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QUEENSLAND AGRICULTURAL JOURNAL

VOL. XXIII. 1 JUNE, 1925. PART 6.

Event and Comment.

The Current Issue.

The June Journal covers a very wide range of interest. Banana-growers will find the record of Mr. Girault's investigation of "Thrips" of particular value. Mr. Edmund Jarvis has an excellent series of science notes which will be very useful to sugar men. Mr. Grenning, of the Forestry Service, has a timely contribution on the question of the establishment of softwood plantations, in the course of which he reviews the present position of our softwood resources. Mr. Tardent, who is so well known to the farmers of the State, and who now controls the horticultural section of the Queensland Magazine, has a seasonal note on frost prevention. Some of the causes of low-grade cotton are discussed by Mr. Ballard, who calls particular attention to two insects whose destructive activities often escape the notice of cotton-growers. Pig-selling systems in Queensland are described and commented upon by Mr. Shelton. Both special and regular features of this month's issue are sure to meet with the appreciation of readers.

Agriculture on the Screen.

The Department of Agriculture and Stock is engaged on the making of a complete series of films depicting all phases of rural life and industry in Queensland. Already films of our cattle, wool, sugar, and banana industries have been made, and copies have been released for metropolitan circuits. Copies have also been sent overseas as a migration stimulant. The films show glimpses of country social life as well as Queensland at work. Each production is realistic and was "made on the farm," and its excellent photography reflects great credit on the departmental cinematographer, Mr. Burne. This is a State that can stand the truth, and each picture is an excellent presentation of things as they are in rural Queensland.

The State Radio Station.

The Premier (Hon. W. N. Gillies), when Minister for Agriculture, saw early the possibilities of wireless telegraphy and its value to agriculture and country commerce, and his efforts have led to the establishment of a large scale State radio service. The work of construction of a Government broadcasting station on the roof of the State Insurance Building is already nearing completion, and before long it will take its place as an important influence in the social life of Queensland. The aim of the Government is to bring this modern medium of education and amusement within the reach of every citizen. The operations of station 4 Q.G., the radio designation of the new broadcasting centre, will be controlled in such a way as to render complete community service. Daily general news services, morning market reports, morning Stock Exchange information, and morning cable news will be broadcast. The farmer will, while seated at his own lunch table, be able to hear by wireless the actual market reports relating to that very morning's sales in Roma Street. Special arrangements are being made between the Queensland Radio Service and the Council of Agriculture for the supply of this information. The farmers' own market representatives on the Council will collect the market data and will actually speak by wireless to the farmers themselves each day. Every afternoon, between three and four o'clock, a musical programme will be provided for the social hour of country women. From half-past six to seven o'clock in the evening bedtime stories will be broadcasted for the benefit of country children. At the conclusion of this session, the farmers' own representative will review the day's markets for the benefit of those who did not listen-in at lunch time, and will also give later market reports. Late news and cable services, as well as any late sporting results, will also be provided. The night session will occupy from eight to ten o'clock, in the course of which high-class musical entertainments will be transmitted. In this feature all tastes will be considered. Short lectures on interesting subjects by prominent authorities will also be a feature of transmissions from the station. Parliament House is being linked to the centre, and on occasions parliamentary debates will be broadcasted. It is intended to place a line in the Premier's own office, so when it is necessary to make an announcement on matters of public interest the head of the Government will be able to speak direct to the people of Queensland. Special attention has been given to the provision of weather forecasts, and excellent arrangements which should result in the farmer being supplied with accurate, speedy, and reliable weather information two or three times a day have been completed.

Revival in the Cattle Industry.

In cattle circles optimism is becoming evident and there is a distinct feeling that the industry has plumbed bottom. Present values already indicate a definite upward trend. Reports from America show that liquidation in the industry has run its full course there. In an article in the current American Bankers' Association Journal the writer (Robert A. Cooper, chief of the Federal Farm Loan Board) asserts that the shrinkage of a million head of cattle a year in America's herds as disclosed by Government figures understates the actual drop in the supply. At the request of President Coolidge he recently made an extended tour through the Western live stock States. He reports that the industry is now financially on the up-grade, declaring that war-time over-production has been followed by decreased herds in every State west of the Missisippi River. In the United States, as in Australia, constructive upward tendencies are much in evidence.

Ratooned Cotton.

The quality of ratooned Queensland cotton is discussed by Frederick Summers, B.A., M.Sc., of the British Cotton Industry Research Association in chapter XXV. of volume III. (1924) of Shirley Institute Memoirs. The advantages and disadvantages of ratooning are discussed from the horticulturist's point of view. A comparison is described between a sample of Queensland cotton grown from seed and a sample grown under the same conditions from plants which have been ratooned at the end of the previous season. In the case investigated, the conclusion drawn is that the quality of the ratooned cotton is inferior to that of the normal product. It is not suggested, however, that ratooning should be condemned without more evidence from other parts of the world.

Bureau of Sugar Experiment Stations.

CANE PESTS AND DISEASES.

Mr. W. Cottrell-Dormer, who is investigating pests and diseases in connection with sugar-cane crops, reports for the period March-April to the Director, Mr. H. T. Easterby, under date 24th April, 1925:—

As the greater part of the month which has elapsed has been excessively wet, a great deal of the time was spent in the laboratory studying fungus diseases of cane in the South Johnstone, and some very interesting information was obtained. By far the most serious disease factor in these wet districts is the group of little known fungi which cause root disease.

Leaf Scald.

This disease is present in most parts of the Johnstone River Districts, but, on the whole, is not yet doing really serious damage, with the exception of one or two isolated cases where N.G. 24B is being very seriously injured along the Main Line and on No. 2 branch in the South Johnstone. It will be remembered that in my last report on this district it was observed that the disease was at its worst in the Japoon area, but as I was unable to visit this area on this occasion I am unable at present to make any comparisons with the extent of damage in the areas visited, though it can safely be said that in no case was the infection found to be quite as great as that observed last year in the Japoon district. However, the symptoms of this disease are very elusive, and we may find that fields which appear perfectly healthy in April will prove to be badly infected in September. Next in order of apparent infection to the areas mentioned above would come No. 6 branch and Daradgee and the Moresby, all of which are lightly infected throughout according to the existing evidence, while Mundoo would rank about last. The Goondi growers are fortunate in being provided with the services of Mr. J. Trivett, and will be well advised to take careful heed of his instructions.

Leaf Stripe.

Leaf stripe was met with on three farms at Boogan, Moresby, and Currajah, which is better known as the Five-mile. In each case the affected variety was Badila and the disease was in the yellow stripe stage. There is but small likelihood of this disease ever becoming serious in Badila, and in the cases mentioned above only a few stools were found showing signs of the disease, yet it is the more dangerous for this very reason, since, because of the inconsequence of the damage done, the average grower will take but little notice of it, thereby allowing the disease to spread; at the present time as much as 20 per cent. of the cane grown in some localities is Pompey, which, as is well known, is very susceptible to this disease. Thus if the disease is not checked in its present small proportions there is every chance that it will find its way into the Pompey and cause very serious losses.

Root and Leaf Sheath Diseases.

By reason of the conditions of excessive humidity which obtain in the Johnstone River districts during a great part of the year this is a true wonderland of the lower botanic flora. Wherever one goes in this great cane district beautiful and grotesque fungi are constantly met with. Some are parasitic on the cane plant itself, but the greater number are merely saprophitic and depend for their sustenance on the refuse of the cane field, such as trash and dead or dying stalks.

The Stinkhorns.—Prominent among these wonderful plants are the Stinkhorn fungi, so-called from the unpleasant effluvium which invariably accompanies them. These are of interest to the canegrower, since in Hawaii and other cane-growing countries closely related species have been attributed with powers of attacking the roots of sugar-cane and thereby causing serious root disease, though the general tendency with pathologists to-day is to discredit these powers.

Two species were met with in the districts visited—a white one and an orange-yellow one. Both are similar in shape, and consist mainly of a central stem tapering from a base about 1 inch in thickness and reaching a height of about 6 inches, where a large thimble-shaped cap is attached, while from this cap a billowing mantle

is suspended which reaches down to about an inch from the ground, the mantle being composed of a frail fungus network whose meshes somewhat resemble those of a mosquito net, though they are rather larger. On digging about in the soil below these plants a quantity of thin pink strands of fungus roots are found which interweave themselves amongst the roots of the cane, though no intimate connection can be seen between the two.

Sclerotial Disease.

This disease, which was described in my last report, is a leaf sheath disease, and is the cause of clinging trash and of spindly sticks. It is due to the activity of a fungus which thrives in very moist conditions and whose occurrence in cane fields is very much extended by the indiscriminate use of pink sticks, where the variety Badila is concerned, during the plant-season. This disease is very prevalent indeed in the Johnstone River districts, but especially in the Mourilyan areas, about Moresby, and in parts of the South Johnstone.

