ANNUAL RATES OF SUBSCRIPTION.

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

VOL. XLVII. 1 MARCH, 1937. PART 3

Event and Comment

The Problem of Unemployed Youth.

REPRESENTATIVES of all the States were present at a recent conference in Melbourne on the employment of youth, and which was convened by the Commonwealth Government. The problem was discussed from all angles. The general consensus of opinion affirmed the acceptance of the duty which we of this generation have in respect of the boys and girls now entering the period of adolescence. In Australia, as in most other countries, many young people are approaching full maturity without knowing what it is to have had a real job in life. In fact, many have already arrived at manhood and womanhood without finding a settled place in the industrial life of the community. The Premier (Hon. W. Forgan Smith, LL.D.) represented Queensland at the conference. Discussing the business done, he made it clear that while a pronouncement on the proceedings would be premature the problem would be attacked in a new way.

In the course of a statement on the subject, the Premier said that at the present stage it was interesting to review what Queensland had done to provide employment for boys and girls. The depression had brought

with it so many problems that young people were left to fend for themselves, and consequently fared very badly. He added—

"It was not until 1935 that Queensland made a determined and united effort to solve juvenile unemployment, and our real progress began from the day in January, 1935, when, as a result of a conference, a Juvenile Employment Board was set up and a Juvenile Employment Bureau opened.

"The problem was looked at fairly and squarely, and it was decided that the best means of assisting children towards permanent employment was by directing them from school to work. The Department of Public Instruction was made the central point of activity, and the Juvenile Employment Bureau was set up to work in three sections:—

1.—Commercial Section: At the State Commercial High School and College.

2.—The Industrial Section: At the Apprenticeship Office.

3.—The Rural Section: At the Head Office of the Department of Public Instruction.

"It was appreciated that there was little value in waiting for employers to approach the Bureau, so the policy from the beginning was to seek employers in order to find the right boy or the right girl for the right job. Employers were afforded the services of the Bureau which saved them much time and trouble in interviewing and classifying applicants, and the worry and bother of selection passed to the skilled officers of the Juvenile Employment Bureau.

"There have been 6,072 boys and girls placed in employment through the Bureau during those two years of operation, and when the placements of the other Government activities are added, it is found that between 1st July, 1932, and 31st December, 1936, 16,856 boys and girls have been placed in jobs. That is a record of which Queensland has cause for pride.

"First steps were taken in Brisbane. Each year 5,500 boys and girls complete their full-time education and seek employment, and of that number the Bureau, during its first year of operation, placed 53 per cent. of Brisbane's output. This excellent result was obtained by energy and enthusiasm. Nearly 2,000 children were found positions by the Commercial Section, over 3,000 by the Industrial Section, and nearly 1,000 by the Rural Section. Trained children from the Commercial Section find more or less ready employment in the offices, shops, and factories, but it is in respect of the rural employment that the most difficulty is encountered."

The Claims of Agriculture.

CONTINUING, Mr. Forgan Smith remarked that it was well known that in Queensland there was an aversion on the part of many parents from employment of their boys in the country. He said:—

"Many parents prefer that their boy should remain out of work rather than that he should take a job on a farm; but such a view is a narrow one, when it is appreciated that the source of wealth is the land, and that the city is dependent on the country for its

prosperity. Agriculture is a science, not a form of drudgery. The farmer must be a man of knowledge and experience, who needs many qualities for success, and success in agriculture is as worthy as success in any other profession. But the public outlook has not been favourable.

"I pointed out in early announcements that 'it was definitely the Government's policy to encourage these boys to become future settlers with farms of their own.' In continuance of that policy we are training boys who will ultimately become successful farmers and good citizens of the State. Invaluable in that direction has been the assistance of the St. Lucia Farm School, the history of which is a particularly interesting one. Some five years ago the Minister for Agriculture outlined a project for the establishment of a farm training school at a place convenient to the city, and St. Lucia was the result.

"The idea behind the scheme was to give workless city boys an opportunity for training for a country career, to assist Australian youth to become good Australians. Since that date, 100 per cent. of the boys admitted to the school have been trained, employed on farms or proceeded to higher studies at the Agricultural College at Gatton, and 263 graduates of the school are now making their way in agriculture. But our attack upon youthful employment problem was not limited to that sector. Our apprenticeship scheme, which had long proved its worth, has been continued and increased, and since 1932 there have been 2,445 boys apprenticed in this State to skilled trades. Side by side with the work is the work of the Juvenile Employment Bureau. The Labour Bureau through its various offices in Queensland has been endeavouring to fill vacancies, and 1,708 boys and girls were placed through its agencies. The State Children's Department is another means of youthful employment, and 1,593 boys and girls have been placed by this Department.

"When the revival of employment of youth was instituted in 1935, the Government appreciated that it must give a lead to private enterprise, so Crown employment was stimulated, and as a result 1,305 young people have been placed in this way. One of the outstanding successes in Juvenile Employment has been the New Settlers' League, a body which works quietly and efficiently, placing boys in selected employment on farms, watching their progress, supervising their employment, and generally acting as father to 675 lads who have been found employment in this way since 1932.

"Prior to the Juvenile Employment Bureau operating, we had a Vocational Training Scheme which absorbed some 1,043 boys, and in addition through the Railway Department, the Forestry Department, the Police Department, the Rural Training Scheme, the Department of Labour and Industry, and the Riverview Training Farm Scheme, the total employment of boys and girls has been brought to 16,856, and now at this stage the Commonwealth proposes a scheme which is described as 'industrial repatriation' operating over two or three years, and provided the necessary grant is made available, the States will be enabled to multiply their efforts to achieve the aim which is to provide a job for every boy and girl in the community."

The Grasshopper Outbreak in Queensland. 1934-35.

J. A. WEDDELL, Entomologist.

INTRODUCTION.

QUEENSLAND as a State does not suffer so severely from grasshopper plagues as some other areas throughout the world. Numerous species are, of course, present in the State, but only one or two are capable of plague incidence. The far western districts normally carry a moderate grasshopper population, of little economic significance, and only when large swarms tend to invade and breed heavily in the more valuable near western areas, or, alternatively, when the numbers in the far western districts rise to extraordinary proportions, would the problem of the plague grasshopper arise. It is mainly with the first of these alternatives as illustrated by the grasshopper outbreak of 1934-35 that the present report is concerned.

SECTION I.

HISTORY OF GRASSHOPPER OUTBREAKS IN QUEENSLAND.

Recorded Plagues Prior to 1934.

It is recorded in the Proceedings of the Royal Society of Queensland, Vol. 1, 1884, pp. 59-60, that Mr. H. Tryon referred to a locust plague infesting sugar plantations in March, 1884, on the Lower Herbert, North Queensland, the species being mentioned as probably *Stenobothrus vittifrons*. Damage to the extent of £30,000 was alleged. Some three years earlier, grasshoppers had spread over the plain, of 150 square miles, bounded by the Herbert and Stone rivers and the coast.

Another early reference in Queensland to grasshopper plagues is contained in "Report on Insect and Fungus Pests, No. 1," Tryon, 1889, pp. 217-223. The insect is referred to as *Oedipoda* sp., but the descriptions given establish the species as *Chortoicetes terminifera* Walk. Life history, habits and control are also discussed. It is recorded that Toowoomba was visited during December, 1886, by quite a plague of grasshoppers, which did immense damage to pasture.

Other records of past grasshopper invasions in Queensland usually refer to the yellow-winged locust, *Locusta danica*, L., by which is possibly meant *Gastrimargus musicus* Fabr. The following brief summaries of the records of significant outbreaks are taken from the annual reports of Mr. H. Tryon, then Government Entomologist and Vegetable Pathologist:—

1902-03.—Pasturage: Grasshoppers, Darling Downs.

1907-08.—Pasturage: Grasshoppers (*Locusta danica*), Rockhampton.

1911-12.—Yellow-winged grasshoppers (*Locusta danica*), Mossman River, Cairns, Tolga, Townsville, Springsure, Clermont, Kamerunga, Central and Western districts. Swarms of young hoppers occurred in Central and Western districts, September, 1911. In February, 1912, several properties were still suffering severely over hundreds of square miles. A mite (*Podolipus* sp.) preyed upon the adults, and a small hymenopterous insect, *Scelio* (*Australis* Frog.) attacked the eggs.

1914-15.—Grasshopper (*Locusta danica* L.). Considerable damage in the Ayr district to sugar cane. Grasshoppers (*Locusta danica*), throughout a vast area in the Central district of which Springsure might

be regarded as the centre. The grasshopper parasite (*Podolipus* sp.—*Acarina*) was very numerous on adults in the Burdekin district in April, 1915.

1915-16.—Yellow-winged locust (*Locusta danica*), Townsville, Lower Burdekin, Herbert River—affecting grass, a brood hatching out during the middle of October; very destructive.

1916-17.—Grasshoppers, affecting pasturage, Toogoolawah district.

THE PLAGUE OF 1934-35.

The grasshopper outbreak in 1934 was unexpected, but surveys soon showed that pasture and crop destruction was bound to be extensive. In the more closely settled areas control operations were clearly necessary. This report summarises the observations made in Queensland and discusses the control programme that was put into operation.

Several officers took part in the investigations and control organisation. Associated with the writer in South Queensland at various times were Messrs. N. E. H. Caldwell, W. J. S. Sloan, and T. H. Strong; Mr. A. R. Brimblecombe investigated the outbreak at Wallumbilla; Mr. Sloan later reported an outbreak in the Callide Valley; Mr. J. H. Smith was responsible for the survey in North-western Queensland. The writer saw most of the phases of the outbreak in the southern portion of the State.

Species Concerned and Distribution.

The main species involved was the common plague grasshopper of Australia, *Chortoicetes terminifera* Walk., usually referred to in literature as "the wandering grasshopper," but better known in Southern Queensland as the "plague grasshopper." This species was widely distributed. Plate 73 illustrates the observed distribution of *C. terminifera* during 1934-35. Two species—*Gastrimargus musicus* and *Austacris proxima proxima* Walk.—were associated with *C. terminifera* in the North Queensland outbreak, but the lastmentioned species was even there the most important. A small species—*Phaulacridium gemini* Sjostedt (a brachypterous form)—attacked tobacco in the Texas distrct.

Species-locality records made during the currency of the attack are listed below:—

BRIEF SUMMARY OF SPECIES, DISTRIBUTION, AND IMPORTANCE OF GRASSHOPPERS IN QUEENSLAND, 1934-1935.

1. *Chortoicetes terminifera* Walk.—wandering or plague grasshopper.

Toowoomba	Occasional specimens collected.
Warwick, Oakey, Jondaryan, Wallumbilla, Tara, Roma, Mitchell, Taroom, Callide Valley	Infestations of relatively minor importance.
St. Helens, Irongate, Yarranlea, Millmerran, Kooroongarra, Leyburn, Inglewood, Yelarbon, Texas, Goondiwindi and surrounding districts.	The main area in which infestation was important, both locally and as a potential menace to other districts. Successive generations bred in the localities mentioned.
Far Western districts, including Cunnamulla, Eulo, Charleville, Quilpie, Tambo, Blackall; Northern districts, including Julia Creek, Richmond, Sellheim	Pastoral districts over which mainly adult swarms of various size and density were observed.

2. *Gastrimargus musicus* Fabr., known as the "yellow-winged locust"—

Dalveen, Texas, Goondiwindi, Tambo	Occasional specimens collected.
Richmond, Hughenden, and otherwise widely distributed in North-west Queensland	Important as pasture pest in the North.

3. *Austacris proxima proxima* Walk.—

Tara, Goodiwindi, Tambo ..	Occasional specimens collected.
Julia Creek, Cloncurry, N.Q. ..	Fairly important as a pasture pest in the North.

4. *Phaulacridium gemini* Sjostedt—

Glenarbon, Texas, Riverton ..	Important as a pest on young tobacco.

Of the following species, only occasional specimens were collected at the centres mentioned against each:—

5. *Caledia propinqua* Walk. ..	Dalveen, Texas, Goondiwindi.
6. *Oedaleus australis* Sauss. ..	Toowoomba, Texas, Cunnamulla.
7. *Aiolopus tamulus* Fabr.	Westbrook, Texas, Goondiwindi, Richmond.
8. *Acrida turrita* Linn.	Dalveen.
9. *Pycnostictus seriatus* Sauss. ..	Dalveen.
10. *Monistria* sp.	Dalveen.

Position in South-eastern Queensland.

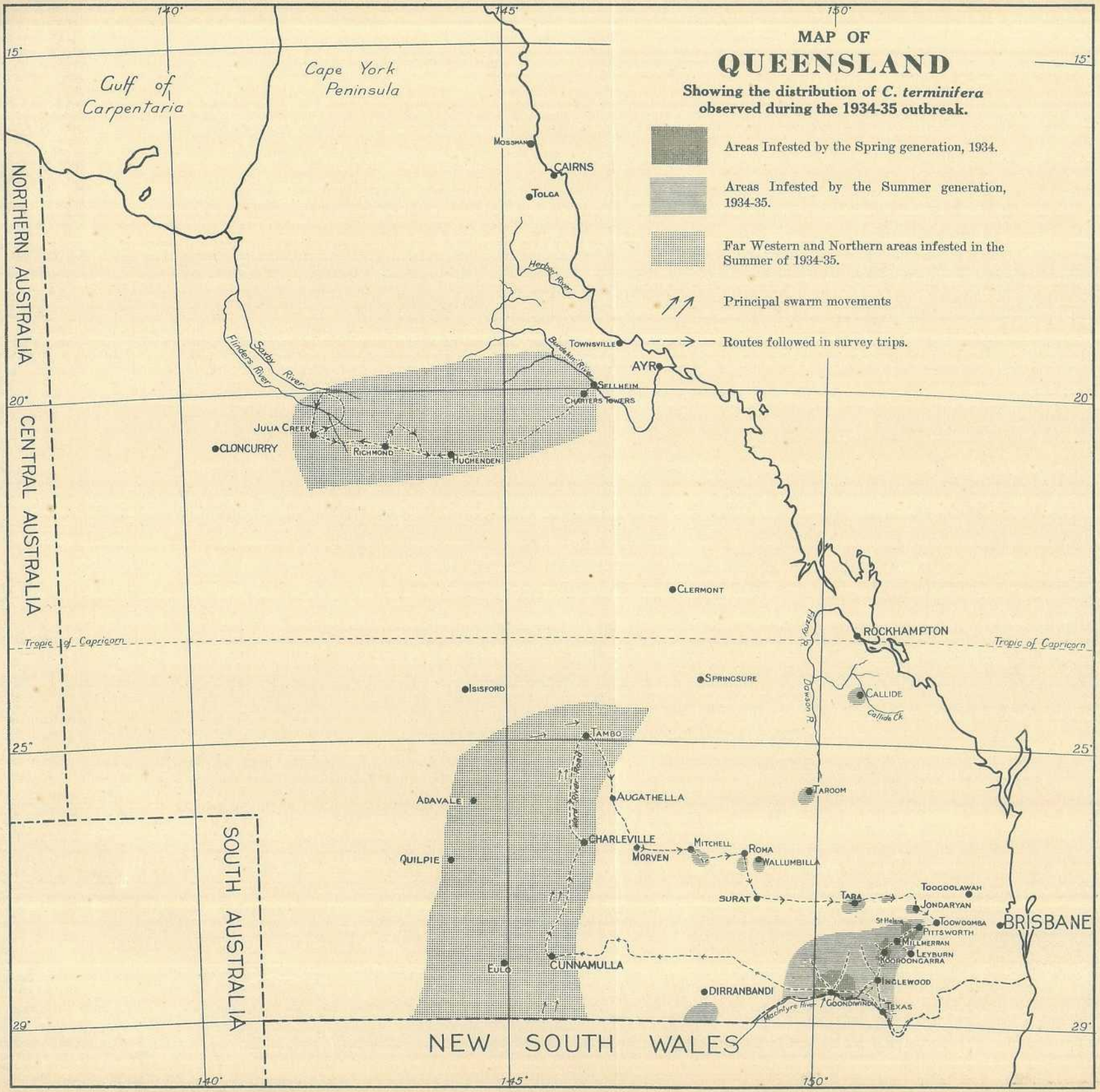
Several small-scale invasions had occurred some time prior to the main outbreak in Southern Queensland, but their significance was not realised until the main attack appeared. For instance, during the preceding three or four years, flying grasshoppers from New South Wales had crossed the McIntyre River, which constitutes the State border at Goondiwindi, and invaded holdings in Queensland. Neither the degree of the invasion nor the area occupied seem to have been very great, except in the case of swarms that were reported as having been dense in April-May, 1934.

In parts of the Kooroongarra-Millmerran-Pittsworth area flying swarms of grasshoppers were said to have been common from the end of March until the beginning of May, 1934. The swarms were very dense and caused considerable damage to pastures, young cereals, and other fodder crops. Extensive egg-laying was observed by the farmers, but as the swarms diminished and a period elapsed during which hoppers did not emerge, it was locally thought that the trouble was at an end. Egg-laying, however, had been very considerable, and the non-emergence of hoppers was simply due to the cold weather.

Early in September, 1934, young hoppers were noticed, and by the middle of the month the size and density of the swarms were alarming. About the same time hoppers emerged in the Goondiwindi-Yelarbon districts. Control measures were not then thoroughly organised, and countless survivors completed their development by the end of October. Dense swarms of adults commenced to traverse the country about 1st November, the general migration in the Goondiwindi area being to the east and north-east. At the same time further swarms crossed the McIntyre River into Queensland.

Oviposition was first noted on 3rd November, when a large egg-bed, an acre or more in extent, was located at Goondiwindi. Hopper emergence commenced on 22nd November—an incubation period of nineteen days. The egg-period for this brood varied from nineteen to twenty-one days.

The Inglewood district suffered two mass invasions of flying adults, these occurring on 2nd and 3rd November and again from 13th to 25th November. A somewhat dispersed population persisted for approximately the whole month of November. Oviposition occurred at numerous


MAP OF
QUEENSLAND
Showing the distribution of C. terminifera observed during the 1934-35 outbreak.
Areas Infested by the Spring generation, 1934.
Areas Infested by the Summer generation, 1934-35.
Far Western and Northern areas infested in the Summer of 1934-35.
Principal swarm movements
Routes followed in survey trips.
Gulf of Carpentaria
Cape York Peninsula
NORTHERN AUSTRALIA
CENTRAL AUSTRALIA
SOUTH AUSTRALIA
NEW SOUTH WALES
Tropic of Capricorn
140°
145°
150°
15°
20°
25°
29°
MOSSMAN
CAIRNS
TOLGA
Herbert River
TOWNSVILLE
AYR
Burdekin River
SELLHEIM
CHARTERS TOWERS
Saxby River
Flinders River
JULIA CREEK
CLONCURRY
RICHMOND
HUGHENDEN
CLERMONT
ROCKHAMPTON
Fitzroy R.
SPRINGSURE
ISISFORD
Dawson R.
CALLIDE
Callide Ck
TAMBO
Warrego River
AUGATHELLA
TAROOM
ADAVALE
CHARLEVILLE
MITCHELL
ROMA
MORVEN
WALLUMBILLA
QUILPIE
SURAT
TARA
TOOGOOLAWAH
JONDARYAN
St Helens
TOOWOOMBA
BRISBANE
PITTSWORTH
MILLMERRAN
LEYBURN
KOOROONGARRA
INGLEWOOD
EULO
CUNNAMULLA
DIRRANBANDI
Macintyre River
GOONDIWINDI
TEXAS

places, and control work aiming at hopper destruction was somewhat complicated by the inevitable overlapping of generations that followed.

The first adults from this generation were flying in the Goondiwindi district on 4th January, 1935.

Various parasites and birds did excellent work, particularly during the second generation, and these, together with the control operations, considerably reduced the pest population. Weather conditions were also unfavourable for the pest. The rainfall towards the end of the year was above average in the districts concerned, and culminated in exceptional falls giving flood conditions. Large numbers of grasshoppers were found dead in creeks and low-lying ground. This phenomenon was not personally investigated, and it is uncertain whether grasshopper

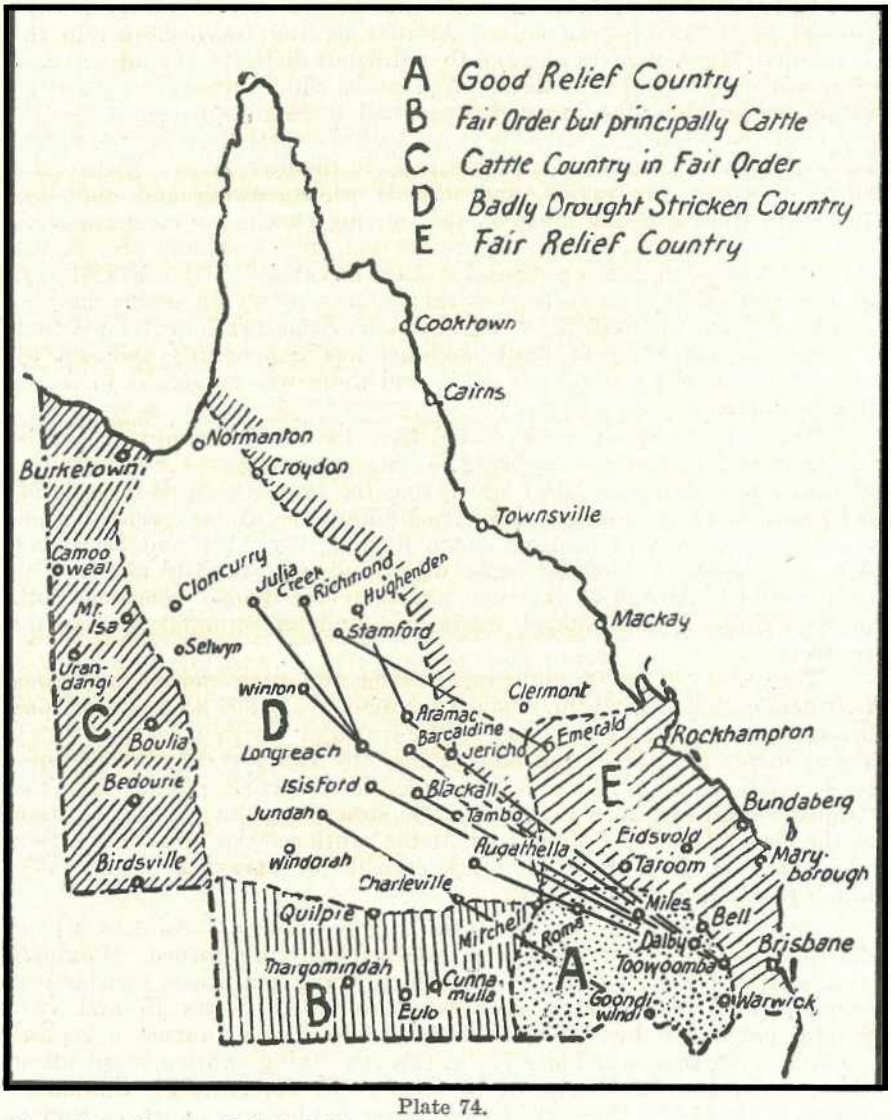


Plate 74.

From the "Courier-Mail," Brisbane, 23rd February, 1935, showing the condition of the country at the time.

destruction was due to drowning or pathogenic organisms aided by the moist conditions. The probability is that both factors were operative.

The last record of breeding at that time was from the Yarranlea district, where hoppers emerged in the second week of January, 1935. These were almost certainly delayed second-generation insects, as in that district insufficient time had elapsed for the development of another brood.

A slight recrudescence of grasshopper trouble occurred in portion of the Goondiwindi-Texas country in November, 1935, when a report from the resident stock inspector indicated that small numbers of hoppers were hatching. The outbreak was on quite a small scale, and the situation did not develop further.

In the 1934-35 outbreak, concerted measures were necessary for the control of *C. terminifera* only. At first baiting was confined to the Pittsworth-Kooroongarra and the Goondiwindi districts, the latter being more correctly referred to as the Waggamba Shire. However, with the second generation, the infested areas had markedly increased, giving practical coalescence (Plate 73). Agricultural activities in the north-easterly portion of this area, particularly in the direction of Millmerran and Pittsworth, are varied, and include wheatgrowing and dairying. The main wheatgrowing areas on the Darling Downs are comparatively close. The grasshoppers were therefore not only a serious pest in the areas first invaded, but a potential menace to valuable adjacent country. The Goondiwindi district is pastoral country, carrying sheep mainly, and here again the pastures were attacked. Some graziers claimed that the carrying capacity of their holdings was temporarily reduced by amounts varying up to 25 per cent., and there was no reason to doubt this estimate.

On pastures that were eaten bare by the grasshoppers, early regrowth followed only if growing conditions were good. For instance, certain areas that were eaten out during the previous April-May, 1934, remained bare for several months, including the winter period. Fortunately, regrowth in pastures eaten during November and December was very rapid, the weather being warm and exceptionally moist. The contemporary rainfall at the time was therefore doubly beneficial both in rounding off the control operations and in stimulating pasture recovery.

The value of the Goondiwindi district and surrounding areas was well demonstrated early in 1935. The summer of 1934-35 was a serious drought period for large areas of Central and North Queensland. A useful map (Plate 74), reproduced here by courtesy of The Queensland Newspapers Pty. Ltd., was included in an article published in the "Courier-Mail" on 23rd February, 1935, describing the pastoral position at the time. It will be observed that the south-eastern area in question was rated as good relief country capable of carrying considerable numbers of stock on agistment.

Crops were variously attacked by the insects. Swarms which destroyed a variety of other plants left tobacco untouched. Potatoes were stripped bare, but under suitable growing conditions satisfactory recovery took place and a crop was produced (Plates 75 and 76). Several patches of lucerne were destroyed by flying swarms, a typical example being shown in Plate 77; in this case flying swarms frequenting the crop for two days stripped 10 acres ready for cutting. Similarly, oats were stripped (Plate 78), while other fodder crops such as Sudan grass were eaten to the ground. Young wheat was completely destroyed

by hopper swarms, being eaten out on a face. The flag of half-grown wheat was taken by both hoppers and adults, but usually these plants made a recovery. Adults attacking mature wheat fed on the ear, often also cutting the stalk (Plate 79).

Secondary losses occurred in one or two instances. In a misguided attempt to use crops that were threatened by hoppers, certain farmers ran dairy cattle on young Sudan grass, which is not normally grazed. A number of deaths unfortunately followed, due to prussic acid poisoning, and indirectly added to the toll levied by the grasshoppers.

Practically all vegetable crops were stripped bare, or, if young or succulent, the plants were eaten to the ground. This damage was important in western districts generally and on large holdings which need to be self-supporting as regards fresh green vegetables.

Plate 75.
Potato crop stripped by flying swarms.
[*Photo. N. A. R. Pollock.*

The significant features in the south-easterly phase of the outbreak may be stressed as follows:—

1. The insects were present in large numbers, causing very definite losses.
2. The country infested was valuable, and closely settled areas slightly further east were menaced by the possibility of grasshopper movements in that direction.
3. The size of the holdings was not, as a rule, too large to prevent the successful adoption of effective control measures.

Position in South-western Queensland.

West of the Goondiwindi area small-scale infestations were located in the vicinity of Talwood, and south of Dirranbandi, in November, 1934. These represented migrations from the south. Some breeding took place, but there was no tendency towards district-wide infestation. Occasional reports also were received from points further west, notably Eulo (October), Charleville (November), and Tambo (December). In order to obtain some idea of the status of these infestations in relation to the south-eastern phase, a rapid survey of the southern and western

Plate 76.
Showing regrowth of the potato crop illustrated in Plate 75 after four weeks.
[*Photo. N. A. R. Pollock.*

areas was made early in January, 1935. The route followed is indicated on the map.

The map shows diagrammatically the significant features of the grasshopper position as determined both by observation and by enquiry. No sign of grasshopper activity between the infested south-eastern areas and a point about 30 miles east of Cunnamulla was observed. Here a dispersed swarm of adult grasshoppers was located. Much of the intervening country had been open forest on poor sandy soils growing coarse grasses. Isolated areas of Mitchell grass flats were not uncommon. It

Plate 77.
Remains of lucerne crop destroyed by flying swarms infesting patch for two days.

was on such an area, carrying at the time poor herbage—mainly stunted saltbush—that the grasshoppers were found. In travelling westward, timbered red-soil country free from hoppers and the open areas with light grasshopper populations alternated until the country opened out into the Mitchell grass plains, commencing some few miles east of Cunnamulla. On a pastoral station 10 miles east of Cunnamulla adult grasshoppers were fairly dispersed over wide areas, but with a heavy concentration along the bore drains. Conditions were very dry, and there was little grass away from the edge of the bore drains, the main herbage

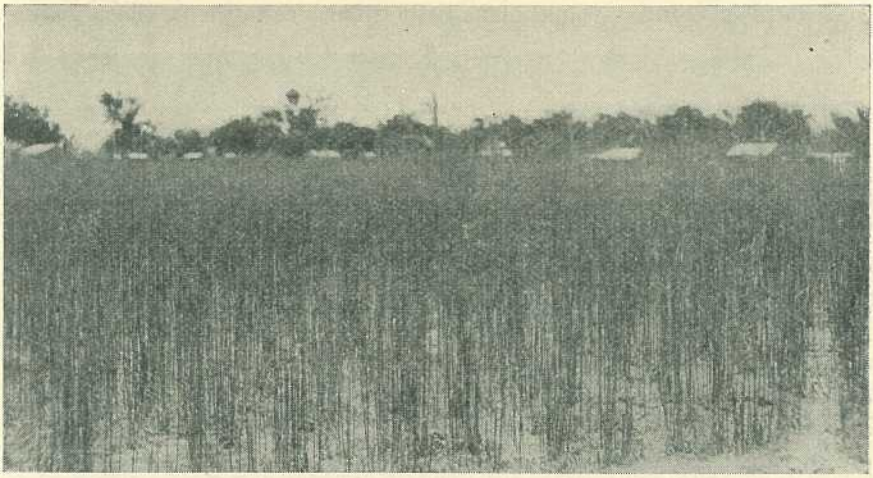


Plate 78.
Oats stripped by flying swarms.
[*Photo. N. A. R. Pollock.*

being only stunted saltbush 6 inches high. The grasshoppers were feeding, but the concentration was not sufficient to cause serious damage.

Late in December a heavy swarm—the largest that had been seen in the district for some years—was reported to have passed over, travelling north. A similar swarm had apparently swept over the southern border during December from New South Wales and moved north in the direction of Cunnamulla. There seems little doubt that these records refer to the same migrants.

From Cunnamulla to Tambo scattered swarms of various dimensions were encountered, flying always with a generally northerly trend. Adult grasshoppers were said to be common further west, but there were few indications of the pest occurring in numbers very far east of the line joining Cunnamulla and Charleville. Swarms were reported from at least as far west as Quilpie and Adavale. North of Charleville, on the Ward River road, several reports of grasshoppers were received to as far as Tambo. In most cases a northerly flight of the adults had been noticed. So far as the observations went, the grasshopper density increased northwards, and this may possibly have been due to the overtaking of migrating swarms that had been reported to be passing northwards. Near and into Lansdowne Station, south of Tambo, a huge swarm of flying adults, the swarm extending 20 miles north and south, was encountered, the flight direction being almost due north.

Beyond the limits of the migrant swarm just mentioned the infestation on this property was widespread. There was marked concentration of the insects along the bore drains and in slight hollows. The grasshoppers had arrived in two main swarms, the first being about the third week of December, and the second during the first week of January.

Much of the country was drought-stricken, and a few points may be worthy of mention. There was practically no green feed for the grasshoppers, except the tiny shoots of herbage on the drain margins. This paucity of feed may account for the fairly rapid migration of the insects. Many observers felt that even large swarms wandering haphazardly over such parched country would make little difference to the graziers' losses.

Plate 79.
Wheat showing loss of ear; adult grasshoppers invaded and damaged the portion to the right.

Conversely, in good seasons the stock carried on western lands could consume only part of the available fodder, and it would appear that even a considerable grasshopper population would not appreciably reduce the carrying capacity of the properties. The insects are more or less common every year in these parts of the State, the noteworthy feature during the period under discussion being the much larger and denser swarms that were present. Even so, there were large areas between swarms on which it would have been difficult to collect grasshopper specimens.

Swarms were reported as having passed through the Tambo township early in January, moving in an easterly direction. Other reports were received of flying swarms up to 100 miles west of Tambo.

Apparently little or no breeding had taken place in the Cunnamulla-Tambo country, for only the flying insects were seen by the writer, and few residents were aware of the breeding habits. Only one station-owner had noticed egg-laying and hopper swarms, on a small area, and a few had seen the mating and clustering of adults which normally precede egg-laying. Large or widespread breeding grounds such as could give rise to the extensive swarms were quite unknown. Certain

areas on which clustering had been observed were thoroughly examined, but although the general soil conditions of these areas seemed suitable for oviposition, no evidence that it had occurred could be discovered.

Grasshoppers occurred sporadically along the stock route from Tambo to Augathella and in the neighbouring properties in the plains country until the timbered country was entered, about 20 miles north of Augathella. With the change in vegetation there was a complete cessation of grasshopper occurrence. A few hoppers were seen on isolated timber-free areas between Augathella and Morven, but no worthwhile pasture destruction had been recorded.

The Morven district was badly in need of rain, but towards Mitchell and further east there was feed in abundance. Swarms of half-grown hoppers were encountered on the road a few miles east of Mitchell, and on some properties grasshoppers had been present since late November. On one property baiting work on a big scale had been necessary and had given good results. The infestations were, however, quite patchy, fortunately not being of the general nature seen in the Goondiwindi and allied areas.

Roma district showed even better growth than Mitchell, and the grasshopper position was of much less importance. Only a few properties appeared to have been affected, and these to only a small degree. At Surat nothing was known locally of any grasshopper trouble. This district was more or less isolated from infested areas by timber barriers, and these, together with the fairly general timber cover still existing, ensured some protection against invasions from elsewhere.

At Glenmorgan, about 60 miles east from Surat, grasshopper infestation on a property south on the Moonie River was reported. This appeared to represent the northernmost extension, in that locality, of the Goondiwindi infestation. As has elsewhere been indicated, there were minor outbreaks at Wallumbilla, Tara, and Jondaryan, where two small generations occurred in the spring and summer months.

The main impressions gained from the survey were as follows:—

1. The really serious economic infestation had been correctly recognised early in the campaign as covering the Pittsworth, Millmerran, Inglewood, and Goondiwindi areas.

2. The main western infestation occurred on the open plains country, and its eastern margin was delineated by the western margin of the main timber belt which follows a line drawn somewhat east of Cunnamulla and Charleville. The area involved was at least 100 miles wide east and west, no information being obtained from points further west, and extending from the southern boundary of the State northwards. A dispersed grasshopper population is usual to this territory, but during the period from November, 1934, to January, 1935, there was a marked increase much above the usual in the numbers of the pest.

3. The country in between the infested south-eastern and south-western areas was comparatively free from grasshoppers, except for a few sporadic outbreaks.

4. The control of grasshopper infestations of a general nature in the western country, consisting as it does of large pastoral holdings, was quite impracticable, except in isolated cases. In this connection, therefore, it was important that there were few records of actual breeding. It would be difficult in that country to assess the losses—if any—caused by the pest.

Position in North and North-western Queensland.

