations from all bodies claiming to represent domestic consumers, from which it would select a representative."

The Prime Minister went on to say—

"Owing to the urgent necessity for restricting the expenditure of public funds, the Government considers that each interest represented should bear the expenses of its representative. The Commonwealth Government, however, is prepared to pay the expenses of the representative of the domestic consumers. It is proposed that the Queensland Government will provide secretarial assistance for inquiries in Queensland, and that the Commonwealth Government will provide such assistance elsewhere."

In connection with the above it was stated in the newspapers that the Government turned a complete somersault in its promise to renew the sugar embargo for a limited period as mentioned above, and that when the Prime Minister brought his proposition for doing so before the party there was a first-rate row, and there was no alternative but for the Government to withdraw its proposal for renewing the embargo for twelve months.

The number of the Committee was subsequently enlarged to eight in all. This Committee was to have commenced the inquiry on 17th September, but due to the illness of two of the representatives the opening of the inquiry was postponed till 15th October, 1930.

The members of the Committee were as under:—

Hon. John Gunn, Chairman.

A. R. Townsend, Commonwealth Representative.

F. C. Curlewis, Representative Australian Sugar Producers' Association.

W. J. Short, Representative Queensland Cane Growers' Council.

Clarence George Fallon, Representative Employees in the Sugar Industry.

Eliza Elsie Morgan, Representative Australian Consumers of sugar.

Francis Austin Leigh Dutton, Representative of Australian Manufacturers using sugar in their manufactures.

William Young, Representative of Australian Fruitgrowers.

This Committee were to inquire into and report upon the Sugar Industry in Australia, and particularly in relation to—

(1) Costs, wages, profits, and prices in relation to the production, manufacture, and distribution of sugar;

(2) The financial condition of the growers of sugar in Australia;

(3) The conditions of the workers employed in the sugar industry;

(4) The terms of the existing agreement known as the Sugar Agreement, 1928-1931, and any variation of it considered to be desirable;

(5) The efficiency of the industry in field and factory;

(6) Values of land used for sugar-growing;

(7) Economies which might be effected in relation to sugar production;

(8) The effect of sugar prices on manufacturing industries and on fruitgrowing and fruit-processing;

(9) Any possible reduction in sugar prices;

(10) The necessity for the continuance of the present prohibition of the importation of sugar;

(11) The relation of sugar prices abroad to the sugar industry;

(12) Over-production of sugar and the sale of surplus sugar abroad;

(13) The utilisation of by-products of sugar-cane;

(14) Alien penetration into the sugar industry.

The Committee commenced taking evidence in Brisbane on 15th October, 1930. It then visited all the important sugar districts in Queensland and New South Wales, taking evidence, and afterwards proceeded to the various capital cities of the Commonwealth, where evidence was given by refining interests, manufacturing and domestic consumers, and others interested. It then settled down to prepare its report to the Commonwealth Government.

It might have been predicted at the outset that a Committee so formed could not hope to wholly agree on all subjects, and consequently it is not surprising to find there were three reports. The first was a joint report by all members in respect of subjects on which the Committee reached unanimous conclusions, namely:—

1. The conditions of the workers employed in the sugar industry;
2. The values of land used for sugar-growing;
3. Alien penetration;
4. The utilisation of sugar by-products;
5. Suchar process of manufacturing sugar;
6. Beet sugar industry.

Regarding these questions, the Committee found—

1. The Conditions of the Workers.—That, on the whole, arbitration had worked satisfactorily with the result that except in isolated cases there had been no serious major industrial conflict since 1911. It was, therefore, recommended that the wages and conditions of employment

in any industry receiving any direct benefit as a result of the sugar agreement should be fixed by arbitration, and that in the case of any employees or section of employees who are now or who may subsequently be removed from the operations of any existing tribunal the Commonwealth Government should establish a suitable tribunal for the purpose of fixing wages and conditions of employment.

2. The Values of Land Used for Sugar-Growing.—There is little doubt in our opinion that properties have changed hands at prices in excess of their productive value, and are based upon the remunerative price obtained for sugar prior to the time that the loss on exported sugar commenced to be felt in reduced returns to the growers and millers. It is questionable whether this tendency is more marked in the sugar industry than in other rural industries where there has been a keen demand for land, largely as a result of the encouragement which has been given by Governments to land settlement, the creation of a sheltered market, and high prices for primary products. According to the evidence there has been a falling off in the demand for sugar lands during the past few years owing to the present low prices of sugar in the oversea market, which render the exportable surplus unprofitable and have resulted in diminished returns to the industry.

3. Alien Penetration.—Complete and permanent merger of alien settlements into the economic structure of the Commonwealth as effective, self-reliant, independent national units, is in the last analyses, the ultimate measure of our community value. Charges have been that aliens predominate in the sugar industry and receive the profits therefrom to the exclusion of the native-born Australians, and various other charges have been made.

The total number of persons employed in all branches of the sugar industry in each district and the percentage thereof rated as "wholly foreign" is—

—	Number.	Percentage wholly Foreign.
No. 1 District	10,652	23·4
No. 2 District	10,153	2·4
No. 3 District	7,932	2·2
Districts combined	28,737	10·1

The percentage thus disclosed in respect of the whole industry is not such as to detract from its general standard as a typical Australian industry—a census of other industries may disclose an equal or greater blend of foreign extraction. . . . From a balanced view of all the evidence the Committee is convinced that in general the whole problem is passing through a transitory stage, and that satisfactory communities will eventually be evolved out of the new settlements in the far north.

However, the present policy of the Commonwealth Government in co-operation with the foreign Governments concerned has, since 1928, resulted in a decreased flow of alien migrants to Australia, inasmuch

as it has been mutually arranged that visas shall be granted only in respect of female relatives or fathers or sons of aliens already residing in Australia.

The whole Committee is in agreement with such policy, realising that if the rate of flow of aliens to Australia of a few years ago had been maintained the dilution of British personnel engaged in the industry and the measure of foreign control of the settlements would have been a measure of some concern.

4. Utilisation of Sugar By-products.—Every possible avenue has been exploited for the utilisation of the by-products from manufacture of raw sugar, but so far there is nothing to indicate, on the information now available, that the costs of sugar production can be further lowered by the exploitation of the by-products. However, this should not deter the industry from making further investigations.

5. Suchar Process of Manufacturing Sugar.—In view of the technical evidence tendered to the Committee on this subject, we are of the opinion that there is no advantage to be derived from the manufacture and marketing of mill whites under Australian conditions.

6. Beet Sugar Industry.—The sugar beet industry occupies a different position from the cane sugar industry in that it caters for a limited local market, and there is no export. In this connection it should be noted that the beet sugar production in Victoria is not included in the special control applying to cane sugar production in Queensland and New South Wales. This means briefly that it is not subject to the following responsibilities:—

(1) It pays no home consumption rebate to fruit-processors.

(2) It pays no export rebates on the sugar contents of manufactured goods exported.

(3) It does not share in the loss on surplus sugar exported from Australia.

If beet sugar were brought into the Australian sugar pool it would have to meet its share of the foregoing rebates, &c., and this would appreciably diminish the present net returns on beet sugar.

The Committee has not had the time to fully examine the economics of beet sugar production under Australian conditions.

The above is the gist of the conclusions of the Joint Report; the Majority and Minority Reports will be dealt with in the next article.

[TO BE CONTINUED.]

If you like this issue of the Journal, kindly bring it under the notice of a neighbour who is not already a subscriber. To the man on the land it is free. All that he is asked to do is to complete the Order Form on another page and send it to the Under Secretary, Department of Agriculture and Stock, together with a shilling postal note, or its value in postage stamps, to cover postage for twelve months.

Bureau of Sugar Experiment Stations.

CANE PEST COMBAT AND CONTROL.

The Director of the Bureau of Sugar Experiment Stations, Mr. H. T. Easterby, has received the following Entomological Hints from Mr. E. Jarvis, Meringa, for the month of January, 1932.

Prepare for Grub Fumigation.

About the middle of this month it will be advisable to make an examination of any blocks of cane thought likely to be attacked by grubs. In order to estimate the probable extent of such infestation, it will be necessary to look at the roots of a number of stools at distances of about a chain apart on various portions of the area being scouted.

If finding an average of three to eight or more grubs in second or third stages of growth under each stool, the soil should be fumigated as soon as possible.

For this work either carbon bisulphide, paradichloro. benzine, or a mixture of these two chemicals have been found equally effective in field practice.

As far as one can see at present, carbon bisulphide appears to be the most popular fumigant in the Mulgrave area, owing possibly to its being less costly and easier to manipulate than the other two. When applied by hand injector at the rate of about 19 gallons per acre, the cost works out at £9 10s. This fumigant costs about 35s. a drum, holding 5 gallons, such price, however, being offered to those ordering from 6 to 12 drums at the one time. Cumming Smith, of 65 William street, Melbourne, are the manufacturers. A suitable hand injector can be obtained from Danks and Company, Bourke street, Melbourne, and costs about £8.

Growers should always remember that before fumigating grub-infested soil with carbon bisulphide, it is of first importance to see that the land be in fit condition to allow the poisonous fumes to penetrate amongst the soil particles. It must not be too wet, or too dry, but in a friable state, such, for instance, as would be suitable for working the land with horses and plough.

Food Value of Greybacks for Poultry, &c.

A fig tree (*Ficus benjamini*) growing against a veranda of one of the buildings was found to harbour a multitude of greyback cane beetles. An oil lamp was accordingly stood on a table a few yards from the tree, the limbs of which were then shaken vigorously for a few seconds to alarm the beetles. The result was an immediate dispersion of the pest which, gathering again, flew at once towards the light literally in hundreds like a swarm of gigantic bees—an illusion rendered more realistic by the loud, continuous hum of innumerable wings. For about fifteen minutes three children and two older people were kept busy picking up and catching handsfull of the cockchafers from the floor, and throwing them into a kerosene tin containing soil in the bottom. When they left off a few were still flying around the light, and others falling on the ground outside the veranda rail and were allowed to escape. On counting this catch next morning the total was 1,495.

Of these, 500 were fed to seventeen young ducks and two chickens; and on the evening of the same day another meal of 500 were devoured by the same ducks with avidity, their breakfast next morning consisting of the remaining 495. This fact suggests what an excellent poultry food could be made from the dried bodies of these cockchafer beetles. An analysis of specimens of this insect made into a kind of meal has shown its food value to be as follows:—Proteins or flesh-forming foods, 63.75 per cent.; nitrogen, 10.20 per cent.; potash, 1.75 per cent.; and phosphoric acid, 1.66 per cent.

This account of a fifteen minutes' catch shows that the fig tree referred to would be a good species for growing as a trap-tree, since it evidently has an attraction for the greyback. Specimens observed in the past at Highleigh are generally loaded with these beetles each season. From the single tree mentioned several thousand beetles have been shaken in the last few weeks.

Notes on Cultivation.

Land reserved for early planting should be kept free from weeds during the flighting season, or period when cane beetles are on the wing. A dense growth of weeds between cane rows often attracts egg-laden females of both the greyback cockchafer and French's cane beetle, the latter species being accustomed to oviposit in such places over areas of forest country. When ploughing these patches or weedy blocks later on (April to July), when the grubs of *frenchi* are quite small, these are often disregarded and left in the soil, although, as a matter of fact, they still have six months in which to feed before pupating, and after the weeds have been buried will often turn their attention to the young roots of newly planted cane setts.

CANE GRUB PARASITE FOR NORTH QUEENSLAND FROM PHILIPPINES.

The Director of the Bureau of Sugar Experiment Stations, Mr. H. T. Easterby, has received from the Entomologist at Meringa (Mr. Edmund Jarvis) the subjoined report, which deals with the recent introduction into North Queensland of a scoliid digger-wasp parasite from the Philippines, for the purpose of helping to combat the grubs of our "greyback" cockchafer.

THIS biological control work, which was first suggested and planned in February last (1930) commenced about twelve months ago, and has been undertaken in collaboration with the Entomologist of the Philippine Sugar Association, Mr. A. W. Lopez, whose laboratory is situated in Negros, P.I. During the course of our early correspondence we considered that, in view of the shortness of the journey from Cairns to Manila (about ten days), and that the pupal stage of scoliid wasps of genus *Campsomeris* occupies a period of five to six weeks, an exchange of the cocoons of our respective economic species of these useful parasites should be attended with successful results.

Before undertaking this work, the important question of suitability of climate was, of course, carefully considered, and we found conditions of temperature, &c., in Cairns and Negros to be practically similar, both places being situated about the same number of degrees from the equator.

The nature of the flora, moreover, apparently favoured such introduction, some of the species of honey-bearing plants, of herbaceous kinds, visited by Philippine scoliids, for example, happening to occur plentifully also in the Cairns district. Chief amongst these is *Stachytarpheta jamaicensis*, which in Negros is said to be a favourite feeding-plant of *Campsomeris aureicollis* Lep.; in place of which we have *Stachytarpheta dichotoma* Vahl., which closely resembles *S. jamaicensis*, but has dark blue instead of pink flowers, and is quite a common species around Cairns.

Allusion has already been made in my previous reports to the value of some of our honey-bearing plants which are much frequented by these scoliid wasps.*

Mr. Lopez opened the campaign by sending us ten cocoons of *Campsomeris aureicollis* Lep., the most useful cane grub parasite in the Philippines. These arrived in Cairns on 4th January, 1931, by the s.s. "Changte."

Our return consignment of fifteen cocoons of *Campsomeris tasmaniensis* Sauss. left Cairns by the "Taiping" on 28th February, reaching Manila on 10th March.

During the period January to May we each received and exchanged three lots of cocoons, and being fortunate enough to obtain by such means female wasps of the abovementioned species were able, by breeding same through their life-cycle stages, to definitely prove their value as controlling agents. The Philippine wasp *aureicollis* readily paralysed and oviposited on our cane grubs when placed with them in cages of soil, while our own digger wasp *tasmaniensis* was found by Mr. Lopez to be equally effective against the grubs of *Lepidiota pruinosa* and *Leucopholia irrorata*, which do most damage to cane in the Philippines.

* "Queensland Agricultural Journal," Vol. XXXV., pp. 6-9, 1931.

Our next step was to effect an exchange of living adult wasps of these two scoliids from which to breed up stocks for field liberations.

On 30th July Mr. G. H. Fairchild, secretary-treasurer to the Philippine Sugar Association, arrived in Cairns on the s.s. "Taiping" with a large consignment for us of adult wasps of *C. aureicollis*, which, when opened up, was found to contain eighty-three living specimens. These were kept in quarantine at Meringa Experiment Station during the period while Mr. Buzacott and I were breeding them, and when transferred to separate cages of moist soil adapted themselves at once to their new host grubs, viz., those of our greyback cockchafer (*Lepidoderma albohirtum* Waterh.), which at that time of year (September) were easily procured from canefields close at hand.

In this way a total of 106 eggs were obtained, all being deposited on grubs of this species, and maggots of the imported parasite were reared to the pupal stage of development.

Wasps derived from these eggs commenced to emerge from their cocoons on 10th October, and are at present being used for propagating a larger brood, which, all being well, should produce wasps in January next, when we hope to be able to make a first liberation of fertilized females in a grub-infested canefield.

It should be noted that although this Philippine parasite (when captured for shipment to Queensland) had been accustomed to depositing its eggs on the grubs of cockchafers which do not occur in Australia, it made no demur about attacking those of our principal cane-beetles, a fact which speaks well, I think, for the success of its future activities under natural conditions in our canefields.

At present (September to November) we are rearing this digger wasp on the grubs of *Lepidiota consobrina* Gir. and *L. frenchi* Blkb., which act as good intermediary hosts during the months when those of our greyback cane beetles are not available.

Description of *Campsomeris aureicollis* Lep. (Gold-collared Digger Wasp).

The female insect may be briefly described as a black, hairy-looking wasp, with shining body, blue-black wings, and a conspicuous ruff-like collar behind its head composed of long buff or golden-brown hairs. Its legs, being used for digging, are stout and strongly spined, while the short, thick antennæ, curved at the ends, are situated in front of the face and arise from amidst tufts of silver hairs. The body varies in length from 17 to 27 mm. (1 inch), the wing expanse being about 25 to 38 mm.

The male, as is usual in the scoliidæ, is very unlike its partner, from which it differs in size and general form. The body—including legs, head, and antennæ—is black; the wings pale yellowish-brown with darker nervures. The dorsal surface of abdomen is barred transversely by five conspicuous yellow bands, the posterior edges of these being fringed with long ochraceous hairs, while the anal segment terminates in three stout black spines. The blotches of pale yellow which so often afford points of specific distinction between the males of genus *Campsomeris* are disposed on the body in the following positions:—Face, above mandibles broadly bordered on three sides; frontal edge of prothoracic collar; dorsal surface of mesonotum with two oblong blotches; each side of ventral surface of abdominal segments 1 to 3, with 2 more or less triangular blotches; under surface of femora and tibiæ; and basal portion of mandibles. Body slender [see illustration], about 15 mm. in length; vestiture white or silvery; wing expanse about 30 mm (1¼ inches) [see Figs. 5, 7, and 8 on accompanying plate].

DESCRIPTION OF PLATE 26.

1 and 2. Female of *Campsomeris aureicollis* Lep. "Gold-Collared Digger-Wasp" (nat. size).
3. Female of *Campsomeris tasmaniensis* Frogg. "Queensland Digger-Wasp" (nat. size).
4. Male of *C. aureicollis* (twice nat. size).
5. Face of same, showing position of yellow blotches, in black (magnified).
6. Neuration of wings of same (magnified 5 times).
7. Dorsal surface of thorax of same, showing position of yellow blotches, in black.
8. Ventral surface of abdomen of same, showing position of yellow blotches, in black.
9. Antenna of same; 15-jointed (magnified).

Figures 1 and 2, after A. W. Lopez: 3 to 5 original.

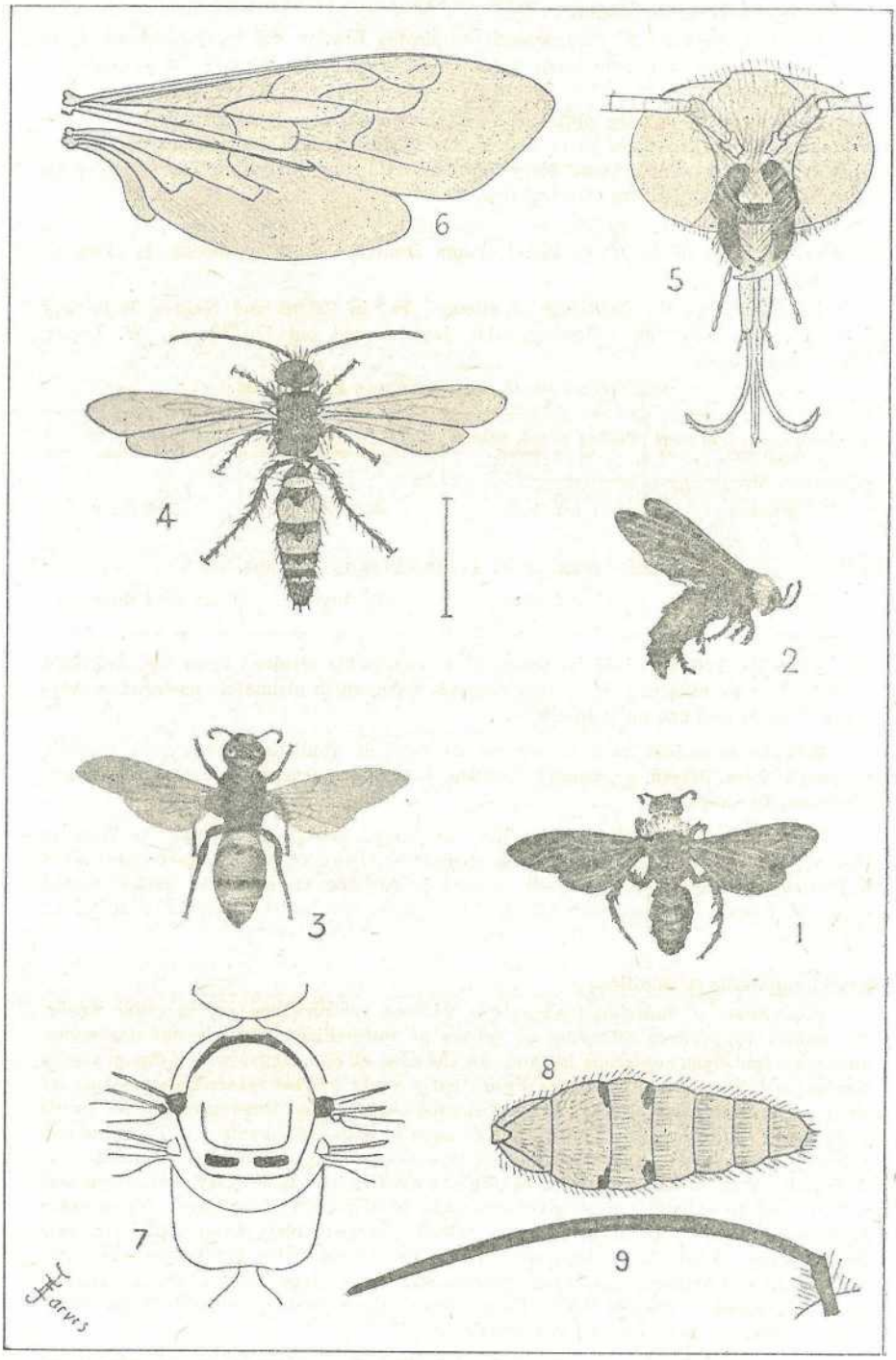

PLATE 26.