Another leaf sheath disease, which was observed in the South Johnstone district on one farm near the Cross Roads, is that caused by a species of Himantia, perhaps *H. Stellifera*, which sometimes causes appreciable damage to cane in other countries. The infection in this case, however, was very small, and there is little likelihood of the fungus ever becoming a serious factor in these parts.

A rather serious leaf and leaf sheath disease, which was observed in the Babinda district, was also found occurring in this district in small patches here and there. This consists of large dead spots 1 to 2 square inches in surface surrounded by a dull red and irregular border, which are found on the leaves and leaf sheaths of affected stools. These spots often coalesce and form very large dead strips on the leaves or leaf sheaths. In damp weather at least are found a light fluffy growth of fungus and small oval conglomerations of fungus mycelium on the under side of the leaf. Affected cane when young is usually backward, so that the disease is probably a virulent one and is well worth watching lest control measures may prove necessary.

Grubs.

The larvæ of the Greyback Beetle would seem to be striving to excel themselves this year in their work of destruction. Acres of fallen cane are to be seen on the red soil ridges and the loss to some growers promises to be quite ruinous. The two worst affected localities seen by me were the Crossroads and parts of Daradgee, though I was led to believe that some of the country about Nerada and Japoon was even worse. Branches No. 1, No. 2, No. 6, and the Main Line in the South Johnstone have their full quota of injury, and about 70 per cent. of one farm on the No. 1 Branch is entirely wiped out. Yet many of the grubs at present under the cane stools are only in the commencement of their third stage, so that the visible damage may be expected to extend a great deal further during the course of the next month. The soil in all of these infected areas is loose and friable and aptly suited to fumigation, while nature invariably provides the district with at least a fortnight of fine weather late in December or early in January, so let the Pest Destruction Committees be up and doing, in preparation for the coming season, by planting out suitable trial plots to be laid out by them under the direction of the Entomologist, especially since everything points to ultimate success in this line of control provided the freightage on the necessary chemicals is not too high. The advantages of fumigation with paradichlor. do not stop at saving the treated crop, but also enable the grower to ratoon his cane. The fumes act as a stimulant to the cane in an indirect manner, so that manurial effects are also obtained, and again a recent experiment done by the writer would indicate that the action of certain parasitic fungi which cause obscure root diseases in these parts is very much retarded or even stopped by the fumes of paradichlor, thus giving the cane a good start in its career of productivity.

A very noticeable feature in this year's grub infestation is the marked definition of the damaged fields. In almost every case it is found that the grubs have limited their attack to cane which was fairly big at the time of the beetle flight, such as April plant and late-cut ratoons, while adjoining fields which had recently been cut or which contained young spring plant were left untouched. A combination of this knowledge and of fumigation technique provides a rational control for grubs.

Gumming Disease in the Mulgrave District.

During my stay in the Innisfail district a report reached me that doubt was being evinced by one or two interested farmers in the infected area. As gumming is such a very serious disease, I decided to visit the district. It was found on this visit that during the six or seven weeks which had elapsed since the previous visit

instead of the leaf symptoms of the disease being confined to a small area of about a quarter of an acre, and to two varieties, twelve varieties now plainly showed the symptoms and the area involved was about 10 acres. This would indicate that the weather had become more favourable to the appearance of leaf markings and that the next few weeks will be the time par excellence for growers to carefully go through their fields and report any suspicious symptoms to their secretary (Mr. Curlewis), so that this Bureau may be kept in touch of any further developments during the writer's absence.

To prove beyond doubt that the disease actually was gumming, smears were made from infected leaves and the bacillus causative of the disease recognised. It is to be hoped that this short note will prove sufficient to quell any doubt on the matter.

ENTOMOLOGICAL HINTS TO CANEGROWERS.

By EDMUND JARVIS, Entomologist, Bureau of Sugar Experiment Stations.

Cane-grubs at their Worst.

During this month grubs of our grey-back cane-beetle are fully grown, and on badly infested areas (as shown on the accompanying photograph) have either caused the sticks to fall over or fairly eaten them out of the ground.

It is now too late to save the cane by practising remedial measures, since most of the damage is already done, and by the end of this month these grubs will commence tunnelling downwards to depths varying from 9 to 18 inches or more in order to construct cells in which to transform into the pupal state. (See sketch of pupa).

If desired, these pupæ can be destroyed by fumigation at any time during July to October; most growers preferring, however, to leave the beetles to ultimately emerge from such infested land in November or December, hoping that they will then be considerate enough to wing their way to distant fields. It is well to remember, however, that in the event of numerous feeding-trees being situated within half a mile or so to the north-west of such pupæ-infested land the beetles arising from it are likely to migrate to these trees, and after feeding for a couple of weeks to return and lay their eggs in the vicinity of the land that gave them birth.

How to Steal a March on the Weevil Borer.

Growers are advised to place bait-traps on headlands of low-lying blocks of Badila, &c., where weevil-borers have been sufficiently numerous to materially injure crops in previous seasons. By this means it is possible to discover infestation before damage has been effected, thereby enabling farmers to take prompt measures for coping with this pest. Such traps consist merely of pieces of split sugar-cane about 18 inches long, placed in little heaps of from ten to twenty pieces and covered over lightly with trash to exclude sunlight and prevent the sticks from drying too quickly. Visit and examine these bait-traps every second day, and if weevils be found in them among the split pieces advise the Entomologist at Meringa without delay. Tachinid parasites of this beetle borer will be released by the Sugar Bureau free of cost on such infected areas, on condition that the grower will agree to leave about a quarter of an acre of the cane uncut for the parasites to breed in. This should be allowed to stand for about three months, and must not be burnt.

Protect Your Insect Friends.

Do not destroy soil-frequenting larvæ, &c., of beneficial insects which are parasitic or predaceous on grubs injuring your cane, and are often brought to the surface when ploughing.

Some of the commonest of these are figured and described in my hints for March, 1925 (see "Queensland Agricultural Journal," vol. xxiii., pp. 273, 274; and "Australian Sugar Journal," vol. xvi., p. 831).

Combating White Ants.

Growers on the Burdekin should be careful when planting to see that cane used for this purpose does not contain termites.

Field experiments were carried out in this district last month with certain insecticides and fumigants for treating cane sets on termite-infested land, both

before and just after planting same; the chemicals used in such work having previously given promising results in our laboratory at Meringa. Common-sense methods of fighting this pest must not be neglected. Try to locate the source of invasion of canefields, which can sometimes be traced to termite-infested roots,

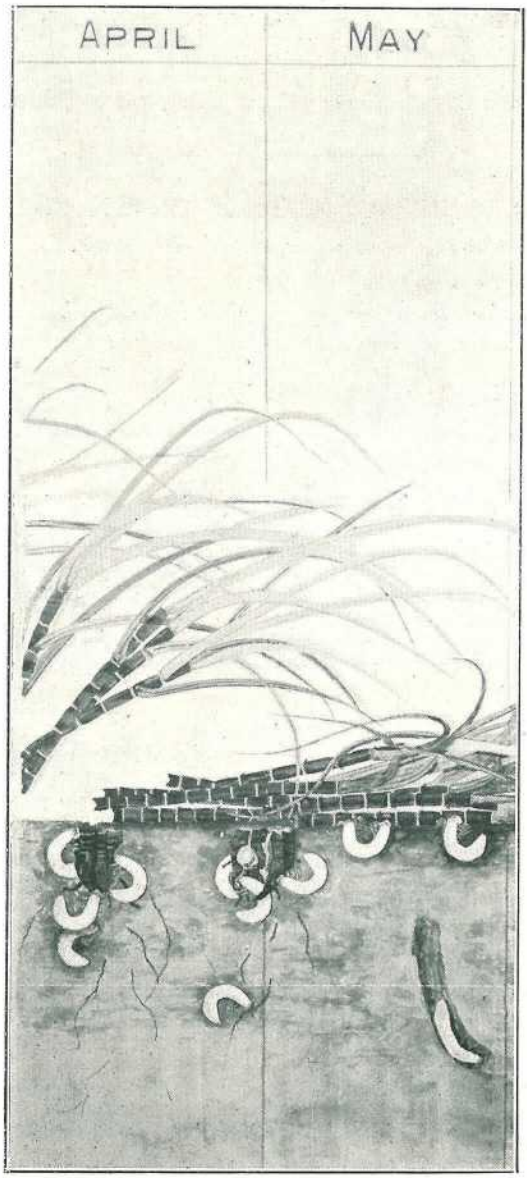

PLATE 82.—GRUBS OF *Lepidoderma albohirtum*.
(Grey-back Cane-beetle).

tree stumps, &c., either situated in the field or on land adjoining it. Burn all affected logs, posts, or timber on or close to headlands. Read Report for February to March dealing with control measures in this connection ("Queensland Agricultural Journal," vol. xxiii., 248, 249; and "Australian Sugar Journal," vol. xvi., pp. 831, 832).