During January, 1935, Mr. J. H. Smith visited several western districts, including Julia Creek, Hughenden, and Charters Towers, and investigated reports of grasshopper activity.

Three species of grasshoppers were implicated in the outbreaks, these being *Gastrimargus musicus, Austacris proxima proxima,* and *Chortoicetes terminifera.* The three species will be separately discussed.

In the past the more spectacular flights of grasshoppers in the North-west appeared to be due to the species *G. musicus.* The only authenticated record of breeding immediately prior to the visit was near Richmond, hoppers showing a considerable colour variation being seen in October and November, 1934. The adults migrated from these breeding grounds early in December towards the cattle stations of the Gulf and the Cape York Peninsula. The species is widely distributed in North Queensland. There can be little doubt that the occasional outbreaks in cane on the coast can be ascribed to this species; it has not, however, been implicated in the injury reported in other crops—*e.g.,* tobacco, tomato, and sundry vegetables.

The comparatively large species, *Austacris proxima proxima,* was present on most western properties. In the more drought-stricken districts, adults swarmed round the homestead greenery, and vegetable gardens were almost wiped out; the foliage was stripped from fruit and shade trees, while the bark was frequently gnawed from the twigs and lesser limbs. Only the oleander came through unscathed, while the saltbush in common use as hedge was less attractive than most other plants. Graziers contended that this insect was most active in the more heavily timbered country, particularly in the vicinity of the Flinders and Saxby Rivers. Certainly adults were much more common in January in the cattle country thereabouts than elsewhere, but fair rains had fallen previously; and the recent growth may have drawn them from the less favourable country lying to the south.

The plague species, *C. terminifera,* was apparently quite familiar to the graziers. It was very common wherever green feed was to be found in the sheep country adjacent to the north-west railway line. Towards the north it yielded place to the larger species already discussed, but for the most part both forms existed side by side. Hughenden seemed to have been invaded much later than centres further west. As already mentioned, the slight hopper outbreaks in October and November, 1934, were mainly due to the larger species, and an invasion from the south was generally postulated to explain the presence of *C. terminifera.* Only one relevant piece of information came to hand to support this. A large swarm passed over a property at Ruthven, in the Isisford district, south of Hughenden, on 22nd December, 1934, then travelling north and making no attempt to settle locally. The insects present in Hughenden in January showed a more or less dilatory flight a few feet from the ground during the morning hours in an easterly direction.

So far as the three species were concerned, the position at the time of the survey was as follows:—*G. musicus* was quite absent from the country under review; *A. proxima proxima* was dominant in the vicinity of the Flinders River, but occurred sporadically elsewhere; *C. terminifera* was the most important species in the sheep country as far west as Julia Creek and east to Sellheim. Nearer the coast, occasional

individuals were to be found, but the grasshopper fauna was of the mixed type usually associated with the wetter areas.

Dissections of a large number of adult females of *C. terminifera* and *A. proxima proxima* were made. The ovaries in *C. terminifera* were quite undeveloped and occupied a small part of the body cavity. On the other hand, the ovaries of *A. proxima proxima* contained well-defined and fully formed eggs. In many insects the distended ovaries occupied the greater part of the abdomen and extended well into the thorax, giving the impression that egg-laying was imminent.

In considering the significance of grasshopper outbreaks in the North, Mr. J. H. Smith discussed the matter as follows:—

Though the damage to station gardens and fruit and shade trees was considerable, adverse troubles of this kind have little effect on the commercial wellbeing of the graziers. Enquiries into the effect of grasshoppers on the feed distributed over the run elicited a variety of opinions, but generally the insects are not regarded as serious pests. Hopper swarms have occasionally overrun a property and destroyed much of the grass, but appreciable losses through the adults have not so far been recorded. In any case such losses would be difficult to estimate, for their importance depends on the growing conditions at the time and the numbers of stock carried on the property.

March outbreaks of either hoppers or adults would invariably be a less serious matter than spring plagues of the insect. At that time of the year the ground is, as a rule, well soaked with rain, and, as growing conditions are good, the ravages of the pest are made good in a very short time. Spring outbreaks are, however, a more important matter. Fodder reserves are frequently reduced to a minimum at that time, and any abnormal depletion may compel the grazier to send his stock to agistment pending the recovery of his run when the summer rains fall —usually in February.

The relative importance of hoppers and adults in pasture losses is difficult to determine. Hopper injury has in the past been more spectacular. The dispersed adult phase was, however, common to the whole district, and must have caused appreciable injury in 1934, when feed was comparatively scarce. In January, 1935, the adult phase alone was of any consequence.

Possible Climatic Association.

Attempts to explain the original appearance of the grasshopper plague in the Millmerran Shire can only be conjectural. The insect normally frequents the drier areas of the State; yet for several months prior to the invasion rainfalls were generally above the average in the more important grasshopper-infested districts. Table 1 gives the monthly rainfall records in Millmerran for the period June, 1933, to May, 1934, together with the respective monthly means. Months in which more than average rain fell are indicated by an asterisk:—

TABLE 1.

Rainfall.	1933.							1934.				
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.
Actual	200	228	129	270	236	514	360	320	507	5	149	39
Mean	189 *	158 *	115 *	136 *	192 *	263 *	301 *	321	290 *	253	146 *	147

TABLE 2.—SHOWING THE MONTHLY RAINFALL RECORDS FOR 1934 AND THE MONTHLY MEANS (IN ITALICS BENEATH) IN THE SOUTHERN DISTRICTS OF QUEENSLAND HAVING SOME ASSOCIATION WITH THE GRASSHOPPER INCIDENCE OF 1934.

* Indicates month in which rainfall was above average.
H Indicates presence of hopper swarms.
A Indicates presence of adults in swarms.
E Indicates presence of eggs.

District.	Rainfall.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Districts little or not infested.													
Toowoomba	Actual	542	1,088	23	628	134	111	381	140	87	312	365	738
	Mean	*508*	*460*	*367*	*266*	*216*	*242*	*210*	*165*	*213*	*256*	*338*	*446*
			*		*			*			*	*	*
											A. & H.	small	numbers
Allora	Actual	376	353	4	316	25	94	332	107	104	298	303	786
	Mean	*395*	*290*	*236*	*180*	*158*	*176*	*171*	*126*	*180*	*217*	*266*	*324*
			*		*			*			*	*	*
		No infestation.											
Districts Infested in which Heavy Breeding Occurred.													
Pittsworth	Actual	308	364	0	505	120	83	276	67	78	228	344	876
	Mean	*379*	*308*	*297*	*174*	*141*	*110*	*180*	*119*	*165*	*217*	*287*	*364*
			*		*			*			*	*	*
				A	A	A	E	E	E.	H	H	A E H	A E H
Millmerran	Actual	320	507	5	749	39	70	229	151	68	349	480	901
	Mean	*321*	*290*	*253*	*146*	*147*	*189*	*158*	*115*	*136*	*192*	*263*	*301*
			*		*			*	*		*	*	*
				A	A	A	E	E	E	H	H	A E H	A E H
Goondiwindi	Actual	134	422	5	53	101	115	199	164	78	377	247	446
	Mean	*290*	*257*	*249*	*154*	*173*	*185*	*176*	*125*	*151*	*180*	*228*	*299*
			*					*	*		*	*	*
				A	A	A	E	E	E	H	H	A E H	A E H
Inglewood	Actual	266	433	33	246	7	68	274	180	145	356	174	880
	Mean	*321*	*278*	*257*	*134*	*173*	*190*	*182*	*130*	*166*	*216*	*267*	*310*
			*		*			*	*		*		*
												A E H	A E H
Texas	Actual	266	284	60	158	35	142	263	237	100	506	273	769
	Mean	*331*	*258*	*223*	*155*	*156*	*192*	*186*	*141*	*161*	*216*	*234*	*320*
								*	*		*	*A E H	*A E H
Districts Typical of the South-west carrying Swarms of Adults towards the end of the Year.													
Cunnamulla	Actual	18	155	0	129	15	132	116	83	25	268	219	16
	Mean	*126*	*210*	*138*	*113*	*115*	*120*	*90*	*67*	*86*	*91*	*106*	*160*
					*		*	*	*		*	*	
				No special records									A
Tambo	Actual	102	276	38	222	11	91	197	0	12	93	50	23
	Mean	*286*	*303*	*258*	*146*	*143*	*127*	*116*	*76*	*89*	*139*	*189*	*261*
					*			*					
				No special records.									A

It will be seen that in the month of March, 1934, only 5 points of rain fell in the Millmerran district. The migratory adults arrived about this time and found an excellent body of feed, which enabled them to flourish and lay a full complement of eggs. The serious infestation in the district may then possibly be explained by the following sequence of events:—

1. A building-up of grasshopper population in some contiguous locality (the nearest record was from the New South Wales border at Goondiwindi);
2. Suitably dry weather conditions coinciding with the appearance of a swarm of winged adults;
3. The earlier rain ensuring a fine body of feed locally.

This correlation is purely tentative both from the point of view of the origin of the first swarms and with regard to the rainfall association. Information within the district was quite conflicting as to the direction from which the swarms first appeared. This was probably due to the extensive circling flights that took place within the district. The insects thus appeared to the several farmer observers to come from different compass points. It is possible that these swarms flew in from Goondiwindi in an indirect line, proceeding first north and then east. The invasion did not arrive by way of Inglewood, for the whole of this area was continuously free until the 1934 spring brood became adult and invaded the area travelling north-easterly from the direction of Yelarbon. Had the earlier swarms passed over Inglewood district, the insects would have found conditions there similar to those in Millmerran, and, of course, their passage would have been noted. Residents at Kooroongarra were emphatic in their statement that, prior to the autumn of 1934, grasshoppers had been practically unknown in the locality, and that the adult swarms that were prevalent in that autumn had not developed in the district.

The further spread of the insects that occurred in November, 1934, is not explicable by the low rainfall theory, as all of the recording stations within the district as a whole showed rainfall totals higher than the average for the months of October and November. The ultimate disappearance of the grasshoppers as a plague was in part linked with heavy rainfall, for by the Christmas period flooding effects were common.

The accompanying rainfall table (Table 2) may be of some interest in relation to the incidence of *Chortoicetes terminifera*. In this table will be seen the high rainfall totals in the main grasshopper-infested districts for the months of October, November, and December.

[TO BE CONTINUED.]

Carcass Quality of Bacon Pigs.

E. R. HOLLAMBY, Inspector of Slaughter-houses.

THE type of pig suitable for bacon curing is frequently a subject of inquiry. Local market requirements are a dressed carcass weighing from 95 to 120 lb., producing finished sides from 38 to 42 lb. Bacon pigs should be so slimmed, as it were, that the back fat at the shoulder shall not exceed 1¾ inches, tapering to ¾ inch at the loin.

The British market requires a slightly heavier carcass, weighing from 130 to 160 lb., with dressed sides ranging from 56 to 65 lb., and so slimmed that the fat at the shoulder shall not exceed 1¾ inches, tapering to ¾ inch at the loin.

Some pigs cannot slim. Briefly, the type of pig that can slim must be long and have fairly well sprung ribs, with fine bone and skin and hair of fine texture. These essentials put nondescripts and mongrel-bred pigs right out of consideration and place a limitation of choice on breeds or crosses that supply the requirements of the trade.

Some breeds are so short and predisposed to fat that they simply cannot comply with the essential conditions. Given suitable housing and conditions, feeding has a most important influence in developing the characteristics required—the development of the thickness of lean meat without getting too much fat, which is the main problem in pig production to-day.

It is the protein in the food that produces lean flesh. The fats, carbohydrates and digestible fibre provide heat and energy and form fat, but cannot make lean meat. The baconer must produce plenty of lean flesh with only a moderate amount of fat if it is to grade well on slaughter. Although it is not possible to convert a fat matured pig into a clean fleshed animal simply by feeding it on protein-rich food, it is, nevertheless, true that a potentially lean fleshed pig can be converted quite easily into an overfat carcass by improper feeding.

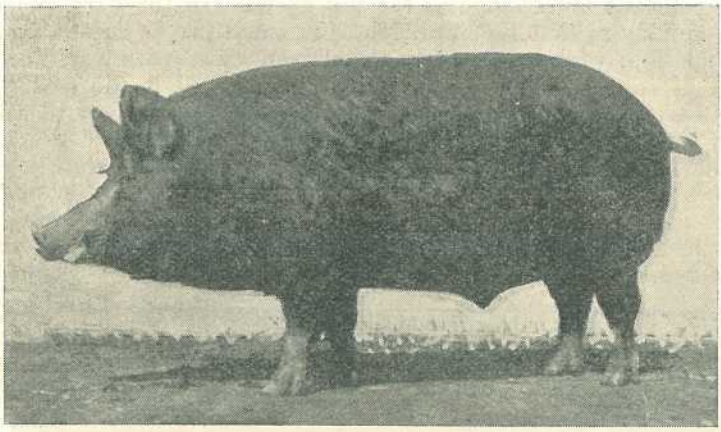


Plate 80.

Champion Prize-winning Tamworth boar, Zillvale Skipper, owned and exhibited by Wide Bay Stud Piggery, Gympie, Q. Zillvale Skipper is probably the most successful Tamworth boar exhibited at Brisbane R.N.A. and other Shows for many years, for, in addition to winning championships at Brisbane, he has been most successful at other Shows. He is a reliable stock-getter, and his progeny are in great demand.

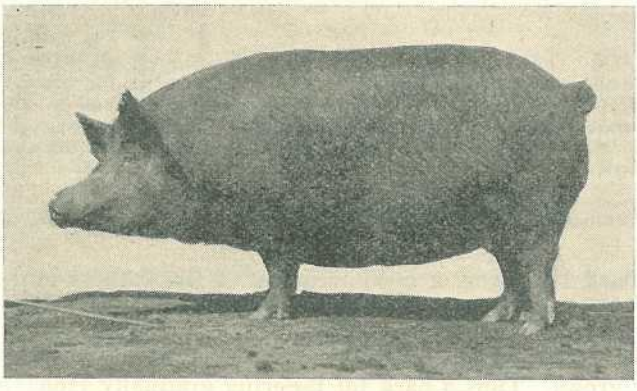


Plate 81.

Champion Prize-winning Tamworth sow at Brisbane Exhibition, 1936. This sow, shown by Wide Bay Stud Piggery, Gympie, is Wattledale Trilby, assuredly one of the best of her breed in the State. Note deep, lengthly body, well-developed hams, and neat, attractive carriage of this well-known animal, winner also of many prizes at country Shows.

The various points which go to make up good carcass quality are mainly a matter of body proportions and composition, which do not remain constant but change as the pig grows. In the pork type, they change quickly so that they are right, i.e., small proportion of head and bone and high proportion of loin and lean meat with just the right amount of fat—½ inch over the loin—at 70 to 80 lb. dressed weight. In the bacon type, these proportions are not attained until the pig reaches bacon weight. The proportions required by the consumer are the same for both pork and bacon pigs, but the weights at which these two types arrive at these proportions differ, the one being early maturing and the other late maturing. The difference between pork and bacon pigs is mentioned so that farmers may realise the difference between the two types.

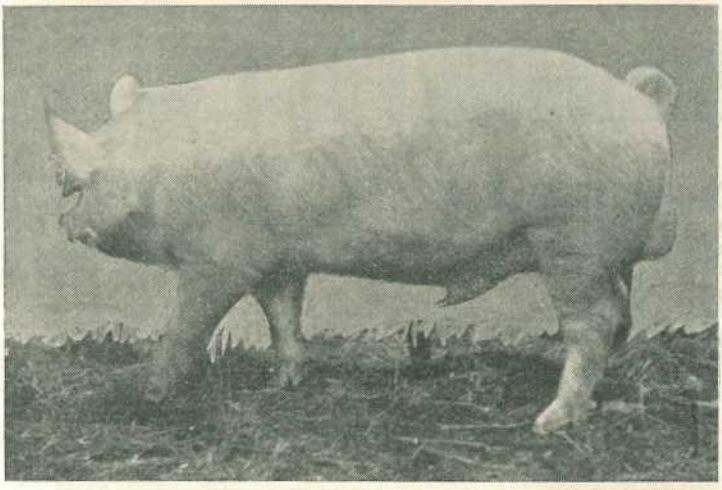


Plate 82.

Large White boar, Highfields Faithful 10th, winner of Reserve Championship at Brisbane Exhibition and of prizes at other Shows in the State. This boar, shown by Mr. J. A. Heading, of the well-known Highfields Stud at Murgon, is of a long, compact type, neat and attractive, light in the forequarters, and showing plenty of character. The Large White of to-day is a much superior animal to that of former days.

The various points required in the dressed carcass, if it is to grade well, are:—

The back fat forms a good measure of the fatness of the carcass generally, and to-day the public do not require very fat bacon. The fat is always much thicker at the shoulders than at the loin in a young pig, and the difference in ratio between these two parts narrows gradually as the pig grows. Thus a back fat tapering gradually from shoulder to loin is an indication that a carcass has not yet attained its full maturity and fatness; such carcasses are required for bacon production. The pork types—being small, short, blocky, and early maturing—carry more fat at bacon weight than do the larger, longer and later maturing bacon types. By lengthening the pig, the chances of getting too thick a back fat are reduced. On the same feed, sows usually grade better than barrows in respect of back fat measurements. A soft, oily fat is objectionable to the consumer and curer; as firm a fat as can be produced is required. This is influenced more by feeding than by the breed, except that slow growing pigs tend to have a softer fat than fast growing ones.

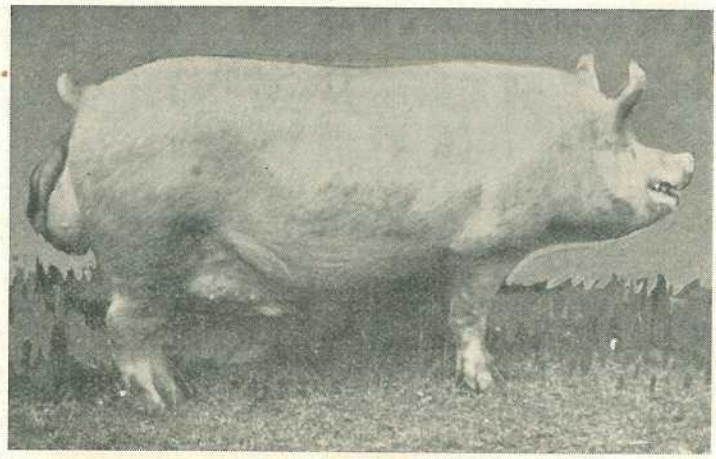


Plate 83.

Champion Large White boar at the Brisbane Exhibition, 1936, and winner of many other champion prizes. Mr. J. A. Heading has in Gatton David a Large White he can be justly proud of, because this boar has a type and conformation sought by pig raisers in every breed. His length, depth, light forequarters, and an even temperament are features that stamp him as an excellent sire of quality stock.

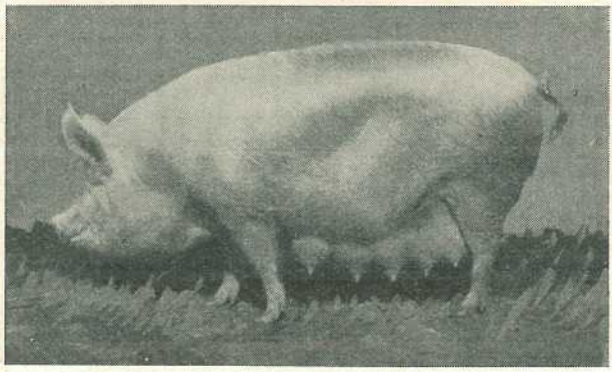


Plate 84.

The imported Large White sow Grinton Sunbeam, winner of Female Championship in Large White Section, Royal National Exhibition, Brisbane, 1936. After winning her championship she returned home to produce a litter of nineteen pigs. Her progeny are in constant demand, and she has proved a most profitable animal, upholding the world-wide reputation of the pig as a rent-payer and a mortgage-lifter.

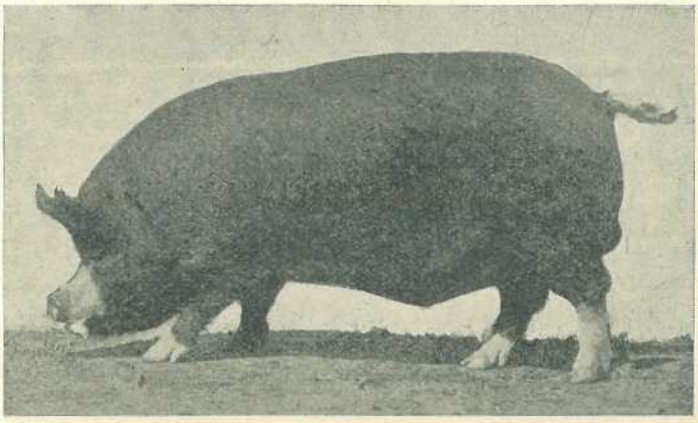


Plate 85.

Championship Berkshire boar at Brisbane Exhibition, 1936, shown by Queensland Agricultural High School and College, Lawes, Q. This boar, Grafton Jock, is of the latest English type, and has a long, deep, masculine body, well-developed hindquarters, and is nicely marked, as is required in this breed. He has also been successful at many country shows.

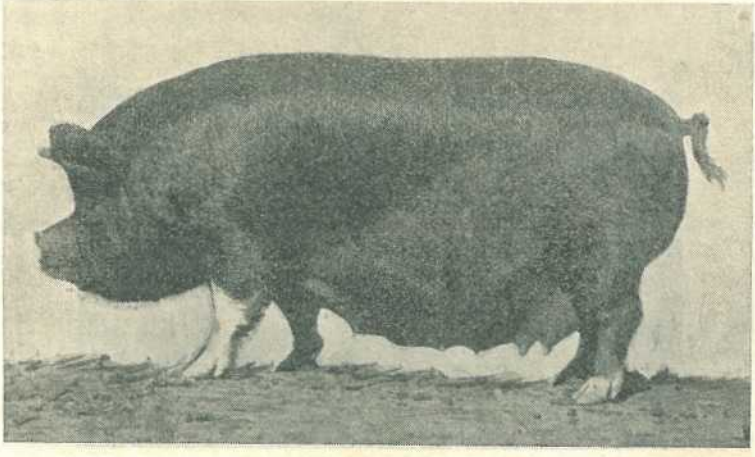


Plate 86.

The Champion Berkshire sow at Brisbane Exhibition, 1936, J. Barkle and Sons' Cawdor Pride, a sow of excellent conformation, capable of producing and suckling large, thrifty litters. Note her well-developed udder and teats and her compact frame. She is an even-tempered animal of up-to-date type, and has won for her owner many premier awards, including sow and litter class at Brisbane in 1935.

The consumer requires a thick streak of lean meat, and this should be obtained by developing the thickness of the muscle or lean meat without getting too much fat. On the young pig, bone reaches its maximum growth first, then muscle, while fat makes its maximum growth later. This knowledge provides a sound reason for weighing pigs at regular intervals after weaning, for it is just after this time that the lean meat begins to develop; and pigs which grow well then will grade better than those whose growth is checked at this stage.

At birth the ham is nearly all bone and poorly fleshed, while as the pig grows the bone becomes proportionately smaller and the meat is " let down " to the hocks. A good ham is one in which these age changes are well developed. The ham should be fleshy, well rounded, deep and broad. Width of the buttock just below the tail is a character that could be improved in many pigs.

Apart from the fact that a pig which is long for its weight will tend to have less fat than one which is short for its weight, length is required in order to give a larger portion of back cuts as compared with belly cuts, for the former are higher priced than the latter. A thick streak is required, but not a long one (so as to form a good rasher) and this compared with the live pig means one which is not too deep at the time of slaughter and one which has a clear cut straight underline; such a pig will appear to be long for its weight. One requires the type of pig which at bacon weight has only just begun to deepen; otherwise it is likely to be deficient in thickness of streak, for this is partly a question of maturity.

The shoulder is a low priced part of the carcass compared with the loin, and should be reduced as far as possible.

A coarse-skinned pig grows a thick rind which detracts from the bacon when it comes to be sold—hence the skin should be of fine texture. Many of these qualities cannot be determined until after the pig is slaughtered. Testing the offspring of breeding stock for carcass quality, and using the parents of those which test out best as the foundation of the next generation of breeding stock (and they should be kept and used as long as possible for producing breeding stock) is the only means of ensuring a sound breeding policy. It is important when these tests are being made that the nutrition should be suited to develop the characteristics that are required. Otherwise little progress will be made by selection, for the quality selected will be limited by the nutrition and not by the breed qualities of the animal.

SOME NEW BOOKS.

Quite a lot of new books have been added to the library list issued by the Tutorial Classes Library, which supplies a special postal library service for country residents. This is a first-class library of excellently-chosen books. Books on almost any subject and all the best types of fiction may be borrowed.

The Tutorial Classes Department has also added to its lists series of talks on several new subjects, such as—Elocution, Debating, Australian Economics, Economic Geography, and Food and Diet. You may get a series of twenty-one talks for 8s. 6d.; if you want to join the library and not bother about these type-written talks, the library fee per year is 18s. 6d. Write for information to the Director of the Department of Tutorial Classes, corner Edward and Ann streets, Brisbane.

Spraying Oil Concentrates.

F. B. COLEMAN, Officer in Charge, and R. A. TAYLOR, A.A.C.I., Inspector and Examiner, Seeds, Fertilisers, Veterinary Medicines, Pest Destroyers, and Stock Foods Investigation Branch.

OWING to frequent enquiries received by this Branch with respect to types of spraying oils on the Queensland market, it has been considered advisable to publish this article, which may be defined as:—

A classification under the definitions prescribed by the Pest Destroyer Regulations, of the Spraying Oil Concentrates registered for the current year under the Pest Destroyers Act.

The Pest Destroyer Regulations prescribe standards for spraying oils and emulsions as follows:—

(*a*) Light mineral oils and/or emulsions shall consist of preparations containing benzine, benzole, petrol, kerosene, and other light oils which will readily form an emulsion with distilled water.

(*b*) Heavy mineral oils and/or emulsions shall consist of any preparation containing a heavy mineral oil which will readily form an emulsion with distilled water.

(*c*) Tar oils and/or emulsions.

The spraying oils registered for the current year may be divided into these three classes, as set out in table 1.

All of these oil concentrates are in a form which, on the addition of water, gives an emulsion.

Some may be "concentrated" emulsions, consisting of oil, water, and an emulsifier or emulsifiers; others may be "miscible oils," consisting of oil and an emulsifier—without water.

The thorough preparation or emulsification of these concentrates by the manufacturer is an important factor controlling the fineness of division and permanency of emulsion obtained on dilution; of course the emulsifiers used are also of importance.

As may be seen from table 1 almost all of the spraying oils registered contain as the active constituent heavy mineral oil, and consequently fall into class (*b*) of the table in question.

The mineral oil used in this class of spraying oils falls into three distinct groups:—

(1) White oil;

(2) Red oil;

(3) Crude oil.

White oils, although they may in any particular oil concentrate consist of a "blend" of several "named" oils, are pure mineral oils. Generally speaking, they are safer to use than red oils with respect to plant injury, but the properties of the emulsions made from different white oils vary according to the physical properties of the oil or oils and other factors involved (such as emulsifier, &c.).

For instance, certain white oil concentrates are recommended as "dormant sprays," whereas the majority are recommended for "all the year round" application.

TABLE I.

Class.	Name of Spraying Oil Concentrate.	Constituents Declared.		Queensland Primary Dealer.
(a)	Light Mineral Oils—	%		
	Irving's prepared Soluble Spraying Emulsion	62	Kerosene*	John Irving and Sons, Mayne
(b)	Heavy Mineral Oils—			
	Albarol White Oil	83·4	Petroleum Oil (Heavy)	Buzacotts (Qld.) Ltd., Brisbane
	Clarifol	82	Mineral Oil (S.G. ·890)	Neptune Oil Co., Ltd., Brisbane
	C.O.D. Improved Red Oil	75	Mineral Oil	The Committee of Direction of Fruit Marketing, Brisbane
		7	Cresylic Acid	
	Cooper's Alboleum	80	Hydrocarbon Oil	Queensland Fruitgrowers' Society, Ltd., Brisbane
	F.D.L. White Oil	80	Mineral Oil	Fertiliser Distributers Pty., Ltd., Brisbane
	Gargoyle Red Spraying Oil	85	Red Mineral Oil (S.G. ·925)	Vacuum Oil Co., Pty., Ltd., Brisbane
	Gargoyle White Spraying Oil	85	White Oil	Vacuum Oil Co., Pty., Ltd., Brisbane
	Harbas	75	Total Mineral Oils (S.G. ·93)	Buzacotts (Qld.) Ltd., Brisbane
		5·5	Tar Acids	
	"Neptune" Prepared Crude Spraying Oil	83	Crude Petroleum Oil (S.G. ·948)	Neptune Oil Co., Ltd., Brisbane
	"Neptune" Prepared Red Spraying Oil "A"	85	Mineral Oil (S.G. ·910)	Neptune Oil Co., Ltd., Brisbane
	"Neptune" Prepared Spraying Oil "C"	65	Mineral Oil (S.G. ·920)	Neptune Oil Co., Ltd., Brisbane
		7·5	Cresylic Acid	
	"Neptune" Prepared White Spraying Oil	82	Mineral Oil (S.G. ·87)	Neptune Oil Co., Ltd., Brisbane
	Q.F.S. Red Spraying Oil	80	Mineral Oil	Queensland Fruitgrowers Society, Ltd., Brisbane
		5·5	Tar Acids	
	Shell P.C.S.	83	Crude Petroleum (S.G. ·948)	The Shell Co., of Australia, Ltd., Brisbane
	Shell Red Spray	85	Mineral Oil	The Shell Co., of Australia, Ltd., Brisbane
	Shell White Spray	82	Refined Petroleum Oil	The Shell Co., of Australia, Ltd., Brisbane
	Shellicide "D"	82	Refined Petroleum Oil	The Shell Co., of Australia, Ltd., Brisbane
	United Red Oil Spray	75	Mineral Oil	United Chemical Co., Ltd., Brisbane
		7	Cresylic Acid	
	Vallo Prepared White Oil	89	Mineral Oil	A. Victor Leggo and Co., Pty., Ltd., Brisbane
	Vallo Red Spraying Oil	89	Red Oil	A. Victor Leggo and Co., Pty., Ltd., Brisbane
	Volck	80	Refined Petroleum Oil	A.C.F. and Shirley's Fertilizer Ltd., Brisbane
(c)	Tar Oils—			
	Coopers Ovicide Tar Oil	48	Tar Oils	Queensland Fruitgrowers' Society, Ltd., Brisbane
		20	Mineral Oils	
		10	Phenols	

All percentages declared under the Pest Destroyers Act and Regulations must be weight to weight.

* The Specific Gravity of Kerosene is approximately ·80.

S. G. Specific Gravity.

Red oils are more impure than white oils, and may be refined into white oils.

Crude oil is crude petroleum oil; the use of this product naturally requires more careful control than is necessary with the above oils.

Generally speaking, the specific gravity of the above oils is greatest in crude oil and lowest in white oil; in other words, the specific gravity is lowered by the "refining" process.

A subdivision of class (*b*) of table 1, with respect to the type of oil contained, is set out as follows:—

TABLE II.

Class (b) Subdivision.	Name of Spraying Oil Concentrates.	Specific Gravities of Oils Present as Declared on Respective Labels.
(1)	White Oils—	
	Albarol White Oil	..
	Clarifol	·890
	Coopers Alboleum	..
	F.D.L. White Oil	..
	Gargoyle White Spraying Oil	..
	"Neptune" Prepared White Spraying Oil	·870
	Shell White Spray	..
	Shellicide "D"	..
	Vallo Prepared White Oil	..
	Volck	..
(2)	Red Oils—	
	C.O.D. Improved Red Oil	..
	Gargoyle Red Spraying Oil	·925
	Harbas	·930
	"Neptune" Prepared Red Spraying Oil "A"	·910
	"Neptune" Prepared Spraying Oil "C"	·920
	Q.F.S. Red Spraying Oil	..
	Shell Red Spray	..
	United Red Oil Spray	..
	Vallo Red Spraying Oil	..
(3)	Crude Oil—	
	"Neptune" Prepared Crude Spraying Oil	·948
	Shell P.C.S.	·950

It will be seen from the above that by subdivision into white, red, and crude oil sprays, the concentrates are also subdivided in accordance with the specific gravities of the respective oils contained in them.

It should be noted that in table 1 a number of the oil concentrates are shown as containing cresylic acid as well as mineral oil.

It is not advisable to classify these oils according to the presence or absence of cresylic acid or other tar acid, as this material is not necessarily an "active constituent," but is added as an emulsifier. When comparatively large quantities are present, however, the declaration of same is set out on the label for the information of the purchaser.

A dividing line has been drawn at 3·1 per cent.; consequently spraying oil concentrates having less than 3·1 per cent. by weight of cresylic acid do not declare on their respective labels the presence of such tar acid, while concentrates containing 3·1 per cent. or more disclose this fact.

For the purpose of this article, only materials specially prepared as "spraying oil concentrates" are considered; no recognition is made of pest destroyers which claim "spraying oil uses" as one of many properties.

Summary.—Spraying oil concentrates may be divided first into three classes:—

(*a*) Those containing light mineral oils (kerosene, &c.).

(*b*) Those containing heavy mineral oils.

(*c*) Those containing tar oils.

Class (*b*) contains the bulk of the spraying oils sold in Queensland.

This class may then be subdivided into—

(1) Those containing white oil;

(2) Those containing red oil.

(3) Those containing crude oil.

White oils are "pure" oils, and red oils are purer than crude oils.

The *active constituent* in "spraying oil concentrates" is the oil, and where cresylic acid is declared on the label, this is done because such tar acid, although used as an emulsifier, is present in comparatively large quantities, and this information is considered of use to the purchaser.

GRANADILLA GROWING.

In the growing of granadillas it is most essential that suitable trellising be erected to carry these plants.

The most successful method noted is to plant cuttings (decidedly preferable to the planting of seed) in the field at a distance of 16 feet between each cutting in the rows, and 6 to 8 feet between each row. A wise plan is to plant a greater number of cuttings in each row than are actually required, the grower removing any surplus after a reasonable period has elapsed, such period being long enough for these young vines to take root, and thus establish their certainty of growth. It is necessary for these vines to be trained up on to a trellis and a trellis is erected above them in the following manner:—

Two straining posts, one at each end, are very securely erected. Supporting posts are placed between these two posts at intervals of from 12 to 14 ft. The main wire is strained through the middle of these posts at approximately 5 ft. from the ground. At the top of each of these posts an arm is fastened (a piece of 3 x 2 timber 3 ft. long is ideal for this purpose). Two holes are bored, one in each end), and two additional wires are strained through these holes, thus making a 3-wire trellis to carry the vines.

It is imperative that these vines be trained so that the main leader grows along each of these wires, and it is preferable to have all vines running in the one direction.

Under tropical conditions these vines should come into fruit in approximately eight months. The first crop would be somewhat light; the second crop should be much heavier, and from then on these vines should produce two crops per annum.

The amount of fruit produced is greatly increased if hand pollination is adopted, and although this is quite a tiresome and difficult procedure it gives results that easily repay the grower.

It is particularly hard to estimate the actual weight of fruit produced per acre per annum, as so many factors are responsible. The best granadillas produced in Queensland are from vines growing on the rich alluvial lands just north of Cairns, and fully considering this fact it would appear that in districts as far south as Mackay similar returns would be obtained.