For description of plate, see page 94.

Duration of Life-cycle Stages.

The first specimen of *Campsomeris aureicollis* Lep. reared in Queensland, from egg to adult, was a female wasp which emerged on 14th January, 1931, from an imported cocoon.

Twenty-two eggs were obtained from this parasite and thirteen cocoons. The average life-cycle period of seven male wasps derived from these cocoons was thirty-nine days (the maximum being forty-four and minimum thirty-four days), under an average shade temperature of 80.62 deg. Fahr.

This corresponds very closely to the life-cycle of *Campsomeris aureicollis* in Negros, the average of which insect, taken from five male specimens, is given as 43.1 days.

As illustrating the similarity of climate, &c., in Cairns and Negros, it is very interesting to note the following table just worked out by Mr. A. W. Lopez, Entomologist:—

LIFE CYCLE OF C. TASMANIENSIS IN NEGROS.

Incubation period, average of 50 eggs.	Feeding period, average of 33 larvae.	Pupal period, average of 5 adults.	Total life-cycle, average of 5 males.
2·8 days	5·7 days	34·4 days	42·6 days

LIFE CYCLE OF C. AUREICOLLIS IN NEGROS.

2·9 days	5·2 days	35 days	43·1 days

From the 106 eggs laid by wasps of *C. aureicollis* received from Mr. Fairchild on 30th July we obtained thirty-four cocoons, from which ultimately emerged twenty-seven females and one male specimen.

Had the sexes been more evenly proportioned, it would have been quite possible to breed from fifteen or twenty females, sufficient parasites for making a first liberation in canefields.

Unfortunately, the single male lived only long enough (five days) to fertilize two of the twenty-seven females. The remainder, however, which—as occurs under parthenogenetic conditions—are at present ovipositing on our cane grubs, should certainly ensure an emergence of plenty of male specimens from the next lot of cocoons.

Parthenogenesis in Scoliidae.

Production of individual organisms without fertilization, or, in other words, the ability to produce offspring by means of unfertilized eggs, is not uncommon among certain hymenopterous insects. In the case of our digger wasps *Campsomeris tasmaniensis* Sauss. and *C. radula* Fabr., early study of this interesting question by the present writer during 1917 to 1918 showed that both of these parasites were able under such conditions of virginity to lay eggs in a normal manner, which, although yielding mostly males, will also at times give rise to a specimen of the opposite sex. A female of *C. tasmaniensis*, for example, reared in our laboratory, but which was not allowed to copulate, lived sixty-two days, laying eighty-four eggs. From these forty-five cocoons were obtained, from which emerged thirty-seven males and one female wasp. Again, a specimen of *C. radula*, also bred in the laboratory, and carefully kept unfertilized, lived for twenty-seven days, depositing nineteen eggs on grubs of *Lepidiota frenchi* Blkb. Only eight of these produced cocoons, from which finally issued seven males and one female scoliid.

On the other hand, a record number of ninety-five eggs laid by an unfertilized bred female of *tasmaniensis* during the period 11th March to 20th May, 1918, produced sixty-eight cocoons, from which emerged forty-two wasps, all being males.

Habits of the Female Parasite.

The eggs of *aureicollis* are usually deposited centro-ventrally on the third or fourth abdominal segments of the paralysed grub; the basal end, which is of slightly less diameter than the apical portion, being affixed to the skin in such manner as to cause the egg to project from the body of the grub at an angle varying from 60 to 90 deg.

In several instances, under laboratory conditions, we have found eggs attached subventrally, or on the first or fifth to seventh segments, and more rarely on the subventral anal portion.

After affixing an egg, the wasp returns to the surface, pushing its head and shoulders out of the burrow, while the rest of the body remains underground out of sight. At such times it has the appearance of a sentinal keeping watch over some hidden treasure. Under normal conditions it takes to wing on warm days between the hours of 9 to 10 a.m. in search of certain honey-bearing flowers, which are rifled of their sweets with assiduous voracity. While thus pleasurably occupied these wasps may be closely approached, and are easily captured. The food used for specimens confined in breeding cages was garden honey (1 part to 1½ parts water).

A drop or two of this syrup placed on the surface of a leaf is given once a day after the examination of each cage and removal of the paralysed grub carrying an egg of the parasite. When ovipositing freely, a female will generally produce an average of one egg a day.

Like other species of genus *Campsomeris,* this Philippine scoliid wasp, when tipped out of its cage along with the soil or otherwise suddenly alarmed, generally plays "possum," and at first sight might easily be mistaken for dead. In whatever strange position it may chance to fall in such cases, whether flat, or with body nearly vertical, or standing on its head, this wasp generally remains motionless, as though fixed and rigid in death, offering no visible sign of life.

The sting of this species causes a slight numbness and whitening of the flesh around the puncture, the pain being peculiarly keen, as though the wound were deep and inflicted by a long stinging hair of some large nettle. If handled gently, however, it makes no attempt to use its sting.

Mating generally occurs between the hours of 9 to 11 a.m., the act of copulation occupying five to nine seconds. No additional connection was observed to take place, either with its partner or other male specimens. In the case of parthenogenitic females (reared at the Experiment Station, but not fertilized) which had lived for about six weeks and laid a number of eggs, it was interesting to find that when male wasps were at length available (derived in the present instance from females of the same brood as the unfertilized wasps in question), mating, although so long deferred, took place as usual.

It appears, therefore, that in the case of these scoliid parasites, parthenogenesis enables them to produce offspring continuously throughout the year—one long, unbroken life-cycle as it were—the unfertile adult females commencing oviposition a few hours after emerging from their cocoons.

Such wonderful provision among the scoliidæ for producing an abundant supply of male wasps is probably intended to ensure at all times of the year the multiplication and activity of a class of parasites whose work is to check the undue increase of the great tribe of root-eating scarabæid grubs, many species of which—including our common greyback cane beetle and various grub pests in other countries—are included amongst the most destructive insect pests with which we have to contend.

I would like to take the present opportunity of thanking those officers of the Philippine Sugar Association who have helped in any way in this biological control work.

Special thanks are due to Dr. Atherton Lee, Director of Research, and Mr. W. A. Lopez, Entomologist, for their courtesy, keen interest, and valued co-operation, which has been greatly appreciated.

RED-STRIPE DISEASE OF SUGAR-CANE IN QUEENSLAND.

By W. COTTRELL-DORMER, Assistant Pathologist, Bureau of Sugar Experiment Stations.

PART II.

DESCRIPTION OF CAUSAL ORGANISM.

ON the completion of isolation and inoculation experiments at Ayr the morphologic and cultural characteristics of Organism W were studied in the pathological laboratory in Brisbane. Unless otherwise stated the directions given in the Manual of the Society of American Bacteriologists as issued at various times until 1930[13] for the preparation of media were closely adhered to. Three strains of the organism were used, two of which were isolated from naturally occurring lesions from Ayr and one from similar material from Gordonvale, North Queensland. The organism was studied in such a manner as to facilitate a comparison with the findings of Miss Purdy[9] as outlined in her description of *Phytomonas rubrilineans* Lee et al.

Morphology.

The organism is a short straight rod with rounded ends occurring singly, and frequently in pairs, but seldom in short chains. Forty-eight hour old stroke cultures on nutrient agar, pH 7, incubated at 27 deg. C., and stained with gentian violent showed the organism to vary in length from 2 μ to 1 μ, and in width from 0·5 μ to 0·33 μ, with an average of 1·64 μ by 0·43 μ.

No spores, endospores, zoöglœa, or pseudozoöglœa have been observed. On fourteen days' old 1 per cent. glucose beef-extract agar culture capsules were demonstrated by Richard Muir's method and by J. Kirkpatrick's method.[11]

Motility is moderate. Typically the organism possesses one polar flagellum, about two or three times its own body length, but not uncommonly two or even three are seen. For flagella staining agar cultures from one to eight or more days in age proved suitable. Success was obtained with the methods of Van Ermengen as modified by Stephens,[14] of Gray,[13] of Casares Gil,[13] and of Bailey.[1] By far the best results were obtained by the lastmentioned method. (See Plate 27.)

Gram staining failed to give positive results. Both the original method and Jensen's modification were tried together with control smears of *Staph. albus* (positive) and *Esch. coli* (negative). Twenty-four to thirty-six hour old stroke cultures on nutrient agar, pH 7, incubated at 27 deg. C. were used.

The organism stains readily with carbol fuchsin and gentian violet, but rather weakly with methylene blue. With carbol fuchsin certain portions, usually at the poles but sometimes also at the centre of the rod, stain more deeply than the remainder.

Cultural Characteristics.

Agar Stroke.

On 1 per cent. glucose beef-extract peptone agar, pH 7, seeded from an eighteen-hour old broth culture and incubated for twenty-four hours at 27 deg. C., growth is slight, flat, filiform, slightly raised, and shiny.

The colour is dirty white to colourless by reflected light and pale buff or straw by transmitted light. Consistency is shiny, and a slight amount of white sediment is present in water of syneresis. After forty-eight hours growth is moderate and very light buff in colour, no widening of base of stroke occurs. A very thin, radially striated, and almost colourless film of spread develops along margin as culture becomes older; this is quite noticeable after ten days, but if the reaction of the medium is very slightly acid this film can sometimes be noticed as early as forty-eight hours after seeding. Colour of medium remains unaltered until cultures are very old. A very faint putrefactive odour is observed.

PLATE 27.

The red-stripe bacterium is a straight rod and usually bears one polar flagellum which has two or three crimps.

(Preparation stained by Bailey's method and photographed by means of a Zeiss "Phoku" attachment.) (x 1,200 approx.)

Agar Colonies.

On 1 per cent. glucose beef-extract peptone agar, pH7, incubated at 27 deg. C., forty-eight hour old surface colonies are round, flatly convex, glistening, translucent, milky white by reflected light and pale buff by transmitted light; margin is entire, and on thinly sown plates diameter may reach 1 mm. After four days the colonies exhibit opalescence and irregular concentric markings in certain oblique lights; by reflected light the colour is a very pale buff and is straw by transmitted light; margin is still entire, and diameter has reached about 1·5 mm.; internal structure is very finely granular. Ten days old colonies, in most cases, have a slightly undulate margin and measure from 2 to 3 mm. in diameter; the internal structure is more coarsely granular, particularly at the centre, and a thin film of spread is seen around the colonies. Appearance of medium remains unaltered. Submerged colonies are punctiform, ovoid, or elliptical in shape and pale buff in

colour; as they increase in age they tend to become more or less lobate. Colonies growing against the bottom of the dish spread slowly over the glass.

On glucose agar, pH 6 and pH 6·5, forty-eight hour old colonies are surrounded by a very thin narrow concentric film, whose width is about half that of the main body of the colony, and whose surface is radially striated; this film extends, as the colony increases in size, and forms hardly perceptible concentric rings. On these media, after five days the colonies are also surrounded by a cleared halo bordered by a small amount of white precipitate in the medium.

Nutrient Broth.

Tubes of nutrient broth, pH 7, seeded with an eighteen-hour old broth culture and incubated for twenty-four hours at 27 deg. C. show faint clouding and sometimes a very thin pellicle. After forty-eight hours clouding is moderate and a thin pellicle is present from which a few small flakes hang into the medium; a slight amount of white sediment is produced. After four days the clouding is marked; the pellicle is greyish white, heaviest at the centre, and flakes hang from it which, on agitation, become dispersed in the medium producing turbidity; at the bottom of the tube a heavy viscid white sediment is formed which mixes with the liquid on continued agitation.

In broth containing 1 per cent. glucose, pH 7, the characteristics are similar, but growth is much more rapid; colorimetric tests made from time to time showed the cultures to be alkaline in reaction throughout.

Gelatine Stab.

In non-nutrient gelatine, pH 6·7, kept at room temperature (highest maximum 27·5 deg. C., lowest minimum 5·5 deg. C., during the period under consideration) growth is very slow, at first filiform, and greatest along the upper 1 in. of the stab, being almost negligible below 1½ in.; it is white to creamy white in colour. After about fifteen days it becomes more or less beaded—that is to say, lobe-like projections measuring up to about 4 mm. in diameter are produced here and there from small dense granulations along the line of growth. In nutrient gelatine, pH 6·7, growth along the stab is similar to that just described but more vigorous. Tubes of both media were kept under observation (some in a sealed jar to prevent evaporation) for fourteen weeks, but no sign of liquefaction could be observed even when the stabs were finally dissected. Tests for gelatine liquefaction on Frazier's medium also gave definitely negative results.

Gelatine Colonies.

On non-nutrient gelatine, pH 6·7, growth at room temperature is slow; after four days surface colonies are very coarsely granular and have diffuse margins; they are dull white and do not glisten. After ten days the colonies are round and white in reflected light; in oblique light centre is buff and remainder is bluish in colour; throughout a tendency towards radial and concentric structure is observed; margin is finely cilliate; colonies are each situated in a shallow depression, but medium is not liquefied; on thinly seeded plates the diameter of colonies reaches a little over 2 mm.

On nutrient gelatine, pH 6·7, surface colonies are glistening and white in reflected light and pale straw coloured in transmitted light—in this light the surface of the medium immediately below the colony has the appearance of having been etched. The surface of each colony is convex and bead-like while the medium itself is slightly depressed. Margins are finely undulate. No halo or precipitate can be observed surrounding the colonies. Submerged colonies are similar to those in nutrient agar but are very finely concentrically zoned.

Potato Cylinders.

Growth is moderate, filiform, slimy, and shiny on moist potato; butyrous, dull, and somewhat wrinkled on a drier substrate; colour is a pale reddish brown and is darker on dry potato than on moist. Seven day old cultures smell fairly strongly of ammonia, and a piece of moist red litmus paper changes to blue in a short time when placed near the potato; colour of potato gradually becomes greyish brown; no diastatic action was detected. After twenty-one days definite diastatic action was demonstrated when potato cylinders were split along the line of bacterial growth and flooded with Gram's iodine solution; a thin slice was cut off where the potato had been split and immediately below the area where the organism had been growing, a region from 1 to 3 mm. in width remained white while the rest of the slice assumed a blue colour.

Chromogenesis.

As no standard colour chart was available it has not been possible to state exactly the colours of the growths obtained on various media. In general terms the organism would be stated as being white on nutrient gelatine, very pale buff on beef-extract agar, and pale reddish brown on potato.

Oxygen Requirements.

In an atmosphere of hydrogen held in a bell jar containing also pyrogallic acid and sodium hydroxide, very good growth was obtained on freshly poured 1 per cent. glucose agar dilution plates. Hence the organism would appear to be a facultative anærobe.

Indol Production.

No indol could be detected by the vanillin test in cultures grown in peptone nitrate solution[16] with reaction adjusted to pH 7, incubated for twenty-two days at 27 deg. C.

Nitrate Reduction.

In peptone nitrate solution, pH 7, incubated for twenty-four hours at 27 deg. C., a doubtful positive reaction indicating the presence of nitrites is obtained on the addition of sulphanilic acid and a-naphthylamine. After forty-eight hours a definite positive reaction is obtained. No gas formation was observed. On 1 per cent. potassium nitrate beef-extract agar, pH 7·1, incubated at 27 deg. C., similar results are obtained.

Ammonia Production.

As has already been mentioned, a strong smell of ammonia is given off by seven-day old potato cultures. On 1 per cent. potassium nitrate beef-extract agar, pH 7·1, incubated for twenty-two days at 27 deg. C., a

positive reaction indicating the presence of ammonia is obtained on the addition of one drop of Nessler's reagent.

Diastatic Action.

On beef-extract agar. pH 6·7, to which had been added 0·02 per cent. soluble starch, incubated at 27 deg. C., weak diastatic action was detected on streak plates after seven days. After twenty-two days, when flooded with Gram's iodine solution, moderate starch hydrolysis is observed; a completely cleared zone 10 mm. in width surrounds the streak, and a further zone 10 to 15 mm. in width and port wine in colour surrounds the cleared zone, the remainder of the plate being deep blue in colour.

On beef-extract agar, pH7, plus 1 per cent. wheat starch, incubated at 27 deg. C. for twenty-two days and then treated with iodine solution, streak plates show a similar fully cleared zone as previously described; but the semi-cleared region is narrower, measuring only about 5 mm. Remainder of plate is deep port wine in colour.

Hydrogen Sulphide Production.

Stab cultures made in beef-extract lead acetate agar, pH 6·8, incubated for twenty-two days at 27 deg. C., failed to reveal any browning of the medium along the line of puncture. These results were confirmed by tests made on Wilson's fierric chloride medium.

Milk.

Milk cultures incubated at 27 deg. C. showed considerable variation; no coagulation was observed in any tubes, but clearing commenced at different times with different batches of milk; the most rapid series commenced clearing after eight days, the process being completed in twenty days; the cleared milk is lemon yellow in colour, and a heavy viscid sediment, which mixes fairly readily with the supernatant fluid, is present at the bottom of the tube; a strongly putrescent odour is evolved. The reaction of the milk becomes definitely alkaline after four days and remains so.

In litmus milk[16] a blue tint is observed after forty-eight hours; the blue colour becomes quite definite after four days; reduction of the litmus commences on about the fifth day and is complete about the eighth day. The milk later becomes cleared, and after three or four weeks is dark blue or mauve in colour.

In milk to which 0·75 c.c. of a 10 per cent. aqueous solution of methylene blue had been added per 200 c.c. of milk (as was used by Miss Purdy), reduction of the methylene blue became evident on the fourth day, and was complete on about the seventh day.

Fermentation Tests.

Tubes of beef-extract broth, pH 7, to which had been added 1 per cent. of carbon source, and each containing a Durham tube, were incubated at 27 deg. C. after seeding with one loopful of an eighteen-hour old broth culture. The carbon sources used were glucose, lactose, sucrose, and glycerine. Moderate growth accompanied by an alkaline reaction occurred in each case and no gas was produced. In another test the broth was heavily seeded with *Esch. coli.* incubated at 37 deg. C. for forty-eight hours, autoclaved, and filtered through filter paper before

the carbon sources were added. When the latter was done the reactions of the broths were adjusted as follows:—Glucose pH 6·7, lactose pH 7·0, sucrose pH 7·1, glycerine pH 6·7. They were then sterilised intermittently and seeded as above. In all four batches the same results were obtained as in the previous tests.

Indicator Sugar Agar.