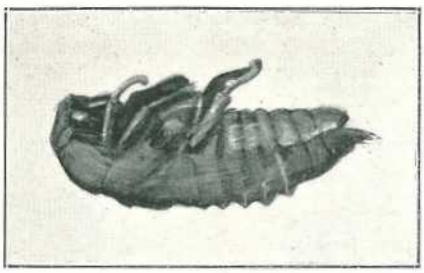

PLATE 83.—PUPA OF GREY-BACK CANE-BEETLE.
(Natural size).

Fighting Grasshoppers.

Our two most injurious species of locusts, viz., *Locusta danica* Lin. and *L. australis* Brunn., may at any time invade plantations; and in the event of their proving troublesome this month or being noticed in great numbers in the vicinity of cane-fields, growers should communicate with the Entomologist at Meringa, in order that such infestation may be duly recorded and position of eggeries noted with a view to subsequent destruction of the early spring brood of young hoppers while they are in the wingless larval condition.

When invasion has taken place a poison-bait may be used, consisting of fresh green grass finely chopped and soaked in a solution of arsenite of soda and 4 to 11 lb. of treacle in 12 gallons of water. This bait should be scattered thinly in front of the swarm while the locusts are moving and feeding, or among the cane upon which they are settled when roosting. I may state that it has given great success against migratory locusts in the Sudan, being readily devoured when the treacle is in the proportion of 4 to 12 gallons of water, but proving still more attractive when the proportion of treacle is increased.

Examine Cane-Sets before Planting.

During planting operations reject all seed showing tunnels of the Weevil Borer, or that may have come from a locality known to be borer-infested. Such seed often harbours eggs or young larvæ, and after planting same the latter may devour enough of the set to cause it to be worthless for support of the growing shoots, with the result that they may die later on, causing unsightly misses.

Moreover, it is by means of such diseased seed that this borer often obtains a footing in clean localities, and, once becoming established, it is not easily got rid of.

In the Burdekin district care must be taken to select seed from plantations known to be free from the presence of the large white-ant or termite, *Mastotermes darwiniensis* Frogg.

Combating Weevil Borers.

Tachinid parasites of this beetle borer will be released by the Sugar Bureau free of cost on infested areas, provided growers will agree to leave about one-quarter or half an acre of such borer cane uncut for the flies to breed in. This should be allowed to stand for about three months after liberation of the parasites, and must not be burnt. For construction of bait-traps see last month's Hints (''Australian Sugar Journal'' and ''Queensland Agricultural Journal,'' May issue, 1925).

Insect Friends of the Canegrower.

Various larvæ, &c., of predaceous and parasitic enemies of cane-grubs are brought to the surface at times when ploughing out cane. Some of the commonest of these are figured and briefly described in the Hints for March, 1925 (''Queensland Agricultural Journal,'' vol. xxiii., pp. 273, 274; and ''Australian Sugar Journal,'' vol. xvi., p. 831).

Movements of Cane-Grubs.

The feeding season being now over, grubs of *albohirtum*, as seen by the accompanying diagrammatic illustration, have gone down into the soil and formed chambers in which to pupate. These are generally found directly under a damaged

stool, at depths which are largely determined by the mechanical condition of the soil and percentage of moisture present at the time. The pupa of this cane-beetle occupies a position of complete isolation, being placed in a specially prepared chamber with its smooth walls lined in a manner calculated to effectually exclude small insect enemies, and prevent it from drying up prematurely or being harmed by

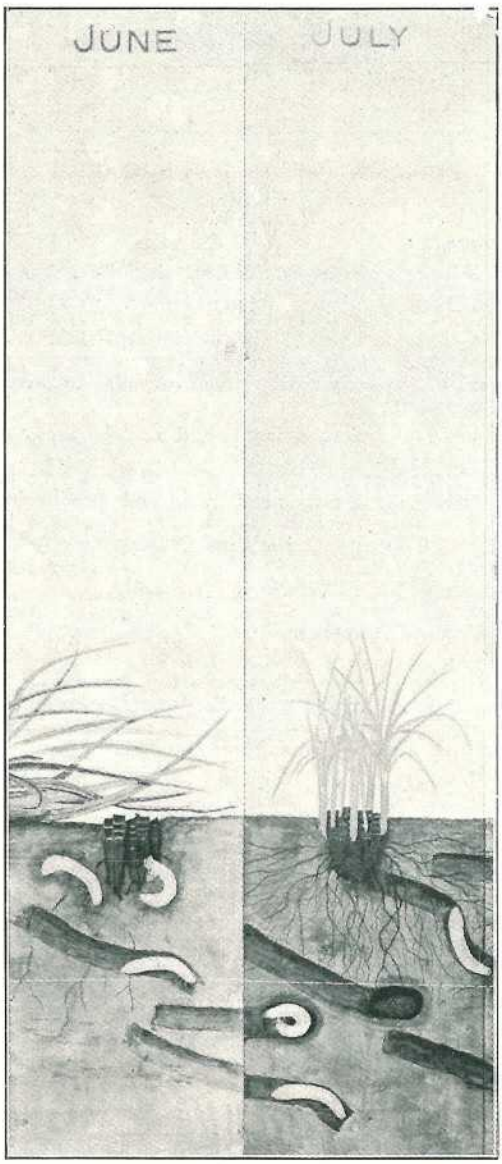

PLATE 84.—ACTION OF CANE GRUBS BELOW THE SOIL

soaking rains. Such isolation of the pupa proves advantageous also to the beetles themselves, which often have to remain several weeks, occasionally months, in these subterranean chambers while waiting for rain to soften the ground sufficiently to allow them to tunnel to the surface and enter upon their aerial existence.

SCIENCE NOTES.

By EDMUND JARVIS, Entomologist, Bureau of Sugar Experiment Stations.

ON THE VESTITURE OF CANE-BEETLES.

Among other specific distinctions characterising certain of our scarabæidæ affecting sugar-cane, variations in the form and arrangement of the scales present on the elytra in *Lepidiota* and *Lepidoderma* deserve special attention.

This curious vestiture observable in insects, and which is believed to be a modified form of the hairs, occurs mostly on species of the Order Lepidoptera (butterflies and moths), the mealy dust-like substance which comes off on one's fingers when handling such insects being in reality composed of microscopically minute scales of more or less definite shape, countless numbers of which cover both the upper and under surfaces of their membraneous wings.

In addition to occurring throughout this Order, many species of Coleoptera (beetles), Colembola, Thysanura, Trichoptera, &c., are provided with scales.

Before considering the colour and structure of such vestiture, however, it will be of interest to glance for a moment at the origin, development, and uses of scales.

Their growth from certain large cells situated just below the epidermis appears to have been first observed nearly forty years ago, and more recently (1896) Mayer noticed that about three weeks before a butterfly emerges from the pupa these hypodermal cells may be seen protruding slightly above the level of the epidermis. (Fig. 1).

At a later stage they become larger and project from the tops of a series of ridges thrown up at regular intervals across the wing, which ultimately develop in the imago condition into parallel rows of scales, overlapping each other and also covering the membrane lying between them.

According to Kellogg, their primary use is to protect the body, while other scientists think they serve to stiffen the wings, or to prevent a too speedy evaporation of moisture from the body.

The support advanced in favour of the latter view is that, among Colembola, &c., they are found only on those species inhabiting comparatively dry situations, and that scaleless forms, if exposed to similar conditions of temperature, will soon die.

Such inference should, I think, be received with caution, as one could hardly expect these scaleless Colembola, when transferred from their natural surroundings and climate, to endure conditions of temperature that they had never been used to.

Moreover, it scarcely follows that ability in the former to stand excessive dryness should necessarily be attributed to the possession of scales. Take, for example, species of Curculionidæ (weevils) occurring in the Cairns district of North Queensland, many of which, although little in evidence during the day, and flying at night time (*Leptops, Cryptorhynchus*) are densely covered with scales, while others of similar habits and structure have no vestiture whatever. Again, many weevils resting on leaves all day in the hot sunshine are found to be either densely clothed with scales (*Stenocorynus*), provided with them sparingly or in patches (*Belus*), or entirely without scales (*Ectocemus*).

Amongst sun-loving beetles belonging to the Buprestidæ practically all of the species are destitute of scales, which when present are usually placed in isolated tufts or bands (*Cisseis Protætia*).