Spray Irrigation.

H. W. KERR.*

SPRAY irrigation has been employed successfully with many crops, notably vegetables, small fruits, and lucerne. With sugar-cane it has received only scant attention, although quite an extensive system was seen on one of the plantations of Hawaii ten years ago, when experiments were also being conducted at the Waipio Sub-station of the Hawaiian Sugar Planters' Experiment Station. The chief drawbacks to the wider employment of the system were (1) the cost of the installation, (2) the faulty distribution of water due to inherent imperfections in sprinkler design and interference from wind.

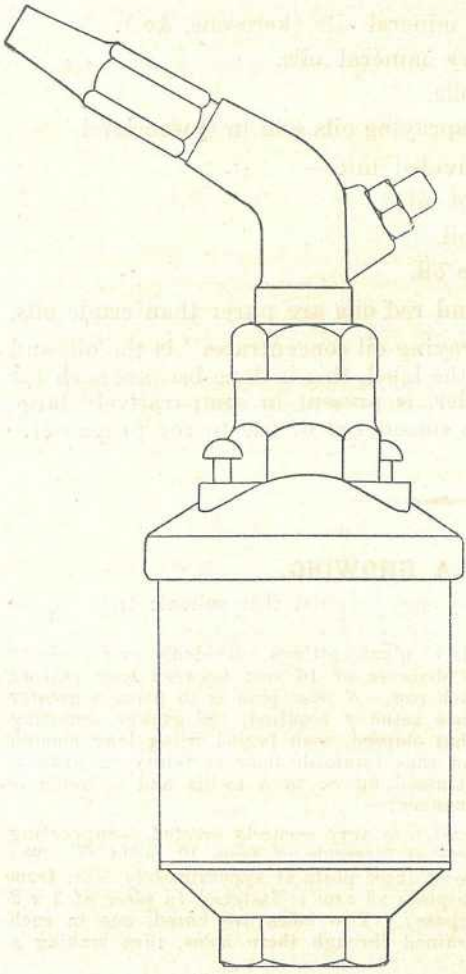


Plate 87.
Illustrating the high-coverage irrigation sprinkler.

At about that time the Thompson Manufacturing Company of California became interested in the problem, and devoted attention to the possibility of supplying a satisfactory sprinkler of wide coverage, so as to reduce the amount of pipe line required. The reduction in the number of sprinklers per acre demanded, of course, increased nozzle size and operating pressure to enable a given amount of water to be applied in reasonable time. The first model developed (Plate 87) was partially successful, and the number of sprinklers per acre was reduced to less than nine. More recently, a further improvement in design has permitted the production of sprinklers with the following characteristics:—

	Sprinkler (*a*).	Sprinkler (*b*).
Diameter of nozzle	$\frac{3}{8}$-inch ..	7/16-inch
Discharge of sprinkler ..	29 G.P.M. ..	42 G.P.M.
Nozzle pressure	45 lb. ..	60 lb.
Sprinklers per acre	3·0 ..	2.37

The greatly improved coverage provided by this system allows of big reduction in the amount of piping required, although this is,

* Reprinted from the "Cane Growers' Quarterly" by courtesy of Dr. Kerr, Director, Bureau of Sugar Experiment Stations.

naturally, of larger diameter. At the same time it permits of the pipe line being laid on the land surface without seriously interfering with cultivating operations.

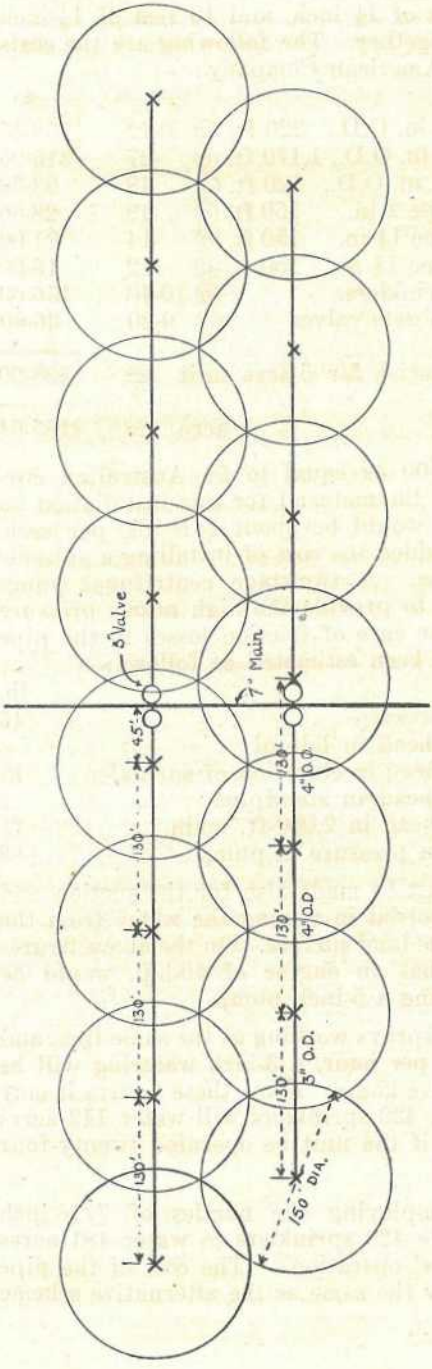


Plate 88.—Illustrating the Arrangement of Pipe-lines and Sprinklers for a 5-acre Unit.

The Sprinkler.

The construction of the sprinkler is such as to ensure positive action; that is, the slow speed at which the nozzle must revolve is achieved by a small water wheel placed horizontally in the base of the sprinkler, which is operated at a high speed by the large volume of water which passes it. By means of a series of gears, packed in a watertight case filled with grease, the positive drive is transmitted to the nozzle through a reduction of 3,750 to one. The nozzle then revolves once in two minutes, and there is but slight danger of failure.

The sprinkler is provided with two jets—the smaller delivers a fan-like spray, which covers a circle adjacent to the standpipe; the larger takes care of a wide ring surrounding this circle. Together these provide a coverage over a circle 150 feet in diameter in the case of sprinkler (*a*), when set on a standpipe 30 feet high. This installation was designed essentially for banana plantations, and for cane growing the height of the standpipe would probably be reduced to 18 to 24 feet, depending on the habit of growth of the variety; a reduction in height would, of course, substantially affect the coverage.

The Installation.

Plate 88 supplies the essential data for one unit of a large installation employing sprinklers of $\frac{3}{8}$-inch nozzle diameter. This unit is 5 acres in extent, and all sprinklers are operated simultaneously.

The pipe consists of black steel piping with outside diameters (O.D.) as shown; it is specially bevelled for welding in the field. Welding results in a reduced installation cost, but increases the difficulty of moving the pipe line later. The standpipes (Plate 89) consist of 10 feet of 2 inch, 10 feet of 1½ inch, and 10 feet of 1¼-inch piping screwed together. The following are the costs supplied by the American Company:—

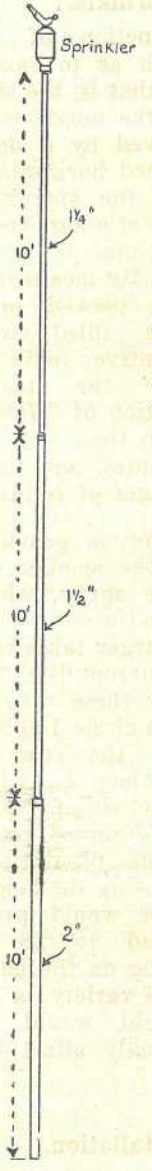


Plate 89.—Illustrating the Standpipe and Sprinkler Set-up.

			$	$
Plain steel pipe 7 in. O.D.,	220 ft.	@	0·72	158·40
Plain steel pipe 4 in. O.D.,	1,170 ft.	@	·27	315·90
Plain steel pipe 3 in. O.D.,	520 ft.	@	·18	93·60
Screwed stand pipe 2 in.	150 ft.	@	·19	28·50
Screwed stand pipe 1½ in.	150 ft.	@	·14	21·00
Screwed stand pipe 1¼ in.	150 ft.	@	·12	18·00
15 super rotor sprinklers		@	10·40	156·00
4 3-in. iron clamp gate valves		@	9·20	36·80
Material for 5-acre unit			=	828·20
1 acre			=	$165·64

Allowing $4·00 as equal to £1 Australian currency, the cost of the material for this installation on the above values would be about £41 10s. per acre. To this must be added the cost of installing a suitable pump and engine. A two-stage centrifugal pump will be necessary to provide the high nozzle pressure required, and take care of friction losses in the pipe line. These have been estimated as follows:—

	lb.
Nozzle pressure	45
Loss of head in lateral	6
Loss of head in elevation of sprinkler ..	13
Loss of head in standpipe	2
Loss of head in 2,000-ft. main	17
Minimum pressure at pump ..	83

Provision must be made also for the suction and delivery head involved in raising the water from the spear or well to the land surface. On the above figures it is estimated that an engine of 40-h.p. would be necessary, operating a 5-inch pump.

With fifteen sprays working at the same time and delivering ¼-inch per hour, a 3-inch watering will be completed in twelve hours. From these figures it may be calculated that 429 sprinklers will water 143 acres in fourteen days if the unit be operated twenty-four hours per day.

With a similar installation employing the nozzles of 7/16-inch diameter, a 70-h.p. motor will enable 429 sprinklers to water 181 acres in fourteen days (twenty-four hours' operation). The cost of the pipe line installation would be practically the same as the alternative scheme described.

Unit Installed at Ayr.

During the past year a small spray system employing these imported sprinklers was laid out at Ayr. Although one object of the layout was to determine the practicability of spray irrigation, it should be made quite clear that the main purpose was the provision of a scheme which would permit of accurately controlled water application for irrigation experimental work, which it is hoped may be carried out at this centre.

Through the courtesy of Messrs. Landa and Co., an area of about 3 acres of land was made available for our use. A well was sunk, and a 2½-inch two-stage pump, operated by a 15-h.p. electric motor, was supplied from a 6-inch slotted brass spear. A 3-inch diameter galvanised pipe line (Plate 90) carried the water to the edge of the field, where the

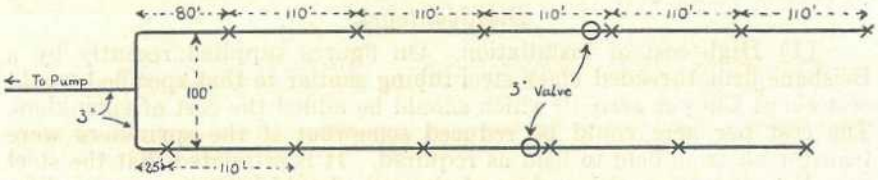


Plate 90.—Plan of the Pipe-line System installed at Ayr for Experimental Purposes.

line was divided into two branches, each carrying six sprinklers. As the standpipes were reduced to 18 feet in length, the distance between sprinklers was fixed at 110 feet, with 100 feet between the pipe lines. This installation was capable of operating three sprinklers simultaneously. With this arrangement it required three hours to apply 1 acre-inch of water.

Our first experiment was designed to determine the effect of the amount of irrigation water applied at each watering. One-half of the area received 2 acre-inches, and the other 3 acre-inches. The intervals between applications varied with the season of the year—from three weeks in the cooler months of slow growth, to nine days in the months of December, January, and February—the season of vigorous growth.

The spring and early summer months were unusually hot and dry, even for this district, and it was early evident that, under these conditions, the 3-inch application was much superior to the 2-inch watering. The full details of the experiment will, however, be deferred until the crop is harvested.

It was found that wind interfered seriously with the evenness of water distribution, and for experimental purposes it was found necessary to conduct the watering during the night hours. Under still atmospheric conditions, measurements made with a series of tin cans spaced over the field showed that the distribution was quite good. For a 3-inch application, for example, the measurements ranged from 2¾ inches to 3¼ inches. In spite of the dryness of the season, little in the nature of dry spots could be detected in the crop growth, which could not be explained by visible soil variations.

Advantages and Disadvantages of the System.

The following summarises the main advantages and drawbacks of spray irrigation:—

Advantages.

(1) Economy in water utilization due to evenness of distribution of even light applications.

(2) Complete elimination of seepage losses from drains.

(3) Reduction in water distribution costs with respect to (*a*) labour in watering, (*b*) labour and implements in forming water-furrows.

(4) Flat cultivation is possible and an increased number of ratoon crops should be profitable.

(5) Trash conservation may be practised with ease.

(6) Fire protection, as sprinklers may be operated to control accidental burning.

Disadvantages.

(1) High cost of installation. On figures supplied recently by a Brisbane firm, threaded black steel tubing similar to that specified would cost about £39 per acre, to which should be added the cost of sprinklers. The cost per acre could be reduced somewhat if the sprinklers were transferred from field to field as required. It is estimated that the steel pipe line, if laid on the surface of the soil, should have an average life-time of twenty-five years.

(2) High pressures, necessitating an increase in engine power over that normally employed. This would be partially or possibly completely off-set by the reduced volume of water required, with even distribution and elimination of seepage losses.

(3) Moving of pipe line when ploughing. This could be eliminated almost entirely if the main were buried to a depth of 12 to 15 inches, and ploughing confined to the area between surface laterals.

Conclusion.

The results obtained from the trial plot installed by the Bureau at Ayr should, in the course of two or three years, supply data which will permit of a true estimate of the value of spray irrigation. The financial outlay must, however, always remain a serious obstacle to its extensive adoption.

SULPHATE OF AMMONIA—DOES IT EVAPORATE?

This is a question which we are repeatedly asked, despite a detailed discussion of the point in an earlier issue. We would repeat that it may be applied quite safely in dry weather, and it will be taken into the soil by the first rains or even by the dew.

Further, it is not necessary to throw the material into the stool. It is much simpler and just as good to apply alongside the stool; and one-side application is just as good as uniform distribution on both.

H.W.K. in the "Cane Growers' Quarterly."

Alternative Crops for the Canegrower.

H. W. KERR.*

THE canegrower is constantly reminded of the dangers which beset the farmer who is entirely reliant on one crop for his livelihood. At the present time excess sugar production, which results in the disposal of a large proportion of the crop at a value below production costs, renders it more important than ever to seek for alternative crops, for which there exists a ready market, and thus relieve the pressure which at present threatens the existence of many of our growers.

Another aspect of this problem is one which affects the future of Queensland agriculture in its broadest sense. Doubtless the arable lands of our coastal plain must ever constitute the most valuable agricultural areas of the State, and the future of primary production in Queensland appears bound up in the intensive development of this limited tract. Despite popular supposition to the contrary, the major proportion of these good-quality lands has already been brought under cultivation, while the best of these are devoted at the present time to cane culture. The value of intensification of production in reducing unit costs in a country which demands a living wage for its workers, has been repeatedly demonstrated; and a broad review of the question along these lines suggests a solution of the canegrowers' problem, while providing a brighter outlook for the general agriculture of the State.

Due to the uncertainty of rainfall incidence, even in parts of this comparatively humid coastal plain, intensive methods cannot be initiated successfully without the aid of irrigation. What can be achieved where adequate water is available is exemplified by recent developments on the large sugar plantations of Southern Queensland; and results have demonstrated that while assuring the desired crop, production costs are also reduced. By the full development of all available irrigation resources in these districts, similar results could be achieved on substantial areas of the coast. Production control could then be effected with safety and certainty, and it is reasonable to predict that with the assistance of irrigation, the acreage now devoted to cane on such areas could be more than halved, with no reduction in crop harvest. The release of this area of good-quality land for alternative crops, also by irrigated methods, would serve to provide the outlet for an increased farming population, and the relegation of marginal lands to their true position in the economic scheme.

As an illustration of how such a project could be brought into operation, we might consider the red volcanic soils of the Woongarra area, Bundaberg. Some few years ago, serious consideration was given by the growers of that district to the development of an ambitious irrigation scheme, whereby water from the Burnett River would be diverted to this area. As is general with all large irrigation schemes, the initial installation cost would be high, though it was estimated that water could be delivered to all farms in the benefited area for approximately £5 per 1,000,000 gallons. The proposal was finally rejected on

* Reprinted from the "Cane Growers' Quarterly" by courtesy of Dr. Kerr, Director, Bureau of Sugar Experiment Stations.

the grounds that intensification of cane production would but lead to further embarrassment, as the average crop production under natural rainfall conditions is sufficient to supply "peak" crops to the local mills. Apparently, little or no consideration was given to the possibilities of other crops.

At this time, a small irrigation plant was installed at the Bundaberg Experiment Station, for the purpose of studying irrigation problems on the red volcanic soil, and allowing us to gather information regarding the possibilities of intensive production on this valuable soil type, of which the chief drawback is its low water-holding capacity and droughtiness. Our cane experimental plots have already demonstrated the true potentialities of the land, when the natural soil moisture deficiency is overcome, and no difficulty is experienced in the economical production of a 60 or 70-ton crop of cane in sixteen months.

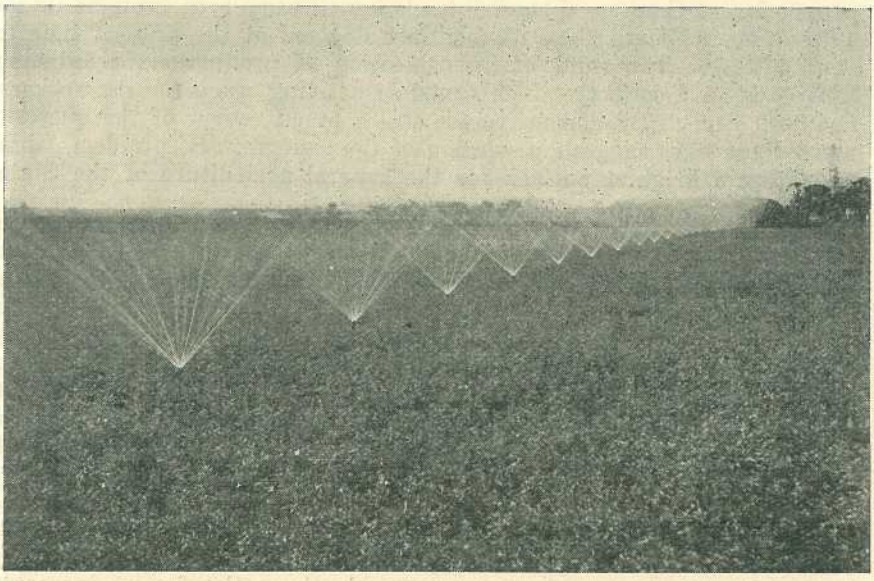


Plate 91.
Operation of the spray system recently installed for the irrigation of lucerne.

Attention was then turned to the possibilities of lucerne production, by watering. For years a lucerne block had been maintained on the station under dry land conditions, and we were generally well supplied with hay for our station horses; but by the use of a spray irrigation system (see Plate 91) some very interesting results were recorded during the past year. The old block was ploughed out, and after thorough preparation, was reseeded in April, 1935. A good stand resulted, and the first cut was made in August. This was allowed to lie on the field. Thereafter the block was irrigated as frequently as required, and cut

whenever the crop had attained the desired growth stage. The following table summarises the history of the field for the year:—

Irrigated.	Crop Harvested.
1. November 13th, 1935	1. October 2nd, 1935.
2. November 26th, 1935	
3. December 8th, 1935	2. December 16th, 1935.
	3. January 28th, 1936.
4. February 3rd, 1936	4. Half February 18th, 1936.
	Half March 11th, 1936.
	5. Half April 6th, 1936.
	Half April 14th, 1936.
	6. Half April 14th, 1936.
	Half May 18th, 1936.
5. May 28th, 1936	
6. July 17th, 1936	7. Half July 29th, 1936.
7. August 7th, 1936	Half August 19th, 1936.

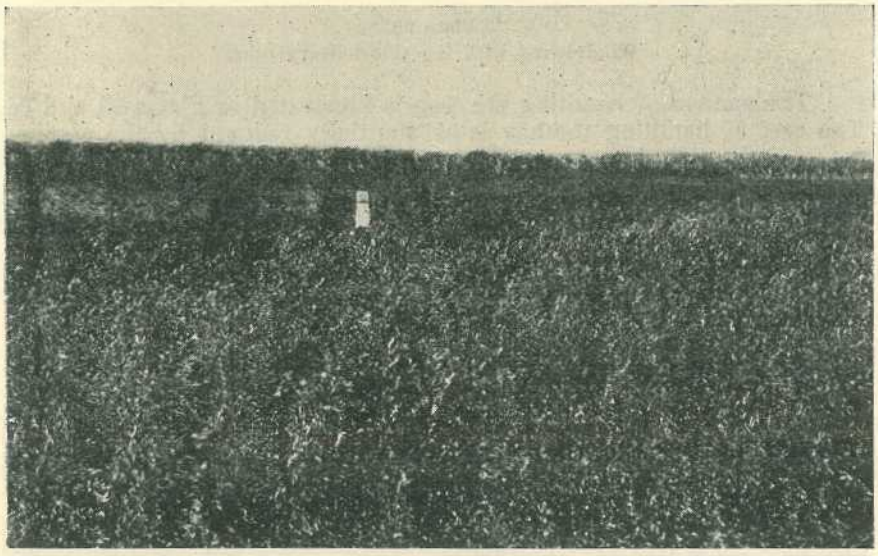


Plate 92.
A fine stand of lucerne on the Bundaberg Station.

In the first year of the stand it was therefore possible to harvest seven cuttings of lucerne, while seven waterings, each of 3 acre-inches, were given. It will be remembered also, that the past season was notable for its rainfall deficiency. Yield determination showed that somewhat more than 2 tons of *hay* per acre were obtained at each cutting, or a total of 15 tons per acre for the year. It should be pointed out that at no time was an attempt made to force growth to its limit, due to the superabundance of hay on hand, at all times, for horse feed. It is the opinion of Mr. N. J. King, who is in charge of this project, that no difficulty will be experienced in the coming year in producing 20 tons of hay per acre.

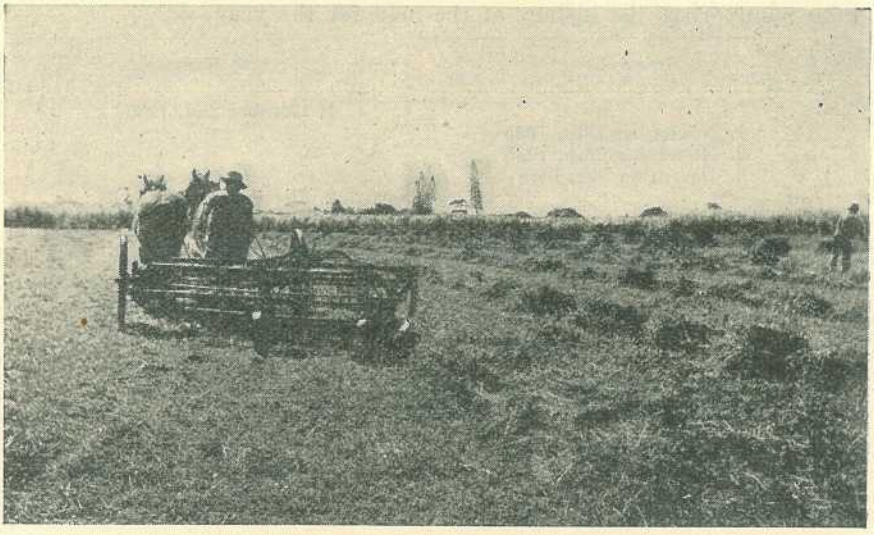


Plate 93.
Windrowing with the side-delivery rake.

The method of handling the crop is illustrated in Plates 93 and 94. The cost of handling the hay is substantially reduced by the employment of the side delivery rake in windrowing. Though the implement has also proven useful in cocking, it is found that this operation is best effected by hand.

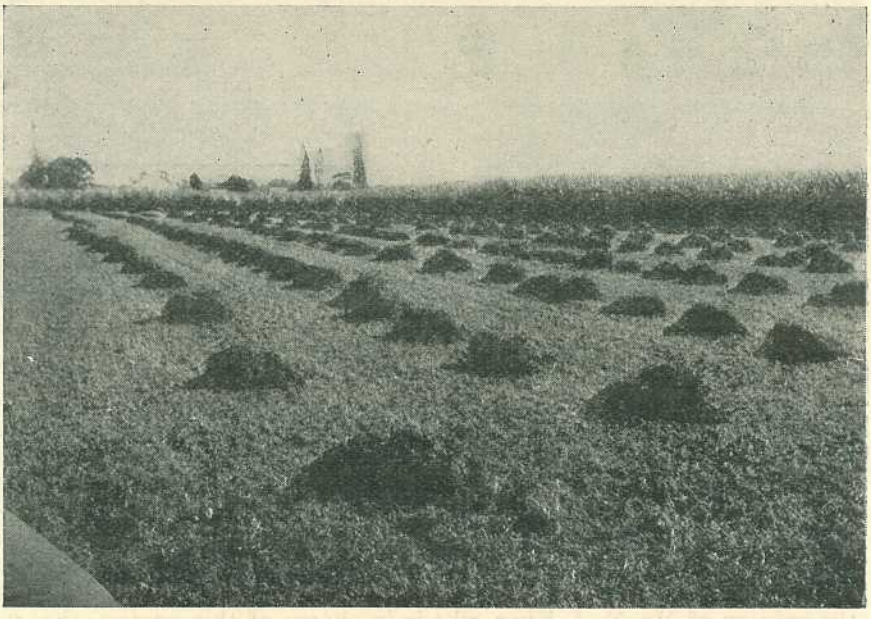


Plate 94.
The cured hay ready for transfer to the barn.

One must conclude, from the above results, that the red volcanic loam of the area is a first-class lucerne soil under irrigated conditions. At average market values for the hay, the gross return per acre would be in excess of £100 per annum, while in the absence of a market for the quantity of hay which might be produced, the development of a stock-fattening industry offers considerable promise.

The production of fat lambs, for example, is an industry for which a ready market is assured, both in Queensland and overseas. It is, therefore, of interest to examine the prospects which such a project would offer, when combined with canegrowing. For it provides a ready means of disposing of crop refuse (green tops), and a mill by-product (molasses) in a much more economical manner than it at present possible on a wide scale. It is suggested that the production of cross-bred lambs, by mating, say, a Dorset Horn ram with Merino ewes, would be productive of the best results under these conditions. The ration for the breeding ewes would be substantially lucerne hay, supplemented by cane tops (when available) or grass for roughage, and with the addition of molasses to supply any deficiency in carbohydrates. The lambs would be fattened rapidly on a similar ration, and marketed at the age of four-five months, when they should yield a dressed weight of from 30-32 lb. On dry land such as this, foot trouble and coastal parasites should be at a minimum, while with small flocks it would be practicable to deal readily with any complications from these causes. Should it be found undesirable to retain the ewes for more than a limited period, both ewes and lambs could be fattened and marketed.

In considering the cost and returns from such a scheme, the cost of labour has not been considered in detail. Doubtless, this would vary with the handling facilities available; but the following estimates of out-of-pocket expenses are presented to indicate the margin which the project offers. Costs are calculated on the basis of 100 ewes, producing eighty lambs.

Feeding costs.

Allowing 750 lb. lucerne hay per ewe per annum—

One hundred ewes will require 34 tons of hay; supplemented by 50 tons of cane tops, &c., as roughage, which would be yielded by 200 tons of well-grown cane.

Adding molasses to the above at the rate of ½ lb. per day, 8 tons of molasses would be required.

Allowing an average of 1 lb. lucerne hay per lamb per day, for four months—

Eighty lambs will require 4½ tons hay.

A molasses ration of ⅓ lb. per head per day, would consume 1½ tons molasses.

Summary.

	Tons.
Total lucerne hay	38½
Total cane tops, &c.	50
Total molasses	9½

Allowing £6 as the cost of 1,000,000 gallons of irrigation water, one half million would be used per acre per annum, at a cost of £3. On the basis of the lucerne yields suggested above, 2 acres would be necessary to supply the required hay. The cost of water would then be £6 per annum. For molasses, a value of £1 per ton, on the farm, might be allowed.

Summary of Above Costs.

Lucerne irrigation	£6
Molasses purchased	10
Fertilizer for lucerne block	5
	£21

Cost of marketing must also be added.

Return from Ewes and Lambs.

Eighty lambs at 20s. each	£80
Wool from 100 ewes at 8s.	40
Profit, from sale of fat sheep, at 4s. per head	20
	£140

In addition to any income which would be derived from this source, it must be borne in mind that the utilization of cane tops and molasses as feed would result in the economic disposal of these by-products, while the droppings voided by the animals would contain a large proportion of the plant-food materials contained in the feed, and would constitute a valuable manure for the cane lands.

It should be emphasised that the above suggestions are presented, not as a cure for the ills of excess sugar production, but merely as a line of thought which should interest those of our growers who are earnestly seeking some way out of our present difficulties. Moreover, while such schemes might be of value in the drier cane areas, the problem of the humid north offers greater difficulties.

CROWN LAND FOR GRAZING HOMESTEAD SELECTION.

CUNNAMULLA DISTRICT.

The resumption from Cunnamulla Holding has been surveyed as portion 4, parish of Eunama, and is situated about twelve miles southerly from Cunnamulla.

It will be open for Grazing Homestead Selection at the Land Office, Cunnamulla, on Monday, 12th April, 1937, at 11 a.m.

The selection will be for a term of twenty-eight years, and the annual rent for the first period of seven years is 2¾d. per acre.

The selection must be stocked to its reasonable carrying capacity with the applicant's own sheep within a period of three years.

The portion is good wool-growing country, and is well watered by four bore drains.

Free lithographs and full particulars may be obtained from the Lands Department, Brisbane, the Land Agent, Cunnamulla, and the Government Tourist Bureaux, Sydney and Melbourne.

Soil Erosion.

H. W. KERR.*

DURING recent months the subject of soil erosion has been given considerable prominence in agricultural discussions. Doubtless, it is one of the most serious agricultural problems with which a country is faced, and it is of national importance. It is, at the same time, one which is conveniently ignored by those who are most adversely affected by it, and the realization of its nature is truly appreciated only when the damage has been done. As with most other problems, methods of prevention are always simpler than cures. Since the question of soil erosion is a matter of decided importance to some of our valuable cane-growing areas, it would appear fitting to place before cane farmers a few observations on—(1) its causes, (2) its prevention, and (3) its cure.

The Causes of Erosion.

The term "erosion" means the loosening and removal of soil from its previous resting place, through the agency of wind or water. Insofar as the Queensland cane areas are concerned, the action of wind is of minor importance, and we will therefore confine our attention to water erosion. When rain falls on the land surface, a proportion is absorbed by the soil, while the balance flows away and ultimately finds its way to a neighbouring watercourse. Flowing water possesses the power of carrying with it a greater or less amount of solid matter, gathered from the surface over which it flows. The gradual removal of soil in this way, insignificant though it may appear in some circumstances, is one of the most potent forces in converting valuable land—and notably land of appreciable slope—to a state of low productivity. Water which percolates through the soil carries with it valuable plantfood materials which it dissolves. To replace these, the application of simple and appropriate fertilizers is sufficient treatment. But the removal of the solid soil particles by surface "run-off" water is something which cannot be so readily restored. It is common experience that the finest particles of the soil are those most readily removed in this way, and these materials also constitute the most fertile portions of the land. When a river carrying such sediments overflows its bank, its speed is checked and the suspended matter is deposited on the flood plain in the form of sediments, which eventually provide characteristically fertile alluvial soils.

The major factors affecting the intensity of erosion are—(*a*) Type of soil, (*b*) slope of the land, (*c*) farm management methods, (*d*) amount and rate of rainfall.

(*a*) Sandy soils are, in general, least subject to erosion, since they are capable of rapid absorption of water. But should conditions result in the creation of a fully-saturated sandy soil, the absence of binding material permits it to be carried down a slope at a very rapid rate; again, the coarseness of the particles may cause it to be deposited before it has travelled any great distance.

Heavy clay soils are more subject to gradual wearing down by water, but the strong cohesive forces which exist in such soils offers great resistance to loosening.

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*Reprinted from the "Cane Growers' Quarterly" by courtesy of Dr. Kerr, Director, Bureau of Sugar Experiment Stations.

The soils most liable to erosion are the intermediate class known as loams. When saturated with water they may move off in large masses due to their plastic nature. A loam rich in organic matter possesses advantages over those not so favoured, for this important soil constituent promotes more complete water absorption, while acting also as a mechanical obstruction due to its fibrous character. Unfortunately, few cane soils could be classed as rich in humus.

The presence of gravel and stones is sometimes helpful in preventing erosion, as they are themselves moved with difficulty; they also offer resistance to the free flow of water, and definitely protect the soil which lies beneath them.

(*b*) The steepness or "gradient" of the land has a very direct and obvious influence on the degree of erosion experienced. While silts are removed even by water flowing over relatively level land, the carrying capacity of flowing water increases at a very rapid rate with increased slope. This is very apparent when we study the rate of gully formation in a field. A series of measurements which were made to determine the influence of slope showed that, while 8,000 lb. of soil were removed annually from an acre of "level" soil, the rate of removal was doubled where the gradient was 1 per cent., and trebled where the slope was between 2 and 3 per cent. Steep slopes also affect the relative amounts of moisture absorbed and shed by the land.

(*c*) The nature of the surface of the soil is one of the greatest factors in determining the extent of erosion, and is indeed one of the major considerations in devising control measures. Soils in their natural condition possess a protective covering of forest, scrub, or natural grass, which prevents erosion on all but the steepest slopes. The removal of the vegetative cover, and particularly the subsequent tillage operations to which the land is subjected, results in a drastic disturbance of these natural conditions, and erosive factors are given full play. A loose layer of surface soil—particularly when underlain by a subsoil hardpan created by tillage implements—presents an ideal medium for the absorption of the first rains which fall, at least to the point where it becomes saturated. Should deep percolation of the excess moisture be hindered in some way, it requires little further water to cause the plastic surface layer to move down a slope, should this condition exist. The adverse influence of even surface tillage implements is readily seen on a tilled hillside field following heavy rains. The removal of the surface mulch layer reveals the tracks of the individual tynes of even the homely scarifier.

(*d*) It is readily evident that the rainfall rate is one of the potent factors in erosion. Heavy and rapid downpours inevitably cause greater removal of soil than an equal amount of rain falling over a longer period. This is due to the time factor which is involved in the moisture absorption rate for any soil, and the soil removal influence is thus bound up in the amount of run-off water. The state of the soil at the time a heavy downpour is experienced—whether it be relatively dry or already water saturated—is an important consideration. Heavy rains themselves beat and compact the surface soil layer and destroy in some degree the natural absorptive capacity of the land. In the coastal regions of Queensland, with their recurrent tropical deluges, the effects of erosion are widely evident even on relatively gentle slopes.

The character of the crop to which the land is devoted has a very marked bearing on the degree of erosion experienced. The following series of figures obtained from studies conducted in the middle west of the United States of America is very interesting in this connection:—

Soil Treatment,	Percentage of rainfall which ran off.	Total weight of soil removed per acre per year.
	Per Cent.	Tons.
Not cultivated	49	30
Ploughed 4" deep	31	36
Ploughed 8" deep	28	31
Grass sod	12	¼
Wheat each year	25	6
Maize each year	27	16

The slope of the land was slightly less than 4 per cent., and the annual rainfall varied from 24 to 50 inches over the duration of the experiment (6 years). Certain features of these results are worthy of note. Firstly, erosion was greatest on the loose, ploughed soil without crop. Secondly, the presence of a growing crop reduced the loss, and this influence was greatest with the crop which afforded the most complete cover. Maize—which might be compared with sugar-cane in this regard—reduced the erosion loss by one-half, wheat effected a reduction of five-sixths, while with grass sod an insignificant amount (¼ ton) of soil was carried away. In passing, attention should also be drawn to the loss of water due to run-off which occurred under the various systems of husbandry. The rate of soil removal on a well-tilled slope is commonly evidenced in our Queensland cane areas, when a deluge of rain is experienced during the planting season. How often the farmer awakes to find his soil and plants washed down to the low end of the block!