To beef-extract agar, pH 7, equal parts of solutions of brom-cresol-purple and of cresol-red (as recommended in the Manual)[13] and 1 per cent. of carbon source were added—namely: Glucose, lactose, sucrose, and glycerine. Stroke cultures of the organism were prepared and incubated at 27 deg. C. A permanent alkaline reaction was registered in all tubes after a few days. No indication of acidity was observed at any time on any of the tubes during the twenty-three days they were incubated, and no gas was produced. Growth was good in all tubes, but rather better on the glucose and glycerine media than on the others.

Synthetic Peptone-free Sugar Agar.

On the synthetic medium used by Miss Purdy[9]—viz.: potassium chloride 0·2 gm., dibasic ammonium phosphate 1 gm., agar 15 gms., distilled water 1,000 ccs., to which were added the indicator mixture alluded to above and 1 per cent. of carbon source—moderate growth was obtained in all cases. An acid reaction was registered after five days' incubation at 27 deg. C. This reaction was especially marked in the cases of glucose and of glycerine with which better growth was also obtained.

Influence of Sodium Chloride.

Sodium chloride was added to beef-extract broth in the following proportions:—1, 2, 3, and 4 per cent. Tubes of the various concentrations were seeded with one loopful of a twenty-four hour old broth culture and incubated at 27 deg. C. for seven days. Growth occurred in all tubes excepting those which contained 4 per cent. of sodium chloride. The principal effects of the addition of the salt were slower growth and an increase in ring formation. The pellicle was also influenced, and in the 2 per cent. concentrations hung from the surface in streamers measuring up to half an inch in length; in the 3 per cent. tubes very little pellicle formation occurred.

Effect of Physical Conditions.

Thermal Death Point.

Tubes each containing 10 cc. of beef-extract broth, pH 7, were inoculated with two loopsful of an eighteen-hour old broth culture, and immersed almost to their necks in water at various temperatures for a period of ten minutes. They were then placed in the 27 deg. C. incubator for four days. The thermal death point was found to be about 51 deg.C.

Exposure to Sunlight.

Half of the top and one side of the lid of each of a number of petri dishes were covered with black paper which again was covered with white paper. These prepared dishes were then used for pouring several series of dilution plates with 1 per cent. glucose beef-extract agar, pH 7. The poured plates were now exposed over cracked ice to direct sunlight

at 12 noon on 31st May, 1930, for periods of ten, fifteen, twenty, twenty-five, and thirty minutes, after which they were incubated at 27 deg. C. for five days. At the end of this time no growth whatever had occurred on the exposed portion of any of the plates, whereas perfectly normal colonies were growing on all of the unexposed portions. Thus the organism is unable to survive a ten minutes' exposure to the sun under the conditions outlined.

Overwintering.

The organism was readily isolated from red leaf stripes which had been kept in a dry cardboard box for a period of seven months, including the winter season. Typical red leaf stripe infections were obtained when growing cane leaves were inoculated with a pure culture of the organism isolated from this dried material. Attempts to isolate the organism from old dried lesions collected in the field at South Johnstone, North Queensland—that is, lesions which had been exposed to all weathers for some three or four months—were unsuccessful.

Longevity of the Organism in Culture.

Only one test was made with a stroke culture on Brown's synthetic medium kept at room temperature for four months. On "subbing" this culture was found to be living. No pathogenicity trials were carried out in this instance, but other strains which had been maintained in regularly transplanted stock cultures for over one year were found to still possess apparently their full virulence.

Index Number.

According to the Descriptive Chart of the Society of American Bacteriologists, published on 30th December, 1920, the index number of the organism described above is 5322—32220—1333. If the 1929 chart be used the index number is 5020—32020—1000.

Host Relationships.

In order to obtain information on the host relationships of Organism W, leaf puncture inoculations from agar slopes were made in a number of grasses and cereals, chiefly at the main laboratory in Brisbane. Control punctures were made with a sterile needle. Most of the plants treated were grown in 4 in. by 6 in. earthenware pots in a transfer chamber. Great difficulty was experienced in trying to maintain a moist atmosphere, the relative humidity sometimes descending as low as 50 per cent., consequently the conditions under which these plants were grown were really unfavourable for infection. However, wherever the same plants were used, the results agreed with those obtained in Hawaii by Atherton Lee and his co-workers, and will therefore be briefly summarised.

The following plants were grown in pots and inoculated in the transfer chamber:—

Wheat (varieties Huguenot and Florence),
Skinless barley,
Oats (varieties Rua Kura and Sunrise),
Setaria (*Chætochloa*) *nigrirostrum, S. geniculata, S. italica,*
Sorghum (varieties Imphee and Sacchaline),

Sudan grass (*S. sudanensis*),
Broom millet (*S. vulgare*),
Johnson grass (*S. halopense*),
Tambuki grass (*S. verticilliflorum*),
Sorghum plumosum (a native grass),
Paspalum dilatatum,
Crowsfoot grass (*Dactylis glomerata*),
Japanese millet (*Echinochloa* sp.),
Italian rye grass (*Lolium italicum*),
Perennial rye grass (*L. perenne*),
Wimmera rye grass (*L. subulatum*),
Maize (variety Golden Beauty), and
Guinea grass (*Panicum maximum*).

Negative results were obtained on all of these grasses with the exception of sorghum (both varieties), broom millet, Sudan grass, Johnson grass, Tambuki grass, *Sorghum plumosum*, and maize. The results of the positive inoculations were as follows:—

Sorghum.—Small very dark areas around punctures.

Broom Millet.—Bright vermillion red areas extending to $\frac{1}{8}$ in. around punctures, with in some cases a short red stripe about $\frac{1}{4}$ in. in length and slight red exudation.

Sudan Grass.—Dark chocolate red discoloration around punctures; a few very short stripes and slight dark red exudation at wounds.

Tambuki Grass.—Lesions similar to those on Sudan grass.

Sorghum plumosum.—Punctures very dark red.

Maize.—Fairly large water-soaked areas, turning greyish green and yellow with age, and considerable watery exudation when humidity was high.

A few of the control punctures in broom millet became slightly reddened, otherwise none of them showed any discoloration.

A further sowing of all these plants on which lesions were produced, with the exception of *S. plumosum*, was later made in a small outdoor plot, together with one young plant of Badila. The cane plant and ten of each of the other plants were inoculated when two months old, control punctures being also made. That weather conditions were unfavourable in the experiment was demonstrated by the fact that only comparatively small red lesions were produced around the punctures in the Badila leaves. In the remaining plants the same results were obtained as in the transfer chamber. Later, on the advent of summer, the culture strain used in this experiment was tested on young Badila and found to be still very virulent.

In January, 1930, during hot humid weather, some grasses growing adjacent to an infected canefield at Ayr were inoculated *in situ*. Negative results were obtained on summer grass (*Panicum sanguinale*), *Paspalum dilatatum*, Guinea grass (*Panicum maximum*), Foxtail, or Rat Tail grass (*Setaria aurea*), and Elephant grass (*Pennisetum purpureum*). Leaf, leaf sheath, and stem inoculations of young actively growing sorghum, on the other hand, yielded dark red leaf stripes reaching up to $1\frac{1}{2}$ in. in length, leaf sheath stripes extending the whole length of the sheaths, and dark red localised stem lesions, both internal and external, reaching 8 in. in length.

Comparison of Top Rot with Red-Stripe of Other Countries.

The Lesions.

The appearance of red-stripe has been described in more or less detail in Hawaii by Atherton Lee and Jennings,[8] in Java by Bolle,[2] and in Louisiana by Christopher and Edgerton.[4] The lesions described and illustrated by these authors agree in almost every respect with those which occur in Queensland when plants are attacked by top rot in its various forms. Slight divergences are as follows:—

1. In Java "watery dark green limits of the lesions" were never observed. (The present writer is indebted to Mr. A. F. Bell for a translation of Miss Bolle's paper.) In Queensland, provided that the relative humidity is very high, and more particularly in wet weather, the limits of young active stripes are always dark watery green. In dry weather, on the other hand, this does not hold, and the true limits of the lesion cannot be seen, the only visible portions being those where the products of the organism have actually attacked the chlorophyll of the infected tissues.

2. In Louisiana the leaf stripes "are not confined to the leaves but extend down on the sheath," whereas in Queensland it is rarely that a stripe travels below the junction of the leaf blade with the leaf sheath. But this divergence could be accounted for on a varietal basis since, as we have pointed out earlier, the variety P.O.J. 2714 is susceptible to attacks of the leaf sheath.

3. Christopher and Edgerton also state that "usually each stripe is bordered by a yellowish or chlorotic zone of about the same width as the stripe." We have not observed this to be the case in Queensland excepting during dry or cool weather, which is unfavourable to the disease.

4. In Hawaii the stripes would appear chiefly to take their origin about midway up the leaf blade and to affect principally young ratoon. In our experience plant cane is most commonly attacked, in which case the stripes nearly always originate near the base of the leaf blade. However, when young ratoons are affected, and especially in cool, wet weather, it is by no means uncommon to find streaks in the upper half of the leaf.

The Causal Organism.

In most respects the cultural study of Organism W has yielded results which agree very closely with those reported by Atherton Lee and his co-workers[9] and by Bolle[2] concerning *Phytomonas rubrilineans*, the causal agent of red-stripe. The few differences which the writer considers worthy of note will now be tabulated—

——	Hawaii.	Java.	Queensland.
Length of bacterial chains	short	long	short
Capsules	absent	sometimes present	sometimes present
Gram stain	probably negative	positive	negative
Gelatin liquefaction	positive	positive	negative
Diastatic action	very weak	very weak	moderate
H_2S production	negative	positive	negative
Milk reaction	unaltered	unaltered	alkaline
Reaction of 1 per cent. glucose beef-extract agar	partly acid	alkaline	alkaline

Index number (1920), Hawaii: 5322—32120—1233; Java: 5321—32120—1333; Queensland: 5322—32220—1333.

Of these differences probably the most important is the failure of the Queensland organism visibly to liquefy gelatine.

Varietal Susceptibility.

Whereas in Queensland Badila (N.G. 15) is one of the varieties most susceptible to top rot, emphasis has been placed on the resistance of this variety to red-stripe in Hawaii. In both countries the disease is most active during the wet season. However, the wet season occurs during the winter in Hawaii and during the summer in Queensland. It has been our experience that even Badila is difficult to infect during cool weather, so that this difference in varietal susceptibility can perhaps be explained on a climatic basis.

Host Relationships.

In a comparison of two diseases the question of host relationships is perhaps of even greater importance than that of the cultural and physiological characters of the causal organisms which, as is well known, are apt to show considerable variation with different strains. In this respect our findings coincide exactly with those of the Hawaiian investigators. In both cases definitely negative results were obtained when inoculations were made on *Panicum maximum, Eleusine indica, Paspalum dilatatum,* and *Pennisetum purpureum*; small dark red lesions were produced on Sorghum (*Holcus*) *halopense,* and comparatively large watery lesions on Zea mays.

Conclusion.

In view of the very close agreement of most of the characteristics of the disease hitherto known in Queensland as top rot with those of red-stripe, and of the great similarity between their causal agents, we must conclude that top rot and red-stripe are identical and that they are both caused by the bacterium known as *Phytomonas rubrilineans,* Lee et al.

SOME OBSERVATIONS ON THE DISSEMINATION OF RED-STRIPE.

As has been pointed out by Atherton Lee and Weller[9] and by Bolle[2] red-stripe is primarily a disease of the parenchyma. In very young stripes the bacteria are practically confined to the inter-cellular spaces of this tissue which they occupy in enormous numbers, so much so that in cross-sections the spaces appear to be completely filled with a rich culture of the organisms (see Plates 28 and 29), which would explain the water-soaked appearance of young lesions. At night, in hot humid weather, guttation occurs at some of the stomata along the lower surface of the stripes with the production of drops of exudate which frequently contain large numbers of red-stripe bacteria. On such nights hydathode action is also very marked and serves to produce at the tips and along the margins of the leaf blades large drops of water, which run down the more upright leaves and fall from overhanging tips. In this way the bacterial exudate can be distributed over already infected stems and splashed to others. Wind and rain would, of course, bring about a wider distribution of this material. The infective nature of the exudate was demonstrated by placing a little of it on five leaf blades by means of a sterile platinum loop without wounding; three days later typical lesions were found on two of these leaves.

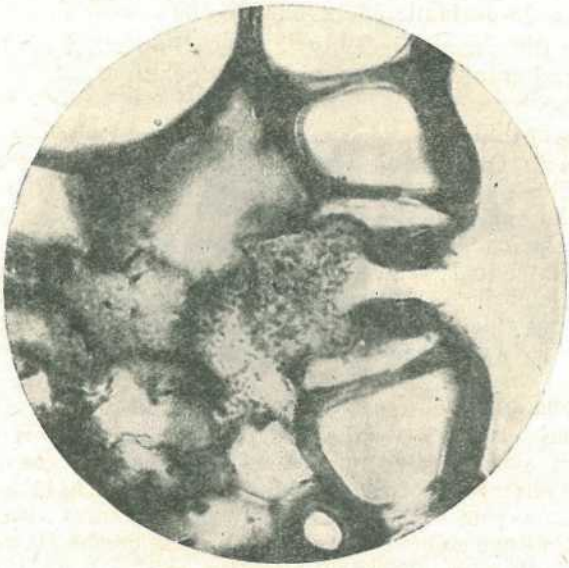

PLATE 28.

Transverse hand section through young red-stripe leaf lesions in Badila. The sub-stomatal cavities and intercellular spaces are crowded with bacteria. (x 1,200 approx.)

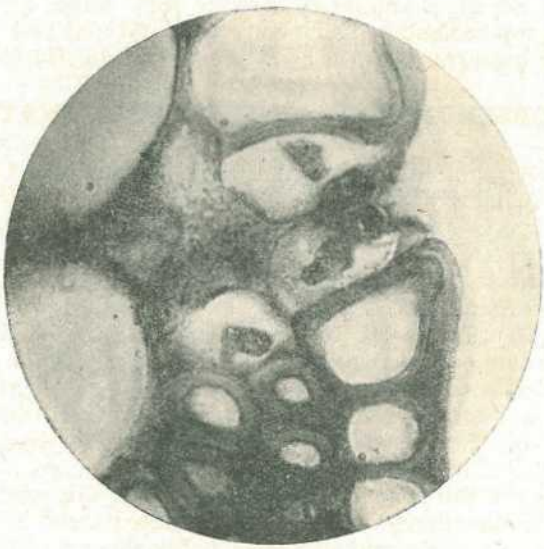

PLATE 29.

Another section showing a sub-stomatal cavity of a Badila leaf crowded with red-stripe bacteria. (x 1,200).

The infection of leaves with red-stripe is much favoured by the presence of wounds on either side of the leaf surface. Thus in one of our experiments the leaves were lightly scratched with the marginal spines of another leaf after which a bacterial suspension was applied with a platinum loop; all of the ten leaves developed red-stripe a few days later. On another occasion some splits were made about midway up a number of leaves, causing damage such as commonly occurs during a high wind. Three hours later they were lightly sprayed by means of an atomiser with a weak suspension of bacteria. The day was hot, dry, and windy, so that at the time of spraying the wounds were fairly dry, and the fine spray evaporated very rapidly after leaving the atomiser. Yet nineteen of the forty stalks whose leaves had been intentionally wounded, and four neighbouring ones which had not, later developed red-stripe, the lesions originating from the splits in the case of the wounded leaves. Ten checks had been sprayed with sterile water and remained healthy.

In the description of the disease it was pointed out that the top rot stage quite commonly occurs in the total absence of red leaf stripes. This indicates that the organism is able to penetrate other portions of the stalk as well as the leaf blade. Experiments were carried out in order to obtain some information on this point. Attempts to bring about infection by lightly puncturing the leaf sheaths with a needle previously drawn over a culture of the bacteria resulted only in small red localised lesions being produced around the punctures. Thirty-five other stems were inoculated by very gently pulling on one young or middle-aged leaf of each and then dropping a small quantity of bacterial suspension down the narrow space thus formed on the inner side of the leaf sheath. Care was taken not to cause any wounding. An equal number of other stalks were similarly treated with sterile water. Only one of the inoculated stalks developed top rot; all of the others remained quite normal.

At about the same time another experiment was carried out in which each of twenty stems were inoculated with an agar culture by means of one very shallow needle-prick just above or just below one young node. Five other stems were inoculated by placing a little bacterial growth at the upper end of a naturally occurring split in the rind of one young internode. Seventeen of the former and two of the latter stalks developed very active top rot infection without leaf stripes. These results emphasise the clear cut distinction between the two stages of the disease, and explain the occurrence of top rot infected stalks which show no red leaf stripes. They also suggest that top rot could readily be disseminated by means of any of the small insects which are commonly found under the outer leaf sheaths of cane. It also seems probable that, in the case of Badila at least, most of the cases of top rot which follow leaf infection are brought about by the washing down of bacterial exudate on to minor wounds, cracks, or insect punctures in the younger portions of the stem, rather than by way of the young leaf sheaths.

LOSSES DUE TO RED-STRIPE.

It has been stated already that the red stripes characteristic of the earlier stages of the disease usually appear during late spring and early summer, to be followed later in the season by the top rot stage. However, a heavy infestation of red-stripe in the leaves, say, in January does not necessarily signify that severe losses are to be expected later in the year for two reasons, namely:—

(1) That a period of cool weather may check the onset of the disease; and

(2) That should the top rot phase follow, shoots destroyed at this time of the year will be quite young.

Many of the shoots then showing would die in any case as the plants grew older, the possible number of stems which can be expected to reach maturity in a given field being largely governed by physical factors quite apart from the disease.

The principal losses due to red-stripe are brought about by the top rot phase. These losses are at present being made the subject of special study by this Bureau, and the results thus far obtained have been fully dealt with in a paper by the writer, which will be presented before the fourth Congress of the International Society of Sugar Cane Technologists to be held at Porto Rico early in 1932. This paper will be summarised here for the sake of completeness.

As a result of rather intense field studies of the disease made during 1930 in the worst infected fields in the South Johnstone district, several points were brought out which have an important bearing on the estimation of losses:—

1. Although the disease may be widely scattered throughout a field, stem infection of any pronounced amount is almost invariably confined to comparatively small patches in the field.
2. Within infection centres the disease does not attack stools entirely at random but favours those containing the greater number of canes.
3. The weight of healthy sticks from diseased stools is significantly greater than that of sticks from healthy stools.
4. The sucrose content of healthy sticks from diseased stools was slightly greater than that of sticks from healthy stools in a test made at South Johnstone; the difference was possibly significant.

These four points lead to the inference that the losses due to the disease are not so great as would appear at first sight. In order to test this hypothesis, an experimental method was evolved, based on the South Johnstone studies, which aimed at imitating in a yield trial a severe natural outbreak of top rot. An experiment was laid out at Ayr, North Queensland, in February-March, 1931, in the form of a Latin Square containing five treatments. The treatments were as follows:—

A—No treatment.

B—5 per cent. of "tops" of stalk cut off below growing point.

C—10 per cent. of "tops" of stalk cut off below growing point.

D—20 per cent. of "tops" of stalk cut off below growing point.

E—20 per cent. of stalks inoculated with a pure culture of causal organism at about growing point.

The trial was harvested in August, and the following are the averages of yields and sugar contents recorded:—

	A	B	C	D	E
Cane, tons per acre ..	44·58	43·13	40·43	42·65	39·53
C.C.S.	14·94	15·17	16·34	16·05	15·38

It will be seen that the greatest difference between mean yields is that between A (untreated) and E (20 per cnt. inoculated). However, the difference is not significant when examined statistically, so that it cannot

be definitely stated that the difference was actually due to treatment. This may be because of lack of uniformity, as the trial was carried out in irrigated cane, or perhaps because the loss due to treatment actually was insignificant owing to the increased growth of untreated canes. The c.c.s. figures recorded suggest a further compensation of loss by increase of commercial sugar content. The results of this experiment are not sufficiently clear cut to be used in the estimation of losses due to red-stripe, and we plan carrying out two repetitions of the experiment on unirrigated land in districts of greater natural rainfall early in 1932. However, the results do support our view that losses are lower than they seem, especially when it is remembered that 20 per cent. death of stalks only occurs in comparatively small patches of affected fields. Finally we must make it clear that we do not maintain that severe losses never do occur, but we consider that such cases are unusual if not very rare.