Such occurrence of scales on flower-frequenting species in which the elytra are of uniform thickness or consistency affords conclusive evidence of the vestiture being intended to serve some purpose other than that of merely checking evaporation of moisture.

Although perhaps helping to protect the bodies of certain microlepidoptera from mechanical injuries and stiffen their delicate wings, I am inclined to believe that scales are intended primarily to protect a species by bestowing upon it such colours as will best match or harmonise with those of the flowers, leaves, bark, &c., on which it habitually rests or resides.

Amongst lepidoptera, such so-called protective coloration is certainly displayed in a most marvellous manner, having attained, perhaps, its highest expression in the well-known Indian "Leaf Butterfly" (*Kallima inachis*), the under surfaces of whose wings exhibit an exact representation of a brown decaying leaf, showing midrib, branching veins, and, in some specimens, blotches in imitation of stains caused by wet weather or fungus growth.

When disposed on the elytra of beetles in tufts or patches—as already noticed in the case of Buprestidæ—such variously coloured scales often tend to disguise the presence of an insect by breaking up its general appearance and body surface, this mode of protection being seen in species of Cerambycidæ belonging to such genera

as *Rhytiphora, Clytra, Glenes, Batocera,* &c. Similarly, the scales when present in Curculionidæ sometimes afford protective coloration, evidence of which is not wanting in such genera as *Cryptorhynchus, Euteles,* &c.

Do not let us forget that the presence of scales on lepidopterous insects makes possible that riotous feast of colour which to most of us recalls pleasant memories of childhood's chase after some bright-winged butterfly; in days when the glamour of early youth cast a golden lustre over the simple joys of life.

Although often unconscious of the spiritual significance of colour, as displayed in the insect and floral worlds, its all-pervading influence is, nevertheless, seeking in a thousand ways to reveal to us the beauty of truth.

Structure of the Scales in Cane-Beetles.

We will now consider very briefly the structure of the various scales found on our cane-beetles, comparing their form with that of those occurring on certain primitive species of class Insecta.

Scales, as already mentioned, are thought to be merely modified hairs, and if we examine the wings of Mecopterous insects, which in structure and metamorphosis are very closely allied to lepidoptera, we shall find numerous examples of remarkable hair-like scales.

An interesting variation in the form of these occurs in one of our common Queensland Hemerobidæ, in which they pass from a decided linear to a broader shape (Fig. 2).

The gradual transition from such more or less primitive vestiture to that displayed by butterflies and other lepidopterous insects is effected insensibly by a beautiful diversification in the size, form, and structure of scales, which vary, for instance, from those with from two to four acutely-lanceolate projections (*Acræa*) (Fig. 3, leaf-shaped (*Psychidæ*) Fig. 4), to elongate to broadly oblong (*Morpho* and *Papilio*) (Figs. 5 and 6).

Again, in moths belonging to the family *Glyphipterygidæ* remarkable scales often occur on the patagia, some of which (Fig. 7) are more or less hair-like, spatulate, or clavate, measuring as much as 0·38 mm. by 0·03 mm.

In the group Coleoptera one meets with scales of strange formation in some species of *Batocera, Leptops, Cryptorhynchus, Mimadoretus,* &c. (Figs. 8, 9, 10, 19).

Among scarabæidæ, commencing with our common grey-back cockchafer *Lepidoderma albohirtum* Waterh., we find the wing-cases of this insect to be uniformly clothed with rather large boat-shaped scales (Fig. 11), measuring 0·20 by 0·06 mm. These project from the surface of the elytra at an angle of about 20 degrees, appearing at such times of elongate or pear-shaped form; the obtuse basal portion of each scale touching or overlapping others slightly, while the free projecting ends taper gradually to a point. They are very convex above and hollow or concave beneath, the lower ends being attached to the chiten by means of a short stalk-like root.

As a result of microscopical examination, I am inclined to believe that in *albohirtum* they serve to aid the beetle during its escape from the ground. In addition to the free ends of these scales being directed backwards, the edges of each (especially where close to the point) are fringed with exceedingly minute spines, which also face towards the anal segment.

In all probability such vestiture helps this cane-beetle to retain its grip on the ground whilst tunnelling to the surface, the position of these scales serving to prevent unintentional retrogressive movement during its upward journey through compact soil.

To illustrate this point the reader should hold a grey-back beetle firmly and pass a finger lightly over the surface of its elytra. Whilst passing from head to tail one feels only a silky smoothness, but in the opposite direction a decided roughness will be felt.

Our species of *Lepidiota* are characterised mainly by the possession of flattened scales of almost circular outline, which do not, like those of *albohirtum*, project from the surface, but rest in shallow concavities formed in the elytra.

In *Lepidiota frenchi* Blackb. and *L. consobrina* Gir. they are rounded, slightly convex above, and finely granulate (Figs. 12, 13); those on the elytra of the latter species being 0·13 mm. in diameter, while on *frenchi* they measure 0·10 mm. These scales, which are scattered thinly over the wing-cases of both the above species, are barely visible to the naked eye as minute white specks that viewed collectively produce the effect of a pale whitish bloom overspreading the reddish-brown ground colour.

In *Lepidiota caudata* Blackb. they are very much smaller, 0·06 mm., and also more sparingly distributed, imparting to freshly emerged specimens a faint opalescent sheen (Fig. 14).

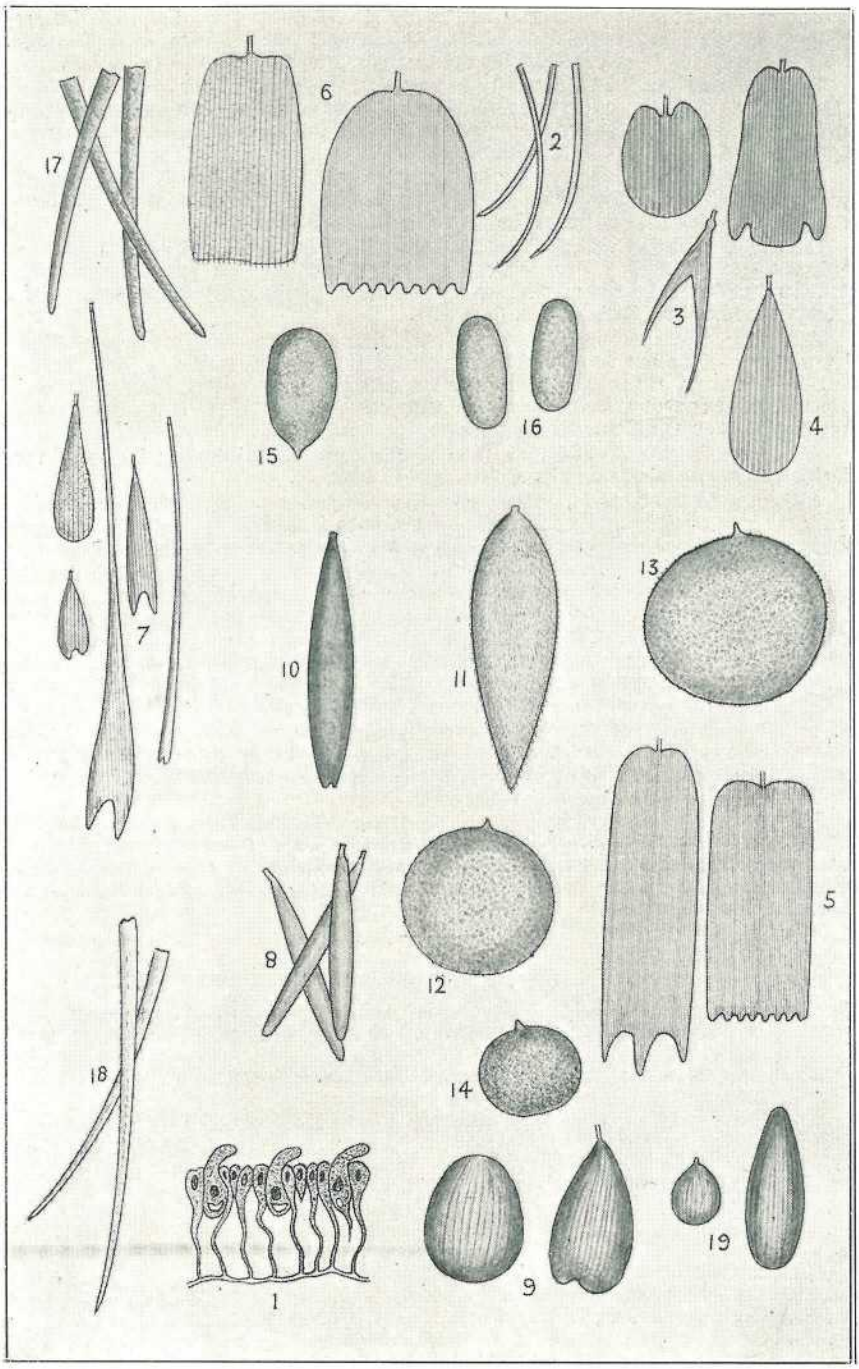

PLATE 85.