The Prevention of Erosion.

From the preceding discussion it may be concluded that soil erosion is caused by water running from higher to lower levels over the surface of the ground. Erosion control therefore consists in decreasing or diverting the run-off, or both. The possible methods are—

(1) Reducing the run-off by making the soil more readily absorbent.

(2) Keeping the soil covered; a good vegetative cover also slows down the run-off and causes more water to be absorbed.

(3) Holding and diverting the water along courses having such a gradient that the erosion damage is negligible. This principle is employed in terracing.

(4) Conveyance of water from higher to lower levels in artificial channels. This principle is generally applied in disposing of concentrated run-off from fields, and in checking deep gullying.

These several preventive methods will be discussed in some detail.

1. The absorptive capacity of the soil may be improved by sub-drainage. The growth of deep-rooted crops—*e.g.*, lucerne—will open up stiff soils and provide channels through which the water may pass. Deep ploughing and subsoiling or grubbing will also assist in increasing absorption. In ploughing on slopes, the furrow slice should always be thrown up-hill, by the use of a reversible hillside plough. Land left in this condition will always absorb more water than where the furrow slices are thrown down-hill. Contour ploughing is obviously better than ploughing up and down the slope for similar reasons. All methods of humus restoration are to be encouraged, slow though the process may be; a soil rich in organic matter will remain open and make for more complete rainfall absorption.

2. Unfortunately, the canegrower has little opportunity for keeping his land covered. Where crop rotation is the vogue, the farmer may keep his land under grass cover for a proportion of the rotation period; and the steeper the slope of the land the greater the proportion of the rotation during which grass cover should be kept. The canegrower has, however, two opportunities of doing something in this regard; during the fallow, a green manure crop should invariably be sown; where serious erosion losses are encountered, trash should *never* be burned but left on the land surface to serve as a mulch. The benefits of trash conservation are twofold—(*a*) the avoidance of ratoon cultivation leaves the soil undisturbed and reduces the rate of subsurface packing; (*b*) excess water is shed by the trash layer instead of by the loose soil, and, therefore, a sediment-free run-off replaces the normal sediment-laden stream. On certain farms in the humid northern cane districts, this practice is being employed systematically with very good results. Relieving of the trash from the stools promotes a more rapid ratooning, and facilitates the application of both mixed fertilizer and sulphate of ammonia.

Experience shows that land of greater slope than 5 per cent. should never be devoted to cultivated crops continuously; where the slope reaches 10 per cent. cultivated crops should occupy the land only during a small fraction of the rotation period, while land of more than 15 per cent. slope should be kept in permanent pasture. From these data it is evident that much land which is being cultivated at the present time will be *completely useless* in a few years. Unfortunately, no means are available whereby the farmer may be obliged to devote his land to those crops for which it is suited, and thus avoid the national calamity of denuded hillsides of waste land.

3. Where the methods hitherto discussed are not adequate or suitable for the purpose of effecting erosion control, the farmer must resort to terracing his land. Such a suggestion is generally dismissed by the farmer as something both costly to carry out and difficult to deal with. A careful study of the accompanying notes will show, on the contrary, that terracing may be effected at very little cost, while its presence is scarcely noticed during subsequent cultural operations.

The terrace is a flat ridge of earth like a steeply-graded road or an extra large back-furrow, from 15 to 20 feet wide at the base, and built almost on contour lines around the slope. Above this ridge is a flat, broad channel. The crest of the terrace is 15 to 24 inches above the bottom of this channel. Terraces control the run-off, because they are spaced in a series like steps down the slope, each taking its share of water before the total quantity becomes large enough to do damage. The water which each traps is carried in a broad slow-moving stream to the side of the slope without damage to the field. This slow movement keeps the water in the field for a longer time, causing more of it to be absorbed into the land, and reducing run-off and loss of soil by erosion. Reference to the accompanying sketch (Plate 95) together with a detailed description of the process of terrace construction should make these points clear.

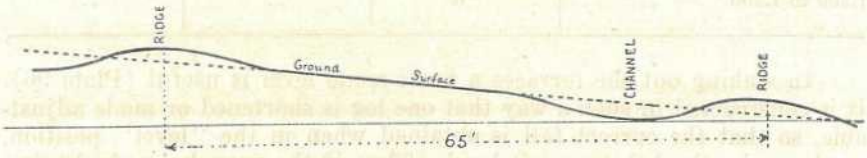


Plate 95.

Showing the cross section of a terrace on a slope of 10 per cent. Under these conditions terraces will be formed at intervals of 65 feet down the slope.

Terraces are constructed in such a direction across the slope of the land that they provide a fall of not more than 6 inches in 100 feet. They are spaced so that each will take care of the water which falls between it and the one above; they must be close enough together so that the run-off water from average storms will not have an opportunity to descend in small rivulets between the terraces. Where the slope is slight, practically all sediment carried to the terrace under abnormal conditions will be deposited immediately. The most suitable distance between terraces is governed by the slope of the land and the soil type. As a rule, there should be a vertical fall of from 4 to 6 feet between terraces on land with a grade of from 5 to 10 per cent. A greater vertical distance should be allowed where the slope is greater.

The most suitable distance between terraces is shown in the following table:—

Slope of Land.	Vertical Drop between Terraces.	Distance between Terraces along Slope.
Per cent.	Feet inches.	Feet.
3	3 0	100
5	4 3	86
8	6 3	78
12	7 0	58

The gradient along the terrace is also governed by the length of the terrace and the natural slope of the land; the following table offers a useful guide in this respect:—

Length of Terrace.	Gradient per 100 feet along Terrace where Land Slope is.		
	5 Per Cent.	10 Per Cent.	15 Per Cent.
Feet.	Inches.	Inches.	Inches.
0 to 300	½	¾	1
300 to 600	1	1½	2
600 to 900	2	3	4
900 to 1,200	4	6	7
1,200 to 1,500	6	..	..

In staking out the terraces a home-made level is useful (Plate 96). It is constructed in such a way that one leg is shortened or made adjustable, so that the correct fall is obtained when in the "level" position, as shown by the bob or spirit level. Thus if the span be made 16 feet 8 inches six steps will be required per 100 feet of terrace; hence, to strike a fall of 6 inches in 100 feet, one leg should be made 1 inch shorter than the other.

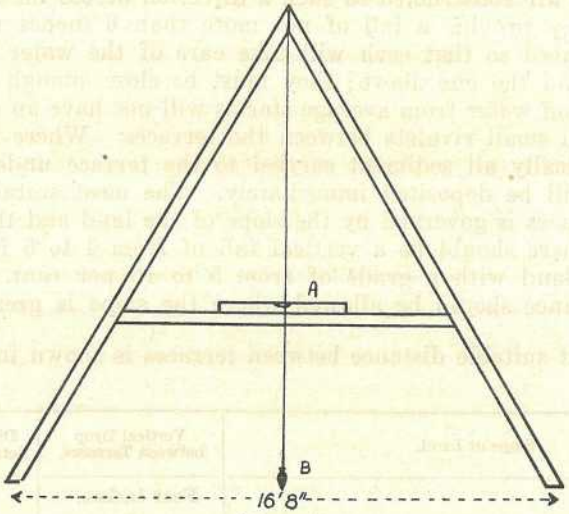


Plate 96.

Illustrating the home-made leveller for use in laying out terraces. Either spirit level (A) or bob (B) may be used.

The first step in the construction of the terraces is to find a suitable outlet for the water which will be discharged at either end of the terrace. A well-sodded pasture is best. Care should be taken that any gully into which the water is discharged is protected against erosion,

using saplings or rocks where necessary (Plate 97), whilst at times earth dams may be necessary. The point at which a terrace crosses an intermediate small gully must be higher and stronger than at other points to eliminate the danger of the water breaking through. The top terrace is made first, and should be built up sufficiently high, so that water from higher up will not collect and break across it before it has settled. An ordinary swing plough may be used to mark out the line of stakes on the terrace; the stakes may then be used in setting out the next one below. It is important to exercise care in laying out the terraces accurately.

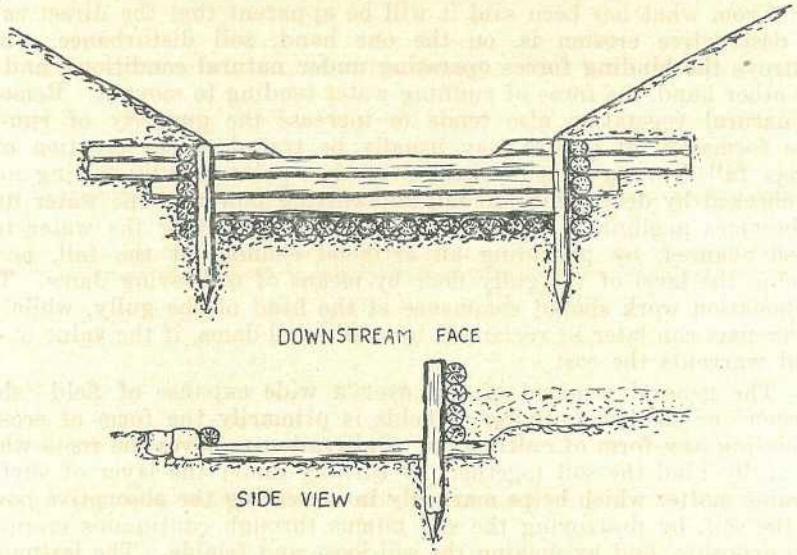


Plate 97.

A suitable type of log dam which may be built across a gully. The apron of timber effectively prevents erosion by the falling water.

The terrace is built up first by means of a team and plough, and later by the use of a light road grader or V-shaped drag. Very little ploughing is necessary in light soils. It is customary to throw together six or eight furrows, and then push the soil towards the centre by means of the grader. This process is continued until the top of the terrace is 12-18 inches higher than the lowest point above the terrace—that is, in the water channel. When completed the terrace should be fairly compacted, and no low points should be left. It is important to build sufficiently highly over low places or small gullies.

During subsequent ploughing and planting operations, the contours should be followed; if the slope is less than 8 per cent., and the terraces are well established, they may be ignored in all cultural operations. When crossing the terrace it is an advantage to plough slightly shallower so that the bank is not weakened early in its lifetime. It is advisable to pay careful attention to the terraces during their first year, so that any break may be repaired as it forms. It is best to throw a little soil on to the terrace when ploughing, and the channel on the upper side of the ridge must be kept clear. For safety sake, the land should first be devoted to grass or to a cover crop of peas or beans to give it the best opportunity to consolidate.

Although terracing has not been exploited in the Queensland cane areas, it is a practice worthy of the closest consideration by growers who are farming high slopes. The cost of the work in the American states is about 10s. per acre, which is certainly not excessive. The farmer should take care that the work is carried out after the risk of heavy rains is past—that is, during the autumn or winter months. The terraces will then have an opportunity of settling down by the late spring, when a cover crop of legumes may be planted to protect the terrace during its first wet season.

Cure of Erosion Damage.

From what has been said it will be apparent that the direct cause of destructive erosion is, on the one hand, soil disturbance, which destroys the binding forces operating under natural conditions, and on the other hand, the force of running water tending to move it. Removal of natural vegetation also tends to increase the quantity of run-off. The formation of gullies may usually be traced to the creation of a direct fall for run-off concentrated at that point. Gully-cutting must be checked by decreasing the fall and cutting power of the water until it becomes negligible. This may be done by diverting the water to a fresh channel, by providing an artificial channel at the fall, or by raising the level of the gully floor by means of soil-saving dams. This reclamation work should commence at the head of the gully, while the lower part can later be reclaimed by additional dams, if the value of the land warrants the cost.

The general removal of soil over a wide expanse of field (sheet erosion) or shallow gullying of fields is primarily the form of erosion attending any form of cultivation. Cultivation removes the roots which naturally bind the soil together, by turning under the layer of surface organic matter which helps markedly in increasing the absorptive power of the soil, by destroying the soil humus through continuous cropping and exposure, and by making the soil loose and friable. The lastnamed also assists in water absorption, but when water begins to run off it hastens the removal of the soil.

The surest method of preventing erosion is to keep the soil continuously covered with vegetation. For steep slopes and poor rocky soils, forest growth is the best and safest plan. For better soils, capable of producing good yields, permanent grass is recommended for moderate slopes with but intermittent planting of cultivated crops. Fertilization of such pastures will assure more luxuriant growth of grass, and hasten the rate of fertility restoration.

Finally, many soil erosion problems are not individual but community concerns, which can only be tackled and solved through the concerted effort of all concerned. This must usually be achieved through the intervention of an independent authority; this course must inevitably follow the full realisation of the seriousness of soil erosion from the national standpoint.

Some Important Factors in Cane Irrigation.

H. W. KERR.*

IN the October, 1934, number of the Cane Growers' Quarterly Bulletin (page 25) were reported the results of an irrigation trial conducted at the Bundaberg Experiment Station. A small block of P.O.J. 2878 was March-planted and given weekly irrigation treatments until harvested. In order that plant-food deficiencies might be avoided, monthly applications of fertilizer were also made. Under these conditions it was possible to follow the relationship between atmospheric temperature and crop growth. As reported, the plant cane at eighteen months yielded 93·4 tons per acre, with a c.c.s. of 12·1 per cent.; the monthly growth rate was also presented, and the striking differences between these rates for respective months were emphasised.

The block was ratooned and the first ratoon crop harvested in October, 1935, when the cane was twelve months old. This crop gave 72·8 tons of cane per acre, with a c.c.s. of 13·0 per cent.

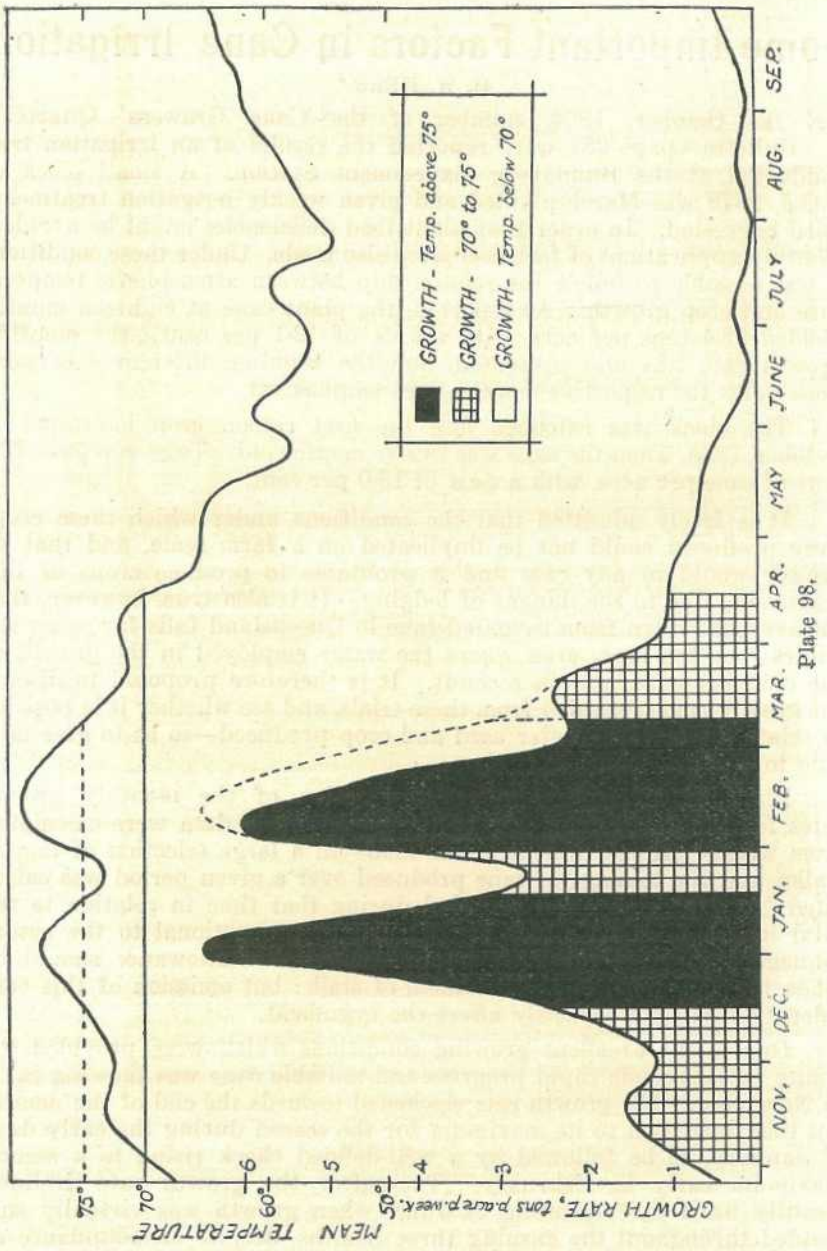
It is freely admitted that the conditions under which these crops were produced could not be duplicated on a farm scale, and that no grower would in any case find it profitable to produce crops of this magnitude due to the danger of lodging. It is also true, however, that the average return from irrigated cane in Queensland falls far below the values recorded here, even where the water employed in the growth of the crop is comparable in amount. It is therefore proposed to discuss the growth rates recorded from these trials, and see whether it is possible to relate the factors—water used and crop produced—so as to give us a clue to our problem.

Plate 98 is a graphical representation of the monthly growth rates for the first ratoon crop of the trial. These data were calculated from weekly growth measurements made on a large selection of tagged stalks, and the tonnage of cane produced over a given period was calculated from the elongation recorded during that time in relation to the total length of stalk, which is regarded as proportional to the actual tonnage at harvest time. It is appreciated that allowance should be made for variations in the thickness of stalk; but omission of this consideration will not seriously affect the argument.

Due to the excellent growing conditions which were provided the young ratoons made rapid progress and millable cane was showing early in November. The growth rate slackened towards the end of the month, but then increased to its maximum for the season during the early days of January, to be followed by a well-defined check rising to a second maximum early in February. Thereafter the growth rate declined steadily until the beginning of June, when growth was virtually suspended throughout the ensuing three months, despite an abundance of available plant food and soil moisture.

The actual cane production per month (Plate 99), as calculated from the growth measurement records, was more than 18 tons per acre for both January and February, while for the three summer months—December to February—the total crop growth was 49 tons of cane per acre. As this is in itself an accomplishment of which any cane grower would be proud for a full year's growth, it may be well to investigate the factors involved in this phenomenal performance.

* In the "Cane Growers' Quarterly" (reprinted by courtesy of Dr. Kerr, Director of the Bureau of Sugar Experiment Stations).



Graph illustrating the growth rate of a ratoon crop of P.O.J. 2878 at the Bundaberg Experiment Station, 1934-35 season, together with the mean atmospheric temperature curve for the period.

During February trouble was experienced with the irrigation plant, and the dotted portion of the curve suggests the maximum growth rate obtainable.

In Plate 98 is recorded also the mean atmospheric temperature curve. It will be observed that provided soil moisture deficiencies have been eliminated there exists a very close correlation between temperature and growth rate. The following points are clearly demonstrated:—

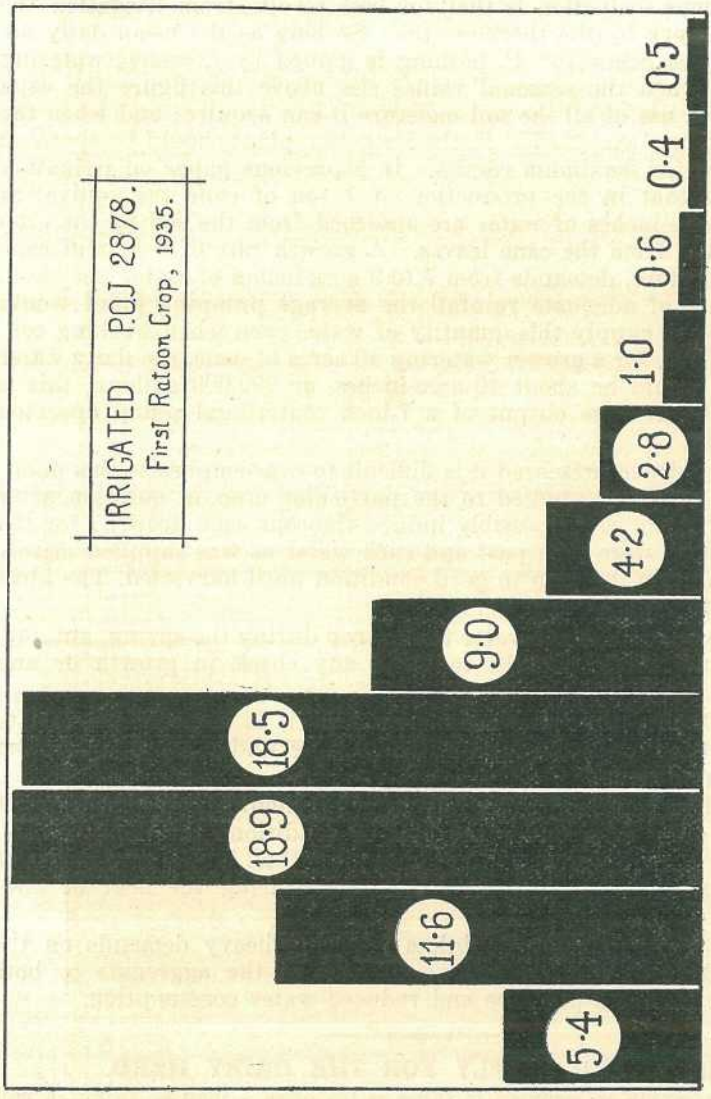


Plate 99.
The blocks represent, by their height, the average monthly growth rates, while the figures in the circles give the actual cane tonnage produced during the month.

(1) Vigorous cane growth commences when the mean temperature rises above 70° F., and declines when it falls below this limit.

(2) Between the limits of mean temperature, 70–75° F., the rate of growth increases at a rapid rate.

(3) When the mean temperature exceeds 75° F., the cane growth rate amounts to more than 6 tons of cane per acre *per week*.

An attempt has been made to bring out these facts more clearly by checking and blocking in those areas of the curve representing the above temperature ranges. It is then observed that the growth check recorded during January was due entirely to a "cool change" in the weather at that time.

The obvious deduction is that for best results from irrigation the farmer must work by the thermometer. So long as the mean daily air temperature lies below 70° F. nothing is gained by excessive watering of the crop; when the seasonal values rise above this figure the cane will make good use of all the soil moisture it can acquire; and when the mean temperature exceeds 75° F. the irrigation plant should be operated day and night for maximum results. In a previous paper on irrigation it was stated that in the production of 1 ton of cane the equivalent of 1¼ to 1½ acre-inches of water are absorbed from the soil by the crop and evaporated from the cane leaves. A growth rate of 6 tons of cane per week, therefore, demands from 7 to 9 acre-inches of water per week. In the absence of adequate rainfall the average pumping plant would be fully taxed to supply this quantity of water even when working continuously. Thus, for a grower watering 40 acres of cane, the daily water consumption would be about 40 acre-inches, or 900,000 gallons; this is practically the average output of a 7-inch centrifugal pump operated day and night.

On the evidence presented it is difficult to over-emphasise this point. No quantity of water applied to the particular crop in question after the month of April could possibly induce vigorous cane growth; for the long, warm days were then past and such water as was supplied merely served to maintain the crop in good condition until harvested. The ideal watering system would then be:—

(*a*) Apply sufficient water to the crop during the spring, autumn, and winter months to avoid any check in growth or any distress due to wilting.

(*b*) During the three summer months it is scarcely possible to over-supply the land with moisture under average farming conditions.

Even when beneficial rains fall watering should be resumed almost immediately; for even under the best of conditions the depth of soil drawn on by the crop roots will not hold more than 5 or 6 acre-inches of available moisture—barely a week's supply during the heat of mid-summer.

Such a policy, though doubtless imposing heavy demands on the irrigation plant at this season, would lead in the aggregate to both greater cane tonnages per acre and reduced water consumption.

THE WATER SUPPLY FOR THE DAIRY HERD.

The water supply on many dairy farms is too often a limiting factor in milk production. An abundance of pure, fresh water, is essential for the best results. While not spoken of as a food, it is absolutely necessary for all the processes of nutrition. It is a well-known fact that mastication, digestion, absorption, and assimilation are all impeded by a lack of water. No food can be utilised by the body until it has been brought into solution, and as water is the chief agent in accomplishing this, it will be seen that a good, pure water supply is essential at all times. It is the common carrier of the body, both in the distribution of the nutrients and in the elimination of waste and the various poisonous products through the skin, kidneys, and the digestive tract. Through evaporation from the surface of the body and the lungs it regulates the body temperature. It is, of course, well known that the largest constituent of milk is water, of which it forms about 87 per cent. A shortage of water will cut down a cow's milk flow more quickly than a shortage of feed. The dairyman, in order to maintain a maximum flow of milk, must, in addition to good feeding, provide an ample water supply, as each cow on an average consumes about 12 gallons daily. The quantity consumed depends very largely on the temperature and the milk flow. Cows in milk require three or four times as much water as dry cows. Drinking does not produce milk, but heavy milk production and the heavy eating that results from it induces the consumption of a great quantity of water.—L. VERNEY, Instructor in Dairying.

The Breeding of New Varieties of Sugar-Cane.

ARTHUR F. BELL.*

POSSIBLY no phase of the agriculture of sugar-cane is now receiving as much attention by Experiment Stations as cane breeding, and rightly so. Yield per acre can be improved by various methods, most of which involve the expenditure of considerable sums of money, but once a variety of superior yielding power has been produced it continues to give higher returns per acre with no added outlay.

The cane-breeding programme of the Bureau is now undergoing considerable expansion, and so it was thought that a survey of the aims and methods used might be of some interest at this time. The conditions permitting the expansion of the programme are—

(*a*) The Northern Station has been transferred to Meringa, where the lower rainfall does not interfere so much with the shedding of the pollen of the male parents.

(*b*) The Mackay Station has been transferred to Te Kowai, thus permitting a larger and more representative area to be devoted to seedling raising.

(*c*) A small irrigation plant has been installed at the Bundaberg Station and this will ensure our being certain of raising seedlings under reasonably good conditions in the frequently recurring drought years.

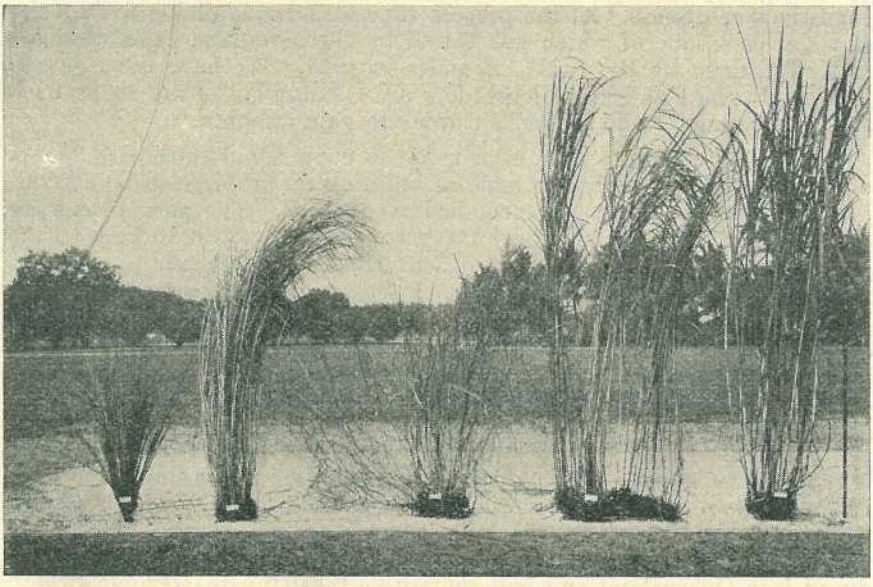


Plate 100.

Showing the diversity in type of "wild" canes which may be used as parents in crosses with "noble" canes in order to introduce desirable characters in commercial canes. (After Venkatraman.)

*In the "Cane Growers' Quarterly," and reprinted by courtesy of the Director, Bureau of Sugar Experiment Stations.

It may be emphasised, however, that such irrigation as is used will not be excessive; over-good or over-bad conditions tend to bring the majority of seedlings to the same level and make selection impossible—our aim is to be certain of having reasonably good conditions.

Sugar-cane breeding dates back only to 1889, when seedlings were raised in both Java and the British West Indies, but it is interesting to note that the Queensland Acclimatisation Society was soon in the field and raised a few seedlings in 1890. This work was continued by the Society on a small scale until 1907, when it was abandoned; Q. 813 and Q. 1098 are the best known of the canes produced by this organisation. From 1901-5 seedling raising was carried out by the C.S.R. Company at their Hambledon Plantation, and here were bred the well-known H.Q. 426 (Clark's Seedling) and H.Q. 285. With the establishment of an Experiment Station within the tropics (South Johnstone) this Bureau was enabled to commence seedling raising in 1921, and S.J.4 is the best known of the early seedlings.

During this period most Sugar Experiment Stations had undertaken the breeding of new varieties of sugar-cane, but in general this work had not met with the success which had been anticipated, and the methods employed had not been greatly improved. Within recent years, however, rapid advances have been made, due in part to the better circulation of knowledge through the conferences of the International Society of Sugar Cane Technologists and the discovery of new species of sugar-cane and their value in breeding. In the early period at South Johnstone we were forced to breed only from the "noble" species, with the result that although many vigorous canes of high sugar content were produced, most of them were too "aristocratic" and could not withstand hard conditions or disease. At the present time we have available five species of sugar-cane, one of which was found by the aeroplane expedition led to New Guinea by Dr. E. W. Brandes in 1928. We have been forced, just as all plant and animal breeders are eventually forced, to go back and reintroduce "wild blood" in order to gain stamina.

Recently attempts have been made to cross sugar-cane with plants other than sugar-cane in the hope of building up crossbreeds which will contain some qualities at present lacking in cane. The most promising of these are the sugar-cane sorghum crosses carried out in India by T. S. Venkatraman, who recently visited Queensland as a delegate to the Congress of the International Society of Sugar Cane Technologists. In India, as in parts of Queensland, early maturing canes are a pressing need; it occurred to Mr. Venkatraman that perhaps the crossing of cane with a short cropping plant, such as sorghum, might bring about this result. The attempted crossing was successful and gave progeny which look more like cane than sorghum and reach maturity in five to six months. Unfortunately, they still lack vigour, although the sugar content is reported to be good. It would appear that by back crossing on to cane for one or two generations there is a fair chance that a cane (or should we say a "sorg-cane"?) will be produced having vigour, high sugar content, and early maturity. Four of these first crosses have been introduced into Queensland and will shortly be taken up to Meringa, where it is hoped that they will arrow and enable Mr. Barke to effect crosses back to cane.

The methods employed in raising seedlings vary considerably in detail according to conditions and cost of labour available. In Queensland the general technique is as follows:—Varieties which it is thought

desirable to try out as parents are planted in a plot in the Freshwater district, near Cairns, where arrowing is usually heavy. In making any particular cross the arrow of the cane selected as the female parent is left growing in the field; just before the flowers commence to open this arrow is surrounded with several arrows of the variety selected as the male parent. The stalks of the latter are stood in a special solution containing sulphurous and phosphoric acids (see Plate 101); this solution

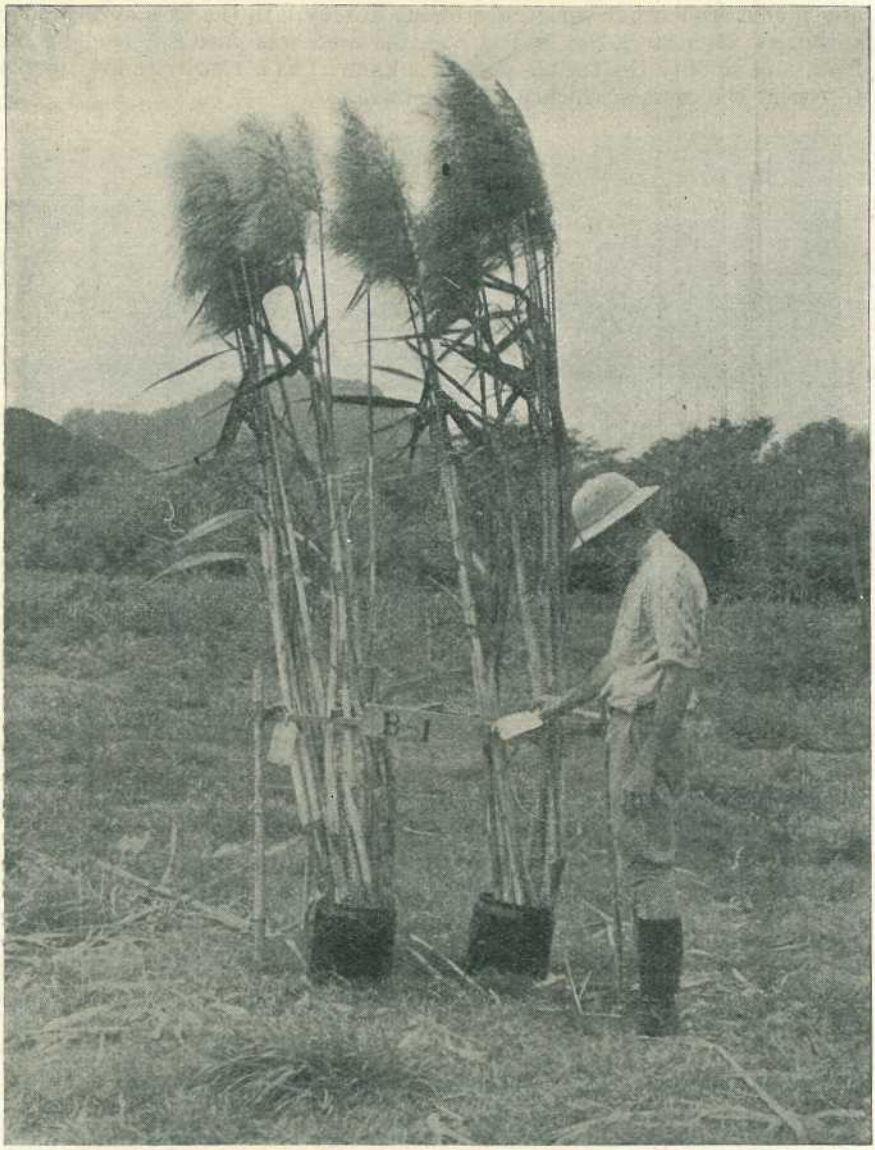


Plate 101.

Arrows of the variety selected as male parents are stood in a special solution and carried to the field, where they are set around the female arrow. (After Mangelsdorf.)

will keep the stalk and arrow alive for weeks, and will allow the normal shedding of the pollen to continue. The canes of the male variety are tapped lightly each morning in order to facilitate the shedding of the pollen.