NOTE ON MOTTLED-STRIPE DISEASE.

Under the name of mottled-stripe, a bacterial disease of sugar-cane in Louisiana has recently been described and illustrated by Christopher and Edgerton.[4] This disease is characterised by the presence of one or more narrow stripes on the leaf blade. The stripes are stated to be "predominantly red in color, though frequently white areas or white margins occur. This difference in color often gives the appearance of red on a white background. . . . . The stripes run parallel to the leaf veins, and range in length from very short up to a meter or more, while the width is usually from 1 to 4 mm. One to many stripes may occur on the same leaf. When many stripes occur they sometimes coalesce, forming mottled red and white bands. A microscopic examination of the diseased tissue shows the presence of motile bacteria in great numbers, though bacterial exudation on the surface of the leaves has not been observed."

In their paper the authors give a technical description of the causal organism and propose for it the name *Phytomonas rubrisubalbicans*. This bacterium is "a motile, short rod, slightly curved, with rounded ends and polar flagella."

Widely distributed in Queensland cane-growing areas, a disease, which agrees very closely with the description and the illustration given by Christopher and Edgerton, has been known for some time. Pending further study we propose referring to it by the name of mottled-stripe. It occurs chiefly in Badila, though this variety is considered to be resistant to mottled-stripe in Louisiana. Up to the present it has proved of no economic importance, and very little attention has been devoted to it. As in the case of mottled-stripe of Louisiana, the Queensland disease is caused by a slightly curved rod-shaped bacterium with polor flagella.

Since in field observations some confusion might arise between this disease and red-stripe, it should be pointed out that the principal difference between the lesions lies in their colour. Whereas those of red-stripe are almost entirely a bright scarlet red generally marked with exudation stains, those of mottled-stripe are a pale yellow speckled to a greater or lesser extent with vermillion and bear no marks of exudation. Sometimes the stripes are almost wholly yellow, and at other times vermillion is the predominant colour. Furthermore, mottled-stripe has not yet been known to produce a top rot.

Microscopically the causal organisms of the two diseases present marked differences in their shape and in the form and disposition of their flagella (cf. Plates 27 and 30.) Examinations of thin sections of young lesions also reveal histological differences since while the red-stripe organism is present in great numbers in the spaces between the cells of the affected tissues (see Plates 28 and 29) that of mottled-stripe occurs in comparatively small numbers, and these are often very hard to find.

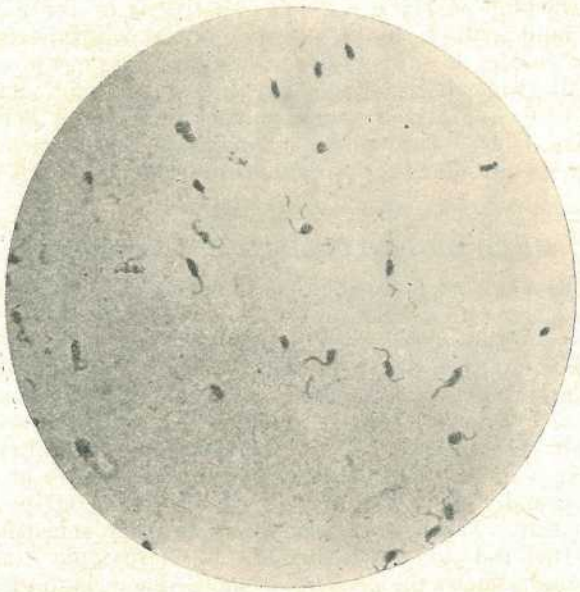

PLATE 30.

The causal organism of Queensland mottled-stripe is a slightly curved rod commonly bearing two or more short curved polar flagella. (x 1,200 approx.)

Technique Employed for Staining Bacteria within Plant Tissues.

Permanent mounts of sections of tissues of plants which have been attacked by bacterial disease are very useful for reference purposes, especially if the bacteria can plainly be seen *in situ*. The principal difficulty met with in this connection is the rapid decolorising of the organisms during passage through the final alcohols. In overcoming this drawback the writer has found the following method of mordanting (based on van Ermengen's flagella stain) and staining very satisfactory with sugar-cane diseases:—

Fixing: Material may be fixed in Bouin's fluid and hardened in usual manner.

Mordant: Three solutions are required—

A.	2 per cent. osmic acid in distilled water	1 part.
	70 per cent. alcohol	3 parts.
	Mix immediately before use.	
B.	Tannic acid	0·1 gm.
	70 per cent. alcohol	10 cc.
C.	Silver nitrate	0·1 gm.
	70 per cent. alcohol	30 cc.

Solutions B and C may be prepared some hours before use, if desired.

Stain—

1. Carbol fuchsin (full strength) .. .. 1 part.
   70 per cent. alcohol .. .. .. 1 part.
2. Light green—1 per cent. solution in 95 per cent. alcohol.

Procedure: Bring sections into 70 per cent. alcohol—

(*a*) Place in solution A 1 minute, wash in 70 per cent. alcohol 1 minute.

(*b*) Place in solution B and wash in 70 per cent. alcohol 1 minute each.

(*c*) Place in solution C and wash in 70 per cent. alcohol 1 minute each.

(*d*) Stain in stain 1 for 15 to 20 minutes.

(*e*) Decolorise in 70 per cent. alcohol a few seconds and take into

(*f*) Stain 2 for a few seconds; then take rapidly through 95 per cent. alcohol and absolute; clear in clove oil and mount in canada balsam.

SUMMARY.

Red-stripe disease of sugar-cane, which has been reported from Hawaii, Java, the Philippine Islands, and Louisiana, is now looked upon as being the same as a disease which has for many years been known in Queensland under the name of "top rot." Badila, which is the staple variety in those regions of the State where the disease is most prevalent, is the variety principally affected.

The disease causes a red striping of the leaves and a top rot of the stalk. These phases of the disease may occur together or either may appear in the absence of the other.

In a series of isolation and inoculation experiments a certain bacterium was found in leaf and stem lesions and was proven to be the causal agent. A cultural study of this organism and a brief study of its host relationship yielded results which agreed very closely with those of workers on red-stripe disease in other countries. As a result of these studies the conclusion has been reached that, in spite of certain minor differences, the causal organism of Queensland top rot must be considered to be identical with *Phytomonas rubrilineans* Lee et al., which causes red-stripe in other countries.

Some observations made in the field show that both the red leaf stripe and the top rot stages of the disease could readily be disseminated by wind and rain.

The view is put forward that losses due to red-stripe are seldom serious.

Another bacterial stripe disease of sugar-cane which, in some respects, is similar to red-stripe is also found in Queensland. This disease bears marked resemblance to the disease known as mottled-stripe which has recently been described in Louisiana. It is proposed tentatively to call this second disease in Queensland mottled-stripe.

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THE SOILS AND IRRIGATION WATERS OF THE BURDEKIN DELTA.

By H. W. KERR and N. G. CASSIDY.

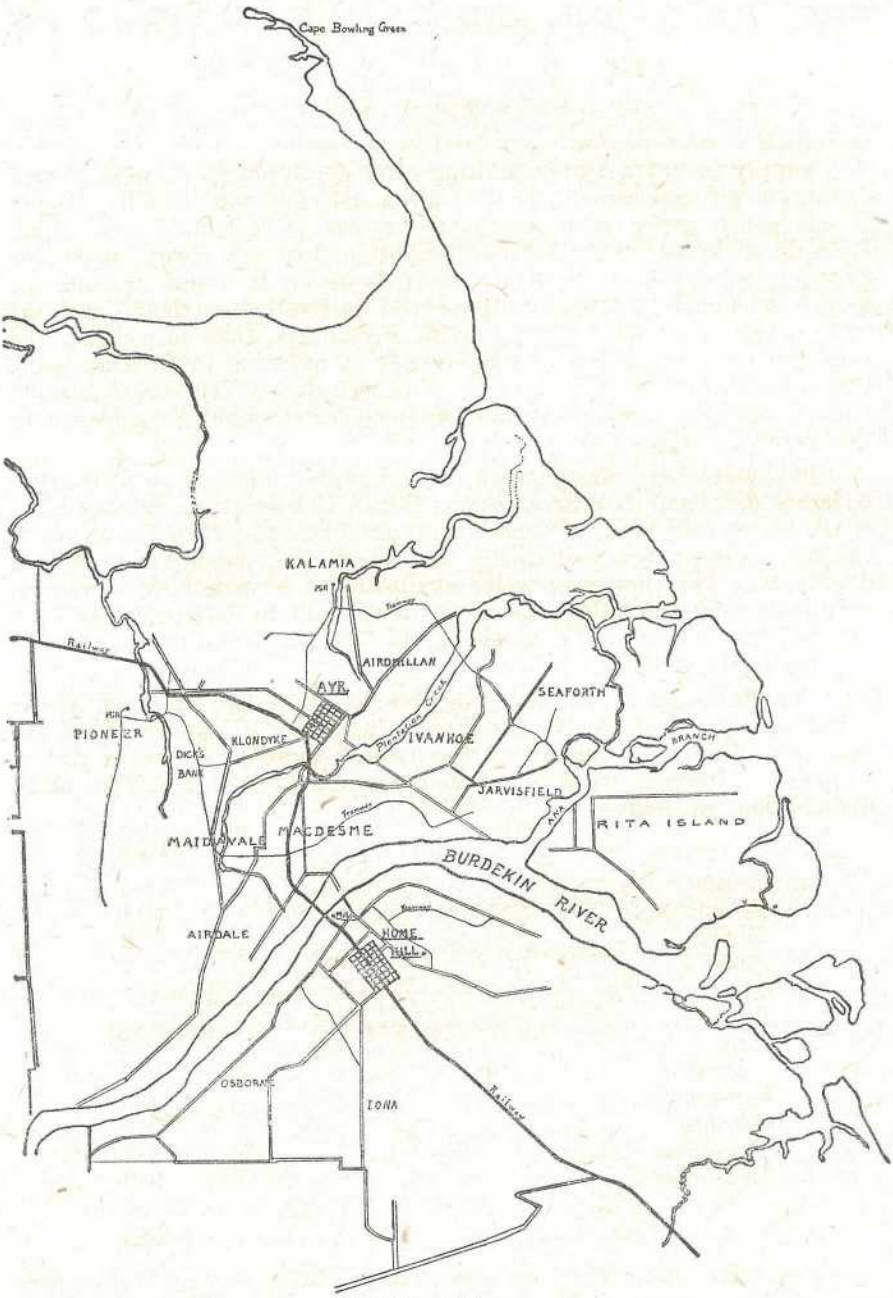
THERE is no canegrowing district in Queensland where soil moisture supply is not a factor limiting crop development at some period during the growing season. In the Cairns area, for example, a dry spring is commonly experienced, and even in the more humid belt—from Babinda to Tully—the rainfall distribution does not always make for maximum crop yields. In these areas, however, it would probably be more economical to attend to improved cultivation methods, and the more extensive use of lime and artificial manures, than to consider the employment of irrigation in any attempt at reducing production costs. Our experimental trials, both on the Northern Sugar Experiment Station and on growers' lands, have demonstrated what might be achieved in this regard.

In the Mackay and Southern areas, however, there is no doubt that moisture deficiency is a most serious factor. These areas embrace some of the better cane lands of Queensland; yet, excluding exceptional years, the cane yield per acre is decidedly low, due to the incidence of prolonged dry spells. The supply of water available for irrigation is, moreover, very restricted, and little attempt has been made to date to utilise what is available, chiefly on account of the cost of installing a suitable distributing system.

The Burdekin area which lies between these two extremes is the driest cane-growing area in the State. Reference to the records of the past forty-four years shows that the average annual rainfall of Ayr is 42 inches. However, when this value is examined in the light of monthly distribution, we find—

	Mean Monthly Rainfall. Inches.
January	11·4
February	9·1
March	6·9
April	2·7
May	1·1
June	1·5
July	0·7
August	0·6
September	1·5
October	0·9
November	1·7
December	3·9
Total	42·0

The table shows that, on the average, little rain of value falls between the months of March and December. The individual records show, further, that the range of variation between annual registrations is extremely great—thus, in 1923 and 1926, 11·4 and 19·6 inches respectively were recorded; while in 1927 and 1929 the respective registrations were 55·2 and 57·6 inches. Under conditions of natural rainfall, then, cane-growing in the Burdekin area would be a most precarious undertaking. Fortunately, Nature has provided the ready



SKETCH MAP

OF THE

LOWER BURDEKIN

SHOWING SUB-DISTRICTS.

PLATE 31.

means for making good the moisture deficiency, and by employing the abundance of sub-artesian water which is found throughout the delta some of the finest crops of cane produced in Queensland are grown on these lands by the aid of irrigation.

Soils of the District.

As might be anticipated, the variations in soil texture from point to point are very marked. The delta has been deposited, worked and reworked by the flood waters as the river found its way to the sea, first by one channel and then another. We find, then, every variety of soil, from the recent sands and silts adjacent to the river bank to the finer textured loams and clays in the more remote areas. The alternation of river mouths has also resulted in the deposition of sands and silts on clay deposits, and *vice versâ*, so that wide variations in soil texture exist over even small areas.

The recent sandy and silt loams are extremely fertile. The material deposited by the river in time of flood has been carried down from the drier back country, where rock disintegration proceeds with but slight decomposition, and the resulting alluvials are able to yield large amounts of plant-foods for the support of the cane crop. Heavy tonnages are harvested from these lands, often without irrigation; but the natural abundance of nitrogen which characterises these soils generally results in the failure of the crop to mature fully, and the sugar content of the cane is frequently low.

The clay soils of the district which are devoted to cane culture are restricted in area, and are generally unfavourable agricultural soils under irrigated conditions. The loams and silt loams lie intermediate to the above two classes, and in general are good quality farming soils. Chemically they show a general abundance of available phosphoric acid and potash, though there are exceptions. Experimental plot returns to date have shown little or no response wherever these plant-foods have been applied on plant cane. The crops do, however, respond to applications of sulphate of ammonia, and this seems to present a valuable clue to the elucidation of an important problem which confronts canegrowers in the area—the growing of profitable ratoon crops.

The Ratoon Problem.

Although even the oldest lands of the area will, following a fallow, produce up to 50 tons of cane per acre as a plant crop, the first ratoons may not exceed 10 tons. There is obviously something wrong with the system of working, for the land is certainly capable of yielding a further 50-ton plant crop after another year's fallow. The stool established by the heavy plant crop ensures a good start for the ratoons, but very soon growth ceases, and results are most disappointing.

This problem is at present receiving the earnest consideration of the leading growers of the area, and it would appear that the solution is in sight. A number of important points must be kept clearly in mind in devising a more satisfactory plan of procedure. Firstly, the system of irrigation employed results in a greater or lesser degree of earthing up to the cane, so that the stool is eventually growing on a hill with the water furrow between the rows. We have seen that during the harvesting season (June to December) the weather is generally dry, so that the young ratoon shoots are drawing vigorously on the depleted moisture supply of this dry hill of soil. When the available moisture has been used up, the ratoons must receive a further supply of water or perish. Now,

the problem of applying the water where it is required—that is, along the row of stools—also presents some difficulties under the system. Undoubtedly, the first operation following immediately on harvesting and burning off should be to level down the field, chopping off the upper portion of the old stubble so as to encourage the deeper stubble eyes to develop. The use of the bumper discs is useful in this regard, and of recent seasons the careful use of the rotary hoe cultivator has been found to give good results. What is really required is some form of efficient stubble-shaver. An early application of water should then be made to supplement the scanty supply remaining in the soil from the previous wet season.

The second point requiring consideration is that of providing an adequate supply of available plant-food to the ratoon crop early in its lifetime. We have stated that the plant-food which appears to be most seriously lacking in the soils of the area is nitrogen. Even though a good supply of nitrate may accumulate in the soil as the result of the fallow, and provide for the needs of a heavy plant crop, the amount available to start the young ratoons may be very slight; and unless the deficiency is corrected the crop cannot thrive. Regarding the supply of potash and phosphate, we are at present attempting to determine the need for applications of these constituents; but the need for nitrogen—preferably in the form of sulphate of ammonia—is undoubtedly established.

The third important point raised by the discussion is that of the maintenance of a favourable soil condition—to provide for the ready absorption and retention of moisture, to allow of the free development of the new root system of the young ratoons, and for the aeration necessary for the functioning of the nitrifying and other bacteria. It is this third aspect of the problem which prompted the present investigation.

Soil Conditions.

It is a characteristic of many of the Burdekin soils to "run together" when wet and to shrink, crack, and bake to an intractable cake on exposure to the sun. This is the case even with soils which are rich in sand and contain only a comparatively small percentage of clay. The difficulty is obviously due to the fact that the clay in these soils is highly dispersed, and these fine particles act as a cementing agent to bind together the silt and sand grains as the soil moisture evaporates.

This condition in the soil is most undesirable from the point of view of the added cost involved in reproducing a state of favourable tilth, following an irrigation or a heavy fall of rain, and, as was indicated, it means that the surface soil is generally hard and badly packed when the crop is harvested, making ratooning operations or even ploughing out of the old stools a difficult job. A compacted soil also makes for a rapid loss of soil moisture by surface evaporation. There are definite indications that the condition of the soil is becoming worse in this respect, and it is a matter for immediate attention.

An attempt to determine the cause of the trouble is a question which presents some difficulty. It might be due wholly or in part to one or more of the following causes:—

(*a*) The nature of the irrigation water.

(*b*) The mechanical effect of the prolonged trickling of the irrigation water over the soil surface.

(*c*) A natural condition of the soil in its virgin state, readily aggravated by the above causes.

It is proposed to discuss these factors in some detail, and to present a picture of the conditions as we see them as a result of our studies.

First of all, we might try to explain what is meant by the "dispersion of the clay," as mentioned above. Now, all soils (excepting pure sands) contain a greater or lesser proportion of the material called clay. Clay is the name given to the very finest particles of soil, and the name is applied independently of the nature of these fine particles. Most farmers will readily refute any suggestion that their soil contains clay, but they may be reassured by the fact that the clay portion of the soil is most valuable from the point of view of the supply of plantfoods to the crop, promoting a good water-holding capacity, and other important properties of the soil. It is only when the proportion of clay exceeds a certain amount, or when it assumes an unfavourable condition, that it becomes troublesome.

Many readers will probably be acquainted with the red volcanic soils. These constitute important agricultural areas in this State, such as portions of the Bundaberg and Innisfail sugar areas, and the Atherton Tableland. The volcanic soils contain a high proportion of clay, yet they are singularly satisfactory from the point of view of tillage and cultivation. The fact is that much of the clay consists of iron oxide and similar compounds which do not readily assume an adverse condition and which are free from the characteristic properties of a sticky clay. On the other hand, we are probably also acquainted with the black "glue-pot" soils, which require extreme care with respect to cultural operations, and can only be worked successfully when the moisture content of the soil is extremely favourable.

If we were to examine these two soils we might show that they contained identical proportions of clay; yet how differently they behave under cultivation. The difference is entirely due to the characteristics of the clay. In the red soil we say that the clay remains "flocculated"; in the glue-pot soils it is readily "dispersed" or puddled if worked under wet conditions. A homely illustration might bring out the distinction more clearly. We notice that when animals trample around a waterhole, the water becomes thick with suspended clay; this clay has been "dispersed" or puddled by the trampling of the animals, and it does not settle readily on standing. If we wish to clarify this water we might add a small amount of lime, or, better still, alum. These materials bring about a change in the clay particles so that they collect into aggregates and settle readily to the bottom. This process is known as flocculation, and the difference between the properties of our good and bad soils is just the difference between the flocculated and dispersed clay particles which they contain. Any farmer who has used lime to improve the condition of a heavy soil will readily understand the difference which we have tried to explain.