Scales occurring on the elytra of Cane Beetles and other Coleoptera; in comparison with scales found on the wings of Lepidopterous Insects.

Figs. 2 to 19 magnified 200; original. Fig. 1, after Mayer.

(*For description of Plate, see page* 466.)

The scales of *Lepidiota rothei* Blackb. (Fig. 15) differ from those of the preceding species in being egg-shaped instead of circular, 0·08 by 0·05; in *L. No. 215*, an insect closely related to *rothei*, they are elongate-oval, 0·08 by 0·03 (Fig. 16).

In this connection it is interesting to note that in the allied genus *Rhopoea* some of the species possess long linear scales which taper from the swollen basal portion to a point, and are very quill-like in appearance; while in *Lachnosterna* again they are longer and practically resemble hairs (Figs. 17, 18).

So closely does the imago of *frenchi* compare with that of *consobrina* in general structure, that for many years systematists failed to recognise them as being specifically distinct (see Bulletin No. 3 of this Office, 1917).

Similarly, *L. rothei* and *L. No. 215* (lately identified at the British Museum as *Lepidiota grata* Blackb.) were classed as being one and the same species until attention was drawn by the present writer to marked dissimilarity between the scales of these cane-beetles (Bulletin No. 3, p. 39).

As a matter of convenience during identification, I have considered the vestiture of the elytra only; but it should be mentioned that scales on the ventral surface, sides, legs, &c., on a few of our scarabæidæ affecting cane often differ slightly in form and arrangement from those on the wing-cases of individual specimens, thereby affording additional specific distinctions.

All scales figured on the plate are of the same magnification, in order that relative differences in size may be appreciated at a glance.

Although so diminutive, each is composed of two separate layers or lamallæ, parallel to one another and kept apart by chitinous filaments, the intervening space being at first filled with protoplasm, which is afterwards withdrawn. In lepidoptera the surface of the upper plate or lamella is usually thrown into a series of parallel ridges, which are often connected transversely by numerous striæ (Fig. 6).

On the wings of species adorned with metallic colours such striations usually exceed 1,000 to the millimetre (1,300 in *Morpho*), but in other lepidopterous insects may be about 100 to the millimetre or even less. In certain blue metallic scales occurring on the wings of *Papilio ulysses* the concavities between striations are closely packed transversely with innumerable minute irregular carinations.

In the scales of our cane-beetles, however, which vary in colour from whitish to very pale yellow, the surface, instead of being striated in this way, is minutely granulate, although in many other coleopterous insects the occurrence of more or less parallel rows of striæ is not uncommon (Figs. 9, 19).

With regard to vertebrate animals, it may be of interest to mention that the cortical portion of the hairs in certain species is formed of imbricated flattened scales, which in some of the bats are arranged around the hair in a series of whorls consisting of long narrow leaflets projecting from the surface of the hairs at an angle of about 30 degrees.

EXPLANATION OF PLATE.

Fig. 1. Longitudinal section through one wall only of the pupal wing of a butterfly, showing development of three of the scales from hypodermal cells.
Fig. 2. Hair-like scales from forewing of Mecopterous insect.
Fig. 3. Scales from the wing of *Acræa andromacha*.
Fig. 4. Scale from a species of Psychidæ (Bag-moth).
Fig. 5. Scales from the forewing of *Morpho ega*.
Fig. 6. Scales from the wings of *Papilio ulysses*.
Fig. 7. Scales of a species of Glyphipterygidæ.
Fig. 8. Linear-shaped scales from an elytron of *Batocera*.
Fig. 9. Convex scales from the elytra of *Cryptorhynchus*.
Fig. 10. Moniliform scales from elytra of *Mimadoretus* sp.
Fig. 11. Scale from a wing-case of *Lepidoderma albohirtum*.
Fig. 12. Scale from an elytron of *Lepidiota frenchi*.
Fig. 13. Scale from an elytron of *Lepidiota consobrinus*.
Fig. 14. Scale from an elytron of *Lepidiota caudata*.
Fig. 15. Scale from an elytron of *Lepidiota rothei*.
Fig. 16. Scale from an elytron of *Lepidiota grata*.
Fig. 17. Hair-like scales from the elytra of *Rhopoea* sp.
Fig. 18. Long hair-like scales from elytra of *Lachnosterna*.
Fig. 19. Convex shell-like scales from elytra of *Leptops*.

Note.—Fig. 1, after Mayer; Figs. 2 to 19 original. All scales magnified 200 diameters.

CANE PEST COMBAT AND CONTROL.

The Director of the Bureau of Sugar Experiment Stations (Mr. H. T. Easterby) has received the following report (28th April, 1925) from the Entomologist at Meringa, near Cairns, Mr. E. Jarvis:—

White Ants Attacking Sugar-cane.

Details of control work against *Mastotermes darwiniensis* Frogg. were recorded in my last report, which contains data regarding results secured at our laboratory by dipping cane-sets before planting in various deterrents. (See "Queensland Agricultural Journal," vol. xxiii., p. 249; and "Australian Sugar Journal," vol. xvi., p. 832).

The most promising of these were tar, and a 10 per cent. kerosene emulsion containing sodium arsenite at the rate of 1 ounce of the poison to each gallon.

Field experiments with these deterrents were carried out on 12th March, when twenty sets were coated with dehydrated tar (ten having eyes well advanced) and planted about 4 inches deep in moist soil. Thirty-three days later (14th April) six of those with forward buds were well above the ground, and two were just shooting, while of the other ten sets only four had developed shoots.

At the same time, 12th March, ten sets after being dipped in the poisoned kerosene emulsion were planted alongside the others; none of these, however, having forward eyes, although one or two were top plants. When examined on 14th April the buds on these sets had not sprouted, being apparently dead.

Wet conditions interfered with the above experiments, as from date of planting to the end of March (an interval of nineteen days) we recorded 18.67 inches of rain; and during April up to the 14th experienced only two days without rain.

Being situated on low-lying ground of a rather heavy clay-loam the planting furrows were repeatedly filled with water, which remained standing over the sets for hours together.

Possibly a coating of tar may help to keep sets from being injuriously affected by continuous wet conditions.

With regard to those dipped in the poisoned kerosene emulsion, failure to grow might have been due to the action of the sodium arsenite on the buds. In laboratory experiments with this solution it was noticed that treated sets in cages did not develop shoots or roots; whereas sets in control cages sprouted and rooted in a normal manner. With dehydrated tar, on the other hand, 100 per cent. development of eyes was obtained in cages containing sets that had been coated with this deterrent.

We are hoping to test the merits of dehydrated tar under field conditions in the Burdekin district this season; and expect to be duly advised by the secretary of the Pest Destruction Board as to when planting will commence on those areas infested by white-ants.

Damage to growing and mature cane sticks from attacks of *Mastotermes darwiniensis* is often of a most serious nature, and unless we combat this pest it may become increasingly troublesome in the future. The accompanying plate affords graphic illustration of these termites at work, and their method of devouring the interior of infested cane sticks.

Liberation of Tachinid Flies.

On 6th March twenty specimens of *Ceromasia sphenophori* were liberated by Mr. G. Bates at Mount Pelion, near Mackay, in standover cane affected by the beetle borer (*Rhabdocnemis obscurus* Boisd.) growing on low-lying ground near the Murray Creek.

In addition to this introduction of living parasites, a breeding-box of cane sticks containing puparia was established in the same situation, from which numbers of these parasitic flies were due to emerge a few days later. Mr. Bates found, upon enquiry, that damage from moth-borer is frequently mistaken for evidence of the presence of weevil borers. Such confusion could easily be avoided if growers would simply cut open an affected stick and locate a specimen of the grub. Should this be plump, creamy-white, somewhat maggot-shaped, and from ¼ to ¾ of an inch long, with pointed tail extremity, light-brown head, and doubled up body, it will be a larva of the weevil borer; but if a pinkish yellow caterpillar from ½ to 1¼ inch long,

and of uniform thickness, will eventually transform into a light-yellowish or silvery-brown moth about 1½ inches across the expanded wings.

On 8th April a liberation of 60 tachinid flies was made at South Johnstone, and a box of three sticks containing puparia of *obscurus* established there.