It is very desirable that the parentage of each seedling should be known with certainty; consequently the variety used as the female parent is chosen because it produces little or no pollen and the male arrows are clustered closely around so as to prevent the deposition of any pollen from other varieties growing nearby. In the case of the older seedlings, such as B. 208 and Q. 813, the seed was just collected in the field, and so only the female parent is known; as a result we are unable to repeat the crosses which produced them.

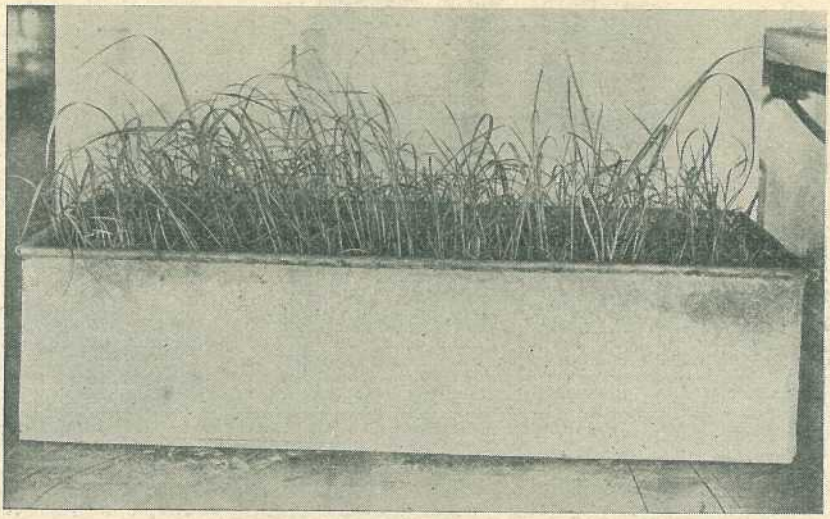


Plate 102.
Seedlings growing in the germination flat, five weeks old, and ready for potting.
[*Photo. by N. J. King.*

When all the tiny flowers on the female arrow have opened and died off, the male arrows are removed and the female arrow is bagged until the seed has ripened, this ripening usually taking some two or three weeks. The seeds are considerably smaller than a pin's head and are light to dark-brown in colour. They do not keep well and, unless stored under special conditions, must be planted immediately if reasonable results are to be obtained. Seed will not set on the arrows produced by the cane in the Mackay and Bundaberg districts, and so all crossing work is carried out at Freshwater and the "fuzz" is sent to the other stations for germination.

The seed is planted in flat wooden boxes containing a mixture of soil, well-rotted manure or leaf-mould, and sand, only a light covering of soil being applied. The boxes are usually set in glass houses or frames which can be heated during the late winter and early spring months when germination is carried out. The seeds germinate after a few days, and the young seedlings appear very similar to certain young grass seedlings at this stage. They are very delicate, and for some time require constant attention to prevent damage by heat, low humidity, or damping-off fungi.

At the age of about four to five weeks they are transplanted from the flats into pots consisting of a length of galvanised iron piping, about 8 inches long by about 3 inches in diameter (see Plate 104). After about eight weeks' further growth they are transplanted into the field. A hole is dug at the base of a plough furrow and the core of soil, with the roots intact, is tapped out and set in the hole. The seedlings then grow in the field until about August or September, when the selection of the best canes is made.

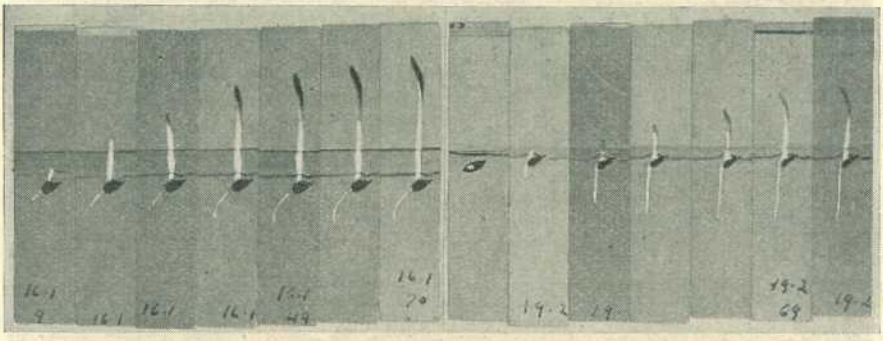


Plate 103.

Photographs taken at daily intervals after the sugar-cane seed has germinated. The seedling on the left had as parents P.O.J. 2878 and P.O.J. 2940, while that on the right was obtained from P.O.J. 2722 and H.Q. 409.

[*Photographs by W. Cottrell-Dormer.*

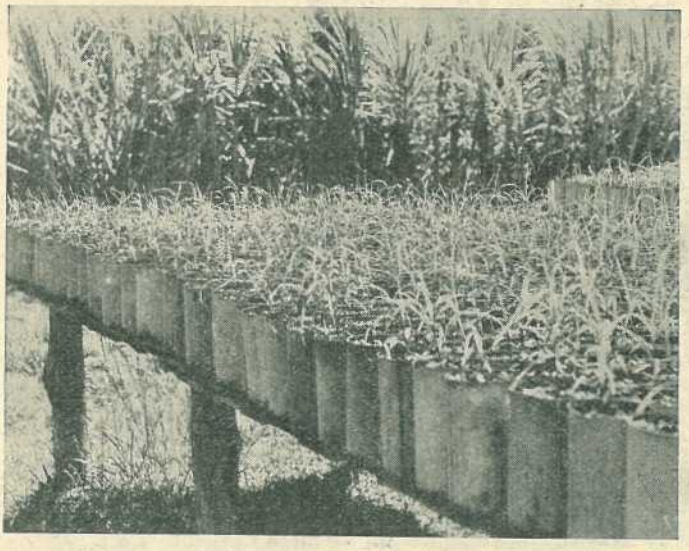


Plate 104.

Young sugar-cane seedlings growing in galvanised iron tubes; these seedlings are ready for transplanting into the field.

[*"Telegraph," Photo.*

Plate 105.
Seedlings being transplanted from pots to field at the Bundaberg Experiment Station.

[*Photo. by N. J. King.*

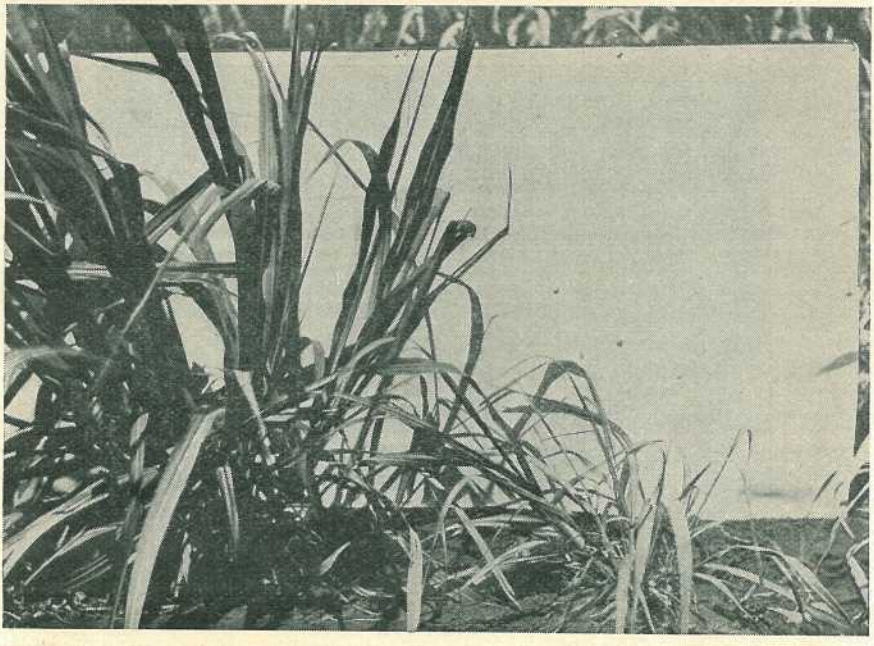


Plate 106.
Photograph illustrating difference in growth in adjacent seedlings of the same cross. Age, five months.

[*Photo. by N. J. King.*

The progeny of any one cross may vary to an extraordinary degree, ranging from fine upstanding stools of 10 to 12 or more stalks per stool, to units which produce practically no cane. Selection is made on the basis of vigour of growth, sugar content, formation of the eyes, type of growth (i.e., whether it is sprawling or not), and so on. As a rule, only about one in a hundred original seedlings is selected for further trial. Thus, if we raise 10,000 seedlings, only about 100 are selected for a second planting, the rest being milled and discarded. It might be thought that such wholesale rejection is rather severe, but there are two points to be borne in mind. Firstly, if we can produce one really good seedling per year which will replace a standard variety, we will be more than satisfied, and if there is only one really good seedling in a batch of 10,000, then it surely should be included in the hundred selected. Secondly, the area of land and facilities available do not permit the handling of large numbers of second and third year seedlings.

Such seedlings as are selected from the original stools are planted out in short rows interspaced with standard varieties and, at maturity, selections are again carried out as in the first year, but naturally with closer attention to detail; about 10 per cent. of these are selected. Third and fourth year tests are carried out on a larger scale, and attention is paid to germination and ratooning qualities, while in the meantime resistance to major diseases has been determined. Finally the 10,000 seedlings are reduced to perhaps two or three which are considered worthy of trial on farms, and these are then set out in comparative trials with standard varieties on different soil types.

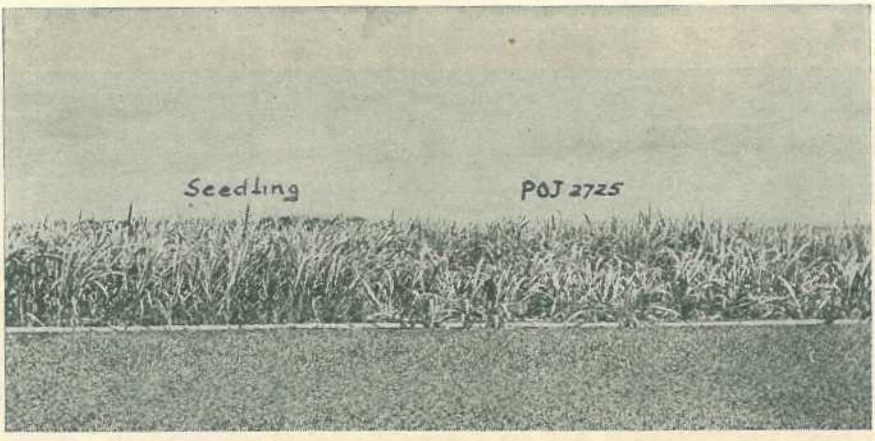


Plate 107.

Comparison of P.O.J. 2725 and a seedling raised and now being tested at the Bundaberg Station. *[Photo. by N. J. King.*

The two outstanding seedlings which have been produced since cane breeding began are P.O.J. 2878 in Java and H. 109 in Hawaii. P.O.J. 2878 was rapidly planted to 98 per cent. of the area, but, unfortunately for the Java planters, they have not reaped the full benefit of this cane owing to drastic reductions in their sugar markets. In Hawaii, even if the Experiment Station had never done anything else of value, its existence would still have been eminently justified, since the cost of its maintenance since its inception has been many times repaid by the extra profit accruing from the planting of H. 109.

The qualities required in a cane breeder are many. He must be a model of patience, painstaking care, and capacity for hard work and long hours. He must be optimistic with an optimism tempered by caution; stout-hearted so that he shall not despair when a promising "world beater" must be discarded on account of disease susceptibility; sympathetic towards and intensely interested in his large family, but ruthless in his destruction of all members who fall short of rigid standards.

On the other hand, the canegrower himself must also be optimistic regarding the final results of a cane-breeding programme. We must ask him to be patient and tolerant also, since it requires time to determine the types of cross and then develop the individuals best suited to the soil, climate, agricultural and disease conditions of each district.

A final word. We are sometimes asked the question, "Why try to breed superior varieties when there is already over-production of sugar?" The answer lies in the reason why farmers till their land before planting and cultivate and fertilize the crop. The function of an Experiment Station, through the efforts of its plant-breeding staff, is to produce superior canes of higher sugar content and thus reduce the unit cost of sugar per acre. The question as to what extent over-production exists and how it shall be controlled is a problem for the economic and not the agricultural advisers of the industry.

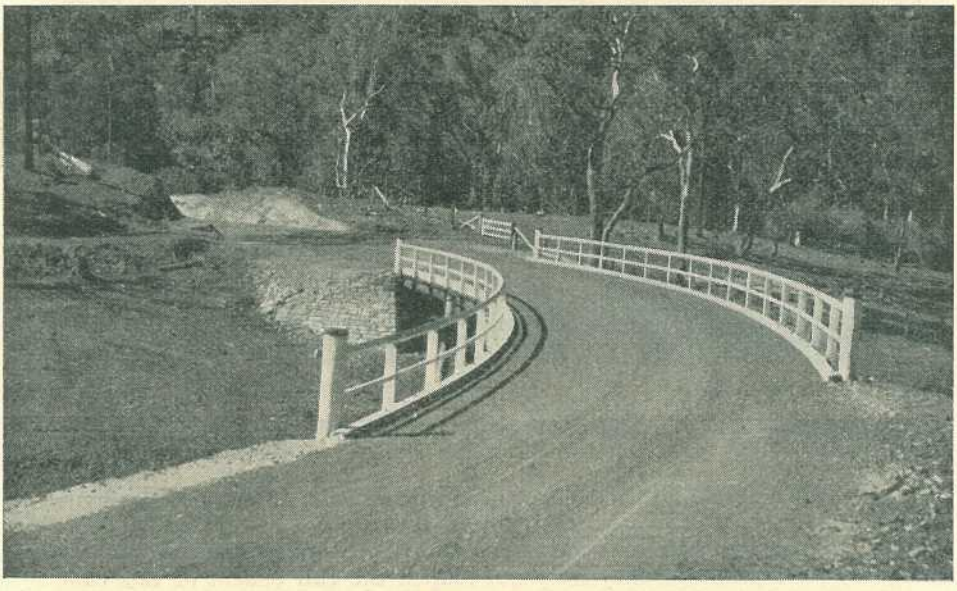


Plate 108.
The Road Through the Forest, Tarampa Shire—Lockyer—Darling Downs Highway.

[*Block by Courtesy Main Roads Commission.*

Fiji Disease in South Queensland.

G. A. CHRISTIE.*

FOR many years gumming disease has been responsible for greatly depressed yields in the cane crops of South Queensland, but by substituting disease-resistant canes for the more susceptible varieties the position has been greatly alleviated and losses are rapidly becoming negligible. In order to combat gumming disease it has been necessary to extend the plantings of P.O.J. 2878 and, to a less extent, P.O.J. 2725, two varieties which are susceptible to another important disease—Fiji disease. This disease is more common in the southern districts but is present on a few farms in the Bundaberg-Isis district. The importance of this disease should not be under-estimated, especially in those districts where P.O.J. 2878 holds such promise, and it is in the interest of all canegrowers to assist in its eradication or control.

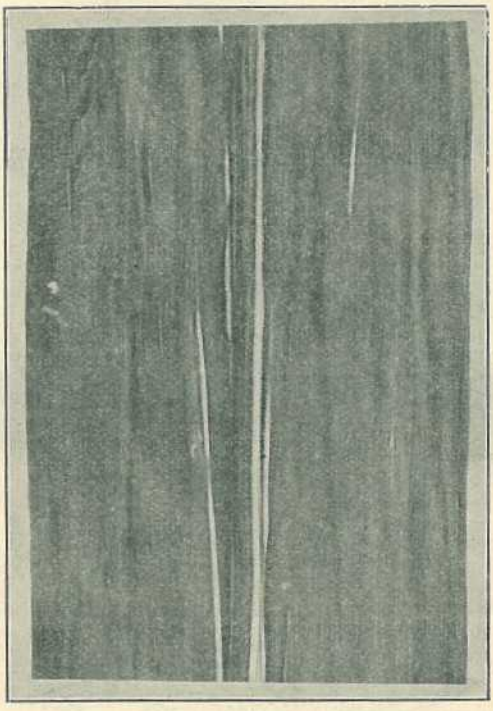


Plate 109.
Illustrating typical galls on the underside of a diseased leaf.

Fiji disease was first recorded about thirty years ago in the colony from which it takes its name. The industry in these islands was threatened for some years and the crops were seriously affected by the ravages of the disease. It probably originated in New Guinea, and by the interchange of varieties has since spread to Fiji, Australia, and the Philippine Islands.

The earliest symptoms and the outstanding characteristic of the disease is the presence of small yellowish galls which are formed on the under surface of the leaves of diseased cane. These galls may be

* Reprinted from the "Cane Growers' Quarterly" by courtesy of Dr. Kerr, Director, Bureau of Sugar Experiment Stations.

one to many in number and are usually 1/32 to 1/16 in. in diameter, ranging from $\frac{1}{8}$ in. to 2 in. in length; they are formed by the enlargement of the veins. (See Plate 109.) In the later stages of the disease the leaves become shortened and erect, very stiff and brittle, and take

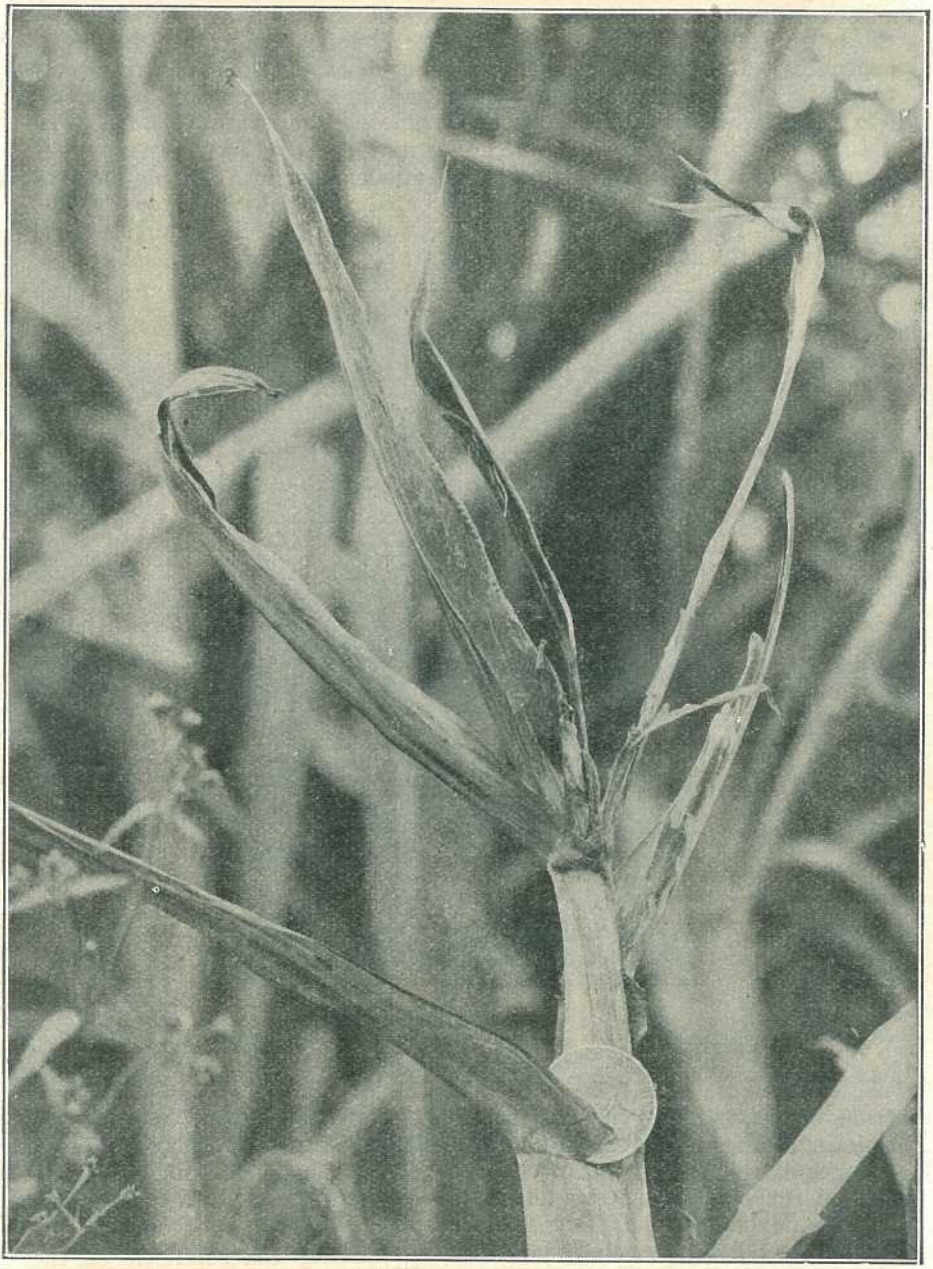


Plate 110.

Illustrating the stiff, stunted, and malformed leaves of a well-advanced stage of secondary infection.

on a darker green colour. In this stage the cane top looks as though it had been eaten by some animal. When such distortion of the top occurs no further growth is made, the leaves become smaller and smaller and eventually the heart dies. (See Plate 110.)

When diseased setts are planted they invariably give rise to diseased stools, which in most cases produce no cane but remain a cluster of stunted grass-like shoots; the ratoon stools from diseased plant stools are also of this type. (See Plate 111.)

Plate 111.

The two small grass-like stools in the foreground are the result of ratooning diseased stools. Variety, P.O.J. 2714.

Fiji disease is permanent, and no authentic cases of recovery from the disease have been observed. It should be stated that the disease bears a resemblance to other minor troubles, particularly to clustered stool, which was described in the "Quarterly Bulletin" for 1st July, 1935 (page 8). The question as to whether Fiji disease is present or not can be settled by the presence or absence of the small leaf galls described above.

The investigation of the manner in which the disease is spread from diseased to healthy cane was successfully undertaken by the Bureau some years ago. Contrary to the belief of many growers, it has been established that no soil infection occurs. After ploughing out and killing diseased cane the soil does not remain infective to cane planted at a later date. Nor does cutting diseased and healthy cane alternately with the same knife produce infection in the healthy cane. The only known means by which Fiji disease is spread is through the feeding activities of the sugar-cane leaf-hopper, a small brownish insect about 1/5 in. in length. After these insects are fed on diseased cane they are capable of infecting any susceptible healthy cane on which they feed. Although cane becomes infected in this way, it does not bear any symptoms for some time after the diseased hoppers have fed on it. Often such diseased cane may appear healthy for some months, and this naturally complicates the job of selecting healthy planting material.

CONTROL.

The methods of control which are recommended, are—

(1) Plant only disease-free cane.

(2) During scarifying and at other times inspect all plant and ratoon cane and dig out any suspicious stools. The leaf-hopper which spreads this disease becomes very scarce during the winter and remains so until about December. Therefore, inspection and digging out of diseased stools should be carried out by November-December.

(3) Restrict ratooning of diseased crops.

(4) The better the conditions for cane growth the better are conditions for the spread of Fiji disease. Therefore, special care is necessary on rich alluvial land or irrigated farms.

(5) Where the disease is well established and spreads rapidly, resistant varieties should be planted. The choice of variety will depend, of course, on what other diseases are present; the best known resistant varieties are P.O.J. 213, P.O.J. 234, Co. 290, Q. 813, H.Q. 285, and Mahona; Korpi and Oramboo are also satisfactorily resistant, while P.O.J. 2379 shows promise in this respect.

DISTRIBUTION OF THE DISEASE.

During this and the previous season a considerable amount of field survey work has been carried out by Bureau officers, and the results are briefly set out below:—

Bundaberg.

Continued field inspections and digging out of diseased stools, together with supervised plant selection, has reduced the disease considerably at Bingera, though infection is still present and the situation requires close attention. In the Kalkie quarantine area, disease surveys have revealed a reduction in the number of infected farms and in the degree of infection. Nevertheless, the disease is by no means under control on some of the river-flat farms, and some more rigid form of control may become necessary.

Isis.

The disease was reported on several farms some years ago, but with the co-operation of growers and mill officers it was speedily brought under control. Recently it has been found on two neighbouring farms, one of which had carried the disease previously. Owing to the extensive plantings of the very susceptible variety P.O.J. 2878 the present outbreak must be regarded more seriously than the previous one.

Maryborough.

A considerable amount of inspectional work has been done in this district, and since February last year some 350 farms have been inspected at least once. In the Maryborough district proper the disease is present to a considerable degree, and the use of resistant varieties should be more widely adopted. In the Yerra-Antigua section the disease was found on 27 farms in a total of 127 inspected, while 7 in a total of 92 inspected were infected in the Pialba-Takura section. In both cases, however, the infection amounted to only a few stools per farm, and hence the situation should be readily controlled by the application of a little care on the part of the farmers concerned. At Mount Bauple 2 infected farms were found in the 72 inspected, so that the situation in that locality could readily be controlled.

Moreton.

A survey of a portion of the area showed that Fiji disease was present on 11 farms in 88 inspected. These farms included all that might be suspected of having the disease, and therefore the situation is better than appears at first sight, although definitely serious in view of the value of P.O.J. 2878 in this district. With one exception the disease amounted to a very few stools per farm.

HOW FREQUENTLY DO GIANT TOADS PRODUCE EGGS?

We have been asked repeatedly whether the toads lay but once in a year or whether they can produce eggs at more frequent intervals. In order to try and find an answer to this question numbered arm bands were placed on females which were definitely observed depositing eggs. Now, for the first time, we have a record of one of these banded females laying again. No. 1, which produced 16,000 eggs on 17th March last, was captured in the act of laying a further large batch on 30th May. Unfortunately, her egg strings were intertwined with those of eight other toads which laid on the same day, so it was impossible to determine accurately the number which this individual laid. The total number produced by the nine females on this morning was 125,000.

At least 52 toads have laid at Meringa since the 17th November, 1935, and as we have only 37 females in all, several have laid more than once.

It is of interest to record that not less than 1,560,000 eggs have been laid to date, and approximately 62,000 toadlets have been caught and distributed. Male toads are to be heard calling almost nightly in Tully and in parts of the Gordonvale area.

J.H.B., in the "Cane Growers' Quarterly."

Subterranean Waters of the Woongarra Lands.

THEIR SUITABILITY FOR IRRIGATION.

N. J. KING.*

THE past four or five years have seen in Bundaberg the advancement of irrigation from an experiment to an outstanding commercial example of crop control. The large Bingera and Fairymead Plantations, with two basically different schemes of water production, have shown that successful irrigation of cane is just as practicable in the sub-tropical south as in the Burdekin delta. The refusal of the Bundaberg farmers (in the proposed benefited area) to be burdened with a community irrigation undertaking has left the onus on the irrigation-mined grower of developing an individual plant for his farm requirements. In the immediate Bundaberg district this involves the search for underground water, as very few farms have access to river water of the necessary purity.

A number of growers have already investigated the subterranean supplies on the forest lands of South Kalkie, Clayton, and Gooburrum; and in most of the cases which have come under the writer's notice, success has rewarded their efforts. The few cases where difficulty has been encountered have probably been due to unsuitable spears or failure to lodge the spears in the proper drift, but in no case has the water been unsatisfactory. It is the purpose of this article, however, to discuss the subterranean supplies of the Woongarra lands, as here the problem is a particular one, and one about which divided opinions are held by local growers. Space will not be taken up by discussing the suitability of the red volcanic soils for irrigation. This has been definitely proved, if proof were needed, by the few plantations and farms on which irrigation plants have already been installed. Rather is it proposed to show the suitability of most of our waters for irrigation.

As far back as 1905 Dr. Maxwell, then Director of Sugar Experiment Stations, carried out a water survey of the Woongarra area with a similar object in view. His report of 1906 contains some valuable and surprising figures in the light of the fact that the general current opinion regarding the underground water supplies is that they are not fitted for irrigation purposes. Tabulated in his report are the following figures:—

No. of Waters.	Total Solids, Grains per Gallon.	Salt, Grains per Gallon.
	From—	From—
6	1 to 10	2 to 6
52	11 to 20	3 to 14
46	21 to 30	3 to 28
17	31 to 40	9 to 32
11	41 to 50	14 to 28
8	51 to 60	22 to 40
2	61 to 70	24 to 32
9	71 to 80	29 to 51
3	81 to 90	33 to 43
8	91 to 100	43 to 61
20	101 to 150	40 to 85
4	151 to 200	86 to 120
2	201 to 250	107 to 133
1	251 to 300	145
1	301 to 350	194
1	351 to 400	229
1	401 to 450	242
1	550 to 600	462
1	650 to 700	427

* Reprinted from the "Cane Growers' Quarterly" by courtesy of Dr. Kerr, Director, Bureau of Sugar Experiment Stations.

From the above 194 samples from wells on the Woongarra, 182 are considered suitable for irrigation *on the Woongarra soils.* Reasons are given below for this belief. It must be remembered that in 1905 the quality of these waters was probably as low as it had ever been, as four droughts had been experienced in the previous five years. Unfortunately we cannot accept the above tabulated figures on their face value. These wells, probably sunk for domestic or stock purposes, were in many cases shallow wells tapping only surface water. Similarly one cannot be certain that, if subjected to severe pumping test, the quality of the water would not change, becoming more or less saline. Another objection is that unless tested with a pump over a fair period, no idea of the amount of water available for irrigation could be obtained.

In 1933 the writer was instructed to carry out a similar survey of the then existing wells. A considerable amount of work resulted in a similar unsatisfactory position. From farm to neighbouring farm well waters varied from excellent to very saline, but in most cases, as above, the wells were sunk purely for domestic supplies, and not with a view to large water output. Consequently most wells were shallow—less than 50 feet—and the greatest pumping strain exerted was that of a windmill. No conclusive data can be obtained from the analysis of such samples. A shallow well may give excellent quality water, but a poor supply. The deepening of such a well to increase the output has resulted on occasion in tapping a deeper supply of lower quality. Experience of the necessity for carrying out a pumping test before installing a pumping plant was gained on the Experiment Station in 1934. The well on the Experiment Station has long been known for the excellence of the water quality—3 grains of salt per gallon—and its ability to stand up to continued pumping during droughts. For many years a windmill was the sole test of the well. Some years ago an engine and pump-jack were installed, pumping approximately 900 gallons per hour, and in 1934 this was replaced by a small centrifugal pump delivering 2,000 gallons per hour. Neither of these small pumps made any appreciable impression on the water level in the well. As the well is only some 42 feet deep the performance was considered a good one. In 1934 we investigated the possibilities of irrigation, and a 3-inch pump was installed temporarily on the well. It succeeded in emptying the well containing its usual 20 feet of water in approximately half an-hour. It could be calculated from the speed of drop of the water, and the rapidity of filling after stopping the pump that the limit of the well would be some four to five thousand gallons per hour.

The above and other cases which have been investigated exemplify the impossibility of calculating the water capacity of a well without actual pumping data. In the above case a bore was put down at the bottom of the well to a total depth of 170 feet without encountering a water-bearing stratum. On another site on the station a bore was sunk to 140 feet, and the only water found was a surface supply between 15 and 45 feet. With four of these bores we were able to obtain a supply approximating to 9,000 gallons per hour. This one instance is sufficient to show that underground water in large amounts cannot be obtained everywhere on the Woongarra. A popular statement is that water can be obtained anywhere if one goes deeply enough for it. Possibly true, but the problem and cost of lifting it must be considered.

It was mentioned above that 182 of the samples of water obtained were suitable for irrigation *on the Woongarra lands.* By this is meant that although suitable here the same waters may not be harmless on sandier soil types. Due to recent developments in soil science and greater knowledge now current on soils and irrigation, waters considered unsuitable for irrigation twenty years ago are now frequently recommended. Not only the water but the soil type must be considered in interpreting water analyses.

During 1933 the well water at Qunaba was investigated insofar as its effect on the Qunaba volcanic soils was concerned. It was desired to find out whether ill effects were likely to accrue from using a water containing 121 grains of total solids, with 89 grains of salt per gallon, on the Qunaba soils. It was already manifest that the water would produce an excellent crop, but the effects of the continued use of it over a number of years were problematical. A detailed analysis of the water was as follows:—

	Grains per gallon.
Chlorides (calculated as common salt)	88·8
Total hardness (calculated as lime carbonate) ..	49·7
Total solids	121·6
Detailed analysis:—	
Chloride	53
Bicarbonate	18
Sulphate	12
Silica	3
Calcium (lime)	6
Magnesium	9
Sodium	20
Potassium	0·35
Total	121·35

It will be observed that the concentration of magnesium salts exceeds that of the lime salts. There was the remote possibility that a concentration of magnesium in the soil may prove detrimental to plant growth. The following test was applied:—A two-foot column of the soil was taken and subjected in the laboratory to leaching with Qunaba water—the equivalent of 20 acre-inches of water being used. This would be comparable with 4 five-inch irrigations. A similar column of soil obtained at the same time was not treated with the water. Both of these samples were taken after irrigation had been carried out with the Qunaba water for five months. Later, after the April, 1933, rains, which aggregated some eight inches, a further sample was taken from the same site to observe the effect of rain in washing out any accumulated salts. The fourth soil sample was taken from a non-cultivated adjacent area which received no irrigation water.

Soil.	pH (Measure of Acidity).		Available Bases as M.E. per 100 Gms.				Available Phosphate p.p.m.	Lime Carbonate %	Chlorine %
	In Water.	In KCl Soln.	Ca (Lime).	Mg (Magnesia).	K (Potash).	Na (Soda).			
No. 1 soil irrigated for 5 months and sampled following a 5″ application	8·27	7·74	32·9	13·1	·43	1·05	481	·32	·03
No. 2 identical with No. 1 but leached in laboratory with further 20″ of water	8·30	7·76	33·3	12·5	·35	1·20	540	·24	·03
No. 3. As No. 1 but sampled after April rains	8·19	7·56	20·8	10·5	·35	1·20	206	·21	·02
No. 4. Non irrigated soil	8·20	7·36	13·8	5·9	·16	·59	169	·03	·006

There is no evidence here of serious accumulation of salt. There is a slight increase in sodium, but so slight as to be almost insignificant. On the figures obtained there appears to be no reason why this water should not be used for crop production on these soils.

It must not be assumed, however, that similar remarks apply to other soil types. On the general run of the Bundaberg forest lands, the subterranean water is of good quality—less than 10 grains of salt per gallon—but it sometimes occurs, on farms near tidal rivers, that the underground water is more saline. In any case outside the red volcanic soils, where only average quality water is procurable, advice should be obtained before continued use for irrigation is practised.

The statement that water unsuitable for washing (that is, which will not lather freely with soap) is unfitted for irrigation is quite incorrect. Many waters contain lime in solution and these certainly could not be used for washing; yet the lime would have a beneficial rather than a deleterious effect on most soils.

"Humus"—What is It?

N. J. KING.*

THROUGHOUT the literature of agriculture from all parts of the world the word "humus" is conspicuous. In seeking a definition we find that "humus" is described as "the somewhat indefinite nitrogenous and carbonaceous material resulting from the decay of plants." When plant remains are added to the soil some of the constituents tend to undergo rapid decomposition. This decomposition is the result of the microscopic population of the soil, which utilizes the material as food. The speed of the decomposition depends on the nature of the plant residues and on the type of soil. Other factors such as temperature and moisture greatly influence the rotting-down of the material also.

The partially decomposed material forms a vague and indefinite group of substances to which has been given the name "humus." It has important physical effects on the soil and possesses a number of properties not usually shown by undecomposed plant residues.