Besides the mechanical treatment of clay to bring about dispersion (such as the trampling of animals or ploughing the soil when wet), the condition might also be affected by chemical treatment. We have seen that lime and alum were substances which brought about flocculation; there are other substances which work in the opposite direction and favour the dispersion of the clay. Such a substance is carbonate of soda (washing soda). Now this compound is sometimes found in natural

waters, and in dry regions is a type of salt which accumulates in the soil to produce so-called "black alkali" lands—lands which are of little agricultural value until the harmful black alkali has been destroyed or removed.

Let us now examine our Burdekin soils in the light of the foregoing discussion. We have stated that this is a "dry" area; however, the rainfall is sufficiently high to prevent any accumulation of carbonate of soda under natural conditions. What about our irrigation waters? Do they supply anything of this nature which might react harmfully?

Irrigation Waters.

Early analyses of waters from the Burdekin area indicated that at least certain of them carried appreciable amounts of carbonate of soda. The continued use of large amounts of such waters would tend to disperse the clay particles of the soil, making it sticky and difficult to work and thus reducing its productive capacity. This prompted an attempt to effect a survey of all the irrigation waters employed in the delta. Our local field officer and one of the writers has been engaged in this work over the past several months, and it is felt that sufficient data are now at hand to present a general statement concerning them.

In all, we have secured the analyses of about 300 waters. The samples were taken by Mr. A. P. Gibson as opportunity arose, and forwarded to Brisbane for analysis. The detailed results of the work are presented in the following table:—

Lab. No.	Salt (NaCl) (grains per gallon).	Total Alkalinity (grains per gallon).	Free Alkalinity (grains per gallon).	Hardness (Grains per Gallon).		
				Total.	Temporary.	Permanent.
49	30·7	15·2	11·5	3·7	..	..
50	13·6	17·0	13·3	3·7	..	..
81	2·1	5·3	1·1	4·2	..	..
82	2·5	7·3	1·9	5·4	..	..
83	2·2	6·1	1·4	4·7	..	..
84	4·2	8·8	2·8	5·9	..	..
85	5·2	..	..	6·7	4·0	2·7
86	2·5	6·1	3·3	2·8	..	..
87	2·2	5·6	3·2	2·4	..	..
88	2·0	5·4	2·3	3·1	..	..
89	2·4	9·7	7·0	2·7	..	..
90	32·5	15·3	1·9	13·4	..	..
91	15·6	5·5	0·1	5·4	..	..
92	2·2	7·2	3·8	3·4	..	..
93	5·7	10·9	4·5	6·4	..	..
94	2·8	..	..	6·8	5·4	1·4
95	6·7	12·1	3·9	8·2	..	..
96	6·2	17·5	9·7	7·8	..	..
97	10·5	..	..	15·0	9·8	5·2
98	13·0	..	..	20·9	9·2	11·7
99	10·2	..	..	14·0	8·4	5·6
100	1·8	3·3	1·1	2·2	..	..
101	4·9	6·6	3·4	3·1	..	..
102	2·8	9·2	3·3	5·9	..	..
103	4·7	7·8	1·5	6·3	..	..
104	3·0	6·8	1·9	4·9	..	..
105	7·2	16·9	7·0	9·8	..	..
106	9·8	..	..	19·8	18·9	0·9
107	4·1	10·5	3·0	7·5	..	..
108	9·5	..	..	13·5	13·5	..

Lab. No.	Salt (NaCl) (grains per gallon).	Total Alkalinity (grains per gallon).	Free Alkalinity (grains per gallon).	HARDNESS (GRAINS PER GALLON).		
				Total.	Temporary.	Permanent.
109	9·0	13·6	2·8	10·8	..	..
110	4·6	9·0	2·7	6·3	..	..
111	29·4	18·4	8·9	9·5	..	..
112	30·6	18·8	9·7	9·1	..	..
113	17·9	..	..	10·5	6·6	3·8
114	208·0	..	..	27·1	7·9	19·2
115	110·0	..	..	20·0	8·0	12·0
116	27·8	..	..	14·7	12·4	2·2
117	1·6	1·8	1·8	Nil	..	..
118	24·8	..	..	17·3	8·5	8·8
119	1·4	3·1	1·3	1·8	..	..
120	107·5	..	..	27·0	19·7	7·3
121	9·4	..	..	10·1	6·6	3·5
122	3·1	4·5	0·4	4·1	..	..
123	3·1	7·7	1·1	6·6	..	..
124	113·0	22·5	8·9	13·6	..	..
125	73·0	..	..	21·8	17·2	4·5
126	23·0	12·2	4·3	8·0	..	..
127	1·0	2·5	1·5	1·0	..	..
128	1·8	6·7	0·9	5·8	..	..
129	52·3	..	..	26·2	14·4	11·8
130	5·5	5·2	5·2	Nil	..	..
131	6·7	8·0	2·7	5·2	..	..
	11·0	..	..	10·3	6·8	3·5
	11·6	..	..	11·3	8·4	2·9
169	4·0	8·2	2·8	5·4	..	..
170	1·7	4·4	1·6	2·8	..	..
171	3·5	6·8	2·5	4·3	..	..
172	2·8	4·4	4·1	0·3	..	..
173	3·4	7·9	2·7	5·2	..	..
174	2·3	7·6	2·0	5·6	..	..
175	1·9	7·0	2·1	4·9	..	..
176	2·5	8·6	4·9	3·7	..	..
177	2·5	7·4	2·3	5·1	..	..
178	4·0	8·2	2·8	5·4	..	..
179	2·2	6·8	2·8	4·0	..	..
180	5·6	9·6	3·1	6·5	..	..
181	6·6	12·9	3·8	9·1	..	..
182	6·2	..	..	8·4	7·9	0·5
183	6·4	6·6	1·2	5·4	..	..
184	5·6	9·5	3·0	6·5	..	..
185	2·3	6·1	2·1	4·0	..	..
186	13·6	..	..	22·7	16·1	6·6
187	13·1	..	..	16·1	10·8	5·3
188	2·6	7·4	2·9	4·5	..	..
189	2·4	6·0	1·8	4·2	..	..
190	2·4	6·6	2·3	4·3	..	..
191	2·4	10·1	5·0	5·1	..	..
192	4·0	8·6	3·0	5·6	..	..
193	10·9	..	..	15·7	8·7	7·0
194	4·9	8·7	2·2	6·5	..	..
195	7·2	9·1	2·6	6·5	..	..
196	12·3	..	..	20·3	8·9	11·4
197	10·8	..	..	13·8	11·0	2·8
233	8·1	10·0	2·5	7·5	..	..
234	3·6	9·6	2·3	7·3	..	..
235	3·8	17·5	4·4	13·1	..	..
236	3·0	6·6	2·6	4·0	..	..
237	2·2	7·8	2·4	5·4	..	..
238	3·6	9·1	4·6	4·5	..	..
239	11·6	..	..	15·7	10·8	4·9
240	7·4	9·7	1·7	8·0	..	..
241	2·6	7·9	3·0	4·9	..	..

Lab. No.	Salt (NaCl) (grains per gallon).	Total Alkalinity (grains per gallon).	Free Alkalinity (grains per gallon).	Hardness (Grains per Gallon).		
				Total.	Temporary.	Permanent.
242	4·0	6·2	1·1	5·1	..	..
243	2·5	4·3	1·0	3·3	..	..
244	3·4	6·6	4·7	1·9	..	..
245	25·0	..	..	25·7	22·8	2·9
246	1·9	7·1	4·4	2·7	..	..
247	2·4	8·4	5·0	3·4	..	..
248	2·7	6·6	1·6	5·0	..	..
249	2·2	6·6	4·9	1·7	..	
250	2·3	5·9	1·4	4·5	..	..
251	4·7	9·0	1·7	7·3	..	..
252	3·5	8·0	2·2	5·8	..	..
253	2·3	6·4	2·6	3·8	..	..
254	3·1	9·0	3·4	5·6	..	..
255	2·3	8·5	2·6	5·9	..	..
256	4·2	9·1	2·1	7·0	..	..
257	1·5	3·9	1·3	2·6	..	..
258	1·8	4·7	1·9	2·8	..	..
259	2·8	10·1	7·1	3·0	..	..
260	4·3	12·2	5·6	6·6	..	..
261	24·4	..	..	18·6	16·5	2·1
262	36·7	..	..	24·0	19·6	4·4
263	22·0	..	..	10·7	6·8	3·9
264	23·2	..	..	11·7	6·7	5·0
265	31·0	..	..	21·0	19·5	1·5
266	2·7	4·8	1·7	3·1	..	..
267	2·3	3·8	0·7	3·1	..	..
268	1·4	5·2	2·2	3·0	..	..
269	2·8	5·5	1·3	4·2	..	..
270	..	4·2	0·4	3·8	..	..
271	25·1	..	..	29·2	24·8	4·4
272	1·7	4·2	0·7	3·5	..	..
273	2·4	5·6	3·3	2·3	..	..
274	8·6	..	..	9·1	6·4	2·7
275	4·6	8·7	2·6	6·1	..	..
276	2·7	7·2	1·4	5·8	..	..
277	3·2	13·2	2·9	10·3	..	..
278	4·3	11·2	1·6	9·6	..	..
279	4·3	13·7	2·5	11·2	..	..
280	3·0	6·4	1·3	5·1	..	..
281	3·4	12·6	4·9	7·7	..	..
282	2·2	5·3	2·0	3·3	..	..
283	2·5	7·5	2·3	5·2	..	..
284	2·2	4·6	1·6	3·0	..	..
285	3·5	5·5	1·8	3·7	..	..
286	3·2	9·8	6·1	3·7	..	..
287	6·2	9·5	5·5	4·0	..	..
288	2·0	6·5	1·4	5·1	..	..
289	2·0	3·0	1·6	1·4	..	..
290	2·0	3·3	1·0	2·3	..	..
291	1·6	3·3	0·5	2·8	..	..
292	5·5	10·2	1·5	8·7	..	..
293	2·0	3·8	1·9	1·9	..	..
299	7·4	9·2	1·1	8·1	..	..
300	10·0	19·6	12·7	6·9	..	..
301	1·4	3·8	1·4	2·4	..	..
302	1·5	5·1	3·4	1·7	..	..
303	63·8	..	..	20·9	8·5	12·4
304	17·0	..	..	19·3	11·5	7·8
305	14·6	9·1	1·5	7·6	..	..
306	4·0	7·4	1·9	5·5	..	..
307	6·7	21·9	9·2	12·7	..	..
308	2·0	4·2	1·0	3·2	..	..
309	4·9	9·1	1·0	8·1	..	..
310	3·4	5·2	0·9	4·3	..	..

Lab. No.	Salt (NaCl) (grains per gallon).	Total Alkalinity (grains per gallon).	Free Alkalinity (grains per gallon).	HARDNESS (GRAINS PER GALLON).		
				Total.	Temporary.	Permanent.
311	3·4	8·8	4·5	4·3	..	..
312	2·0	2·6	1·6	1·0	..	..
313	2·0	5·2	1·8	3·4	..	..
314	3·0	11·8	7·9	3·9	..	..
315	15·7	..	..	21·6	11·5	10·1
316	118·6	23·9	1·4	22·5	..	..
317	10·0	10·8	2·0	8·8	..	..
318	3·9	8·6	3·4	5·2	..	..
319	2·0	4·4	1·3	3·1	..	..
320	2·2	4·0	3·0	1·0	..	..
321	8·9	..	..	9·5	4·7	4·8
322	5·0	6·7	2·2	4·5	..	..
323	4·9	4·7	2·5	2·2	..	..
324	7·3	..	..	6·9	6·5	0·4
325	1·8	2·5	1·7	0·8	..	..
326	9·9	23·4	6·0	17·4	..	..
327	2·5	4·4	3·3	1·1	..	..
328	2·4	3·9	1·7	2·2	..	..
334	3·9	6·4	2·2	4·2	..	..
335	4·8	8·5	1·8	6·7	..	..
336	6·9	7·1	1·5	5·6	..	...
337	4·0	5·9	1·2	4·7	..	..
338	4·4	3·5	3·1	0·4	..	..
339	3·0	6·8	1·2	5·6	..	..
340	3·1	6·4	1·7	4·7	..	..
341	3·3	7·4	1·6	5·8	..	..
342	19·6	16·1	1·5	14·6	..	..
343	4·1	8·6	3·0	5·6	..	..
344	5·0	8·6	2·5	6·1	..	..
345	5·0	8·6	2·8	5·8	..	..
346	8·1	9·0	2·5	6·5	..	..
347	3·4	8·5	2·9	5·6	..	..
348	4·2	9·9	3·1	6·8	..	..
349	2·6	7·5	2·7	4·8	..	..
350	1·5	4·8	3·5	1·3	..	..
351	2·2	7·1	2·2	4·9	..	..
352	62·2	..	..	32·6	26·0	6·6
353	36·0	..	..	29·2	22·8	6·4
354	3·0	7·5	2·3	5·2	..	..
355	3·3	7·5	0·8	6·7	..	..
356	6·3	7·6	0·2	7·4	..	..
357	2·5	5·6	0·4	5·2	..	..
358	3·7	8·4	3·0	5·4	..	..
359	1·6	4·6	0·7	3·9	..	..
360	2·5	5·8	0·2	5·6	..	..
361	2·1	6·4	1·6	4·8	..	..
362	5·2	6·1	1·9	4·2	..	..
363	2·3	9·9	0·6	9·3	..	..
364	17·5	8·0	1·1	6·9	..	..
365	13·0	..	..	12·7	8·7	4·0
366	9·9	..	..	10·3	6·7	3·6
367	3·1	9·4	2·6	6·8	..	..
368	3·3	8·1	2·5	5·6	..	..
369	4·8	11·8	1·7	10·1	..	..
370	5·1	..	..	7·5	7·1	0·4
371	3·1	7·0	3·1	3·9	..	..
372	5·6	10·6	6·1	4·5	..	..
373	15·6	13·6	4·9	8·7	..	..
374	1·7	3·7	0·5	3·2	..	..
375	1·7	3·6	2·2	1·4	..	..
376	2·1	4·6	0·6	4·0	..	..
377	8·9	7·5	2·7	4·8	..	..

Lab. No.	Salt (NaCl) (grains per gallon).	Total Alkalinity (grains per gallon).	Free Alkalinity (grains per gallon).	Hardness (Grains per Gallon).		
				Total.	Temporary.	Permanent.
378	6·3	6·9	2·1	4·8	..	..
379	18·4	..	..	20·7	14·6	6·1
380	17·1	..	..	19·6	12·2	7·4
381	3·4	7·6	0·7	6·9	..	..
382	119·1	49·7	..	..	..	..
383	115·5	55·1	..	..	..	..
384	11·5	8·9	2·2	6·7	..	..
385	11·3	..	..	11·0	9·9	1·1
386	5·1	..	..	6·2	..	..
387	3·1	..	..	3·5	..	..
388	4·5	..	..	7·6	..	..
389	4·3	..	..	6·4	..	..
390	3·9	..	..	7·0	..	..
391	2·1	..	..	3·5	..	..
392	78·9	..	..	23·7	..	..
393	21·6	..	..	21·7	..	..
403	105·8	32·1	5·3	26·8	..	..
404	3·0	11·3	6·1	5·2	..	..
405	2·6	5·2	1·6	3·6	..	..
406	6·1	..	..	8·8	8·3	0·5
407	3·1	5·5	3·4	2·1	..	..
408	4·4	7·1	4·7	2·4	..	..
409	3·0	8·7	2·3	6·4	..	..
410	4·6	8·8	1·7	7·1	..	..
411	35·2	..	..	27·2	19·2	8·0
412	2·6	5·2	3·6	1·6	..	..
413	8·9	10·4	2·3	8·1	..	..
414	11·2	11·3	5·8	5·5	..	..
415	2·8	5·5	3·3	2·2	..	..
416	211·4	..	..	34·5	25·1	9·4
417	6·3	8·8	2·4	6·4	..	..
418	6·2	3·9	1·0	2·9	..	..
419	1·8	2·5	2·0	0·5	..	..
420	1·8	2·5	2·2	0·3	..	..
421	2·5	6·1	2·5	3·5	..	..
422	4·8	6·4	0·9	5·5	..	..
423	2·5	6·7	2·9	3·8	..	..
424	5·5	12·5	1·9	10·6	..	..
425	3·2	1·7	1·0	0·7	..	..
426	17·0	6·3	0·1	6·2	..	..
427	2·3	3·6	0·9	2·7	..	..
428	11·6	..	..	6·4	5·2	1·2
429	19·7	..	..	26·0	17·1	8·9
430	78·0	..	..	27·9	12·0	15·9
431	180·6	..	..	32·0	4·2	27·8
466	7·8	9·1	4·0	5·1	..	..
467	3·3	8·9	1·0	7·9	..	..
468	2·5	6·1	2·4	3·7	..	..
469	2·5	..	..	3·9	2·4	1·5
470	7·5	13·5	11·9	1·6	..	..
471	22·3	..	..	16·4	13·1	3·3
472	2·3	5·1	3·3	1·8	..	..
473	3·6	8·2	1·2	7·0	..	..
474	2·0	2·8	2·8	Nil	..	..
475	4·3	6·9	3·9	3·0	..	..
476	20·6	4·9	4·2	0·7	..	..
477	101·4	..	..	30·1	3·7	26·4
478	3·6	4·0	0·5	3·5	..	..
479	3·6	..	..	4·9	3·9	1·0
480	5·9	11·0	3·5	7·5	..	..
481	2·2	8·0	2·2	5·8	..	..
482	6·3	9·3	1·1	8·2	..	..
483	5·8	7·7	2·3	5·4	..	..

Lab. No.	Salt (NaCl) (grains per gallon).	Total Alkalinity (grains per gallon).	Free Alkalinity (grains per gallon).	HARDNESS (GRAINS PER GALLON).		
				Total.	Temporary.	Permanent.
484	2·8	6·7	2·0	4·7	..	..
485	3·2	15·0	3·4	11·6	..	..
486	2·3	4·7	2·8	1·9	..	..
487	3·5	6·7	3·4	3·3	..	..
488	52·1	..	..	12·6	8·0	4·6
489	10·2	16·3	12·1	4·2	..	..
490	106·1	..	..	21·9	15·5	6·4
491	49·0	12·7	8·1	4·6	..	..
492	16·6	..	..	7·9	6·0	1·9
493	8·4	13·9	4·1	9·8	..	..
494	2·8	3·4	0·6	2·8	..	..

It is not proposed to discuss the analysis in detail, but to indicate certain characteristics of the types noted. The waters can be grouped into two broad classes—

(1) A group constituting about one-third of the entire number, which are "hard" waters; these contain lime and magnesia in excess of the carbonates present and do not contain carbonate of soda.

(2) A larger group embracing those waters containing a greater or lesser amount of free alkalinity (carbonate of soda).

Typical analyses of these classes are as follows:—

—	Class I.	Class II.
	Grains per gallon.	Grains per gallon.
Salt	21·0	4·5
Total hardness	19·3	5·5
Temporary hardness	11·5	..
Permanent hardness	7·8	..
Carbonate of Soda	Nil	2·1

Class 1 waters are higher in salt content, and the more saline waters of the area usually conform to this type. In class 2 the total solids are much less, and free alkali to the extent of a few grains per gallon characterises the class.

It must be concluded that the waters employed are, on the whole, very satisfactory for irrigation, but there are certain notable exceptions which should receive attention. These are—(*a*) those waters high in salt content; (*b*) those with an unduly high proportion of carbonate of soda. Unfortunately, we have no direct information regarding the limiting amounts of each of these materials which may be present in a water in the Burdekin area and give no trouble in practice. We may be guided by results from other countries, but it must be borne in mind that local conditions are of prime importance in this regard. The soil type requires particular attention. On the Hawaiian cane lands, where the soil type is generally the red volcanic loam, quite high concentrations of salt in the waters give no trouble if the water be not applied to excess. But we have stated that the natural tendency of our Burdekin soil is to become difficult to manage, and the treatment of the soil with water containing large proportions of soda or even salt tends to increase the soda content of the soil, with unfavourable results.