During the last eighteen months about 9,000 specimens of this useful parasite have been bred here and distributed at various points in the Cairns, Babinda, South Johnstone, Herbert River, Proserpine, and Mackay districts. Most of these liberations have been effected by the setting up on borer-infested areas of specially constructed boxes holding cane sticks containing numerous puparia of this parasite, selected from our breeding-cages with view to ensuring emergence of the flies taking place a few days after such establishment.

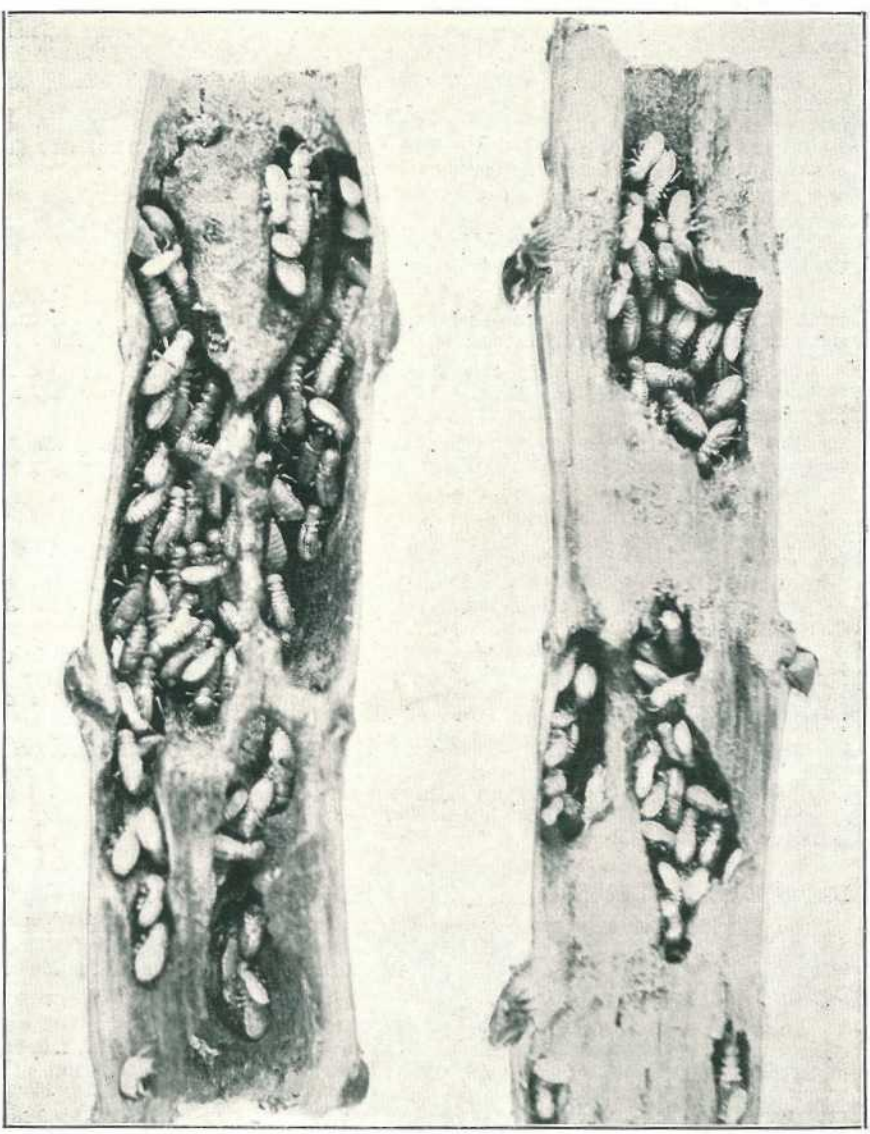

PLATE 86.—TERMITES (*Mastotermes darwiniensis* Frogg).
Devouring the central portion of a stick of sugar-cane. (Natural size).

Cane-grub Activity.

At the present time (17th April) grubs of *albohirtum* (grey-back cane-beetle) being in the third instar or fully grown, have entered upon the period of greatest anxiety for the farmer, who may at any time be confronted with unmistakable evidence of the presence of this pest on areas thought to be free from attack.

In several districts late ratoon crops on high lands have already been completely destroyed before attaining a height of more than 2 or 3 feet.

Generous rains have kept the cane growing well, and enabled slightly grub-infested crops to counteract such injuries by making fresh roots. In the event of showery weather continuing, much of this damaged cane may eventually yield a fair return.

It may be well to remind growers that third-stage grubs of the small brown cockchafer (*Lepidiota frenchi* Blackb.) are likely to be troublesome this year to young plant and ratoon cane; so that, when preparing land for early planting the second-stage grubs of this beetle should, if possible, be collected, as otherwise they will transform into the third instar during June to August, and be ready and eager for action in the months of September, October, and November.

Dexiid Parasite of Lepidiota Frenchi.

Two specimens of a large and hitherto unrecorded species of Dexiid fly were reared last January by Mr. G. Bates from third-stage grubs of our common reddish-brown cane-beetle.

This handsome fly measures about 1¼ inch in wing expanse, and is ½ an inch long by nearly ¼ inch in width; its thorax being ornamented with iridescent dark greenish-brown tints, while the abdomen is lighter brown with a dark bluish median stripe and light-green iridescence. In this connection I may mention that eight species of the family Dexiidæ have previously been bred by us from root-eating grubs of scarabaeidæ affecting cane; two of these being parasitic on *Dasygnathus*, two on *Anomala* and *Heronotus*, one on *Anoplognathus*, and two on *Lepidiota*.

These beautiful diptera, which are often mistaken for gigantic blow flies, are usually adorned with brilliant metallic shades of iridescent green, gold, crimson, or blue.

FIELD REPORTS.

Mr. E. H. Osborn, Northern Field Assistant, reports (31-3-25):—

Mourilyan.

During a thirty-three weeks' run this mill accounted for 120,652 tons of cane, of which only 22 per cent. was burnt. Owing to prolonged season and continuous wet the c.c.s. fell rapidly at the end of the season, bringing the season's average down to 12·97 c.c.s., worth 42s. per ton. To cope with the increased tonnage expected this season, many additions are being made to the mill plant. Crops were growing rapidly and showed great promise. Probably 95 per cent. of the cane is Badila, and of the other 5 per cent. a proportion is Q.813, which is steadily increasing its acreage, plant cane of this variety on very medium to poor soil returning up to 29 tons per acre, with a very high density. Particular notice of Q.813 harvested in December, January, and February proved that its sugar content was practically upon a par with Badila cut at the same time. Cane at Cowley was rather upon the backward side, but a very good block of September plant of Mr. R. Gill's was seen, showing good even growth.

A paddock of fourth ratoons N.G.15, manured with 5 cwt. mixed fertiliser in two applications, and owned by Mr. J. McCutcheon, cut at the rate of 28½ tons per acre, and now looks very promising.

Diseases.—Leaf Scald was noticed in the Cowley area to a fairly large extent, standover ratoon, first ratoon, old ratoons, and a little plant cane being affected. Growers are advised to carefully watch any cane that is intended for seed and grub out any stools that show traces of the disease.

South Johnstone.

This mill accounted for 232,257 tons of cane, and also railed another 12,262 tons to Giru. Had not exceptionally wet weather prevailed, about another 15,000 tons of unpermitted cane would have been handled. The huge total of 232,000 tons crushed

at South Johnstone averaged 12·64 c.c.s., and was put through in thirty-three weeks. The whole season was particularly free from labour troubles of any sort, and all hands are congratulated upon the hearty co-operation that was such an outstanding feature of the 1924 season. Tonnage per acre works out at about 24 tons. All the cane seen showed very great growth, and an immense crop should be harvested. A very big proportion of the crop is ratoons, which in nearly all cases seen carried a tremendous growth. One block of second ratoon N.G.15 cut in August, which had not been worked up, looks easily good for a 40 to 45 ton crop. The volcanic soils in this area are wonderfully fertile, and are also very economical to work. As South Johnstone has some 14,000 acres to harvest during the coming season, the crushing problem is a big one.

Pests in the Innisfail area.—Grubs were showing up badly upon several farms in the Daradjee area, while upon others small yellowish patches were noticed. In one patch twenty-seven grubs were taken from under and adjacent to one stool of young ratoons.

In this area grubs were seen in September plant, standover plant, first ratoons, and old ratoons. At South Johnstone a few were noticed upon several farms in the area, but the infestation was not serious.

Diseases.—More scald was noticed throughout the Goondi area than previously, and it certainly looks as if it were spreading. As N.G.15 is the main cane grown in the district, and Leaf Scald has not so far done as much damage as it would do in a more susceptible variety, it is up to the grower to see that none but the very best seed is to be used when planting operations are being carried out.

Babinda.