Firstly it causes the soil to become "puffed up," and so leads to an increase in the pore space in the soil. This results in a marked improvement in tilth and general physical condition; secondly, it increases the moisture-holding capacity of the soil, since humus has an enormous capacity for absorbing water as compared with the soil minerals; thirdly, although humus is essentially transitional, it has a certain degree of permanency and only slowly disappears from the soil. It disappears more rapidly in tropical than in temperate regions, and more quickly in sandy soils than in loams and clays; finally, humus is rich in nitrogen, which is now universally acknowledged by farmers as an essential factor in cane growth.

In certain European countries where intensive farming is necessary, the utilization of farmyard manure is the general rule, but the production of soil humus by this means on cane farms could not, for obvious reasons, be considered. The canegrower, therefore, grows green crops to be ploughed in, and in some cases utilizes plant residues in the form of cane trash in an attempt to improve his soil. The value of these practices may be considered as follows:—

It will be readily admitted that an improvement in soil tilth is always desirable, and that an increase in moisture-holding capacity would be welcomed on all except the badly-drained farms. Likewise a supply of nitrogen per medium of humus would constitute a saving in fertilizer outlay. If these three objects can be gained by increasing the humus content of the soil, then the end justifies the means employed. In the growing of a green manure crop (Poona pea, Mauritius bean, cowpea, &c.) advantage is taken of the fact that these crops belong to a certain class of plants known as legumes. Legumes have the property of being able to assimilate nitrogen from the atmosphere through the co-operation of bacteria which make their home in the nodules on the plant roots. It is recognised, therefore, that such plants when ploughed in are enriching the soil with so much nitrogen which they have taken from the air. This property is not possessed by sugar-cane, maize, sorghum, and other plants, which return to the soil only such nitrogen as they have taken from it.

A good crop of Poona pea will produce 15 tons of green matter to the acre, and the ploughing in of this mass of material must, when

* Reprinted from the "Cane Growers' Quarterly" by courtesy of the Director, Bureau of Sugar Experiment Stations.

rotted, undoubtedly improve the mechanical condition of the soil. The amount of nitrogen thus added to the soil would be equivalent to approximately 700 lb. of sulphate of ammonia to the acre. The ploughing in of a 15-ton crop of maize would apparently have the same effect on the soil tilth, but other factors operate against it. The prime requirement for rapid and complete decomposition of a green crop—apart from temperature and moisture—is a good nitrogen supply. Decomposition proceeds by means of bacteria and fungi, and a balanced food supply of nitrogen and carbonaceous material is essential for the working of these microscopic labourers. In the case of Poona pea and other legumes the balanced ration is present, but with other crops or a body of trash the nitrogen supply is too low, and the rate of decomposition is retarded. There are two methods of speeding up the rotting of trash—(1) To sow a green manure crop (such as Poona pea) as soon as the trash is ploughed in. This, when ploughed in, in turn, will supply the nitrogen for the rotting of the trash as well as itself; (2) to broadcast sulphate of ammonia on the trash before ploughing in, and thus ensure the necessary food for the bacteria. The method adopted will, of course, be decided by the particular farm or plantation practice.

No doubt many farmers have seen the result of ploughing in trash with no subsequent attempt to supply nitrogen to the soil for decomposition. The writer has observed cases where trash has remained unrotted for twelve months after turning in, only because no green crop was grown, to be ploughed under and assist in the process.

The effect on numbers of soil micro-organisms of ploughing in plant residues is shown by the following figures. Recently one of the Bureau pathologists carried out an investigation on a block on the Bundaberg Experiment Station which is being used as a trash experiment. One portion of the block has been farmed according to standard practice, while the other portion has had all trash ploughed in since 1932. The decomposition of the 1935 trash and the subsequent Poona pea crop were practically complete when the counts were made.

—	Bacteria and Actinomyces.	Fungi.
Trash Plot	108,120,000	2,400,000
No Trash Plot	14,530,000	550,000

These figures are per gram of soil.

It should always be kept in mind that humus affords energy to numerous micro-organisms, and is gradually converted by them into simple substances appropriate for plant nutrition. We may look upon its constituents as taking part in a perpetual cycle—in one stage nourishing the growing plant and storing up the energy of sunlight; in the other stage nourishing micro-organisms and liberating energy and plant foods.

Sometimes humus is lost, sometimes worn out, and at other times destroyed. Rains and floods will often wash humus away from hillsides. Micro-organisms will use it up in the process of making soluble compounds, and it is destroyed by oxidation and by fires. Any intensive method of cultivation increases oxidation, thereby reducing the humus content unless provision is made to replenish the supply by ploughing in more green crops or trash.

Temperature is a very important factor in humus formation and destruction. Humus will be formed wherever conditions of temperature and moisture allow the growth of crops and the survival of micro-organisms in the soil; and humus will be destroyed by micro-organisms under exactly the same conditions. But as the destruction of organic matter is relatively proportional to the temperature we find that two zones can be classified—(1) In which humus will accumulate: here the conditions are more favourable to formation than to destruction, and the temperatures vary between zero and 77 degrees F.; (2) in which humus is destroyed more rapidly than it is formed (assuming that adequate air and moisture are available). This occurs at temperatures above 77 degrees F. This is shown diagrammatically in Plate 112. Here

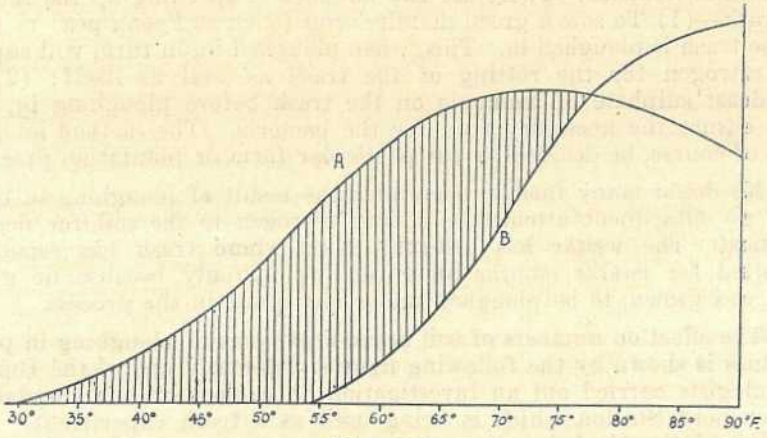


Plate 112.

Curves showing the relationship between temperature and (A) rate of humus accumulation, and (B) rate of humus decomposition. It will be noted that temperatures experienced in the Queensland cane areas lie on those portions of the curve where rates of decomposition are high.

the base line records temperature, and the perpendicular line represents humus formation or loss. The curved line A represents humus formation at different temperatures, and the line B shows humus destruction. The shaded area is therefore the zone of humus accumulation, wherein humus is formed more rapidly than it is destroyed.

The following question is often asked by farmers on the red volcanic soils. Since we already have good tilth, and can supply nitrogen conveniently from a bag of sulphate of ammonia, why go to all this trouble to provide humus? Apart from the argument of increasing the moisture-holding cacapity of the soil, the following convincing reason may be given:—Recent work in the Brisbane laboratories of the Bureau has shown that the addition of trash to three of Queensland's major cane-producing soil types has resulted after twelve months decomposition in large increases in the amounts of available plant foods in the soil. The process of decomposition of organic matter has evidently a weathering effect on the soil particles, thus transforming insoluble compounds into an available form. An extremely important feature of this same work is that the trash treatment of the soil decreased the soil acidity, thus disproving the popular theory that organic matter would make the soil more acid.

Sheep-breeding.

JAS. CAREW, Senior Instructor in Sheep and Wool.

SHEEP-BREEDING in Queensland is confined almost entirely to the Merino for the purpose of producing wool. The enormous area of country over which sheep are run embraces such a wide range of conditions, soil, and climate, which influence the growth and variety of grasses, shrubs, herbage, and edible trees, that it can be fully appreciated that all Queensland sheep country is not suitable for sheep-breeding, apart, of course, from ordinary flock maintenance and increase. Many breeders scattered over an area extending from the New South Wales border to the north-western portion of Queensland are, however, now breeding good quality flock rams, both for their own use and for sale, while some of these breeders are coming into prominence through their establishment of special stud flocks. Large numbers of rams are introduced from New South Wales chiefly, and their influence in improving the type here is well known and appreciated.

This improvement, together with the influence exercised by local success on the minds of sheep breeders, has inspired a confidence which is resulting in a tendency to improve the type and standard of present flocks. The introduction of high-quality stock is always an advantage if they are of the proper type and suitable to the conditions under which they are to live. It is not the introduction of fresh blood that counts for improvement, unless it is of the correct strain and type which possesses the power of prepotency, that is, the power possessed by some animals of stamping their characteristics on their progeny. When a sire of high quality of the desired type is found to possess this power of dominance or prepotency his value should be fully appreciated. It is only the keen and attentive sheep breeder who detects the desired quality in young sheep who will be able to trace these special features to the sire. When commencing on flock improvement the ideal should be pictured in the mind's eye. Obtain a sire of the desired type, and select ewes that should be suitable. If the progeny are true to type, see that the standard is maintained by breeding on correct lines. In order that the pedigree of prominent strains may be watched, flock

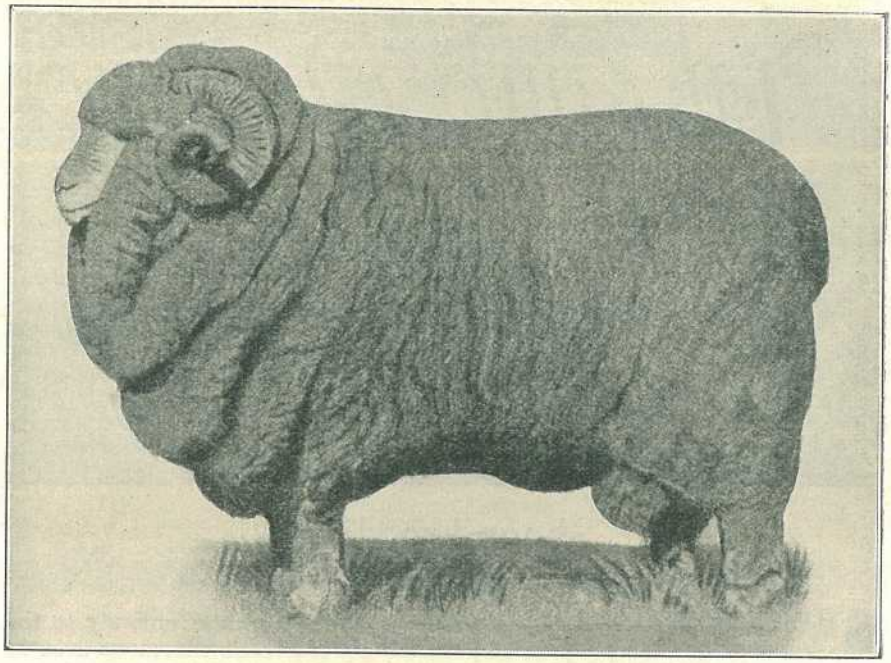


Plate 113.
A Good Type of present-day Australian Merino Ram.

books are necessary. Feeding, local conditions, and environment have also an important influence on successful sheep-breeding.

In Queensland the normally dry late autumn, winter, and early spring, with the consequential shortage of suitable green feed is a serious handicap in some districts. A supplementary ration, rich in protein, will be a decided advantage in times of hard, dry feed and scarcity.

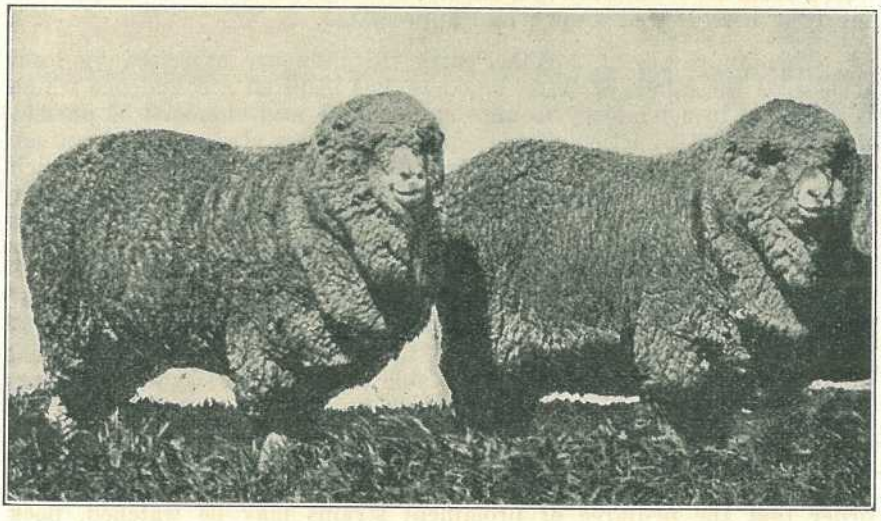


Plate 114.
Merino Ewes.

A Pasture Improvement Programme.

C. W. WINDERS, B.Sc.Agr., Assistant Agrostologist.

DURING the period of conversion of holdings from the virgin state into grazing farms, pioneering conditions necessarily prevail, and settlers with limited capital are obliged to direct their energies to the most urgent requirements, such as clearing and sowing grasses that become established quickly. Most districts have now passed out of the pioneering stage, however, and landholders in such districts are wisely devoting more attention to pasture management and pasture improvement.

There are three distinct angles from which the problem of producing better pasturage may be approached, namely:—

(1) Better use of existing pastures;

(2) Improvement of existing pastures by renovation and topdressing;

(3) Laying down of superior pasture mixtures.

In order that the best possible use may be made of the better-class grazing areas on any farm, it is essential that the pastures be divided into fairly small paddocks. Every farmer knows how the production of his herd rises when the fresh bite is substituted for rank-growing grass. By having a number of small paddocks which can be grazed in rotation the dairy farmer is assured, at all times during the growing season, of having fresh young grass available for his stock. So important is subdivision, that the erection of fences is recommended as the first step in pasture improvement.

Renovation and topdressing of existing pastures, particularly of old stands, offer other means of increasing production of pastures which are not yielding as heavily as they should. Renovation by means of ploughing or drastic harrowing with special implements corrects the sodbound condition of the grasses and improves the soil conditions. The net result is a fresh lease of life for the pasture. In situations where

crops can be grown, a more effective means of maintaining high producing pastures than periodical renovation is to treat pasture as a unit in a crop rotation, allowing one or two seasons for crops between four-five year stands of pasture.

Although adverse weather very often prevents the full benefit of fertilizer applications from being realised, many dairy farmers and graziers have used pasture fertilizers with encouraging results. Most of our coastal grazing country is deficient in lime, and applications of 1 ton and upwards of agricultural lime per acre have produced a marked improvement in the pasture. Superphosphate and sulphate of ammonia are the two fertilizers used most commonly for pasture topdressing. Usually, it is necessary to renovate a pasture by mechanical treatment before efficient topdressing can be carried out.

On a great number of properties the best of the proven general purpose grasses are well established, but each has its limitations and information is every day being sought regarding pastures for special purposes or for special situations. There is an increasing demand for advice concerning winter pastures. Numerous grasses and clovers have been proved to be useful for winter grazing purposes, and recommendations for various districts are obtainable from the Department of Agriculture and Stock, Brisbane. Farmers desirous of sowing winter pastures for the 1937 season are advised to seek advice at an early date, in order that they may proceed with the preparation of land for sowing.

QUEENSLAND SHOW DATES FOR 1937.

April.

Oakey	7th and 8th
Toowoomba Royal	12th to 15th
Dalby	21st and 22nd

May.

Longreach	3rd to 6th
Beaudesert—	
Show	5th and 6th
Bushmen's Carnival	7th and 8th
Wallumbilla	6th and 7th
Nanango	6th and 7th
Dirranbandi	6th to 8th
Ipswich	11th to 14th
Wowan—	
Show	11th and 12th
Rodeo	13th
Crow's Nest	12th and 13th
Biggenden	20th and 21st
Gympie	20th to 22nd
Warrill View	22nd
Kilkivan	24th and 25th
Maryborough	25th to 27th
Charleville	25th to 27th
Maryborough	25th to 27th
Gin Gin	28th and 29th
Toogoolawah	28th and 29th
Kalbar	29th
Childers	31st May and 1st June

June.

Bundaberg	3rd to 5th
Lowood	4th and 5th
Boonah	9th and 10th
Gladstone	9th and 10th
Rockhampton	22nd to 26th
Marburg	18th and 19th
Mackay	28th June to 1st July

July.

Bowen	7th and 8th
Ayr	9th and 10th
Rosewood	9th and 10th
Cleveland	9th and 10th
Townsville	13th to 15th
Nambour—	
Show	15th and 16th
Campdraft	17th
Esk	16th and 17th
Charters Towers	20th and 21st
Laidley	21st and 22nd
Cairns	27th and 28th
Gatton	28th and 29th
Caboolture	30th and 31st
Maleny	22nd and 23rd

August.

Royal National, Brisbane	16th to 21st

September.

Imbil	3rd and 4th
Rocklea	11th
Innisfail	17th and 18th

Poultry Notes.

INCREASE EGG VALUES.

P. RUMBALL, Poultry Expert.

THE well-fed hen produces an egg of maximum food value, and it rests with the farmer to maintain this quality in order to obtain the maximum money value.

Quality and size govern price, quality being the more important. The lack of size is something easily determined, and by using for breeding only birds that lay large eggs, small eggs can almost be eliminated from the market.

To-day eggs of first quality are being retailed at 1s. 3d. to 1s. 4d. per dozen, and in the same street eggs of a similar size may be obtained for 8½d. per dozen. Why the difference? It is due to the internal and to some extent the external quality of the egg. The difference in price is so marked that the average consumer must wonder why, and, to some extent, look with suspicion on the cheaper article. But what of the producer responsible? Does he realise that he is losing at least 6d. per dozen on all the eggs that are sold at 8½d.? His loss is sufficient to pay for all the feed that the birds would consume to produce the better quality eggs; or, to put it in other words, he is going to all the trouble of caring for fowls, carting eggs to market, and incurring other costs without making a profit of one penny piece. Not only is this the case, but he is doing it to the detriment of the man who gives his eggs the necessary attention to maintain market quality, and who has to make his fowls keep him.

Cleanliness of shell is the first essential for the satisfactory marketing of eggs. There is only one degree of cleanliness, although there are several degrees of dirtiness. Cleanliness can be maintained by providing the stock with nests in which clean litter or nesting material is kept, and by gathering the eggs at least twice a day.

Water is usually used for cleaning. It should be changed from time to time, and the cloth used rinsed at frequent intervals. Before the eggs are packed they should be dried off thoroughly to prevent deterioration. Packing should be done in cases and fillers, as the use of materials, such as chaff, &c., soils the eggs; there is also the risk of infection of the egg content by moulds. This infection gains entrance through the pores of the shell.

At the bottom and top of the case, pads of wood-wool or other suitable material should be placed to act as a cushion. Exceptionally large eggs should always be packed on the top layer to avoid breakages, and if petrol cases are used only five layers packed per case.

As the quality of an egg deteriorates with age, frequent despatch to market is essential to secure the highest values. During summer, eggs should be railed twice weekly, and during winter at least once weekly.

Pending despatch, eggs should be stored in a cool place, free from odours, for taints are readily absorbed by the egg.

Many poultry farmers may not have a sufficient quantity to forward case lots twice weekly. To them, it is suggested that consideration be given to the possibility of combining with neighbouring farmers who are in a similar position.

The increased returns that will follow as the result of a little care bestowed on the egg to maintain quality will repay any farmer.

A New Type of Irrigation Sprinkler.

H. W. KERR.*

RECENTLY an interesting type of irrigation sprinkler was imported from England for experimental purposes. It was supplied in response to our demand for a simple and effective spray which would give a wide coverage, and therefore necessitate a small number of units per acre. The essential features of the sprinkler are shown in the accompanying illustration (Plate 115).

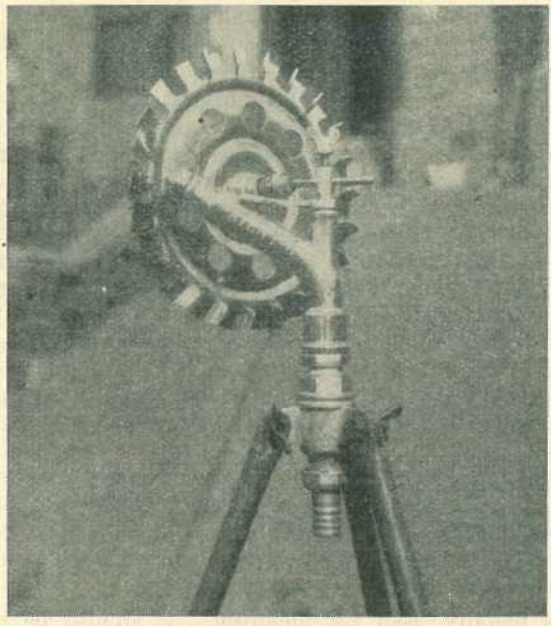


Plate 115.

Illustrating the essentials of the sprinkler head. It is mounted for convenience on a tripod with 5-foot legs.

The water is delivered to the sprinkler through a standard hose connection, and it is ejected through a nozzle set at an angle of approximately 45 degrees. A selection of nozzles is supplied with the unit, enabling one to employ that most suited to the volume and pressure of water available. The device by which the water spread is secured is simple and ingenious. The jet from the nozzle impinges on a wheel, the periphery of which is slotted. The force of the water causes the wheel to revolve, and the small fins break up the stream into drops of greater or less dimensions. A few of the fins are turned in such a manner as to offer a direct obstruction to the water flow, and the intermittent impulses caused by these gives the entire head a slow revolving action. Nozzle and wheel are thus carried through a complete circle in a period of from one to two minutes.

The manufacturers claim that the sprinkler will operate at pressures ranging from 10 to 100 lb., while a coverage of ½ acre is possible under the best conditions. The application of water ranges from 5 to 28 gallons per minute. depending on the pressure

* Reprinted from the "Cane Growers' Quarterly" by courtesy of Dr. Kerr, Director, Bureau of Sugar Experiment Stations.

available and the size of jet employed. The coverage is likewise adjustable by these means. The model under trial was supplied for a ¾ inch hose connection, and the nozzles were from $\frac{5}{32}$ inch to $\frac{13}{32}$ inch diameter. This unit will irrigate ¼ acre. The larger model, with 1½ inch hose connection, is intended for use with water pressures of 55 lb. or more. The nozzle sizes are from $\frac{7}{16}$ inch to $\frac{21}{32}$ inch diameter. This unit will deliver from 30 to 70 gallons of water per minute, and gives a coverage of from ¼ to ½ acre.

The price of the sprinkler is listed as £3, in England, and at this cost it should be of interest to many of our canegrowers. Though it suffers all the drawbacks previously outlined for spray irrigation, there are certain uses to which it might be put on the cane farm. As a means of irrigating the kitchen vegetable patch or a small block of horse feed, on a relatively low pressure, it should prove ideal, while to the grower who wishes to exploit intermittent irrigation on young cane, to help it through a dry spell when necessary, the sprinkler is strongly recommended. In this connection it should have a very definite value where the canegrower could provide water in a channel adjacent to the cane block; from this it could be taken up by a portable engine and small pump, and driven through two or three of these units suitably placed in the field of young cane. The advantage it offers, particularly where the water supply is limited, is its ability to enable a 1-inch watering to be applied uniformly and rapidly. On the average values given above for the large, high-pressure unit, 1 acre-inch could be applied to ⅓ acre, by one unit, in the course of two and a-half hours.

AGRICULTURE ON THE AIR.

RADIO LECTURES ON RURAL SUBJECTS.

Arrangements have been completed with the Australian Broadcasting Commission for the regular delivery of further radio lectures from Station 4QG, Brisbane, by Officers of the Department of Agriculture and Stock.

On Friday of each week a fifteen minutes' talk, commencing at 12.45 p.m., will be given on subjects of especial interest to farmers.

Following is the list of lectures until the 30th April, 1937.

SCHEDULE OF LECTURES.

BY OFFICERS OF THE DEPARTMENT OF AGRICULTURE AND STOCK, RADIO STATION 4QG, BRISBANE (AUSTRALIAN BROADCASTING COMMISSION).

Friday, 12th March, 1937—"Plant Nutrition," by E. H. Gurney, Agricultural Chemist.

Friday, 19th March, 1937—"Sheep Management under the Varying Conditions in Queensland," by Jas. Carew, Senior Instructor in Sheep and Wool.

Friday, 26th March, 1937—"The Care of the Flock," by Jas. Carew, Senior Instructor in Sheep and Wool.

Friday, 2nd April, 1937—"Winter Pastures," by C. W. Winders, Assistant (Agronomy).

Friday, 9th April, 1937—"Pork Products as Regular Items on the Menu," by E. J. Shelton, Senior Instructor in Pig Raising.

Friday, 16th April, 1937—"Some Poultry Farmers' Problems. What to Breed and How to Breed," by J. J. McLachlan, Poultry Inspector.

Friday, 23rd April, 1937—"Strawberry Planting and Other Seasonal Fruit Hints," by H. Barnes, Director of Fruit Culture.

Friday, 30th April, 1937—"Wheat Improvement in Queensland," by R. E. Soutter, Agricultural Research Officer.

Identification of Rats Damaging Cane in Queensland Canefields.

W. A. McDOUGALL.*

DURING the many years prior to 1934 when rats damaged cane in Queensland, they were never referred to under any name but the common collective one of "rats." Undoubtedly, this name fully serves its purpose in several ways, but to those seriously interested in attempting to control these pests it is not sufficient.

The amount of research work done on any pest usually bears some relationship to the losses caused by the pest. This is well illustrated by happenings in the Herbert River cane areas during the past two years. There in 1933 and 1934, exceptionally heavy rat damage to cane was experienced. Control measures were applied, but a further result of these heavy infestations was that work was commenced by local mill and pest board officers to find out something of the habits, &c., of the particular rats with which they were dealing—i.e., of the rats which were found to be pests of cane. At an early stage the different kinds of rats were separated and were submitted for identification to competent authorities. Three species were found to be of interest to the cane farmer—viz., *Rattus rattus, Rattus culmorum,* and *Melomys littoralis.*

Unfortunately, at the present time, very little is definitely known about rat species in Queensland cane districts, other than the Herbert River, and knowledge of the wider distribution of some of the important species occurring there is very scant.

Rattus rattus (the House Rat) is a world-wide species but, as far as is known, it is not a very serious cane pest in Queensland. *Rattus norvegicus,* the species which is considered as being of considerable importance as a pest of cane in Hawaii, has not been reported, as yet, as damaging cane in Queensland, although it is present in cities of the State. The known locality records of *M. littoralis* are Cairns, Ingham, Innisfail, and Ayr. Specimens of *R. culmorum* have been identified from Ingham, Ayr, the Innisfail district, and from the Habana area of Mackay (November, 1935). At the present time this last-mentioned species, which is native to the country, is considered to be of the most importance to Queensland cane farmers. Under such circumstances it is very desirable that as much as possible should be known about its distribution, habits and characteristics, and the farmer should be able to distinguish it from other rats. As an aid towards these ends the following brief descriptions of some of the rats which may be found in cane in Queensland are set out below, together with the correct method for forwarding rat specimens to any of the Sugar Experiment Stations. Farmers are requested to do this as it will be of considerable help in increasing our knowledge of rats and their distribution in Queensland cane areas. Some species of the coast areas of Queensland had not been recorded since first found and described many years ago. Rats from both canefields and outside country are desired; if taken from canefields it is suggested that the specimens should be taken from spots not in close proximity to buildings.

* Reprinted from the "Cane Growers' Quarterly," by courtesy of Dr. Kerr, Director, Bureau of Sugar Experiment Stations.

Rattus rattus (the House Rat).

The total length of the head and body of a full-grown adult of this species is about 8 inches. Its colour is very variable. The fur is fairly soft but sparse and the lack of thick under-fur gives the coat,

Plate 116.
Tree-rat nest in Pandanus.

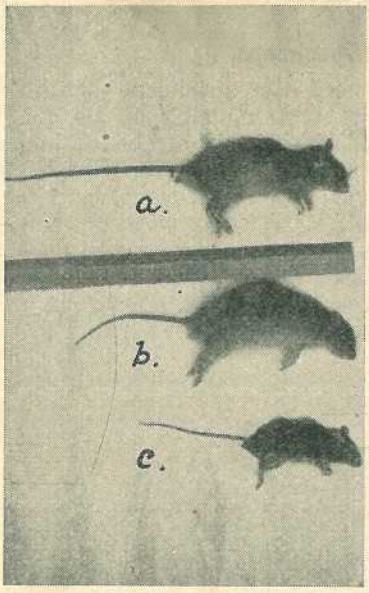


Plate 117.
(*a*) House rat (*Rattus rattus*).
(*b*) Field rat (*Rattus culmorum*).
(*c*) Tree rat (*Melomys littoralis*).

Plate 118.
Typical field rat burrow entrance under a cane stool.

[*Photos. after Gard.*

as a whole, a somewhat thin, harsh quality. The ears are large, almost free of hair, and leafy in appearance. This species can be distinguished from the others by its extremely long, slender tail which, when held

back over the body, reaches an inch or more beyond the tip of the rather sharp nose. Although known as the "ship" and "house" rat it is also found in the bush.

Rattus culmorum (the Coarse-haired or Spiny-haired Rat).

In the Herbert River district this species is called the Field Rat. It is usually smaller than the House Rat and the fur is much denser but rather coarse, and the presence of more or less numerous flattened spines gives the coat a harsh touch and appearance. The general colour, although variable, is dark-brownish flecked with lighter buff-brown. The sides are greyer and the belly is duff-white, often with a tinge of yellow, but never pure white as in some individuals of *Rattus rattus*. The muzzle is not as pointed as in the House Rat. The ears are short and practically naked. The tail when held back over the body reaches to about the shoulders.

Melomys littoralis.

This rat is called the "Tree," "Fruit," "Banana," or "Khaki" rat by farmers in the Herbert River mill areas. The last-named is a reasonably fair indication of its colour. In size it is much smaller and it is softer haired than the three *Rattus* species previously mentioned. It differs from them also in the number of teats; instead of 10-12 the female possesses 4 only. The main character of the genus Melomys is the almost naked tail with its patterned instead of ringed scales.

Preparation of Rat Specimens.

If "break-back" traps are being used the specimen should be collected as early as possible during the first morning of its death. Before it is placed in undiluted methylated spirits a slit of about 2 inches should be made along the centre of the belly of the dead rat. Specimens should not be crowded into receptacles (preferably air-tight) and they should be well covered with the preservative. After a week or more—i.e., when the flesh is well hardened—the specimens may be wrapped in some material, such as cotton wool or rags which will absorb spirits. Then the specimens, with wrapping well saturated with spirits, may be packed in leakless tins or other suitable containers for forwarding to the desired destination.

TREES ON THE FARM.

When a selector first obtains his license to occupy his newly acquired selection, his first objective is to fall the scrub, grass the land, and so make it revenue-producing as soon as possible. A commendable idea, but in his enthusiasm, the selector very often overlooks the fact that his stock will require shade in the summer and protection from cold winds in the winter. If every tree on the selection is cut down, neither shade nor shelter is available. As the summer approaches, cattle and horses look for shade, and in winter they seek shelter from the cold winds, but as the farmer has omitted to leave any trees standing, the cattle do a "perisher." As a consequence, the milk yield diminishes considerably and the cattle lose condition.

When clearing new land, it is always wise to leave a small patch of scrub standing here and there. If a complete clearance of timber has been made the advisability of planting a few weeping fig trees or other good shade trees on the farm shoud be considered. In ten years' time they will be quite big trees giving cool and ample shade to stock when summer comes. The planting of a few well-known timber trees in forest formation is also worthy of consideration.

Pineapple Disease.

A CAUSE OF POOR GERMINATION IN CANE.

A. F. BELL.

PINEAPPLE disease has not frequently been reported in Queensland, but particular attention was drawn to it some four months ago when it was an important factor contributing to the almost complete failure in germination of a sixty-acre planting in the Lower Burdekin district. It is possible that pineapple disease is responsible for considerably more bad strikes than are attributed to it; accordingly the symptoms

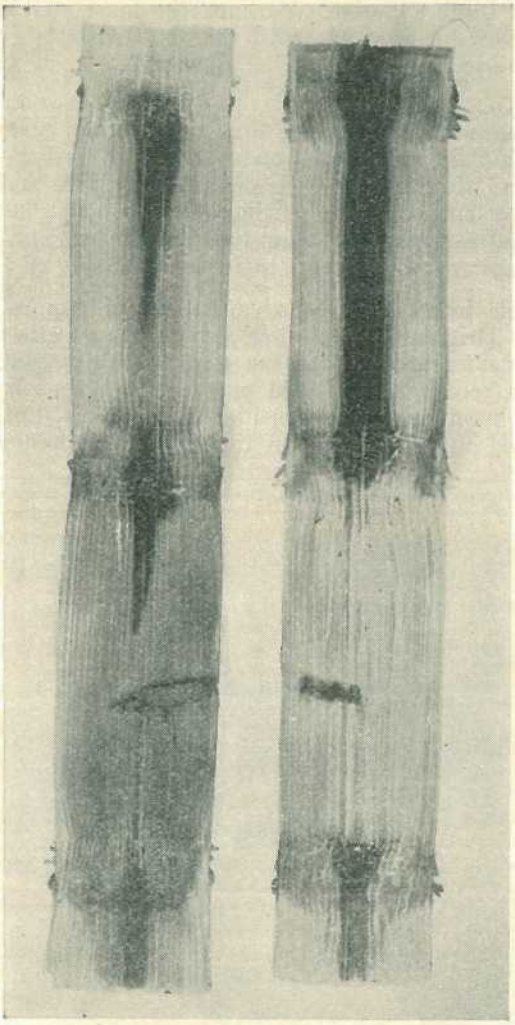


Plate 119.

A B

Pineapple disease of sugar cane produced by inoculation of setts. The lower part of A shows the general reddish discoloration of the flesh caused by the disease, while in B may be seen a good example of the sooty black core characteristic of later stages.

are described and illustrated here in order that the disease may be recognised and reported to our field officers when it occurs.

Pineapple disease is caused by a fungus which also causes the water blister of pineapples, while a similar fungus attacks the banana. At times standing cane may be attacked, but for the most part it is a disease of cane setts which becomes infected after they have been cut. The first symptom which can be seen is a light-red discoloration of the internal tissues or "flesh" of the cane (see Plate 119, A). Later, usually commencing at the cut surfaces, the colour changes to black, due to the production of the spores or "seeds" of the fungus. This black colour frequently extends into the inner joints in the form of a sooty core (see Plate 119, B). Perhaps the most striking symptom is the fact that when cut open many of the diseased setts give off a fruity odour very similar to that of a ripe pineapple.

Once the fungus has invaded the cane sett it soon penetrates to the buds and causes them to rot, thus prohibiting germination. Any condition which delays germination will tend to allow the fungus to enter and spread through the sett, destroy the eyes, and so ultimately prevent germination. Planting during weather which is too cool or too dry for a rapid strike, or placng too heavy cover on the setts, are among the conditions which tend to favour damage by this disease.