The safe limit which we have placed tentatively on the waters of the area are 30 grains per gallon of salt and 8 grains of free alkalinity. Further experience may cause us to modify our views, but it is felt that it is better to adopt a conservative attitude for the present. The presence of other substances (notably lime) in the water acts as a corrective influence as regards soda, and though it may seem strange the waters would in general be more suitable for irrigation should they be more impure, provided the impurity were lime salts. The waters which are highest in free alkalinity are usually lowest in lime salts. The situation might best be summed up by reference to the accompanying sketch map on which sub-districts have been indicated. The waters employed in the Airdale, Maidavale, Dick's Bank, McDesme, Airdmillan, and Jarvis field areas are quite suitable for irrigation. The Klondyke and Kalamia areas are inclined to high proportions of free alkalinity, whilst the Rita Island, Ivanhoe, and Lower Jarvisfield drifts are always to be regarded with suspicion. It is from the last three areas that most of the highly saline samples have been received. On the Home Hill side a salt spot shows up, corresponding apparently to the salt area across the river on Rita Island. However, there are also isolated cases of high salinity elsewhere on the area.

Corrective Measures.

Where the analysis shows that the quality of the water is unfavourable, it is suggested that an attempt be made to locate a more suitable supply. If this be not possible, or if the quality of the water approaches the border line, due precaution should be taken in the use of the water and the care of the soil.

There is no doubt that irrigation water in the Burdekin area is applied in excessive amounts. It must be remembered that labour costs are high, and every attempt must be made to economise on this factor in order to reduce production costs. Further, it is also a fact that irrigation work—particularly the application of the water in the field—is not agreeable to the average Australian farm labourer. The system in general use, then, is to run the water down a furrow between the cane rows, and for preference make this furrow as long as can be conveniently managed. Several furrows are opened from the main ditch at the one time, and the water is allowed to flow until the lower end of the field has received an adequate supply of water. This may take from thirty-six to forty-eight hours under extreme conditions, and the net result is that the portion of the field adjacent to the main ditch is excessively watered.

Undoubtedly, the water is really required along the row of cane stools, so that as it seeps down into the dry soil it will bathe the mass of cane roots, over which it must pass. When flowed between the rows, lateral movement of the water is relied upon to wet the soil below the stools. It is well recognised that the vertical movement of soil moisture is much greater than the lateral, so again excessive amounts of water must be used, or the crop will not receive its moisture. When the cane is young, irrigation in the furrow is resorted to with good results. But the cultivation necessary to control weed growth results in the cane row being filled in, after which the inter-space waterings are made.

Excessive applications of water, particularly where the latter is not entirely suitable, will aggravate an adverse condition of the soil. Harmful compounds do not pass through the soil with the drainage water, but are drawn from the water by the soil as it seeps through.

Further, the washing action of the water trickling in the furrow for prolonged periods results in the destruction of the soil aggregates and the dispersion of the clay. Every attempt should be made, then, to control the application of the water. Undoubtedly, something could be done in this regard by shortening the water furrows.

It is also possible that the employment of certain compounds will bring about an improvement in the soil structure, or at least minimise the deleterious effects of alkali. It has been stated that lime tends to flocculate the soil clay, and this material (particularly burnt lime) might be used to advantage; however, because of its more rapid action as well as for other reasons, gypsum applied to the land should give even superior results.

Unfortunately, this material is not marketed to any extent in Queensland, although extensive deposits occur in the Winton area. As a consequence the material is rather costly. The use of sulphur also warrants attention. If this substance be mixed with the soil it undergoes a process of change whereby it is slowly converted into sulphuric acid, which, with the lime naturally occurring in the soil, results in the formation of gypsum. These materials will be put out in test plots during the coming year, in order to determine their value.

From what has been said regarding the trouble caused by alkali, it will be obvious that any substance tending to neutralise alkalinity would be helpful. That is, anything of an acid nature would work against and destroy the alkali. For this reason growers were definitely recommended that sulphate of ammonia should always be employed as a source of nitrogenous fertilizer for the crops in this area. Before the ammonia is taken up by the crop, it is converted into a mixture of nitric acid and sulphuric acid by soil bacteria, and these acids in turn seize on any alkali present in the soil by which they are neutralised and converted to a condition suitable for absorption by the crop. On the other hand, nitrate of soda works in the opposite manner and tends to cause the accumulation of soda in the soil.

The value of the soil humus in preserving a condition of good tilth cannot be over-estimated, and any practice by which the supply of organic matter in the soil may be maintained or augmented is to be encouraged. Experiments have been made in an attempt to turn under all the trash and tops derived from the cane crop, and undoubtedly this will assist in affecting the desired results. A 40-ton crop of cane yields about 4 tons of dry organic matter, and at least the more resistant portion of the crop residues will be of value in the formation of humus. Growers who are employing this practice—usually in combination with a green manure crop during fallowing—report very good results. The application of molasses to the land, either prior to planting or on young ratoons, should also receive consideration. It results in the supply of large amounts of valuable plant food which readily becomes available to the cane crop, and by reason of the manner in which the molasses penetrates and permeates the soil mass the mechanical condition of the soil appears to be markedly improved. Although the net increase in the organic content of the soil may be slight, the latter is distributed as a thin film surrounding the individual soil particles, and its influence is magnified as a consequence.

In conclusion, we would like growers to keep in mind that we are anxious to help them with any difficulties regarding the quality of their water supply, and will be pleased to carry out analyses of water samples if forwarded to the Brisbane Laboratory of the Bureau.

HALO BLIGHT—A BACTERIAL DISEASE OF BEANS.

By L. F. MANDELSON, B.Sc.Agr., Assistant Plant Pathologist.

BACTERIAL diseases of beans have recently caused considerable losses in Queensland, and in some districts have resulted in complete failures. Similar losses have also been reported in the press from other Australian States.

The extreme seriousness of the position was first brought to the notice of this branch early in February, 1931, by Mr. Leslie, Assistant Instructor in Fruit Culture at Toowoomba. Consequently, in company with Mr. Leslie an inspection was made of several bean crops in the district, and it was observed that approximately 100 per cent. of the plants examined were diseased. From the symptoms observed in the field it appeared that halo blight (*Phytomonas medicaginis* var. *phaseolicola*) was responsible for some of the damage, whilst possibly other bacterial diseases with less characteristic symptoms were also present. A study of bacteria isolated from diseased material collected on this occasion has confirmed the diagnosis.

Historical.

At the present time there are six known bacterial diseases of beans.[1] Three of these are widespread and cause serious losses. The remaining three have only recently been described, and little is known of their distribution and economic importance.

The first bacterial disease to be observed on beans was bean blight (*Phytomonas phaseoli*), which was reported in 1893 in the United States. The organism causing this disease was isolated, described, and its pathogenicity proved by Smith[7] in 1898. For close on twenty-five years no other bacterial disease of beans was recorded.

In 1922 Hedges reported a bacterial wilt of beans (*Phytomonas flaccumfaciens*) from South Dakota, in the United States, and described the causal organism. This disease was soon found to be widespread, and in certain sections caused considerable damage. A full account appeared in 1926.[3]

The third important bacterial disease is halo blight (*Phytomonas medicaginis* var. *phaseolicola*), which was observed in 1924 and was fully described by Burkholder[2] in 1926. This disease, which is the subject of these notes, is characterised by the severity of its symptoms and the rapidity of its spread. It was on account of this severity that attention was first directed in 1924 to the possibility of its being a new disease. In 1930 Burkholder reported[1] that this was the "bacterial disease of greatest importance in New York," and that in certain sections of that State it had become the limiting factor for the production of the "Red Kidney" variety of bean. In Queensland also it was the severity of this disease which first attracted attention to it.

The three minor bacterial diseases[1] consist of a new variety of the bacterial blight organism observed in Switzerland in 1924, and described in 1930, and two new species of bacteria also described in 1930, one from New Jersey, in the United States, and the other from Switzerland.

Life History.

The life history and symptoms of halo blight are identical in some respects with those of blight and wilt. It is, in fact, impossible to distinguish these three diseases on some of their symptoms alone. For instance, wilting and stunting are common with all three, and some leaf, stem, and all pod lesions are similar with both halo blight and blight. Consequently, in the following account where features are peculiar to halo blight alone this will be indicated.

The bacterium or germ causing halo blight is to be found inside and on the surface of bean seed derived from diseased plants. Such seed when planted may fail to germinate. Should it germinate the bacteria are stimulated to activity and pass up through the water-conducting vessels of the growing plant. When pods are formed these bacteria may enter the developing seeds, and the disease may be perpetuated in this manner.

The bacteria within a diseased plant may ooze out on to the surface of the stems or leaves, and be transferred, when the foliage is wet, to healthy tissue of neighbouring plants. Driving rain, hail, overhead irrigation, insects, or cultivation and harvesting operations amongst plants when the foliage is wet with rain or dew are all important factors in the spread of diseases of this type.[9] The bacteria gaining entry to a plant from without, in this fashion, may enter the water-conducting system and so finally lodge in the developing seed, and thus carry the disease over to the following season. The disease is most commonly disseminated in this manner, and consequently is most difficult to control.

It has been shown[4] that the organism causing blight is able to overwinter in the soil. Little work has so far been done on this aspect of halo blight infection. It is probable, however, that in this case also the causal organism is capable of existing in old diseased bean plants in the soil for a considerable time, and so infecting beans planted later in such soil.

Symptoms.

Leaves.—The most characteristic symptom of halo blight is one which is caused by the parasitic bacterium lodging on a leaf surface from some external source, and producing an area of dead tissue surrounded by a pale green zone. This zone or halo is remarkably large in comparison with the size of the dead area, and may be from half an inch to an inch in diameter (Plate 32, fig. B.).

In warmer weather, instead of the typical halo spot, numerous small, angular areas of dead tissue may be produced, in association with a general paleness of the leaf surface.

Another leaf lesion, which is caused by both the bacterial blights, consists of an area of dead tissue of variable size and shape with a narrow yellow border about its edges. Often a pale-green zone is to be found between this border and the healthy tissue, but it is extremely narrow and is distinct from the typical halo spot. This type of injury may be very extensive, and is often the result of the causal organism having gained access to the water-conducting system of the plant, and having destroyed the tissue from within. Affected leaves, with age, dry out and become brown, brittle, and ragged (Plate 32, fig. A.).

A symptom typical of halo blight is the appearance of lighter and darker areas, or "mosaic," distributed over the leaf surface, especially

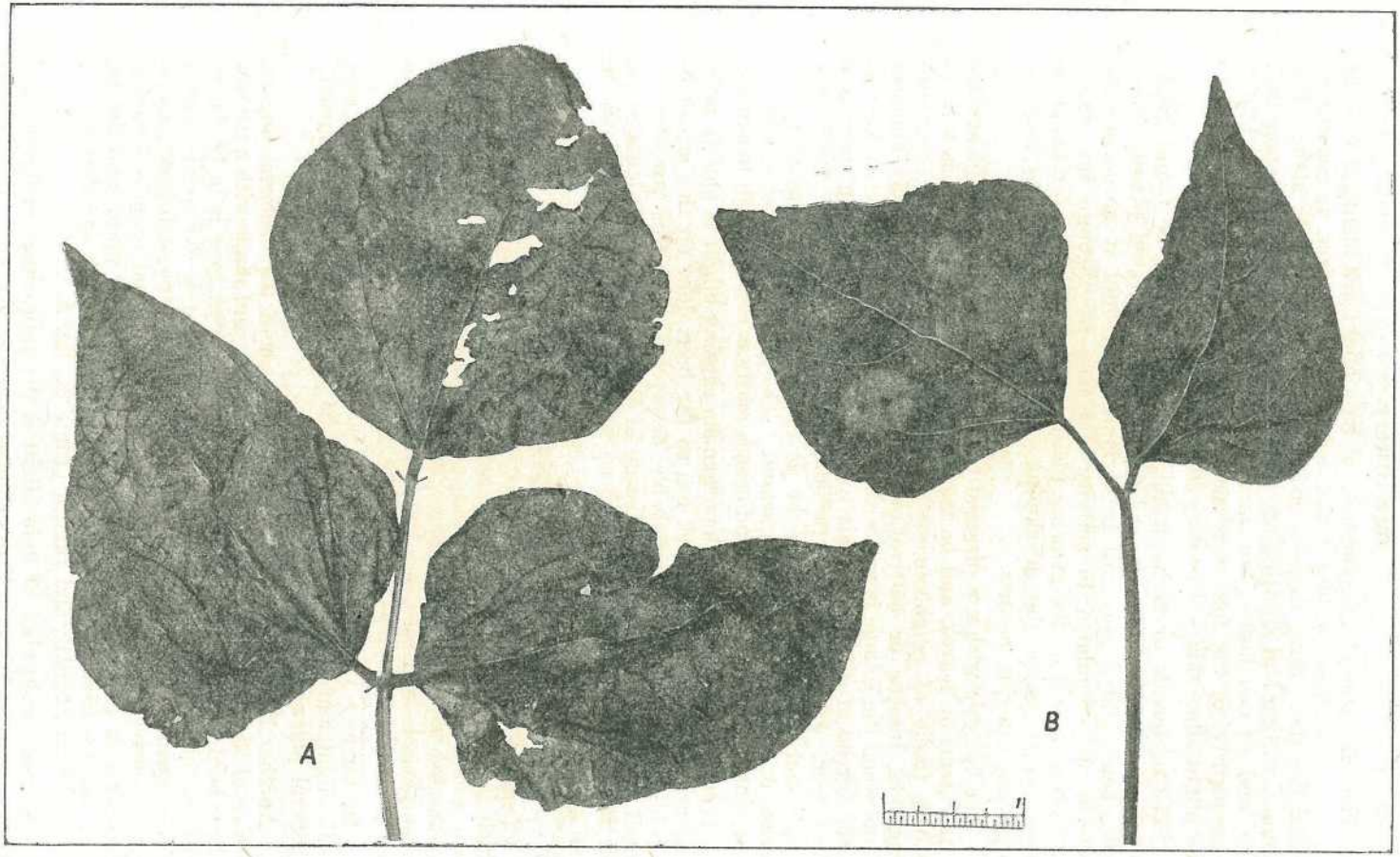


PLATE 32.

A. Leaves showing advanced stages of halo blight. Note the dried and ragged condition of the leaves. B. Earlier stages of infection showing remarkably large haloes in proportion to the size of the central dead areas. Note longtitudinal lesions on leaf stalk.

with terminal leaves. In the early stages this may readily be confused with the true mosaic disease of beans, which is caused by a virus, and is quite distinct from the bacterial diseases. Later, however, dead areas associated with the causal bacterium appear on these areas, and so differentiate the two diseases.

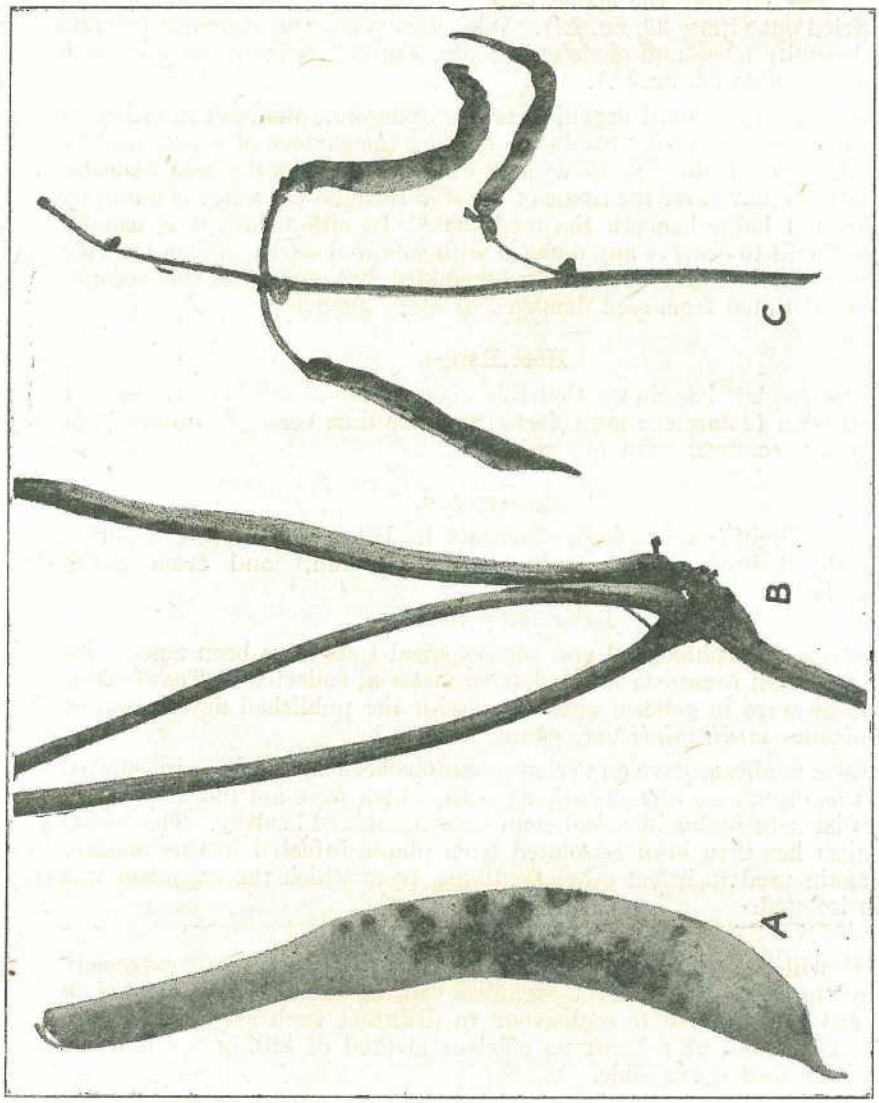


PLATE 33.
A. Pod showing blight lesions. B. Stem lesion where bacterial exudate has occurred. C. Lesions on young pods showing bacterial exudate.

Stems.—As a result of the causal organism becoming established on the stem, longitudinal streaks are produced, which may at first have a water-soaked appearance, but which eventually are a reddish rusty colour (Plate 32, fig. B.).

When the damage is caused by bacteria from within the plant tissue, a symptom typical of halo blight occurs. This consists of masses of bacteria oozing out on to the stem surface in quite large drops of milky

liquid. Usually these masses are to be observed at the junction of stem and leaf stalks, and occur during cool, wet weather (Plate 33, fig. B.).

Pods.—Pod lesions are similar with both blight diseases. At first dark-green and rather circular spots occur, which later become sunken and reddish-brown in colour. Sometimes a faint silvery incrustation is to be observed over the spot where bacteria have come to the surface and dried out (Plate 33, fig. A.). With halo blight this bacterial exudate may be quite large and obvious in moist weather as in the case of stem infection (Plate 33, fig. C.).

Seeds.—The causal organism may contaminate the seed in either of two ways. First, it may produce a spot on the surface of a pod, and by working through the pod tissue may eventually infect the seed beneath. Secondly, it may enter the tissue of the seed through the water-conducting system and lodge beneath the seed coat.[9] In either case it is usually very difficult to observe any damage with coloured seeds. When severely infected, the seed may be small and wrinkled, but cannot on this account be differentiated from seed damaged by other agencies.

Host Range.

Burkholder[2] has shown that this disease may attack both the scarlet runner bean (*Phaseolus multiflorus*) and the lima bean (*P. lunatus*), as well as the common bean (*P. vulgaris*).

Distribution.

Halo blight is very widely distributed. It has already been reported from the United States, Switzerland,[1] Holland,[8] and from South Australia.[6]

Laboratory Studies.

Several morphological and physiological tests have been made with the halo blight organism isolated from material collected at Toowoomba, and these were in general agreement with the published description of *Phytomonas medicaginis* var. *phaseolicola.*

Bean seedlings have on various occasions been successfully inoculated with this organism, whereas other plants, which were not inoculated, but otherwise kept under identical conditions, remained healthy. The causal organism has then been reisolated from plants infected in this manner and again used to infect other seedlings, from which the organism was again isolated.

Control Measures.

As will be seen from the above life history, this disease is extremely difficult to control. Since the organism causing the disease is carried in the seed it is useless to endeavour to disinfect such seed by surface sterilisation, and at present no efficient method of killing the bacteria within the seed is available.