This mill treated a crop of 206,203 tons of cane, of which only 20 per cent. was burnt. The quantity crushed represents 42,382 tons better than its previous record, whilst the small tonnage of burnt cane reminds one of the very early days of the mill, when the cane was either plant or first ratoon and cutting very heavy.

The huge crushing was very successful from every point of view, and the farmers should be highly pleased with their first year's control of operations. No time was lost through disputes, all hands working well together.

An extensive overhaul is now being carried out. During January, February, and well into March very wet weather, accompanied by periods of intense heat, made conditions ideal for good growth. With the cane in general looking promising, it is rather hard to particularise, but the red soils of Bartle Frere take a lot of beating in this area. One crop of ninth ratoons, practically unworked, looks good enough for an 18-ton crop per acre now, while a crop of fourth ratoons cut early was lying down in places.

Some fine cane was noticed upon the Bartle Frere flats and also upon the Josephine Creek area of the Munro Estates. This has been well worked and manured and promises a very heavy crop. Throughout Bucklands Branch and across the Russell good crops were also seen. At the northern end the cane was green and healthy, but was rather backward.

Pest.—Signs of grubs were noticed upon quite a number of farms, on most of which the owners said that they were unaware of an outbreak. Growers would be well advised to read regularly the entomological notes published in the local papers at short intervals by the Government Entomologist at Meringa, and by digging up, say, eight or ten stools of cane (scattered over an acre) a month or six weeks after emergence of beetles, could then fumigate and stop grub damage at an early stage. Otherwise grubs are not noticed until the cane is yellowing off badly. At this time it may also be hard to procure a pump and fumigants in time to get the best results. Where grubs may be expected it is a good idea to always have a pump and a few drums of bisulphide handy.

Varieties.—Apart from Badila, the mainstay in canes here are H.Q.426 (Clark's Seedling), Goru, N.G.24, 24A and 24B, D.1135 (at the northern end), Q.813, H.Q.458, H.Q.409, E.K.28. Of the three last-named E.K.28 is the principal grown, and some small patches of it look well.

Mr. A. Mayers planted out some H.Q.458 and H.Q.409 upon the red soils of Bartle Frere, but they seem to have grown too vigorously there.

Some 20 acres of Q.813 planted early in August by Dr. Knowles has made such rapid growth that a large portion is already lying down. This particular block seems to be too good for this cane; a poorer soil would probably give better c.c.s. returns, although probably not so heavy a tonnage per acre.

(*Sugar Field Reports are continued on page* 525.)

THE BANANA THRIPS RUST.

By A. A. GIRAULT, Assistant Entomologist.

[*Letter of Transmittal.*]

Sir,—I have the honour to transmit the "Report upon an Investigation of Banana Rust," Gympie, by A. A. Girault, Assistant Entomologist, covering inquiries prosecuted in the Gympie District during July 1924-*February* 1925, *a period subject to brief intervals in them only.*

The investigation to which it relates has for the most part covered the instructions under which it was made, and to this extent, and in its following also independent lines of research, is of a very comprehensive nature.

The exact information that it details regarding the life-history of the Banana Thrips insect, as well as the precise methods pursued in elucidating the action of controlling agencies, endow Mr. Girault's brochure with especial scientific interest and practical value, to all those concerned in any way with the subject to which it relates, and cannot be too highly commended as fulfilling the purpose of the inquiry.

Your obedient servant,
HENRY TRYON.

The Under Secretary,
Department of Agriculture and Stock,
Brisbane.

21*st April*, 1925.

Department of Agriculture and Stock,
Brisbane, 18th September, 1924.

INSTRUCTIONS.

FURTHER INVESTIGATIONS, BANANA "RUST" DISEASE.

The investigation is to cover the following matters essentially, premising that the purpose of the work is to discover measures to be adopted for exterminating or controlling the pest—limiting its range of occurrence, as far as possible in each case, without prejudicial effect on the local banana-growing industry :—

1. Bionomics of the *Euthrips musæ* (H.T. MSS.) insect. Supplementary to facts already elucidated, but confirmatory so far as expedient.
   (*a*) Duration of insect's life in different stages—e.g., Egg stage ; larva, 1st stage ; larva, 2nd stage. Prepupa (? 24 hours—has antennal joints distinct). Pupa (? 2-3 days)—has antennal ones coalesced. Adult.
   (*b*) Further inquiry as to where eggs are laid in the plant in addition to where known.
   (*c*) The discovery of the pupa—especially if occurring in soil.
   (*d*) The adult or winged insect—
      (1) General habits ;
      (2) Action as regards light (phototropism), direct observation, relative prevalence in or on shaded or exposed banana plants ;
      (3) Action as regards gravity—geotropism positive or negative ;
      (4) Temperature and humidity, influence on occurrence ;
      (5) Virulence and health of plants as affecting occurrence ;

(6) Movements—flight and migration—

(i.) Direct evidence of flight. Spontaneous spreading as shown by the distribution of occurrence, etc. Influence of wind on.

(ii.) Diurnal and nocturnal movements, especially on occurrence of latter.

(*e*) Alternate food plants, if any. Search of other plants, native or naturalised (securing in each case examples of any thrips occurring for identification).

(*f*) *Second Banana Thrips.* Evidence is forthcoming that a second species of thrips occurs at Gympie on the Banana. This is distinguished by the presence of closely placed rows of granules on the abdominal segments. The circumstances of occurrence of and degree of prevalence of this to be observed. Also its relation, if any, to Rust occurrence.

(*g*) Natural enemies of Banana Thrips.

B.

TREATMENT OF AFFECTED PLANTS.

NOTE.—In considering treatment, the matter of deterring attack or destroying the insect should be considered both from the point of view of practicability and avoidance of injury to the plant or disfigurement of the fruit, such as to prejudice its value as a marketable commodity.

1. *Insecticides.*—The following materials to enter, one or other, into the experimental inquiry :—

(*a*) Soap. Fish oil or whale oil, kerosene soap.

(*b*) Nicotine, as Blackleaf 40—as tobacco dust with water and with soap solution 1 per cent. strength with former.

(*c*) Pyrethrum, as extract, and as dust with fine ashes or other exhibitent.

(*d*) Derrine, fluid and powder preparations.

(*e*) Formalin, as formaldehyde in solution and vapour.

(*f*) Kerosene soap (*vid. supra*) mixture, kerosene emulsion.

(*g*) Bordeaux mixture.

(*h*) Gases, hydrocyanic acid. (Potassium—or sodium—cyanide and calcium cyanide). Others.

The application of those several bodies to have regard to the project of destroying adults, larvæ, pupæ, and eggs.

2. *Preliminary.*—Eggs.—The fruit of the banana is known to serve as a site for the deposition of the eggs in the tissue, and this to be used in the first instance as a guide to the action of the different contact-insecticides. As preliminary, therefore, and as pointing to the use of any insecticide, where the destruction of the eggs in other parts of the banana—e.g., in the suckers—is the object of investigation, there to be, in each such experiment, preliminary experiments of definite potencies, and of definite duration—where time is an element. The eggs are known to remain unhatched in the plant up to say three weeks, with apparently 10 days as a minimum, and observation, therefore, as to presence of issuing larvæ, etc., should be made at intervals during this period.

3. *Treatment of fruit on the plants* (as a guide to plantation treatment).—This to have reference to the following periods :—

(*a*) Prior to first appearance of adults thereon—e.g., Bordeaux mixture experiment as a deterrent.

(*b*) At times of first appearance of adults.

(*c*) Up to 12 days thereafter.

(*d*) When larval Thrips (nymphs) are first appearing, and thereafter as may suggest itself.

Where fluids are used, these to be administered with force consistent with fineness in application, so as to reach entire surfaces and penetrate obscure places in which the insects may reside.

4. *Treatment of Plants.*—

(*a*) Treatment of banana plants in the field, especially when young.

(*b*) Fumigation, especially of latter.

NOTE.—Field experiments in each case to follow smaller experiments.

5. *Treatment of Marketable Fruit.*—Fumigation.

6. *Treatment of Suckers.*—Guided by indications the outcome of preliminary experiments (*vid.* 2 eggs). Experiments to be carried out into the treatment of suckers with a view to rendering them quite free from Thrips presence.

These to involve the use of vessels (tubs, etc.) of adequate size.

In each case, also involving different insecticides, the duration of the procedure to be varied too in the several experiments.

This treatment of suckers to include not only fluid but gaseous and vaporous insecticides, especially the employment of Tobacco Blackleaf 40 (say, 1 oz. to 4 gallons). The observation of suckers treated over the entire period two to three weeks—involved in egg-hatching—to be made, and since any traffic in suckers from infested areas must involve the *certainty* that they are freed from all living Thrips insect, this work to be executed with the utmost care, in this even including the securing of suckers treated from re-infestation on the spot.