Considerable losses have been caused by pineapple disease, particularly in the British West Indies, where cane setts are sometimes soaked in Bordeaux mixture before planting as a means of control. Owing to its infrequently reported presence in Queensland, no control measures have heretofore been considered necessary, but investigations are being carried out at the present time in the pathology laboratory.

Plate 120.

THE ROAD MAKERS.—Wambo Shire: Darling Downs-Burnett Highway (Malakoff Road)—Cement penetration, flood section under construction.

COTTON.

THE rainfall experienced during the month in all of the cotton-growing districts, save in the south-eastern parts, has been of sufficient amounts to promote very satisfactory growth of the cotton plants. The earlier plantings are carrying good crops of well-developed bolls, and in some areas picking was in progress at the end of February. Given sufficient rainfall of moderate intensity during early March, it would appear that many growers will have excellent prospects of producing satisfactory yields.

The splendid progress that is being made by most of the cotton crops in all districts, save the south-eastern ones, where very limited rainfall has retarded development, indicates the ability of the cotton plant to produce satisfactorily under climatic conditions unfavourable for most other crops that can be grown economically in this State. Although appreciably delayed planting of the cotton areas was the general experience of most farmers this spring, and such adverse conditions ruled during the early summer as to seriously affect most farm crops, cotton has progressed very satisfactorily except in the outstandingly distressed areas, and the yields produced will contribute an appreciable portion of the returns that many farmers will obtain this season. Undoubtedly cotton-growing should occupy an important position in the crop rotation practised by many farmers of the main agricultural districts of this State.

SUGAR.

In all cane areas from Mackay northwards growing conditions in the cane areas during the month of February were generally favourable. However, no heavy rains had been received in the far northern districts, and the crops were beginning to suffer.

The drought situation in the southern areas was virtually broken by continued showery conditions during the month; and with a continuance of favourable weather conditions, a satisfactory crop may yet be produced in those parts.

WINTER FODDER CROPS IN SOUTHERN QUEENSLAND.

OWING to the abnormally dry conditions prevailing in the main farming areas during the spring and early summer months, it has been very difficult to establish summer fodder crops, and few have been fortunate enough to bring such crops to maturity.

Farmers should, therefore, take the opportunity of ultilising the large area available for the sowing of winter fodder crops in order to supplement natural pastures and replenish reserves. Under normal conditions the paddocks are prepared after the removal of early sown maize or summer fodder crops, and approximately two months are available to cultivate and fallow the land before commencing seasonal sowings during late March. A thorough ploughing, cross-ploughing, disc or tine cultivation, and harrowing will form a suitable seed-bed on average soils. Succession sowings can be made during April and May if desired, while if seasonal rains are delayed sowings can be extended to early July with reasonable prospects of securing good grazing for a limited period.

Statistics show that an area of oats approximately 100,000 acres in extent is sown annually in Queensland for grazing and green fodder purposes, with smaller areas of wheat and barley used in the same way. These cereals can be combined, with legumes such as field peas, vetches, or tares, thereby providing a richer and more balanced ration.

Drilling methods of planting are preferable, as the seed can be placed at the correct depth. In the absence of suitable machinery, broadcasting is generally practised, sowing the legume first and discing or cultivating in, following with the cereals, which are broadcast and harrowed in.

Of the varieties utilised, Florence, Warren, or Warchief wheat, Sunrise Belah, or Algerian oats, and skinless barley, have proved suitable. Florence wheat 30 lb. and Dun field peas 20 lb. has proved a suitable mixture, as both are fairly early maturing. Algerian oats 30 lb. and vetches or tares 20 lb. per acre is also a suitable combination, being somewhat slower maturing than the former. The earlier maturing varieties of oats, such as Belah and Sunrise, may also be sown with field peas if desired.

Besides adding to the value of the forage, the addition of a legume provides an excellent rotation crop of considerable benefit to the soil.—H. W. BALL, Assistant Experimentalist.

THE FUNGICIDAL TREATMENT OF SEED POTATOES.

Seed potatoes showing the presence of either common scab or black scurf should be treated with a fungicide before planting, otherwise, given the necessary weather conditions, considerable damage may be done by one or both of these diseases to the resulting crop. Two methods are available for the purpose. One employs hot formalin solution and the other acid corrosive sublimate. The latter is more convenient, as no heat is required. The potatoes should be washed but not cut before treating.

Prepare the formalin solution by mixing 1 pint of commercial formalin (40 per cent. formaldehyde) with 15 gallons of water. Heat to 125 deg. Fahr. and arrange for maintaining the temperature at this point by building a small fire under the tank or by keeping some of the

solution hot in a boiler so that a little of this may be added from time to time as the rest cools. No more than a 5 deg. variation in temperature either way during the operation should be allowed. Dip the seed tubers into the solution for two and a-half minutes in successive small quantities in crates or upon sacks. Remove, and after draining excess solution back into the tank, cover the potatoes with bags or canvas for one hour to keep in the formalin fumes. Finally spread out to dry before planting.

The acid corrosive sublimate solution is prepared by adding ¼ lb. of corrosive sublimate and 1¼ lb. of hydrochloric acid (spirits of salts) to 12½ gallons of water. A wooden or well-painted vessel must be used, as this mixture corrodes metal. When all the corrosive sublimate has dissolved, immerse the tubers (in lots of convenient size) for five minutes, and then spread out to dry. The dipping is preferably carried out in wooden crates rather than bags. The solution loses its strength gradually, so that a fresh quantity should be made up after ten successive lots have been treated.

Acid corrosive sublimate must be used on dormant tubers and not on ones which have sprouted, otherwise some injury or delay in germination may occur. Treatment may be carried out three or four months before planting. Corrosive sublimate is a deadly poison and must be used with care. All treated tubers must be planted or buried to avoid the possibility of their being consumed by any person or domestic animal. The solution may cause some irritation to the hands unless they are greased well before immersion.

These treatments are only effective if the soil on which the crop is grown is free from the parasitic fungi causing the diseases. It is of little use treating seed to be planted in land which has borne a badly diseased crop of potatoes within recent years.—J. H. SIMMONDS, M.Sc., Senior Pathologist.

JERUSALEM ARTICHOKE.

Like the sweet potato, Jerusalem artichoke is a crop which should receive much more attention than it does at present, more particularly by those engaged in pig-raising in the western farming districts, for not only is it highly drought-resistant but its tubers are highly nutritious as well. The yield, which is controlled by the soil and seasonal conditions, may range from 300 to 500 bushels or more per acre, and although the plant does best on good friable loams, it will thrive on sandy, gravelly, or clayey soils, which enables the poorer patches of soil on a farm to be put to a profitable use.

The area intended for its reception should be prepared in much the same way as if it were intended for potatoes. It may be planted in early spring in furrows three feet apart, with the sets two feet apart. This spacing with medium-sized tubers will entail the use of between 4 and 5 cwt. per acre.

As with maize and potatoes, until the crop is 4 inches high all cultural operations can be carried out with tined harrows working across the drills. Afterwards the cultivator will have to be used, as the condition of the soil and weed growth necessitates.

When the tops die, the crop is fit for harvesting, which can be accomplished most profitably by turning pigs on to the field. If it is intended to plant the same area in the succeeding season, it will be necessary to remove the pigs before all the tubers have been eaten, if replanting is to be avoided. The area should be cultivated in the spring. Subsequent working will be similar to that of the first season. The white and red varieties are considered to be the most hardy and prolific.—R. SOUTTER, Agricultural Research Officer.

PASSION FRUIT GROWING ON THE SOUTH COAST.

J. McG. WILLS, Fruit Branch.

[*Continued from page* 209, *February*, 1937.]

SELECTION OF SITE.

THE site for the vineyard should be carefully chosen. Here are six important factors to be considered before making the final selection:—

1. Aspect;
2. Elevation;
3. Shelter;
4. Soil;
5. Drainage;
6. Accessibility.

Aspect, elevation, and shelter in many instances will go together, as a good aspect is often elevated and sheltered by higher ground at the rear.

Secure, if possible, an aspect open to the early morning sun, backed by good solid natural growth or rising land to provide protection from strong winds. The site should also be sufficiently high above sea-level to escape the frosts. It should be sheltered from all cold winds, particularly those from the south and west, and for preference should have an aspect of from east to north. Such an aspect is naturally warmer and well protected, thus exerting a marked influence on the early maturity of the vines and the production of large crops of high-grade fruit which colours and ripens evenly and more rapidly than fruit grown in vineyards less favourably situated. Avoid the tops of ridges even when they have the desired aspect, as the soil may have been badly washed, leaving a low humus content. Vines rarely grow vigorously when planted on such sites.

Situations so heavily timbered that the free movement of air is prevented or seriously restricted should not be considered, unless provision has been made to allow the cold air to pass down the lower levels; otherwise frosting or severe chilling may result.

While the passion fruit vine is not very exacting in its soil requirements and will establish itself rapidly on most of our coastal soils, good natural drainage is absolutely essential. Any situation which may possess all the other qualifications will be unsatisfactory if lacking in natural drainage, for the vines will eventually fail, as stagnant water and sour soil conditions are absolutely fatal to their development. The best type of soil for passion fruit growing is more or less a matter of divided opinion. Vines have been grown successfully on many classes of soil ranging from rich vine scrub to poor forest and coastal sand. Provided the soil is put in a good mechanical and physical condition and is not underlaid by any impervious clay subsoil, the vines appear to establish themselves rapidly and flourish, eventually producing crops of good-quality fruit. It is generally acknowledged that good vine scrub soil is richer than forest soil, and tends to produce heavy foliage on the vines; also there is a tendency for the vines to produce a more rank, vigorous growth, which becomes rather a disadvantage in that extra work is entailed keeping the growth in check and combating fungus diseases to which the vine is subject.

Plate 121.

New land prepared for further planting. Established area adjacent. Russell Island, Moreton Bay.

Good forest land will produce a vine of good average growth without the tendency to excessive production of wood growth, while the cropping propensities of the vine are nearly equal to that of vines grown on scrub lands—a distinct advantage, as there is less trouble and cost in controlling the vine growth and combating fungus diseases. In good forest country a retentive subsoil is also a distinct advantage. Normally, forest soils do not possess as great an amount of organic

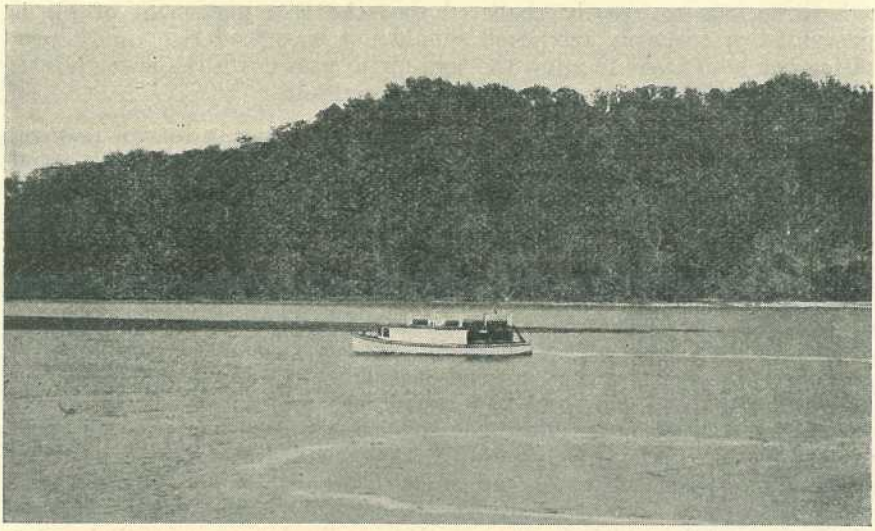


Plate 122.

The entrance to Canaipa Passage, Stradbroke Island in the background. The launch is engaged in regular inter-island transport, in which passion fruit makes up a large proportion of consignments, in Moreton Bay.

matter as scrub soils; consequently it is impossible for forest soil to absorb and retain sufficient moisture to meet the demand of a heavy crop in very dry seasons.

Forest soils require considerably more working in order to bring them into a satisfactory physical condition, as they are seldom as deep or friable as scrub soils.

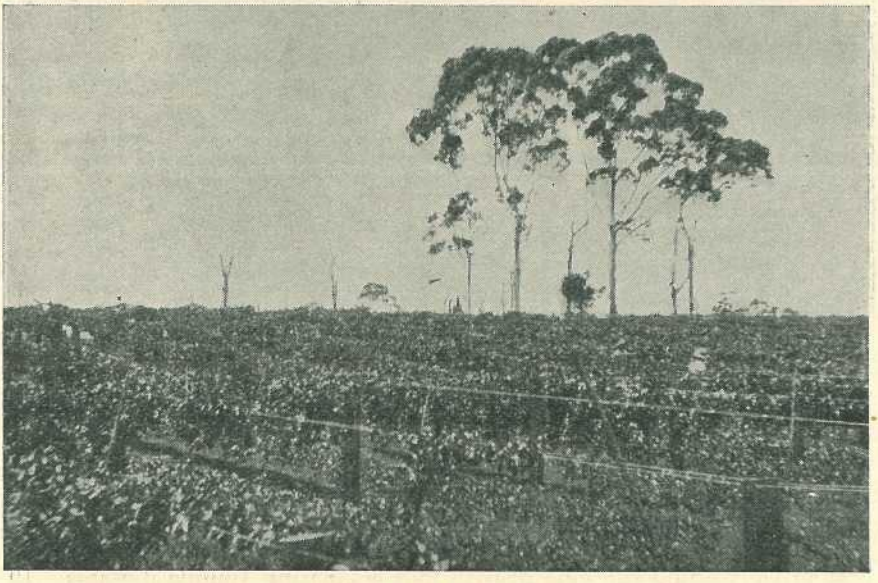


Plate 123.

An established passion fruit vineyard at Springbrook on one of the numerous small, richly fertile plateaux of the Macpherson Range, bordering New South Wales in the south-eastern sector of Queensland.

Very heavy types of soil should not be planted with passion fruit, as the natural drainage is usually poor; while soils having a heavy clay subsoil close to the surface should be left out of consideration.

In common with the banana, passion fruit does well on stony ground, and the presence of surface stone or "floaters" is not detrimental, provided the body of soil is sufficient. Where the surface is stony, cultivation costs will obviously be increased. However, this disadvantage is offset by the prevention of surface soil erosion, retention of soil moisture during dry periods, and the maintenance of a higher soil temperature during winter. This higher soil temperature during the cold months maintains the plants in a more vigorous growth, resulting in a more rapid response to spring conditions and, generally, more satisfactory conditions throughout the year.

Drainage.

As mentioned elsewhere, the passion fruit vine will not thrive under excessive wet or sour soil conditions, stagnant water being absolutely fatal to the plants. Throughout the South Coast there is a very high rainfall, and during normal wet seasons half the annual rainfall may be precipitated during two to three months; therefore the need for adequate natural drainage is obvious. No matter how rich the soil may appear to be, if it is sour or badly drained it should not be planted, unless satisfactory provision can be made to improve this condition by effective drainage, thus lowering the watertable beneath the depth—at least 2 feet—required by the roots of the plants.

High land has the advantage of being drained sufficiently and naturally to cope with even the wettest periods of the rainy season, without permitting wet soil conditions to develop to such an extent that any harmful effect will be noticed on the vines.

The soil should be well broken up to a depth of at least 6 inches and the surface afterwards maintained in a good cultural condition. As a safeguard against surface soil erosion, contour drains should be constructed across sloping land. These drains should be as short as convenient, with a slight fall in order that the rain run-off will not flow too rapidly or with the strengthening volume force of water that occurs in steeply-graded channels.

On flat land where natural drainage is at all faulty, consideration must be given to the construction of deep main drains at regular intervals, into which a series of shallower drains will carry excess water. If this is not possible, through financial or geographical limitations, then the site should be abandoned.

Accessibility.

The method of cultivation used will be decided mainly by the contour of the land. Mechanically or horse-drawn cultivators, where they can be used, are more economical than man power. The presence of logs, stumps, boulders, stony and uneven surfaces all increase the expenditure of time and labour in the performance of cultural operations, as so much work must be done by hand.

On sloping land the packing shed should be erected in such a position that a wiring system can be installed conveniently. By this means fruit can be quickly and safely despatched from numerous suitable positions in the vineyard, so greatly reducing harvesting costs. The location should be, if possible, within reasonable distance of a railway siding or other suitable forwarding centre.

If the fruit has to be conveyed many miles by truck a good road is necessary; otherwise delivery may be interrupted by floods or the roads becoming impassable for several days during wet weather.

It is advisable to fix on a situation from which the fruit can be despatched uninterruptedly, as the daily despatch of fruit to the market is most desirable and any disorganisation of transport may result in heavy loss to the grower.

[TO BE CONTINUED.]

FRUIT MARKETING NOTES.

JAS. H. GREGORY, Instructor in Fruit Packing.

GENERALLY, the market has been firm for all fruits during the last few weeks. Many of the coastal fruits are only beginning to show the effects of the prolonged dry spell.

Stone Fruits.

Plums.—Local supplies have now practically ceased. New South Wales plums—Ponds and Grand Duke—are realising 5s. to 8s. per case, some fine quality coming on to the market.

Peaches.—Stanthorpe peaches are realising 2s. to 5s. per half-bushel for good-quality fruit. The season is now drawing to a close. Supplies have not been as heavy as usual, and prices have remained firm. Victorian peaches, 9s. to 13s.

Grapes.—Excellent fruit has been available throughout the season. Prices have remained firm, with Muscats and Walthams most popular. Prices per half-bushel case: Waltham Cross, 5s. to 7s.; Muscatels, 4s. to 5s. 6d.; Black Prince, 3s. 6d. to 4s. 6d.; Colemans, 3s. 6d. to 4s. 6d.; Hamburgs and Ascots, 3s. to 4s.

Apples.—The demand for cookers and Granny Smiths has eased owing to the prevalence of green fruit on the market. Some excellent Jonathans have been seen, and obtained good prices. Jonathan, 6s. to 9s.; Granny Smith, 6s. to 8s.; Delicious, 6s. to 8s.; King David, 4s. to 8s.

Pears.—Only choice-quality pears were popular, poor lines being hard to move; 4s. to 6s. per case being top prices, with an occasional extra special line at 7s.; Victorian and New South Wales, 8s. to 9s.

Export Consignments.

Apple export consignments are now in full swing. Care is necessary if consignments are to arrive in good condition. Close attention should be paid to labels, &c., in order to ensure that the general get-up is as

near perfect as possible. Attach labels securely. If the label becomes unattached, the fruit loses its identity and trade description. Place labels on squarely. Do not pencil in particulars. It is not permitted, and in any case is only a third-rate method of doing things. Wiring should be carried out with care, so that no undue pressure is brought to bear on the fruit. Keep the wires at the ends of the cases. Stencil cases neatly and cleanly.

These are little points noted at the ship's side which spoil the perfection of many consignments.

Tropical Fruits.

Pineapples.—Heavy supplies are coming to hand, and prices have eased. The position is being complicated by the high percentage of sunburned fruit sent on to the market. Prices: Brisbane, cases, 2s. to 5s. for Smooths; loose, 6d. to 3s. per dozen; Ripleys, 4s. to 6s. 6d.; loose, 6d. to 3s. per dozen. Sydney, Smooths, 6s. to 9s. Melbourne, Smooths, 8s. to 10s. Many lines have arrived in leaking condition. Some lines are also green. Water blister has been noticeable.

Bananas.—Supplies have been maintained, fruit generally being still on the thin side. November dumps are now making their appearance in increasing quantities. Prices: Brisbane, Sixes, 7s. to 11s. 6d.; Sevens, 7s. to 12s. 9d.; Eights, 8s. to 13s. 6d.; Nines, 8s. to 14s. Sydney, Sixes, 11s. to 13s.; Sevens, 12s. to 14s.; Eights and Nines, to 17s. Melbourne, Sixes, 12s. to 13s.; Sevens, 13s. to 15s.; Eights and Nines, 15s. to 16s.

Prices are inclined to show a downward trend. Many lines have been marked down in grade; growers should take every care to keep up to the grade. The smallest fruit in the case should indicate the grade, and the case should be marked accordingly.

Mangoes.—It has been an excellent season for quality mangoes. Supplies are now diminishing. Prices: 4s. to 5s. for commons; special varieties higher.

Papaws.—Supplies are short, prices being maintained at high levels. Brisbane prices: Locals, 5s. to 6s. per bushel; Yarwun, 10s. to 11s. per tropical case. Sydney, 12s. to 16s. tropical case.

Passion Fruit.—Supplies are now plentiful; for average lines 4s. 6d. to 5s., and for specials to 7s. are the prevailing prices on the Brisbane market.

There are some excellently packed lines obtainable, but one still sees the old haphazard "throw them in" methods in use. It pays to pack this fruit. Sydney, 6s. to 12s. per half-bushel. Melbourne, 4s. to 7s.

Citrus Fruits.

Lemons.—Lemons are still maintaining exceptionally high rates on the Brisbane market. Gayndah and Benyenda, 20s. to 21s. per case; small and second grade, 10s. to 16s.; Locals, 14s. to 16s.; Victorian, 13s. to 16s. Melbourne, 6s. to 16s. Sydney, 6s. to 14s.

Oranges.—No local supplies available, New South Wales realising 9s. to 13s. Sydney, Valencias, 6s. to 11s. Melbourne, Valencias, 6s. to 16s.

Grape Fruit.—No local supplies are yet on the market. Early consignments should attract good prices, particularly in Melbourne, where 14s. to 30s. is the present price for imported fruit. Some special selected fruit realised up to 40s. for the 1½-bushel citrus export case.

Tomatoes.—Market demand steady for good tomatoes in Brisbane, good coloured lines selling to 7s. Ripe fruit, 3s. to 6s.; green, 3s. to 5s.

Sydney quotes Queensland tomatoes from Stanthorpe 3s. to 5s. Local supplies, 4s. to 7s.

Miscellaneous Fruits.—Rock Melons, Brisbane prices, Stanthorpe, 3s. to 5s. a bushel case. Quinces, 2s. to 3s. per case. Monstera, Brisbane, 4d. each; Melbourne, to 1s. each; Figs, 4s.; special boxed dessert, 9d.

General.

Banana growers are requested to watch for a change in packing methods with the introduction in New South Wales and Queensland of the cluster pack. A bushel container is also to be introduced. Experiments over three years indicate that better marketing conditions will prevail with the adoption of the contemplated changes.

Plate 124.

THE ROAD WINDING EVER UPWARDS.—The new Nerang-Beechmont road replaces a narrow mountain track shown near the right of the picture.

The Tropics and Man

TEMPERATURE, HUMIDITY, AND AIR-MOVEMENT.

DOUGLAS H. K. LEE, M.Sc., M.B., B.S., D.T.M., Professor of Physiology, University of Queensland.

No. 3.

AT the close of the last article, you will remember, I pointed out to you that the difficulties the human body had to contend with in getting rid of its surplus heat were bound up with the three climatic factors of temperature, humidity, and air-movement. These three are so important that, in spite of my assurances last time, I am going to discuss them separately a little more fully before passing on to Queensland climates in particular.

Heat Factors in Climate.

There is no need to delay over the factor "temperature." Everyone knows that the unqualified word "temperature" refers to the reading given by a naked dry mercury thermometer, and that when the meteorologist speaks of temperature, he refers to the reading made with this thermometer in a standard box with louvres, and thus shaded from the sun. There are other kinds of temperature readings, such as wet-bulb, sun, and ground temperatures, but these have special meanings and are not usually confused with the ordinary "temperature." As I indicated in the February Journal, the temperature of the body's surroundings is important, because, other things being equal, the loss of heat from the body by radiation and conduction depends upon how much cooler these surroundings are than the human body. If, as sometimes happens in desert climates, the surroundings are hotter than the body, the body gains heat instead of losing it by these paths.

Humidity probably requires a little more description. Everyone knows that it means the moisture in the air, but few realise its exact meaning or the fact that its measurement is now of great importance in comparing climates one with another. The term "absolute humidity" is not of much use in climatology; so just note it in order to avoid confusion if it crops up at any time. The term "relative humidity" is of great use, however. It is a comparison between the amount of moisture the air actually is holding and the amount of moisture it could hold at the same temperature. On the western plains the relative humidity is usually 20 per cent.—i.e., the air contains only one-fifth of the moisture it could hold if given the opportunity. On the coast, the relative humidity lies between 60 and 80 per cent., so that it can take up much less extra water vapour than inland air. Evaporation will, of course, go on much more readily when the relative humidity is low than when it is high. Clothes and perspiration dry very much more quickly in the interior than on the coast.

How is this relative humidity measured? In the first place, of course, it was measured by the cumbersome process of extracting all the water from the air and measuring it, and then seeing how much water the perfectly dry air would take up when given full opportunity. Men soon found out, however, that the reading given by an ordinary

thermometer wrapped in wet lint had an important relation with relative humidity. Now all the meteorologist does is to read the ordinary (dry bulb) thermometer and this wet bulb thermometer, refer the readings to a standard table, and read off the result. All perfectly easy, but what of the men who worked out the table in the first place?

It is because the "relative humidity" determines how quickly water (or sweat) will evaporate at a particular temperature that it is so important to us. On dry days sweat can evaporate very readily and thus help tremendously in cooling the body (or in over-cooling it if we are foolish enough to let it get the chance), but on wet days sweat evaporates slowly and is a much less efficient servant.

Air-movement is, of course, a most familiar thing, and a very welcome visitor in hot, steamy coastal regions. Its contribution to comfort lies in removing the layer of air in contact with the skin which has become loaded with heat and moisture, and replacing it with cooler and drier air to which the body can give away more heat and more moisture. If the air is very dry, a very small amount of air-movement will suffice to ensure evaporation of all skin moisture, but the more humid the air the greater the air-movement required. As long as the air is cooler than the skin, increased air-movement will increase heat-loss; but when the air is hotter than the skin, increasing the air-movement will increase heat-absorption of the body. For these reasons, air-movement is very much more valuable in hot humid climates in which the temperature is seldom higher than that of the body, and humidity is high, than in hot arid regions, where temperatures are often higher than that of the body, and humidity is low.

The Measurement of Co-operative Effect.

A suspicion has probably arisen in your minds by this time that if these three factors of climate all interfere in some way with the loss of heat from the body, and if they can all be measured and dealt with intimately by prying scientists as the technical jargon you have been reading suggests, there ought to be some method of dealing with them on a common footing and of expressing their combined result in some simple measurement that all can appreciate. Now that idea, believe it or not, occurred to some of these technically-minded scientists, and attempts were made to devise some formula which would be true to facts and yet yield some simple method of assessing the net effect upon heat-loss from the body of any given set of atmospheric conditions. Two very interesting and important results were developed. The first was evolved by Leonard (afterwards Sir Leonard) Hill and his colleagues in London towards the end of the war, whilst investigating conditions in war-time industry. This was a special instrument known as the kata-thermometer, which, instead of measuring temperature, measured the rate at which it lost heat in a given atmosphere. This was very good, and could be made to imitate a clothed or naked, a wet or dry body. It possessed certain disadvantages, however, which prevented its universal adoption. It is now used chiefly as a sensitive instrument for measuring variable small air-movements, for which purpose it remains very valuable. The most practical scheme was developed in America by Houghten, Yagloglou (the Americans soon shortened this to Yaglou), and others. These workers had two rooms in which they could produce any combination of temperature, humidity, and air-movement they desired. They performed many thousands of experiments in which

human subjects were placed in one room until they got used to it and then transferred to another room and asked whether they felt hotter or colder. These experiments involved an enormous amount of work and took a long time to complete, but the results were very much worthwhile. From the enormous number of answers they were able to plot out a somewhat complicated diagram (what engineers call a nomogram) in which these three factors could be conjointly assessed. They then coined the term "Effective temperature"—a term which has come to stay. The *effective temperature* of an atmosphere is the temperature at which a still atmosphere saturated with water vapour would have to be in order to have the same general effect upon the body. Let me illustrate this difficult definition with an example. An atmosphere with (dry bulb) temperature 76 degrees, wet bulb temperature 62 degrees, and wind velocity of 100 feet per minute would have the same general effect upon the human body as a saturated still atmosphere with (dry bulb) temperature 70·2 degrees. The *effective temperature* of the first atmosphere is, therefore, 70·2 degrees. Again, an atmosphere at 110 degrees dry bulb temperature, 90 degrees wet bulb temperature, and no air-movement would have the same general effect as a saturated still atmosphere with 94 degrees dry bulb temperature; its *effective temperature,* in other words, would be 94 degrees. By means of this scheme, therefore, it is possible, with some degree of accuracy, to compare one set of atmospheric conditions with another, *in so far as they affect the human body.* One notes the dry and wet bulb temperature and the wind velocity of each atmosphere and determines the "effective temperature" of each from the standard chart. These "effective temperatures" mean something comprehensible and can easily be compared. In the next article I shall show you how the climates of different parts of Queensland can be compared, one with another, by means of this scheme, and assessed in respect of their general effects upon the human body.

[*Next issue*: *"The Climates of Queensland."*]

SHELTER FOR PIGS.

Protection from the extremes of weather is essential for the health and economical growth of pigs. During hot weather it is obvious to the observant pig raiser that pigs require cool shade and they even enjoy a bath in a wallow or muddy pool. A number of pigs die each summer from headstroke, which affects the fatter pigs and those which are deprived of cool shelter.

Whilst the wallow is a means of cooling pigs, it is a probable source of infection unless it is well constructed of concrete and capable of being emptied and cleaned frequently. The wallow should also be covered with a roof or a tree to protect pigs from the sun while bathing.

Cool shade can be provided for pigs by the ordinary shelter sheds as recommended in the department's bulletin on pig accommodation, provided the sheds are constructed with the roof not less than 6 feet from the floor at the lowest part, and provided there is a ventilation space of at least 6 inches between the top of the walls and the roof. The front should be at least partly open and the shed faced to the north-east; this latter provision allows the direct sunrays to enter the shed in the early morning, acting as a disinfectant, then, as the temperature increases later in the day and the pigs require shade, the sunrays are on the northern and western walls of the shed, thus leaving the interior shady for the pigs.

A supply of clean, cool drinking water will also help to keep pigs comfortable in hot weather.

PRODUCTION RECORDING.

List of cows and heifers officially tested by Officers of the Department of Agriculture and Stock which have qualified for entry into the Advanced Register of the Herd Books of the Australian Illawarra Shorthorn Society and Jersey Cattle Society, production charts for which were compiled during the month of January, 1937 (273 days unless otherwise stated).

Name of Cow.	Owner.	Milk Production.	Butter Fat.	Sire.
		Lb.	Lb.	
AUSTRALIAN ILLAWARRA SHORTHORNS.				
MATURE COW (OVER 5 YEARS), STANDARD 350 LB.				
Nancy 14th of Springdale	J. Phillips, Sunnyview, Wondai	17,753·3	707·133	Lovely's Commodore of Burradale
Honey 8th of Sunnyside	P. Moore, Wooroolin	12,303·2	499·083	Bruce of Avonel
Kyabram Myrtle	A. H. E. Black, Kumbia	11,872·4	467·916	Ledger of Greyleigh
SENIOR, 2 YEARS (OVER 2½ YEARS), STANDARD, 250 LB.				
Myrtle 2nd of Sunnyview	J. Phillips, Sunnyview, Wondai	13,213·8	523·014	Burradale Byron
Mabreen Honeycombe	V. Dunstan, Mabreen, Wolvi, Gympie	8,418·95	335·174	Numbawarra Headlight
Burradale Favourite 8th	A. H. E. Black, Kumbia	7,570·3	326·237	Burradale Banner
JUNIOR, 2 YEARS (UNDER 2½ YEARS), STANDARD, 230 LB.				
Mabreen Nancy	V. Dunstan, Mabreen, Wolvi, Gympie	9,008·75	343·801	Numbawarra Headlight
Mabreen Gem	V. Dunstan, Mabreen, Wolvi, Gympie	8,062·3	297·861	Numbawarra Headlight
JERSEY.				
JUNIOR, 2 YEARS (UNDER 2½ YEARS), STANDARD, 230 LB.				
Oxford Lady Daffodil	E. Burton and Sons, Wanora	5,231·05	314·13	Oxford Golden Lad
Kathleigh Model	D. Young, Kingaroy	5,429·3	310·045	Retford King's Thorn
Bellgarth Bonzanette II.	D. R. Hutton, Cunningham	4,863·5	274·169	Trecarne Renown II.
Kathleigh Royal Butterfly	J. Goostrey, Bald Knob, *via* Landsborough	5,963·9	320·999	Retford Royal Atavist
College Goldspray 3rd	Queensland Agricultural High School and College, Gatton	5,395·26	258·636	Burnside Defender

Answers to Correspondents

BOTANY.

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

Swamp Millet.

G.L. (Twin View, Elimbah)—

The specimen represents *Echinochloa Walteri*, sometimes called swamp millet, a native grass generally regarded as excellent fodder. It is very closely allied botanically to such well-known cultivated crops as Japanese millet and white panicum. Seed is not stocked by nurserymen, but the plant grows naturally along creek banks and in swampy places, generally in coastal Queensland, and once introduced usually spreads naturally in such localities.

Wild Sorghum.

G.H. (Mount Larcom)—

The specimen represents a species of wild sorghum, *Sorghum verticilliflorum*, a native of South Africa, but now widely naturalised in Queensland. It is rather a caney grass, and like other sorghums contains a prussic acid yielding glucoside. As a matter of fact, it contains more of the glucoside than most of the other sorghums growing in Queensland. On this account, if it is fed to stock, particularly to hungry stock, a certain amount of care should be exercised and the cattle prevented from gorging themselves on it. Preferably, it should be cut and allowed to wilt before feeding.

Mimosa.

D.D.L. (Kilcoy)—

The pods represent those of the mimosa bush, *Acacia farnesiana*. This is the same species that grows in Western Queensland. On the coast or near-coast, a few bushes are occasionally seen in paddocks or along creek banks. We are not sure if they are growing wild in such places, or if they have escaped from cultivation. The leaves are valuable sheep food, but occasionally we have heard of stock refusing to eat them. This, however, is rather unusual. The pods in a greener state than those you sent should be quite good fodder, particularly for sheep. We doubt if there will be enough leafage on the plant to worry about cattle.

Convolvulus. Ruellia.

R.C. (Mundubbera)—

1. The creeping plant or vine is *Convolvulus erubescens*, sometimes called the small convolvulus or morning glory. It is a very common plant throughout a good deal of Western Queensland and often seen right to the coast. As you mentioned, it is quite a good fodder, but these convolvulus vines sometimes cause impaction through their running, fibrous stems, particularly when old.
2. The smaller plant is *Ruellia australis*, a very pretty little native herb fairly common in many places for which we have not heard a distinctive local name. The generic one, Ruellia, however, is short enough for general usage.

Polygonum.

J.McK. (Boompa)—

The specimen is the oriental smart weed, *Polygonum orientale*. This is a fairly common plant in Queensland and usually grows in rather wet or badly drained situations. So far as we know, it has not previously come under suspicion as a poisonous plant, but smart weeds or species of Polygonum are known to cause trouble among stock. A symptom of poisoning by Polygonum is generally an inflammatory swelling of the ears, face, and eyelids. This affection is generally accompanied by itching, causing rubbing, shaking, and scratching of the head.

Yellow Plum.

S.E.S. (Cairns)—

We do not think there is any doubt that it is the Yellow Plum, *Ximenia americana*, a shrub that is fairly widely spread over the coasts of the Pacific in addition to North Queensland. In Queensland, it not only occurs right on the coast and sometimes a considerable distance inland. The fruits are edible but the leaves contain a prussic acid yielding glucoside and have been known to cause the death of goats that have browsed on it.