Plants which are derived from diseased seed will eventually develop the disease, and hence spraying with a protective fungicide in such cases is useless. Spraying the crop would certainly tend to check the spread of the disease from diseased to healthy plants, but the cost of applying a fungicide to such a rapidly growing crop as beans would be too great to justify the results. Furthermore, in a season such as that recently experienced, when apparently a very large percentage of the seed sown was diseased, spraying would have been inadequate, and little could be done to mitigate the inevitable result.

Two practical methods of combating this disease are (1) using only seed from a healthy crop, and (2) using seed of a variety which is known to be to some extent resistant to the disease. In addition, care should be taken that the soil does not become unduly contaminated with the disease organism; consequently all diseased plants should be collected and burnt, and if possible a rotation of crops should be practised so that beans are not continuously grown on the same land.

If the seed is fairly free from contamination, a grower would be well advised to carefully select seed from healthy plants for the following season's sowing. For this purpose a special seed plot should be established some distance away from the main crop. The seed should be planted well apart, so as to obviate as much as possible the transfer of the disease from one plant to the next. Such a plot should be kept under very careful observation, and any plants showing suspicious spots should be immediately removed and destroyed. With a small plot of this description it might also be worth while to maintain a protective covering of a fungicide, such as Bordeaux mixture (4:4:40), to prevent local infection. Such a method of selecting clean seed is useless, however, if the seed originally planted is contaminated to any great extent, for the obvious reason that very few healthy plants would remain after those internally infected had been removed.

The most efficient and economical method of disease control is by the use of resistant varieties. Extensive investigational work has been carried out in the United States[5 9] on this aspect of the problem. So far no variety is known to be immune to bacterial diseases, but at least several are known to be more or less resistant. Many of these, unfortunately, are either very susceptible to other bean diseases or are unsuitable, from the horticultural viewpoint, for supplying the present market. It is to be hoped, however, that either by selection or by hybridisation further investigation will produce a variety of bean suitable for local requirements, and yet possessing considerable resistance to halo blight and other bean diseases.

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REPORT OF BARLEY SMUT EXPERIMENTS, 1931.

By R. B. MORWOOD, M.Sc., Assistant Pathologist.

OWING to the very considerable amount of covered smut (*Ustilago hordei*) in the barley crop of the 1930 season, an experiment was undertaken to test under local conditions certain standard methods of barley seed treatment for the prevention of smut.

The experiment was conducted on an area of heavy black soil in the Toowoomba district. It was planted on 7th April, 1931, and final observations made on 6th November, 1931, when the crop was mature. Thanks are due to Mrs. H. Morwood for the use of cultivated land and to Mr. L. G. Morwood for assistance.

The plot consisted of six blocks of ten rows each, the rows being two chains long. Every block contained one row of each of nine treatments and one untreated control. All the seed used was heavily infested with smut spores. The treatments used were:—

A. One part of commercial formalin to 480 parts of water for ten minutes.

B. One part of commercial formalin to 480 parts of water for half an hour.

C. One part of commercial formalin to 480 parts of water for one hour.

D. One part of commercial formalin to 240 parts of water for ten minutes.

E. One part of commercial formalin to 100 parts of water for ten minutes.

F. Bluestone, 1½ per cent. for three minutes.

G. Bluestone, 1½ per cent. for three minutes, followed by lime.

H. Copper carbonate at the rate of 2 oz. of powder per bushel of seed.

I. Tillantin R. at the rate of 2 oz. of powder per bushel of seed.

J. Check untreated.

A known number of seeds was planted in each row and the resulting plants counted in order to note any difference in the field germination of the seed after treatment. Irregularities masked small differences, the only significant effect being in the case of the use of 1:100 formalin, in which about a 40 per cent. reduction occurred.

The amount of infection in the check rows was disappointing, as it was so low that it very considerably impairs the reliability of the results in the other rows. The figures given in Table I. refer to the number of plants in each row affected with covered smut. There were about fifty mature plants per row.

TABLE I.

NUMBER OF BARLEY PLANTS PER ROW AFFECTED WITH COVERED SMUT.

		I.	II.	III.	IV.	V.	VI.	Total.
A.	1: 480 Formalin, 10 mins.	0	0	0	0	0	0	0
B.	1: 480 Formalin, ½ hr.	0	0	0	0	1	0	1
C.	1: 480 Formalin, 1 hr.	0	0	0	0	0	1	1
D.	1: 240 Formalin, 10 mins.	0	0	0	0	0	0	0
E.	1: 100 Formalin, 10 mins.	0	0	0	0	0	0	0
F.	1½ per cent. Bluestone, 3 mins.	0	0	0	0	0	0	0
G.	Bluestone, then lime	0	0	0	0	0	0	0
H.	Copper carbonate, 2 oz. per bushel ..	1	0	2	2	1	5	11
I.	Tillantin R, 2 oz. per bushel	0	0	0	0	0	0	0
J.	Untreated	1	2	0	2	4	1	10

The experiment demonstrates that copper carbonate is of no use for the control of barley smut. (*Note.*—Skinless barley is an exception, and may be treated in the same manner as wheat.) Formalin is generally considered to be the best chemical for use against this disease, and it is indicated that it should be used at the strength of 1 part to 240 parts of water. Tests with respect to the time of immersion were inconclusive. Owing to the small total infection and to the fact that experiments elsewhere do not confirm these results, little notice can be taken of the apparent good results with bluestone with or without lime. The use of organic mercury dusts such as Tillantin R. is promising but cannot be recommended until further tests have been made with this and allied substances.

Reports to hand indicate that in the main crop as well as in the experimental plot covered smut was not a serious disease in barley in the 1931 season. It is evident that seasonal variation plays some part in the severity of this disease. The barley-grower would be well advised to treat all seed barley as an insurance against the seasons being favourable to the development of smut. The treatment to be recommended in the present state of our knowledge is as follows:—Immerse the seed for ten minutes in a solution of one pint of commercial formalin in thirty gallons of water. Spread the seed out to dry before planting. All bags used to hold treated seed should also have been treated in the same manner.

QUEENSLAND SHOW DATES, 1932.

Stanthorpe: 3rd to 5th February.
Warwick: 9th to 11th February.
Allora: 17th and 18th February.
Milmerran: 8th March.
Oakey: 19th March.
Goombungee: 2nd April.
Chinchilla: 5th to 7th April.
Pittsworth: 6th and 7th April.
Miles: 13th and 14th April.
Clifton: 13th and 14th April.
Toowoomba: 18th to 21st April.
Dalby: 27th and 28th April.
Charleville: 4th and 5th May.
Boonah: 4th and 5th May.
Mitchell: 11th and 12th May.
Roma: 16th and 17th May.
Ipswich: 17th to 20th May.
Wallumbilla: 24th and 25th May.
Maryborough: 1st to 3rd June.
Gin Gin: 2nd to 4th June.
Marburg: 2nd and 3rd June.
Bundaberg: 9th to 11th June.
Rockhampton: 21st to 25th June.
Mackay: 28th to 30th June.
Kilcoy: 30th June and 1st July.
Cleveland: 8th and 9th July.
Charters Towers: 13th and 14th July.
Rosewood: 15th and 16th July.
Nambour: 20th and 21st July.
Ayr: 22nd and 23rd July.
Royal National: 8th to 13th August.
Crow's Nest: 24th and 25th August.
Wynnum: 26th and 27th August.
Enoggera: 3rd September.
Beenleigh: 16th and 17th September.
Rocklea: 24th September.
Nerang: 14th October.

IN MEMORIAM.

MR. W. A. RUSSELL, M.L.A.

SUCCUMBING to a stroke while he was spending a holiday with his brother (Mr. H. Y. Russell, public accountant, of Sydney), Mr. W. A. Russell, M.L.A., prominent grazier and member for Dalby in the Queensland Parliament, died at St. Vincent's Hospital, Sydney, on 8th January.

The late Mr. Russell was recognised as an authority on land settlement and problems associated with primary production, particularly the sheep industry, by reason of his wide experience and extensive knowledge.

Mr. Russell was a native of Rockhampton, where he was born in 1874. He was educated at the Sydney Grammar School, and later studied at the Hawkesbury Agricultural College, New South Wales. Here he secured with distinction the M.H.A.C. diploma. Later, he sought station experience in the New England district, and with his earnings, which amounted to £45, took up a homestead selection in the Tamworth district. In 1909 he acquired an interest in Dalmally station, of which he ultimately became the owner, and at a later date he extended his operations to the Cunnamulla and Dalby districts.

Mr. Russell acquired land near Dalby about fifteen years ago to relieve his Western properties. Prior to coming to the Dalby area he lived at Dalmally, near Roma, for fifteen years, and while there made a scientific study of the blowfly in sheep problem, with the result that he was accepted as an authority on the subject of eradicating or preventing the blowfly menace. In his work Mr. Russell collaborated in experimental research with the Department of Agriculture and Stock and with the Department of Science and Industry. He first advocated the use of aresnic and soda, and to-day his treatment stands at the head of all other specifics.

His far-sightedness and sagacity were frequently demonstrated, and earned for him a wide reputation among primary producers. Illustrating his enterprise about six years ago, when the West was in the throes of a severe drought, and agistment areas, veritable oases of the sun-baked plains, were few and far away, Mr. Russell carried out a signally successful experiment in the transport of sheep. He constructed several large motor-vans, which were comfortably fitted with compartments, and these vans were used to convey a large number of sheep from one of his New South Wales properties in the Bourke district. The sheep, in poor condition, too weak to travel overland in the ordinary way, were carefully placed in the vans, one in each compartment, which was so fitted up that the possibility of injury en route was reduced to a minimum. In this manner the sheep were transported over several hundred miles to one of Mr. Russell's Dalby properties. The sheep were so skilfully handled that of the large number transported very few were lost. A full account of this enterprise was published in the "Queensland Agricultural Journal" for December, 1926.

He was largely instrumental in obtaining beneficial concessions to the settler and pastoralist, and he was untiring in his efforts to obtain better conditions for the man on the land, particularly the struggling settler on the small area.

Apart from his operations in the commercial world, Mr. Russell always took a keen interest in sport. He was president of several sporting clubs in the Dalby district, and was connected with many public institutions, being a member of the Dalby Town Council. He was also president of the Queensland Branch of the Hawkesbury College Old Boys' Union. He lent active support to the proposal to make Lake Broadwater, near Dalby, an inland resort, and when the resort was opened last year special reference was made to his generosity in making a large tract of country available for the purpose. He also made a gift to the public of Queensland for use as a national reserve of a very large area of rich, virgin, jungle land on the beautiful Bunya Mountains.

In 1901 Mr. Russell married Millicent, daughter of the late Mr. Chas. Baldwin, of Durham Court, Manila. He is survived by his widow and four children.

The funeral, at which there was a large and representative gathering, took place at Waverley Cemetery, Sydney, on 12th January, after a service at All Saints' Church, Woollahra.

CLIMATOLOGICAL TABLE—DECEMBER, 1931.

COMPILED FROM TELEGRAPHIC REPORTS.

Districts and Stations.	Atmospheric Pressure. Mean at 9 a.m.	Shade Temperature.						Rainfall.	
		Means.		Extremes.				Total.	Wet Days.
		Max.	Min.	Max.	Date.	Min.	Date.		
Coastal.	In.	Deg.	Deg.	Deg.		Deg.		Points.	
Cooktown	29·82	90	76	98	19	73	17, 21, 22,27,28	1,025	11
Herberton	..	82	64	90	17, 22	57	21	789	17
Rockhampton	29·87	88	71	99	20	65	14	766	15
Brisbane	29·94	83	67	98	19	62	24	911	14
Darling Downs.									
Dalby	29·90	85	61	101	20	49	16	389	9
Stanthorpe	..	77	55	93	20	47	15, 27	374	13
Toowoomba	..	78	58	94	21	48	16, 17	1,150	14
Mid-Interior.									
Georgetown	29·80	95	73	102	12	66	12	391	10
Longreach	29·81	96	68	109	19, 20	61	17	597	5
Mitchell	29·87	87	63	104	20	52	17, 24	999	11
Western.									
Burketown	29·80	96	76	105	12	64	15	165	6
Boulia	29·79	100	71	110	19, 20	63	23	172	4
Thargomindah	29·84	91	69	103	18	60	24	96	6

RAINFALL IN THE AGRICULTURAL DISTRICTS.

TABLE SHOWING THE AVERAGE RAINFALL FOR THE MONTH OF DECEMBER, IN THE AGRICULTURAL DISTRICTS, TOGETHER WITH TOTAL RAINFALL DURING DECEMBER, 1931, AND 1930, FOR COMPARISON.

Divisions and Stations.	Average Rainfall.		Total Rainfall.		Divisions and Stations.	Average Rainfall.		Total Rainfall.	
	Dec.,	No. of Years' Records.	Dec., 1931.	Dec., 1930.		Dec.,	No. of Years' Records.	Dec., 1931.	Dec., 1930.
North Coast. ..	In.		In.	In.	*South Coast*—continued:	In.		In.	In.
Atherton	7·47	30	9·39	4·50	Kilkivan	4·51	52	4·68	1·56
Cairns	8·63	49	23·95	8·59	Maryborough ..	4·68	59	8·95	1·86
Cardwell	8·11	59	13·92	5·03	Nambour ..	6·79	35	10·26	3·05
Cooktown	6·74	55	10·25	5·09	Nanango	3·82	49	3·71	1·55
Herberton	5·76	44	7·89	8·00	Rockhampton ..	4·70	44	7·66	2·44
Ingham	6·80	39	7·47	5·29	Woodford	5·62	44	5·51	1·49
Innisfail	11·55	50	23·35	8·16					
Mossman Mill ..	10·99	18	11·69	8·63					
Townsville	5·45	60	8·31	0·89	*Darling Downs.*				
Central Coast.					Dalby	3·21	61	3·89	1·51
					Emu Vale	3·49	35	3·52	1·23
Ayr	3·87	44	15·50	1·73	Jimbour	3·23	43	2·76	2·07
Bowen	4·40	60	11·06	2·14	Miles	3·00	46	7·12	2·08
Charters Towers ..	3·45	49	1·63	0·35	Stanthorpe ..	3·51	58	3·74	2·08
Mackay	7·24	60	5·92	2·37	Toowoomba ..	4·31	59	11·50	2·02
Proserpine	7·95	28	15·81	3·69	Warwick	3·40	66	3·18	1·38
St. Lawrence ..	4·69	60	8·91	2·59					
					Maranoa.				
South Coast.					Roma	2·45	57	6·77	0·40
Biggenden ..	4·54	32	6·19	1·56					
Bundaberg	4·93	48	9·44	2·25					
Brisbane	4·92	80	9·11	1·94	*State Farms, &c.*				
Caboolture	5·17	44	7·80	2·91	Bungeworgorai ..	2·89	17	6·40	1·10
Childers	5·56	36	7·60	1·82	Gatton College ..	3·90	36	8·99	1·42
Crohamhurst ..	7·04	38	7·71	2·19	Gindie	2·92	32	3·54	0·34
Esk	4·66	44	4·09	3·06	Hermitage ..	2·95	25	2·84	1·36
Gayndah	4·11	60	9·50	3·18	Kairi	6·20	17	..	3·66
Gympie	5·99	61	8·85	2·45	Mackay Sugar Experiment Station	8·57	34	6·17	3·21

GEORGE G. BOND, Divisional Meteorologist.

Answers to Correspondents.

BOTANY.

The following answers have been selected from the outgoing mail of the Government Botanist, Mr. C. T. White, F.L.S.:—

Barrier Salt Bush. Suitable Trees for Dam Protection.

R.H.F. (Bowenville)—

The creeping plant with the red berries is *Enchylæna tomentosa*, the Barrier Salt Bush, quite a useful fodder plant. The tree is *Eucalyptus populifolia*, the Bumble Box, very common on the Darling Downs. Regarding a suitable tree to plant above a dam to hold back silt, we would recommend either *Eucalyptus robusta*, commonly known as Swamp Mahogany, or *Eucalyptus microtheca*, the Coolibah. The former, I think, you would find a much more rapid grower, but it may be somewhat frost tender with you. Some other more vigorous trees, such as Figs, may be planted, but the roots may prove rather a nuisance in the dam itself. *Eucalyptus corymbosa* is worth trying on the Darling Downs, but you may have to protect the trees on frosty nights the first or perhaps the second year.

Native Grape.

A.H.W. (Brisbane)—

The specimens are *Legnephora Moorei*, commonly known as native grape. It is not, however, a member of the grape family, but belongs to the moon seed family, *Menispermaceæ*, many of the members of which are poisonous. Dr. T. L. Bancroft working on this plant some years ago found the root bark to contain an active poisonous principle, and there is every reason to suppose that this extends more or less through the whole plant. The vine is very common in Queensland scrubs, and we have been informed on occasions that children have become violently ill through eating the fruits, though no deaths have come under notice.

Star Thistle.

R.R. (Torbanlea)—

The specimen is *Centaurea melitensis*, the star thistle or "Saucy Jack," a very common weed in the Southern States and in parts of Queensland. It is not generally found on coastal lands to any great extent. It has some slight value as a fodder in its younger stages, but soon becomes unpalatable. It is a plant that should be eradicated from a property as soon as it makes its appearance.

Native Lucerne.

F.R.D. (Barcaldine)—

The specimen is *Andrachne Decaisnei*, very common in Central and Northern Queensland, and often known as native lucerne. This local name is not particularly appropriate, as the plant is not a legume, but belongs to the euphorbiaceæ or spurge family. It has been suspected of poisoning stock on several occasions, and tests carried out by the Agricultural Chemist showed it to contain a prussic-acid yielding glucoside. If, therefore, it was eaten in large quantities, especially by hungry travelling stock, it would likely cause trouble.

The native Thorn Apple, which is very abundant in Central and Northern Queensland, is *Datura Leichhardtii*. All the Thorn Apples are poisonous, but stock rarely eat them in the green state. Most of the cases of poisoning that have come under our notice have been from *Datura stramonium*, a common weed of cultivation in Queensland. Poisoning usually results from the weed having been chaffed up along with lucerne or other fodders and subsequently fed to stock with fatal results. Symptoms of Datura poisoning are paralysis, dilatation of the pupils, suspension of secretion and of the inhibitory fibres of the vagus, leading to rapid action of the heart and sometimes mania and convulsions.

General Notes.

How the Farmer Loses Money.

In the course of a discussion at a recent meeting of a branch of the New South Wales Agricultural Bureau, Mr. J. Crawcour enlarged upon a number of ways in which the dairy farmer lost money. First and foremost, he said, the Australian farmer lost because he seemed satisfied with low production. The average production of butter fat per cow in this country was 290 lb., whereas in England it was just double that figure. It was not a question of better cows, but better feeding methods. An instance was quoted where the owner of a Queensland herd of sixty-eight Jerseys culled twenty-five head and improved his feeding methods, with the result that his returns from the remaining forty-three were greater than he previously got from the sixty-eight, notwithstanding that production in other herds in that particular season showed a decided falling off. The explanation was the feeding of a balanced ration. Farmers should grow all the fodders possible on their farms, but should make sure that the ration fed was properly balanced, and for this purpose a concentrate like linseed meal was often found necessary.

Feeding, Mr. Crawcour remarked, could not be economically carried out unless the farmer erected feeding stalls. Money was also lost through farmers failing to feed their cows properly prior to calving. On proper nourishment of the mother at this stage depended to a great extent the future value of the calf as a milker.

Dairy farmers generally were keeping too many non-paying cows, and these would continue to be a big drain on profits until the value of herd testing was more generally recognised. The scrub bull was also far too common on dairy farms.

Mr. Crawcour, in concluding his address, urged farmers to give more attention to pigs as a side line, mainly with the object of building up the pork export trade, as had been done in Queensland.

Staff Changes and Appointments.

Constables S. Willis, C. Hartvigsen, A. D. McPhail, and Senior Sergeant C. Hegarty have been appointed also Inspectors under the Slaughtering Act.

Brumby Control.

The Governor in Council has to-day approved of the issue of a Proclamation under the Diseases in Stock Acts, proclaiming the Cairns and Cooktown Stock Districts as districts for the control of brumbies or worthless horses for the period from 16th January, 1932, to the 30th April, 1932.

The provisions of section 16A of the Diseases in Stock Acts provide for the destruction of brumbies on stock holdings in Queensland under certain conditions, and apply to such portions of the State as are proclaimed by proclamation, and are limited to a period of not more than four months in any year. Destruction of brumbies may accordingly be carried out in the Cairns and Cooktown districts by stockowners at any time during the stipulated period, provided that the formalities required by the Acts have first been observed.

Bacon, an Economical Food.

Bacon is a body-building food relished the world over. It is recommended as an appetising fat for small children, and in digesfibility it is classed with that of butter. For invalids a piece of daintily cooked bacon will often awaken appetite to eat a nourishing meal. But bacon is not only a meal in itself. Its addition to any foods adds flavour and palatability. Bacon has many valuable attributes when served on its own, and it is safe to say that no other meat permits of so many distinct uses in cooking. The Queensland Bacon Curers' Association in an endeavour to point out the value of bacon in the daily menu, both as a food in itself and as a delicious addition to other foods, is now engaged in an advertising campaign, and the added advantage of bacon now being lower in price should commend this delectable meat to a more frequent use at the hands of housewives. This recipe for bacon fraze will be welcomed: Beat four eggs very light, add half a cup of milk, one tablespoonful of flour and one teaspoon of pepper. Lay eight or nine thin rashers of bacon in a frying pan. When slightly brown pour the batter over them. Brown on both sides and serve on a hot plate.

The Home and the Garden.

OUR BABIES.

Under this heading a series of short articles by the Medical and Nursing Staff of the Queensland Baby Clinics, dealing with the welfare and care of babies, has been planned in the hope of maintaining their health, increasing their happiness, and decreasing the number of avoidable cases of infant mortality.

INFANTILE PARALYSIS.

THAT the present epidemic is making parents anxious is only natural. If anxiety leads to carefulness it will be beneficial. We hope it will not lead to panic. From infantile paralysis there is no safety in flight, for there is no safe place to which to fly. Some of the worst epidemics have been in sparsely populated rural districts. The present epidemic seems to be prevalent only in the metropolis, but country districts may have their turn later.

How it Spreads.

Infantile paralysis is spread by healthy people. It travels as fast as healthy people can travel and as far. Many years ago this was demonstrated in remote districts in Sweden, where the people were so few that all their movements could be followed. To quote one instance out of many: Farmer A sold a horse to Farmer B, who lived in such an isolated place that he had had no visitor for some weeks. Farmer A, who was in good health, rode over to deliver the horse. On the day he left one of his children fell ill. Not until after he left was the illness found to be infantile paralysis. Farmer B invited A to stay to dinner. A, who was fond of children, sat at the table with one of B's children on each side of him. Within a few days both of these children fell ill with infantile paralysis.

Every epidemic disease has its peculiarities, and in every instance we have to study the answers to two questions—How does the disease spread from person to person? How can its spread be prevented? The answer to the second question may be very difficult, and always depends on the answer to the first. According to our present knowledge infantile paralysis is a virus disease, and consequently the answer is really difficult. We have good reasons for believing that during an epidemic the virus is widely spread in the nose and throat of apparently healthy people, and in only a few instances does the virus cause paralysis. Although no age is absolutely exempt, nearly all cases of the disease occur in young people, and most of these are under five years of age. We cannot recognise carriers of this disease. Therefore it is impossible to suppress the disease by quarantine or isolation.

Prevention.

Can we therefore do nothing? We do not think so. If out of one hundred children who receive this infection, ninety-nine become immunised, and one falls a victim, there must be a reason why that one succumbs. Either that one has a weak resistance, or he has received a large—perhaps an overwhelming—dose of the infection. Science has not yet learnt all the factors, which constitute resistance to infection, but we know that one important factor is a healthy diet. We have been trying to educate parents into giving their children a well-balanced diet rich in vitamins, but we know that many thousands of children after reaching two years of age begin to eat the same food as their mothers, an ill-balanced diet poor in vitamins, on which resistance to disease is lowered. Let us remind our readers that among the foods rich in vitamins are milk, fresh vegetables, fresh fruit, eggs, liver, wholemeal bread, bran, and cod liver oil.

What to Avoid.

Overwhelming infections are, at least in part, avoidable. During an epidemic grown-up people should avoid fondling, kissing, and playing with their neighbour's children. They may be carriers of disease, and should exercise some self-denial. If Farmer A in our story had not been fond of children, he might not have infected

Farmer B's children. Wherever people are crowded together—for instance, in picture shows—infection is almost sure to be present in a concentrated form. Mothers always have the right instincts. The lioness will defend her cubs, and the mother her children. But for the mother, instinct without knowledge is a very poor thing. To take babies to picture shows and country dances is really unconscious cruelty. We wish that it could be forbidden by regulation—at least, during epidemics—to admit children under school age to these entertainments.

Obtain Medical Advice Immediately.

Finally, if your child has a feverish attack, obtain medical advice immediately. It is probably not infantile paralysis, but it may be. Doctors are just now keenly looking for cases in the early stages, when paralysis can be prevented. Unless parents give them an opportunity they will fail to find them in time.

Farm Notes for March.

LAND on which it is intended to plant winter cereals should be in a forward stage of preparation. Sowings of lucerne may be made at the latter end of the month on land which is free from weed growth and has been previously well prepared.

The March-April planting season has much in its favour, not the least of which is that weeds will not make such vigorous growth during the succeeding few months, and, as a consequence, the young lucerne plants will have an excellent opportunity of becoming well established.

Potato crops should be showing above ground, and should be well cultivated to keep the surface soil in good condition; also to destroy any weed growth.

In districts where blight has previously existed, or where there is the slightest possible chance of its appearing, preventive methods should be adopted—i.e., spraying with "Burgundy mixture"—when the plants are a few inches high and have formed the leaves; to be followed by a second, and, if necessary, a third spraying before the flowering stage is reached.

Maize crops which have fully ripened should be picked as soon as possible and the ears stored in well-ventilated corn cribs, or barns. Selected grain which is intended for future seed supplies should be well fumigated for twenty-four hours and subsequently aerated and stored in airtight containers. Weevils are usually very prevalent in the field at this time of the year and do considerable damage to the grain when in the husk.

The following crops for pig feed may be sown:—Mangel, sugar beet, turnips and swedes, rape, field cabbage, and carrots. Owing to the small nature of the seeds, the land should be worked up to a fine tilth before planting, and should contain ample moisture in the surface soil to ensure a good germination. Particular attention should be paid to all weed growth during the early stages of growth of the young plants.

As regular supplies of succulent fodder are essentials of success in dairying operations, consideration should be given to a definite cropping system throughout the autumn and winter, and to the preparation and manuring of the land well in advance of the periods allotted for the successive sowings of seed.

The early planted cotton crops should be now ready for picking. This should not be done while there is any moisture on the bolls, either from showers or dew. Packed cotton showing any trace of dampness should be exposed to the sun for a few hours on tarpaulins, bags, or hessian sheets, before storage in bulk or bagging or baling for ginning. Sowings of prairie grass and *Phalaris bulbosa* (Toowoomba canary grass) may be made this month. Both are excellent winter grasses. Prairie grass does particularly well on scrub soil.

Dairymen who have maize crops which show no promise of returning satisfactory yields of grain would be well advised to convert these into ensilage to be used for winter feed. This, especially when fed in conjunction with lucerne or cowpea, is a valuable fodder. Where crops of Soudan grass, sorghum, white panicum, Japanese millet, and liberty millet have reached a suitable stage for converting into ensilage, it will be found that this method of conserving them has much to recommend it. Stacking with a framework of poles, and well weighting the fodder, is necessary for best results. All stacks should be protected from rain by topping off with a good covering of bush hay built to a full cave and held in position by means of weighted wires.

Orchard Notes for March.

THE COASTAL DISTRICTS.

IF the weather is favourable, all orchards, plantations, and vineyards should be cleaned up, and the ground brought into a good state of tilth so as to enable it to retain the necessary moisture for the proper development of trees or plants. As the wet season is frequently followed by dry autumn weather, this attention is important.

Banana plantations must be kept free from weeds, and suckering must be rigorously carried out, as there is no greater cause of injury to a banana plantation than neglect to cultivate. Good strong suckers will give good bunches of good fruit, whereas a lot of weedy overcrowded suckers will only give small bunches of undersized fruit that is hard to dispose of, even at a low price.

Cooler weather may tend to improve the carrying qualities of the fruit, but care must still be taken to see that it is not allowed to become over-developed before it is packed, otherwise it may arrive at its destination in an over-ripe and consequently unsaleable condition. The greatest care should be taken in grading and packing fruit. Only one size of fruit of even quality must be packed. Smaller or inferior fruit must never be packed with good large fruit, but must always be packed separately as required by regulation.

The marketing of the main crop of pineapples, both for canning and the fresh fruit trade, will be completed in the course of the month, and as soon as the fruit is disposed of plantations, which are apt to become somewhat dirty during the gathering of the crop, must be cleaned up. All weeds must be destroyed, and if blady grass has got hold anywhere it must be eradicated, even though a number of pineapple plants have to be sacrificed, for once a plantation becomes infested with this weed it takes possession and soon kills the crop. In addition to destroying all weed growth, the land should be well worked and brought into a state of thorough tilth.

In the Central and Northern districts, early varieties of the main crop of citrus fruits will ripen towards the end of the month. They will not be fully coloured, but they can be marketed as soon as they have developed sufficient sugar to be palatable; they should not be gathered whilst still sour and green. Citrus fruits of all kinds require the most careful handling, as a bruised fruit is a spoilt fruit, and is very liable to speck or rot. The fungus that causes specking cannot injure any fruit unless the skin is first injured. Fruit with perfect skin will eventually shrivel, but will not speck. Specking or blue mould can therefore be guarded against by the exercise of great care in handling and packing. At the same time, some fruit is always liable to become injured, either by mechanical means, such as thorn pricks, wind action, hail, punctures by sucking insects, fruit flies, the spotted peach moth, or gnawing insects injuring the skin. Any one of these injuries makes it easy for the spores of the fungus to enter the fruit and germinate. All such fruit must therefore be gathered and destroyed, and so minimise the risk of infection. When specked fruit is allowed to lie about in the orchard or to hang on the trees, or when it is left in the packing sheds, it is a constant source of danger, as millions of spores are produced by it. These spores are carried by the wind in every direction, and are ready to establish themselves whenever they come in contact with any fruit into which they can penetrate. Specking is accountable for a large percentage of loss frequently experienced in sending citrus fruits to the Southern States, especially early in the season, and as it can be largely prevented by the exercise of necessary care and attention, growers are urged not to neglect these important measures.

Fruit must be carefully graded for size and colour, and only one size of fruit of one quality should be packed in one case. The flat bushel-case (long packer) commonly used for citrus fruits does not lend itself to up-to-date methods of grading and packing, and we have yet to find a better case than the American orange case. Failing this case, a bushel-case suggested by the New South Wales Department of Agriculture is the most suitable for citrus fruits, and were it adopted it would be a simple matter to standardise the grades of our citrus fruit, as has been done in respect to apples packed in the standard bushel-case used generally for apples throughout the Commonwealth. The inside measurements of the case suggested are 18 in. long, 11¾ in. wide, and 10½ in. deep. This case has a capacity of 2,200 cubic inches, but is not included in the schedule of the regulations under "*The Fruit Cases Acts*, 1912-1922." The half-bushel case, No. 6 of the Schedule above referred to, is 10 in. by 11¾ in. by 5¼ in. inside measurements with a capacity of 1,100 cubic inches. The case should be suitable for oranges and the half-case of mandarins. No matter which case is used, the fruit must be sweated for seven days before it is sent to the

Southern markets, in order to determine what fruit has been attacked by fruit fly, and also to enable bruised or injured fruit liable to speck to be removed prior to despatch.

Fruit fly must be fought systematically in all orchards, for if this important work is neglected there is always a very great risk of this pest causing serious loss to citrus growers.

The spotted peach moth frequently causes serious loss, especially in the case of navels. It can be treated in a similar manner to the codling moth of pip fruit, by spraying with arsenate of lead, but an even better remedy is not to grow any corn or other crop that harbours this pest in or near the orchard. Large sucking-moths also damage the ripening fruit. They are easily attracted by very ripe bananas or by a water-melon cut in pieces, and can be caught or destroyed by a flare or torch when feeding on these trap fruits. If this method of destruction is followed up for a few nights, the moth will soon be thinned out.

Strawberry planting may be continued during the month, and the advice given in last month's notes still holds good. Remember that no crop gives a better return for extra care and attention in the preparation of the land and for generous manuring than the strawberry.

THE GRANITE BELT, SOUTHERN AND CENTRAL TABLELANDS.

THE advice given in these notes for the last few months regarding the handling, grading, and packing of fruit should still be followed carefully. The later varieties of applies and other fruits are much better keepers than earlier-ripening sorts, and as they can be sent to comparatively distant markets, the necessity for very careful grading and packing is, if anything, greater than it is in the case of fruit sent to nearby markets for immediate consumption. Instruction in the most up-to-date methods of grading and packing fruit has been published by the Department, which advice and instruction should enable the growers in that district to market their produce in a much more attractive form.

The same care is necessary in the packing of grapes. Those who are not expert cannot do better than follow the methods of the most successful packers.

As soon as the crop of fruit has been disposed of, the orchard should be cleaned up, and the land worked. If this is done, many of the fruit-fly pupæ that are in the soil will be exposed to destruction in large numbers by birds, or by ants and other insects. If the ground is not worked and is covered with weed growth, there is little chance of the pupæ being destroyed.

Where citrus trees show signs of the want of water, they should be given an irrigation during the month, but if the fruit is well developed and approaching the ripening stage, it is not advisable to do more than keep the ground in a thorough state of tilth, unless the trees are suffering badly, as too much moisture is apt to produce a large, puffy fruit of poor quality and a bad shipper. A light watering is therefore all that is necessary in this case, especially if the orchard has been given the attention recommended in these notes from month to month.

THE FIRST CULTIVATORS.

Man in his rudest state, the philosophers say, would first live on fruits or roots, afterwards hunting or fishing, next by the pasturage of animals, and, lastly, to all of these he would add the raising of corn. Tillage, or the culture of the soil for this purpose, is supposed to have been first practised in imitation of the effects produced by the sand and mud left by the inundations of rivers. These take place more or less in every country, and their effects on the herbage, which spontaneously springs up among the deposited sand and mud, must at a very early period have excited the attention of the countryman. This hypothesis seems supported by the traditions and natural circumstances of Egypt, a country overflowed by a river, civilised from time immemorial, and so abundant in corn as to be called the granary of the adjoining States. Sir Isaac Newton and Stillingfleet, accordingly, considered that corn was first cultivated on the banks of the Nile. Sir Isaac fixes on Lower Egypt; but, as Herodotus and other ancient Greek writers assert that that country was once a marsh, and as Rennel, in his work on the geography of Herodotus, is of the same opinion, Stillingfleet considers it more probable that the cultivation of land was invented in Upper Egypt, and proceeded downwards according to the course of the Nile.

ASTRONOMICAL DATA FOR QUEENSLAND.

TIMES COMPUTED BY D. EGLINTON, F.R.A.S., AND A. C. EGLINTON.

TIMES OF SUNRISE, SUNSET, AND MOONRISE.

AT WARWICK.

	January, 1932.		February, 1932.		MOONRISE. Jan., 1932.	MOONRISE. Feb., 1932.
Date.	Rises.	Sets.	Rises.	Sets.	Rises.	Rises.
					p.m.	a.m.
1	5.3	6.47	5.26	6.44	11.55	...
2	5.3	6.47	5.27	6.44	...	12.40
					a.m.	
3	5.4	6.47	5.28	6.43	12.30	1.36
4	5.4	6.48	5.29	6.42	1.5	2.37
5	5.5	6.48	5.30	6.41	1.53	3.38
6	5.6	6.48	5.31	6.40	2.47	4.38
7	5.6	6.49	5.32	6.40	3.46	5.39
8	5.7	6.49	5.33	6.39	4.49	6.40
9	5.8	6.49	5.33	6.38	5.51	7.33
10	5.9	6.49	5.34	6.37	6.51	8.26
11	5.9	6.49	5.34	6.37	7.51	9.19
12	5.10	6.49	5.35	6.36	8.48	10.10
13	5.11	6.49	5.36	6.35	9.45	11.3
14	5.12	6.48	5.36	6.35	10.35	11.59
					p.m.	p.m.
15	5.13	6.48	5.37	6.34	11.24	12.55
					p.m.	
16	5.14	6.48	5.38	6.34	12.18	1.51
17	5.15	6.48	5.38	6.33	1.3	2.49
18	5.16	6.48	5.39	6.32	2.11	3.45
19	5.17	6.47	5.40	6.32	3.7	4.39
20	5.17	6.47	5.41	6.31	4.5	5.28
21	5.18	6.47	5.42	6.30	5.4	6.9
22	5.19	6.47	5.43	6.29	6.0	6.46
23	5.20	6.47	5.43	6.28	6.51	7.21
24	5.21	6.47	5.44	6.27	7.37	7.55
25	5.21	6.46	5.45	6.26	8.15	8.30
26	5.22	6.46	5.46	6.25	8.50	9.7
27	5.22	6.46	5.46	6.24	9.23	9.47
28	5.23	6.46	5.47	6.23	9.56	10.36
29	5.24	6.45	5.48	6.22	10.30	11.31
30	5.24	6.45	...	...	11.7	...
31	5.25	6.45	...	...	11.49	...

Phases of the Moon, Occultations, &c.

7 Feb.	●	New Moon	12 45 a.m.
15 ,,	☾	First Quarter	4 16 a.m.
22 ,,	○	Full Moon	12 7 p.m.
29 ,,	☽	Last Quarter	4 3 a.m.

Apogee, 12th February, 3.42 p.m.

Perigee, 24th February, 11.30 a.m.

The conjunction of Venus with the Moon on the 9th would have afforded an interesting spectacle about two hours after sunrise had it not been for the broad daylight and the nearness of the Sun.

As Venus will be apparently passing through the constellation Pisces from 3rd February till 6th March it will not only point out that constellation along the line of the ecliptic, but on the 13th will arrive at the starting point known as the First Point of Aries. It will then be in a line with Algenib and Alpharat, which mark the eastern side of the Great Square of Pegasus and indicate the meridian from which, like that of Greenwich, all eastern distances are reckoned, either in hours, 1 to 24, with minutes and seconds of time, or in degrees, 1 to 360, with minutes and seconds of arc.

Jupiter will be in conjunction with the Moon on the 20th when below the horizon in Queensland.

The conjunction of Mercury and Mars on the 21st will also be under circumstances unfavourable for observations.

Mercury, on the 26th, will be passing from west to east of the Sun, about three degrees on its southern side. It will then be on the far side of its orbit and at a distance of about 130 million miles from the earth and quite unobservable in the Sun's rays. On the next day Venus will be passing from west to east of Uranus. On the 27th the distance of the two planets from the Earth being, respectively: Venus 92 million miles, and Uranus about 1,782 million miles.

An occultation of Antares, the brightest star in Scorpio, on the night of the 28th, will take place when the Moon and star are nearly overhead in Southern Queensland.

Mercury rises at 4.5 a.m. on the 1st and at 4.52 a.m. on the 15th.

Venus sets at 8.37 p.m. on the 1st, and at 8.26 p.m. on the 15th.

Mars being in conjunction with the Sun on the 1st and rising only 28 minutes before it on the 29th, will be invisible.

Jupiter rises at 7.9 p.m., on the 1st, and at 6.10 p.m. on the 15th.

Saturn rises at 4.25 a.m. on the 1st, and at 3.37 a.m. on the 15th.

The Southern Cross will be upright and on the southern meridian about 4 a.m., and will be at its furthest eastern position parallel with the horizon at about 10 p.m. on the 1st February.

For places west of Warwick and nearly in the same latitude, 28 degrees 23 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.