Carpet or Mat Grass.

W.D.B. (Yandina)—

(1) *Axonopus compressus*, carpet or mat grass, broad-leafed form.

(2) *Axonopus compressus*, carpet or mat grass, narrow-leafed form. These two forms are rather distinct as they occur in Queensland, but botanists generally regard them as the same species. As you know, there has been a good deal of controversy about carpet grass along the North Coast. There is no doubt that this grass is beneficial on second-class country, and in such places some dairymen and stock-raisers speak quite well of it. The common trouble with it is that it invades the ordinary paspalum country and other better class pastures, very much to their detriment. It is not a new grass along the North Coast, as it has, to our knowledge, been there for over twenty years. Probably the heavier stocking and thinning out of the paspalum pastures has given it a chance to invade them and increase.

(3) This specimen bore no seed heads, but we should say it was either an intermediate form between Nos. 1 and 2 or else simply a form of No. 1. If a few seed heads could be found we would much like to have them.

Blue Top.

P.McM. (Ballandean)—

The specimen is the blue top heliotrope, *Heliotropium anchusaefolium*, a native of Brazil and the Argentine that has now become rather a serious pest in parts of the Darling Downs particularly and in other parts of Queensland. It is not known to possess any poisonous properties. The plant was probably introduced originally as a garden plant and has been naturalised on the coastal lands for many years past, but on the coast it does not seem to be so aggressive as it is on the Darling Downs.

If you have a small patch the only plan is to keep it cut off below the ground level regularly so that the roots will eventually become exhausted by sending up numerous shoots. If, of course, they are allowed to get to a fair size the leaves nourish the roots and growth keeps on. The main object is to make the roots exhaust themselves by sending up new shoots and, as these appear, cutting them off. This means, of course, regular work on the plot about once a month. Any of the common weed sprays could be used, but with plants of this type they have to be applied several times before the roots exhaust themselves.

Wild Setaria.

H.P. (Stanthorpe)—

The specimen is *Setaria glauca*, pigeon grass or wild setaria. This grass is very widely spread over the warm temperate countries of the world and is fairly common in Queensland, mostly as a weed of cultivation or growing in rather damp places. It does not seem to invade the ordinary pasture to any extent. It is quite a good grass and is very closely allied to the cultivated setarias, giant setaria, dwarf setaria, panicum, Hungarian millet, &c.

"Early Spring" Grasses. Scented Top.

G.N.H. (Didcot)—

(1) *Eriochloa* sp. Species of Eriochloa are generally looked upon as excellent fodders. They are mostly known as early spring grasses, a not very appropriate name, for they are no earlier than many other grasses which come up with the early summer rains. The genus is at present under revision and we cannot give you a specific name for the particular one you send.

(2) *Capillipedium parviflorum*, scented top, a very common grass, particularly in much of the forest country of coastal and sub-coastal Queensland. It is generally regarded as quite a good cattle grass in such situations.

General Notes

Staff Changes and Appointments.

The appointment of the Officer in charge of Police at Goondiwindi as acting Inspector of Stock has been cancelled.

Mr. A. E. George, Court House, Ingham, has been appointed chairman of the Victoria and Macknade Local Sugar Cane Prices Boards, and also an agent of the Central Sugar Cane Prices Board for the purpose of making enquiries under section 5 (2A) of the Regulation of Sugar Cane Prices Acts in regard to sales and leases of assigned lands, vice Mr. C. B. Buxton, transferred.

Mr. R. A. Taylor, Inspector and Examiner under the Seeds, Fertilizers, Veterinary Medicines, Pest Destroyers, and Stock Foods Acts, has been appointed also an expert under the Pure Seeds Act, during the absence at any time of the Officer in Charge, Mr. F. B. Coleman.

Mr. R. W. Greville (Lane Cove, Sydney) has been appointed Assistant Veterinary Surgeon, Department of Agriculture and Stock.

Mr. R. J. F. T. Wust, Government Teacher at Poid, Moa Island, via Thursday Island, and Mr. G. A. Frusher, Government Teacher at Saibai Island, via Thursday Island, have been appointed honorary rangers under the Animals and Birds Acts and the Native Plants Protection Act.

Mr. D. O. James (Babinda) has been appointed canegrowers' representative on the Babinda Local Sugar Cane Prices Board, and Messrs. P. E. Nielsen (Septimus, Mirani) and T. F. Ross (Oakenden, Eton) have been appointed canegrowers' representatives on the North Eton Local Sugar Cane Prices Board.

Mr. F. Moore, Double Island road, Cook Highway, has been appointed an honorary ranger under the Animals and Birds Acts and the Native Plants Protection Act.

Mr. V. J. Anderson, Acting Clerk of Petty Sessions, Childers, has been appointed chairman of the Isis Local Sugar Cane Prices Board and an agent of the Central Sugar Cane Prices Board during the absence on leave of Mr. L. H. Roles.

Northern Pig Board.

An Order in Council has been issued under the Primary Producers' Organisation and Marketing Acts, amending the constitution of the Northern Pig Board in regard to the furnishing of information and returns by growers and covering any prosecutions for offences.

Tobacco Pure Seed District—Central Queensland.

An Order in Council has been issued under "*The Tobacco Industry Protection Act of* 1933" altering the boundaries of the Tobacco Pure Seed District in the Marmor, Bajool, Archer, and Nerimbera districts, by including therein the parishes of Bouldercombe, Gracemere, and Barmoya.

Barley Board.

An Order in Council has been approved under the Primary Producers' Organisation and Marketing Acts, amending the constitution of the Barley Board by declaring the class of persons who shall be deemed to be growers of barley and eligible to vote at any referendum or poll in connection with barley.

Formerly, a voter was a person who harvested barley during the preceding twelve months. The amendment provides that persons eligible to vote shall be those who at any time during the two years preceding the date of a referendum or poll—

(*a*) delivered their barley to the Barley Board;

(*b*) furnished to the Board a return in respect of barley planted by them during any of those years for delivery of the resultant grain to the Board; or

(*c*) established to the Board's satisfaction that they have planted barley for delivery of the grain to the Board and have failed to obtain a marketable crop therefrom.

Atherton Tableland Maize Board.

An Order in Council has been issued in pursuance of the provisions of "*The Primary Producers Organisation and Marketing Acts,* 1926 *to* 1935," amending the constitution of the Atherton Tableland Maize Board in regard to the furnishing of information and returns by growers to the Board, and covering any prosecutions for offences.

Rural Topics

Banana Planting.

At this period of the year banana-growers are seriously considering their source of planting material, for the time is almost at hand when the very important operation of planting must be commenced.

Various opinions are put forward as to the best class of plants to use, and under certain conditions most of these opinions, if carried out, are capable of producing satisfactory results. The following is a brief description of each:—

Sucker—Should be selected from a vigorous, healthy stool, the actual sucker selected being about 18 inches high, and having a big, strong, clean corm of at least 6 inches in diameter.

Butt—Should be selected from a vigorous, healthy stool, and trimmed so as to allow not more than two eyes to come away. When trimmed a butt plant should measure about 7 inches in diameter and 6 inches deep.

Bit—Should be selected as in the case of the butt, and in reality is a suitable section of a selected butt.

When weather conditions run awry, and lack of rain makes banana-growing somewhat difficult, the butt plant should be easily a first choice on account of its resistance to the harder conditions.

Lantana country, burnt and grubbed, is ready to hole out and plant; scrub country, burnt, logged up if necessary, and holed out, is also ready to plant; but forest country needs digging up to a depth of at least 6 inches before holing and planting.

Planting 10 feet by 10 feet is to be recommended, and big holes are always an advantage; 15 inches square by 12 inches deep, or even larger, are the measurements suggested for the guidance of prospective planters.—J. H. FREEMAN, Senior Instructor in Fruit Culture.

Curdled or Cheesy Milk—Importance of Cooling.

Recently a sample of milk was examined at the Dairy Research Labratory, which had coagulated or curdled when only a few hours old. Through the co-operative action of microbes the curd had become flaky or lumpy, due to disturbance by rising bubbles. It was not appreciably sour, but had a cheesy odour, and the phenomenon was found to be due to an action resembling that of rennet (similar to the action of junket tablets in milk).

Milk which has been curdled by rennet generally turns cheesy, and also can be distinguished easily from sour milk by its appearance. Rennety milk usually curdles with separation of clean whey and a compact curd, whereas sour milk curdles uniformly throughout. This defect arises spasmodically, and may be attributable to unusual weather conditions, and to the lack of efficient cooling of the milk. The well-known phenomena of milk being specially liable to curdle in thundery weather does not seem to be ascribable to any other reason than the high temperatures which usually precede a thunderstorn.

This was one of those pecular cases in which the temperature had not been low enough for the development of favourable bacteria, but where higher temperatures had favoured the growth of undesirable types. If the temperatures had been low enough, the development of desirable microbes would have largely prevented the growth of the undesirable. Thence the importance of keeping the temperatures as low as possible, and the need for rapid cooling of milk. The quicker the animal heat is removed from the milk the less possibility there is of unfavourable changes taking place, due to microbes. As the warmer weather approaches, the need for cooling becomes more and more apparent. Therefore, it is necessary to see that the quality of the milk and cream is not graded down due to lack of a cooling system or to badly-cooled milk. Energy expended in endeavouring to cool milk supplies will be amply repaid by the choice quality cream produced.—L. E. NICHOLS, Dairy Research Laboratory.

Orchard Notes

APRIL.

THE COASTAL DISTRICTS.

IN the Orchard Notes for March the attention of citrus growers was called to the necessity of their taking the greatest possible care in the gathering, handling, sweating, grading, and packing of the coming crop of fruit, as the returns for the labour expended in the upkeep of their orchards will depend entirely on the condition in which the fruit reaches the market. Many growers fail to realise the very important fact that the success of fruitgrowing does not depend merely on the proper working and management of the orchard, so essential for the production of a good crop of high-class fruit, but that the manner in which the fruit is handled and placed on the market is of even greater importance. In no branch of fruit culture is this more evident than in the case of citrus fruits, as no fruit pays better for the extra care and attention necessary to enable it to be marketed in the best possible condition. Every season there is more or less loss in the consignments sent to the Southern markets, the percentage depending mainly on the weather conditions, the loss in a wet year being much heavier than that in a dry year.

A very large percentage of the loss is due to what is known as blue mould—a rotting of the fruit caused by a mould fungus—and this loss can be prevented, provided necessary precautions are taken. Although this matter was dealt with last month, it is of such vital importance to our citrus-growers that it is necessary to again refer to it.

In the first place, growers must clearly understand that blue mould cannot occur on perfect fruit, the skin of which is free from injury of any kind. The fungus causing blue mould can only obtain an entry into the fruit through an injury to the skin; it will thus be seen that the remedy is to take every possible care not to injure the skin of the fruit in any way.

Few growers realise how easily the skin of citrus fruits is injured, especially that of fruit grown under moist and humid conditions, when the skin is full of moisture and so tender that the least sign of rough handling causes serious injury. The cells of the skin are so brittle that they are easily broken, and when so broken a ready means of entry for the mould fungus is provided, and blue mould follows in due course.

The remedy for blue mould is in the hands of the grower, who must learn so to gather, handle, and transport the fruit from the orchard to the packing-shed that it does not receive the slightest injury, and further, that when it has reached the packing-shed it must be carefully placed in shallow bins or on trays and be exposed to the air for at least seven days, so that the surplus moisture in the skin may be removed, and the skin thus become toughened and less easily injured. This drying of the skin is known as "sweating," and during the time the fruit is being sweated it should be kept under observation, and all fruit showing signs of blue mould or injury from fruit flies, sucking or boring insects, mechanical injury or bruising, should be removed.

In order to prevent injuring the skin when gathering, all fruit must be cut and not pulled. Gloves should be used to handle the fruit, and when cut it should be placed in padded baskets or other suitable receptacles. Any fruit that falls or is injured in any way should be rejected, as it is not fit to send to a distant market. At the same time, if the injury is only slight, it can be sent to a local market for quick sale.

For oversea and interstate markets only perfect fruit should be selected, and further, it must be graded for size, colour, and quality, and properly packed, only one grade of fruit being packed in a case. The cost of cases, freight, and marketing is now so high that only the best fruit will pay to export, and even the best fruit must be properly graded and packed in order to produce the best returns.

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

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

Land to be planted with trees should be got ready, as, if possible, it is always advisable to allow newly-cleared land time to sweeten before planting.

Farm Notes

APRIL.

FIELD.—Those areas already lying in fallow for subsequent sowing with wheat should be kept in good tilth, using field implements that have a stirring effect in preference to those which tend to reverse the surface soil. The surface should never be allowed to cake; consequently all showers must be followed by cultivation, as soon as conditions will permit of teams and implements working freely.

Early fodder crops, such as barley (skinless or Cape) and certain varieties of wheat may be sown during April. Growers of winter fodders will be well advised to study the article dealing with dairy fodder plots which appeared in February, 1922, Journal.

Potatoes should now be showing good growth, and must be kept free from all weed growths by means of the scuffler. If sufficiently advanced, and any doubt exists as to the prevalence of blight, advantage should be taken of fine weather to give a second spraying of Bordeaux mixture, a calm and somewhat cloudy day being chosen if possible for the spraying.

Where land has been previously well prepared, lucerne sowing should be carried out this month, and intending growers of this fodder will be well advised to ascertain the germinating qualities of seed submitted to them for purchase. The difference between a good and bad "strike" is often traceable to the poor class of seed sown.

Maize and cotton crops should now be in the harvesting stage, and, once matured, are better in the barn than the open paddock, where weevils and other insects are usually prevalent at this season of the year.

Root crops sown last month should now be making fair growth, and during the early period of such should be kept free from weeds, and where necessary thinned out. Sowings of mangels, swedes, field carrots, sugar-beet, and rape may still be made where conditions of moisture will permit.

As the sowing season is close at hand for certain varieties of wheat—i.e., those which require a fairly long period to develop in—every effort should be made to bring the seed-bed into the best possible tilth and to free it from foreign growths of all kinds. The grading of all seed-wheat is strongly recommended, and growers who favour certain varieties should adopt a system of seed selection from prolific strains with a view to the raising of larger quantities of pure typical grain for ultimately sowing in their larger fields.

Pickling of wheat to prevent smut (bunt) is necessary. Germination tests should be carried out prior to commencing seeding operations.

Sorghums which have matured and are not immediately required as green fodder should, wherever possible, be conserved as ensilage to provide for a reserve, to tide over the period when grasses and herbage are dry. Succulent fodder of this description is the best possible form of insurance against drought, and for maintaining dairy and other stock in thrifty condition.

SCOURS IN YOUNG PIGS.

Scouring due to nutritional anæmia often causes serious losses among suckers. The symptoms first noticed are marked paleness of the skin and failure to put on weight. Scouring generally develops three weeks from birth.

The trouble can readily be treated as follows:—

Dissolve ¾ oz. copper sulphate crystals and 4 oz. ferric sulphate in 1 pint of warm water. Stir in a pint of treacle. Smear the sow's udder lightly with the preparation twice daily. If the mixture irritates the sow—through small lesions in the udder—it may be painted in a strip along the bottom rail of the pen. If the timber is splintery, open an old motor tyre and nail it firmly to the rail. Paint the tyre. The young pigs readily acquire a taste for the material. Continue the treatment until weaning.

OUR BABIES.

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

BREAD—OLD AND NEW.

HOW many thousand years the grain of the wheat has been used by mankind for food we do not know. From the earliest times, the hard grain was ground by hand between two stones in small quantities as it was needed. Gradually this laborious hand grinding was replaced by simple machinery employing stone rollers worked at first by slave or animal labour, later by wind or water power, and quite recently by steam. From all these methods the product was the same; the whole grain was torn to pieces to make wholemeal flour. All wheaten bread was made from this wholemeal flour, and it was a first-class food.

White Bread.

Compared with wholemeal bread, white bread is a thing of yesterday. It dates from only seventy years back, when steel rollers were first introduced in the flour mills in America. These steel rollers produced a very fine white flour, from which the wheat embryo and the bran were sifted out. White flour can be kept for much longer than wholemeal flour, and this is a great convenience for commerce. Unfortunately, the valuable vitamins in the wheat grain are all in the parts of the grain sifted out. As their existence was unknown, no one knew of their absence.

The bread which has formed such a large part of our food was seriously altered in quality; it was still a nourishing food, but it was no longer a health-giving food. Those who lived largely on bread, either

from necessity or choice, suffered from a partial want of vitamins. One consequence of this was the growth of an enormous trade in aperients of all sorts—a trade which is still flourishing.

Wholemeal Bread.

Lately there has been a revival in the use of wholemeal bread. There is, fortunately, still one stone-roller mill in Queensland, and this suffices to supply many bakers. This revival has been the result of many years' work by medical men and health reformers. Yet it does not seem to be realised that wholemeal bread is no new thing, but the good bread on which men have lived for scores of centuries; and the white bread, to which we have become so accustomed, is really a comparatively new thing, which after a short seventy years has been completely discredited as a basic diet.

The Newest Bread.

There are some people who do not like wholemeal bread, though there are only a very few with whom it does not agree. For them there is an alternative in a new sort of bread, which is very palatable. This bread is made of white flour with the addition of a fixed proportion of separately ground wheat embryo. It contains the valuable vitamins of the wheat grain in even larger proportion than does wholemeal bread, and this is an advantage, for in many kinds of foods besides bread there is a deficiency in these vitamins. Cerevite bread, as it is called, is being largely consumed locally.

Most trades are intensely conservative, and it is only natural that many millers and bakers are opposed to wholemeal and cerevite breads. This matters little, for the trade will supply what their customers want, and the enterprising tradesmen will reap the profit.

IN THE FARM KITCHEN.

Eggs San Remo.

Take 6oz. shortcrust, 6 eggs, 1½ gills cheese sauce, paprika to taste.

Roll pastry out to quarter of an inch thickness on a floured pastry-board. Cut into rounds and line some tartlet tins with them. Prick the bottoms with a fork, and bake till crisp and pale golden in colour. Drop a lightly-poached or steamed egg into each. Cover each with a tablespoonful of cheese sauce. Dredge lightly with paprika. Serve with a green salad. Make the cheese sauce by heating a beaten egg-yolk in a double boiler, and by adding it gradually to a cupful of white sauce. Heat for one minute, then add 1 tablespoonful grated cheese, a nut of butter, and seasoning.

Eggs Lyonnaise.

Take 6 eggs, 2 onions, 1½ gills stock, 1 teaspoonful flour, 1oz. butter, pepper and salt to taste, 6 croutes fried bread.

Boil eggs till hard. Peel and mince the onions. Melt butter in a saucepan. Add flour and fry till brown, add onions and brown slightly. Add stock. Season to taste with salt and pepper, then simmer until creamy. Remove shells from eggs, then remove carefully the yolks from the whites. Mince egg-white and add to onion sauce. Bring to the boil. Heap croutes of bread with the sauce, place a yolk on top of each croute, and dab each yolk with a little of the sauce.

Water Lily Salad.

Take 6 hard-boiled eggs, 6 stuffed olives, 1 large lettuce, 1 teaspoonful chopped parsley, radishes, vinegar, olive oil, seasoning.

Boil the eggs for thirty minutes, chill in cold water, shell and cut lengthways, from small end nearly to the other, until six petals are formed. Take out yolks and beat them till smooth, with vinegar, oil, and seasoning to taste, and form into cone-shaped balls. Lay the white petals in the centre of a bed of heart of lettuce leaves, arranged on individual salad plates. Place a cone in centre of each lily, and sprinkle it lightly with finely-chopped parsley. Garnish with one or two tiny radishes and small olives to resemble buds, and mask with a little French dressing.

Spanish Omelette.

Take 3 eggs, 1½ tablespoonfuls cooked peas, 1½ tablespoonfuls tomato, 2 tablespoonfuls water, 1 tablespoonful pimento, ½ tablespoonful butter, pepper, salt, and paprika to taste.

Break the eggs into a basin. Beat slightly and add water. Season. Slice tomato and pimento finely. Stir them with the cooked peas into the beaten eggs. Melt butter in an omelette pan until smoking hot, but not more than slightly brown. Pour in the mixture. Cook quickly till slightly browned beneath and just set on top. Slip on to a hot dish, fold, and serve quickly, garnished with parsley.

Buttered Eggs.

Take 4 hard-boiled eggs, 1 cupful milk, 1 tablespoonful butter, pepper, 6 slices toast, 1½ tablespoonfuls flour, ½ teaspoonful salt, parsley.

Make a thin white sauce with the butter, flour, milk, and the seasonings. Remove the yolks from hard-boiled eggs. Chop the whites finely and add to the sauce. Butter the toast and cover four slices with sauce. Force two of the egg-yolks through a strainer on to the sauce. Garnish with remainder of toast cut into points, and the parsley.

Egg and Mushroom Pie.

Take ½lb. fresh mushrooms, 4 eggs, 2 tablespoonfuls butter, 2 tablespoonfuls breadcrumbs, salt, pepper, and paprika to taste.

Parboil the peeled and washed mushrooms, then saute in a saucepan with the butter and seasonings to taste for ten minutes. Pour into a shallow (au gratin) dish. Gently slip one egg after another on top. Season to taste. Sprinkle with fine breadcrumbs, dab with tiny pieces of butter, and bake until the eggs are just set.

Stuffed Eggs and Jellied Peas.

Take 3 eggs, 1½oz. butter, seasoning, 1 cupful cooked peas, aspic jelly, 1 lettuce, mayonnaise to moisten.

Boil eggs until hard. When cold, shell, cut in half, and remove yolks carefully. Mash these with the butter. Season to taste and moisten with the mayonnaise. Pile up in the egg-whites. If wanted more decorative, sieve the mixture and force mixture into the shells with a forcing pipe. Drain the peas. Divide between five small moulds and fill them up with aspic jelly. Leave till set. Turn out carefully. Serve eggs and moulds on a dish with lettuce leaves.

Aspic Jelly.

Take ½oz. gelatine, ¾ pint white stock, 1 small onion, 3 tablespoonfuls vinegar, bay-leaf, parsley, piece carrot, salt.

Moisten gelatine in a little of the stock and let stand for half an hour. Put the remainder of stock in a saucepan with other ingredients, and bring to the boil. Pour on the gelatine and stir till dissolved. Leave to cool. Strain through a very fine strainer. Before using, add a little browning to colour. Use as required.

Eggs and Anchovies.

Take 6 eggs, 1 teaspoonful minced eschalot, 2oz. butter, anchovies, toast, salt and pepper, 1 tablespoonful milk.

Beat up the eggs with pepper and salt to taste and the minced eschalot. Put the butter into a saucepan with the milk. As soon as the butter is melted, pour in the eggs and stir until it thickens. Prepare some hot buttered toast, spread the mixture over the toast, and put a fillet of anchovy on each piece.

Savoury Egg Toast.

Take 2 eggs, salt and pepper, 2 tablespoonfuls milk, 1oz. butter, anchovy paste, buttered toast.

Prepare the buttered toast in the usual way, and spread it thickly with anchovy paste, and keep it warm. Beat the eggs and mix them with the milk, adding seasoning to taste. Melt the butter in a saucepan, add the eggs, and stir these till they thicken and begin to set. Turn the egg mixture on to prepared toast, and serve.

Egg and Tomato.

Take 2 eggs, 1 gill tomato ketchup, ½oz. butter, ½ gill gravy, salt and pepper.

Place a spoonful of sauce and gravy and a small piece of butter in two ramekin cases. Put an egg in each and cover with tomato sauce and the remainder of the butter. Bake for seven or eight minutes or until set in a fairly hot oven.

Maltese Eggs.

Take a tablespoonful minced ham, 2oz. butter, 1oz. grated Parmesan cheese, 1 lemon, ½ pint white stock, 1 large tomato, pepper, salt, parsley, 6 eggs.

Mix together in a saucepan the ham, butter, cheese, lemon juice, salt, pepper, and parsley to taste, the stock, and one large tomato, sliced. Let this stew for twenty minutes, then strain it over a dish containing six hard-boiled eggs. Cover with breadcrumbs and some grated cheese. Bake in a very hot oven for just sufficient time to brown the surface, and serve in the same dish.

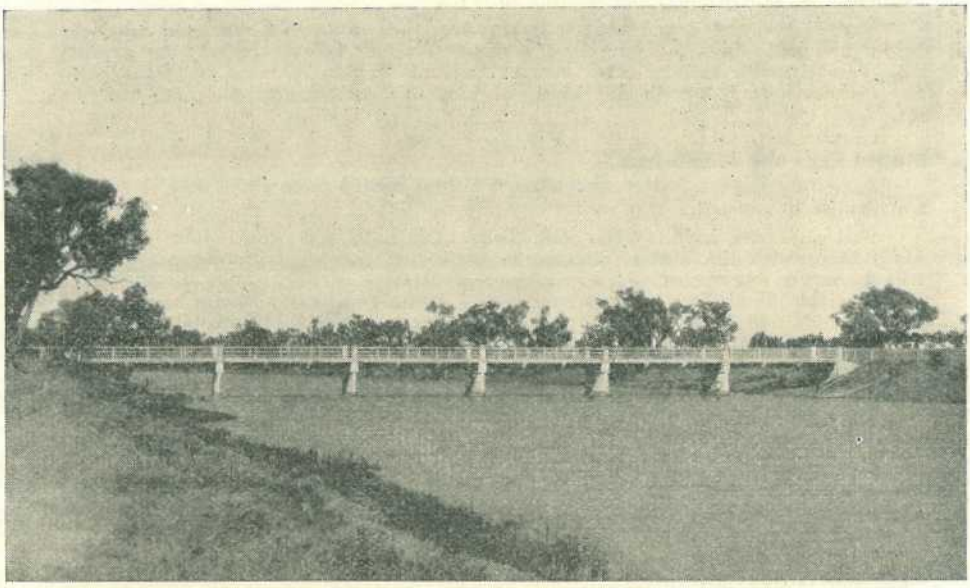


PLATE 125.

NEW BRIDGE OVER THE THOMPSON AT LONGREACH.—This steel and concrete structure has replaced the old wooden bridge, well known to old Westerners, on the Longreach-Winton Road.

RAINFALL IN THE AGRICULTURAL DISTRICTS.

TABLE SHOWING THE AVERAGE RAINFALL FOR THE MONTH OF JANUARY IN THE AGRICULTURAL DISTRICTS, TOGETHER WITH TOTAL RAINFALL DURING 1936 AND 1935, FOR COMPARISON.

Divisions and Stations.	Average Rainfall.		Total Rainfall.		Divisions and Stations.	Average Rainfall.		Total Rainfall.	
	Jan.	No. of Years' Records.	Jan., 1937.	Jan., 1936.		Jan.,	No. of Years' Records.	Jan., 1937.	Jan., 1936.
North Coast.	In.		In.	In.	*Central Highlands.*	In.		In.	In.
Atherton	11·99	36	5·87	8·35	Clermont	5·11	66	4·25	4·88
Cairns	61·70	55	8·92	16·76	Gindie	3·71	38	..	4·78
Cardwell	16·92	65	14·49	10·69	Springsure	4·23	62	1·09	5·43
Cooktown	14·44	61	12·66	10·01					
Herberton	9·67	51	4·32	7·20					
Ingham	15·66	45	11·18	10·65					
Innisfail	20·26	56	7·72	10·53					
Mossman Mill ..	17·94	24	12·47	12·11	*Darling Downs.*				
Townsville	10·98	66	5·52	7·66					
Central Coast.					Dalby	3·31	67	2·94	3·25
					Emu Vale	3·22	41	2·61	4·47
					Hermitage	3·23	31	0·91	3·57
Ayr	10·98	50	7·78	10·75	Jimbour	3·48	49	2·33	2·29
Bowen	10·00	66	1·57	8·15	Miles	3·63	52	3·56	1·61
Charters Towers ..	5·41	55	5·35	2·39	Stanthorpe	3·58	64	7·58	2·88
Mackay	14·10	66	2·81	8·78	Toowoomba ..	5·04	65	2·06	4·24
Proserpine	15·83	34	5·06	18·81	Warwick	3·56	72	2·57	4·44
St. Lawrence ..	9·29	66	5·20	10·14					
South Coast.									
Biggenden	5·20	38	0·85	4·92	*Maranoa.*				
Bundaberg	8·64	54	3·61	4·77					
Brisbane	6·44	85	1·57	5·73	Roma	3·08	63	1·86	2·18
Caboolture	7·57	50	2·10	5·12					
Childers	7·38	42	2·73	4·48					
Crohamhurst	12·26	44	2·11	6·01					
Esk	5·74	50	1·17	6·44					
Gayndah	4·61	66	1·89	5·78					
Gympie	6·62	67	1·29	6·74	*State Farms, &c.*				
Kilkivan	5·54	58	0·62	6·14					
Maryborough ..	7·10	66	1·45	2·86	Bungeworgoral ..	1·82	22	..	1·95
Nambour	9·62	41	2·54	7·03	Gatton College ..	4·34	38	5·97	6·21
Nanango	4·63	55	1·43	3·05	Kairi	9·87	21	..	3·82
Rockhampton ..	7·66	66	3·85	5·98	Mackay Sugar Experiment Station	13·99	40	5·11	11·62
Woodford	7·77	50	1·33	5·76					

A. S. RICHARDS, Divisional Meteorologist.

THE IMPORTANCE OF THE SEPARATOR FLOAT.

Probably the most neglected part of the separator is the float, the function of which is to regulate the flow of milk into the bowl.

This means that it should be perfectly balanced, otherwise an irregular flow occurs and inefficient separation and fluctuation of tests result.

It has been frequently found that floats are badly dented, or leaking. To this condition is added the danger of throwing the float out of balance by amateur repairs. It has also been found that leaking floats have been repaired without first emptying them, which makes them heavier than designed.

Probably the most serious aspect of damaged floats is the fact that cracks and badly soldered joints provide ideal conditions for the growth of bacteria and in consequence milk passing over them becomes contaminated, resulting in many cases of cream being graded down.

Dairymen would be well advised to give consideration to this matter and when repairs are necessary to have them carried out by a competent tradesman, who should be advised of the importance of the work.

ASTRONOMICAL DATA FOR QUEENSLAND.

TIMES COMPUTED BY D. EGLINTON AND A. C. EGLINTON.

TIMES OF SUNRISE, SUNSET, AND MOONRISE.

AT WARWICK.

	March, 1937.		April. 1937.		Mar., 1937.	April. 1937.
	Rises.	Sets.	Rises.	Sets.	MOONRISE. Rises.	MOONRISE. Rises.
					p.m.	p.m.
1	5·46	6·24	6·2	5·50	8·23	9·2
2	5·46	6·23	6·3	5·49	8·59	9·52
3	5·47	6·23	6·3	5·48	9·38	10·44
4	5·47	6·22	6·4	5·46	10·12	11·41
5	5·48	6·21	6·4	5·45	11·8	..
						a.m.
6	5·48	6·21	6·5	5·44	11·59	12·37
					a.m.	
7	5·49	6·20	6·5	5·43	..	1·35
8	5·49	6·19	6·6	5·42	12·54	2·36
9	5·50	6·18	6·6	5·41	1·53	3·38
10	5·50	6·16	6·7	5·40	2·52	4·40
11	5·51	6·15	6·7	5·39	3·54	5·49
12	5·51	6·14	6·8	5·38	4·55	6·56
13	5·52	6·12	6·8	5·37	5·58	8·6
14	5·52	6·11	6·9	5·36	7·1	9·14
15	5·53	6·10	6·9	5·35	8·8	10·19
16	5·54	6·8	6·10	5·34	9·15	11·17
						p.m.
17	5·54	6·7	6·10	5·34	10·22	12·10
18	5·55	6·6	6 11	5·33	11·27	12·53
					p.m.	
19	5·55	6·5	6·11	5·32	12·28	1·33
20	5·56	6·4	6·12	5·31	1·23	2·9
21	5·56	6·3	6·12	5·30	2·11	2·43
22	5·57	6·2	6·13	5·29	2·54	3·16
23	5·57	6·1	6·13	5·28	3·33	3·50
24	5·58	6·0	6·14	5·26	4·8	4·21
25	5·59	5·59	6·14	5·25	4·41	4·54
26	5·59	5·57	6·15	5·24	5·16	5·34
27	6·0	5·56	6·15	5·24	5·49	6·14
28	6·0	5·54	6·16	5·23	6·22	6.59
29	6·1	5·53	6·16	5·22	6·59	7·46
30	6·1	5·51	6·17	5·21	7·36	8·38
31	6·2	5·50			8·17	

5 Mar.	☽	Last Quarter	7 17 p.m.
13 „	●	New Moon	5 32 a.m.
19 „	☾	First Quarter	9 46 p.m.
27 „	○	Full Moon	9 12 a.m.

Apogee, 3rd March, at 6.0 p.m.
Perigee, 15th March, at 1.0 p.m.

Saturn, so inconspicuous to the naked eye, but the most wonderful of planets in the telescope, will on the 16th go down with the Sun and disappear from the evening sky. The rings which are now seen edgewise from the Earth will not be fully open until 1943.

On the 21st, at 11 a.m., the Sun will cross the celestial equator from south to north, and the Australian Autumnal Equinox will occur, the day and night being almost equal. The Sun will then rise due east and set due west, and it will be found useful to mark these points with reference to the horizon.

On the 25th Mercury will be in superior conjunction with the Sun—beyond the Sun from an observer on the Earth. It will on that day set with the Sun, after which it will night after night remain a little longer above the horizon after sunset, until it again reaches its greatest eastern elongation.

On the 27th Venus will apparently come to a standstill, and for about a month seem to move with retrograde motion.

Mercury rises at 4.18 a.m., 1 hr. 28 min. before the Sun, and sets at 5.32 p.m., 52 min. before it, on the 1st; on the 15th it will rise at 5.9 a.m., 44 min. before the Sun, and set at 5.50 p.m., 20 min. before it.

Venus rises at 9.15 a.m., 3 hr. 24 min. after the Sun, and sets at 8.16 p.m., 1 hr. 52 min. after it, on the 1st; on the 15th it rises at 8.54 a.m., 3 hr. 1 min. after the Sun, and sets at 7.41 p.m., 1 hr. 31 min. after it.

Mars rises at 10.13 p.m., and sets at 11.35 a.m. on the 1st; on the 15th it rises at 9.34 p.m., and sets at 11.3 a.m.

Jupiter rises at 1.54 a.m., and sets at 3.32 p.m. on the 1st; on the 15th it rises at 1.8 a.m., and sets at 2.49 p.m.

Saturn rises at 6.45 a.m., and sets at 7.11 p.m. on the 1st; on the 15th it rises at 5.44 a.m. and sets at 6.5 p.m.

The Southern Cross will come into view early in the evening in March. It will be at position III., as on the clock face, about 8 o'clock, and erect about 2 o'clock in the morning on the 1st March, an hour earlier in the middle of the month and two hours earlier at the end.

Phases of the Moon, Occultations, &c.

4 Apr.	☽	Last Quarter	1 53 p.m.
11 „	●	New Moon	3 10 p.m.
18 „	☾	First Quarter	6 34 a.m.
26 „	○	Full Moon	1 23 a.m.

Perigee, 12th April, at 6 p.m.
Apogee, 27th April, at 8 p.m.

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

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

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