General " checks" to be used in all experiments.

HENRY TRYON,
Entomologist-in-Chief.
18th September, 1924.

A. A. GIRAULT,
Assistant Entomologist.

REPORT UPON AN INVESTIGATION OF BANANA "RUST," GYMPIE.*

BY A. A. GIRAULT.

(Plate 87.)

INTRODUCTORY.

In October, 1924, the writer was deputed by Mr. H. Tryon, the Entomologist-in-Chief, to investigate, under his instructions, the causal agent of what is called " Banana Rust"; and accordingly took station near Gympie where that affection is prevalent. Arriving on 8th October, 1924, a laboratory was established near Chatsworth where the affection is worst. The causal agent is a species of thrips. The following report, then, gives the details of the studies made of this insect and of measures for its control.

TIME OCCUPIED.

The investigation extended from 8th October, 1924, to 23rd February, 1925, when the writer returned to Brisbane. A few weeks previous to October had also been occupied in the study of this insect (at Gympie).

*A report covering special investigations during the period September 19–26 was submitted on the latter date. The observations and findings embodied in it are included here.—A.A.G.

PART I.—BIOLOGICAL.

ORIGIN AND NATURE OF THE AFFECTION.

Banana Rust is a leathering of the skin of the fruit due to its being fed upon by the young and adults of the insect in question. It is no doubt somewhat of the same nature as the "silvering" of the foliage and fruit caused by mites upon various plants, and is first manifested as a more or less oval brownish ring near the base of the younger fruits on the sides where they touch. Here the colony of thrips is first established and the ring is the outer boundary of it. This ring is a discolouration, a sort of "powdering," due to the fruits' skin being fed upon by the insects around the margin of the area they inhabit.

As the latter increase in number or enlarge their sphere of action, this more or less oval discolouration extends lengthwise and gradually may be diffused apex-wards over the whole side of the fruit or over the entire fruit. When this discoloured area has been "concentrated" upon it usually hardens and, as the fruit grows, the hardened part splits and becomes more or less corky in texture.

Observation has shown that it is only when the discolouration is extensive that any bad effects are produced. This dark area appears in marked contrast to the rest of the surface of the fruit and looks like a serious disease. The leathering effect gives the same impression. Moreover, it somewhat affects the quality of the fruit and no doubt causes premature ripening. The origin of the affection is intimately associated with the native home of the causal agent—the thrips. The latter attacks sugar, lady-finger, and plantain bananas as well as the Cavendish. The following has reference almost entirely to the latter.

THE SPECIES OF INSECT CAUSING THE AFFECTION.

The insect causing the affection is *Anaphothrips signipennis* (Bagnall, 1914) as identified by Mr. J. D. Hood, a specialist on this group of insects. It was described from a single specimen taken from the sheath of banana at Peradeniya, Ceylon. Both its larva and pupa are opaque white.*

OTHER SPECIES FOUND UPON BANANAS.

Two other species were found upon bananas in the Gympie district. One of these occurs with *A. signipennis*, has similar habits but is scarce. Its name is *Euthrips bilongilineatus* Girault. The second species is but very rarely found in the colonies of *signipennis* and seems to live as a scavenger. The species *bilongilineatus* is quite distinct in colour, has greenish yellow larvæ and pupæ. The second species, or rather third, is black, its larvæ red and its name is as yet unknown.

DISTRIBUTION OF THESE SPECIES.

The principal species, *signipennis*, was first discovered from Ceylon. In Queensland it is perhaps distributed along the North Coast and occurs all through the Mary Valley. The other two species, so far as is known, occur only about Chatsworth, Gympie. The species *signipennis* was not present in a collection of thrips taken in 1924 from bananas at Suva, Fiji (H. W. Simmonds, collector).

* The cause of rust was first discovered by Tryon (1912) but the previous history of the thrips is obscure.

HABITAT.

Wide search was made of miscellaneous plants in forest and jungle without success in finding the first two species ; and so far all seem to be confined solely to the banana plant. Here they frequent solely the fruit and the pseudostem.*

It is a prevalent notion amongst the plantations that the black colouring seen upon the pseudostem, especially in the vicinity of the leaf-sheath, is a symptom of the thrips' presence, but observation does not confirm this, since this same colouring has been found to occur upon shoots not more than a month and a-half out of the ground and in plantations very sparsely infested. Moreover, this blackness was frequently found upon the exterior of the sheath where thrips never occur. It therefore seems to be natural to the plant.

The rusting is therefore the only symptom of the insect's presence and this occurs solely upon the fruit.

INSECTS LIABLE TO BE MISTAKEN FOR THRIPS.

On fruit and stem amongst or near the colonies, occur at least five species of Thysanura, all of which are characterised by their dark or party colours. One bluish species, however, when just moulted is very like thrips larvæ but its short, clubbed antennæ serve to distinguish it.

There are two species of mites, one white, the other red. In regard to the former, its rectangular body and quicker movement distinguish it. All of these animals either have different rates of movement or else appear different, and the experienced eye soon distinguishes them.

LIFE HISTORY STUDIES.

Anaphothrips signipennis (Bagnall).

GENERAL HABITS.

This insect is perennial in its occurrence, being found in every stage throughout the four seasons. In the winter reproduction is merely retarded somewhat, as is development. The places on the plant inhabited by it are the pseudostem and the fruit. In these places they occur in colonies, and the adults in these colonies deposit their eggs under the skin of the plant at the site of the colonies. On the stem these colonies are always in dry places under the sheaths or along under the edges of the sheaths and occur from top to bottom without reference to exposure to the sun. On the fruit, they invariably occur near the base where the sides touch, rarely near the apex or along the entire side, and of course are always dry.

In the colonies, the insects slowly crawl about or remain quiet, feeding. When uncovered, they invariably crawl away in all directions, and their locomotion is considerably quicker in summer than in winter when it is slow and uniform. The adults in summer occasionally erect their wings and hop short distances with their aid but they have never been observed to fly. During the night there is no change of habit but, as the summer advances and the colonies increase, diurnal migration occurs from time to time,

* Garden plants were also searched unsuccessfully. But on 21st May, 1925, Mr. T. P. Reynolds told me, when on a short visit to Gympie, that on 18th May he had found *signipennis* upon tomatoes at Chatsworth. He then showed them to me and at the same time I found them upon this fruit on plants growing amongst bananas. They were causing "rust."—A.A.G.

mostly during the hottest part of the day. The migrating form is mostly the larva, for the adult is rarely seen exposed to direct light. The larva is active from the time it hatches. The pupa occurs within the soil and is able to crawl slowly. Migration was first noticed late in November; the accelerated locomotion on 19th September.

It is seen from what has been written that this insect is practically a stationary one, slow of movement, non-flying (so far as known), always present, active and reproductive. Neither the nymph nor adult curls the body when in locomotion.

GENERAL LIFE HISTORY.

The adult upon changing from the pupa remains in the soil a day or so and then crawls to the surface and on to a banana plant. Here, if a female, it is courted and mated within the week, has already been feeding and soon commences laying eggs. These, as has been stated, are deposited into the skin of the plant, on stem or fruit. A relatively very long time elapses now before hatching occurs, on the average about two weeks, and when this takes place the resulting larva at once crawls away a short distance and commences to feed. It grows rapidly and within eight days is ready to leave the plant, descend to the soil, and pupate. It first spends a day or so within the soil, then transforms loosely, that is without making a cell, first as a short-winged pupa, then as a long-winged pupa and within from six to eight days is again an adult.

THE EGG.

Description and Oviposition.

The egg is so small and delicate that without making sections of the plant it has been impossible to describe its appearance and shape. However, it has the general appearance of the plant cell, and doubtless does not differ materially from the eggs of other species of thrips. It is deposited into the soft tissues of the stem and fruit, and is very difficult to dissect out. The place of deposit is very frequently unmarked in any way, but in the fruit, frequently, minute round pustules are formed over the egg and the larva hatches from a minute slit to one end of the centre of this pustule.

Oviposition is very simple and direct, the female merely selecting a place, inserting the ovipositor and passing the egg through. It does not take more than fifteen minutes, but these observations are fragmentary and the insect's habits make it difficult to observe.

Sites of Oviposition.

Eggs may be deposited at any covered place on the stem or fruit but as a rule they are placed within or near the colonies. The following actual places of hatching on the fruit have been observed :—

1. From a pustule, half-way from middle to apex, near one angle.
2. From a half-grown fruit, 1½ inch from base of fruit.
3. "After hatching a minute hole is left in the surface of the fruit or stem, but the site of oviposition is not distinguishable nor characteristic."
4. From side very young fruit just beyond middle; from about 1 inch from base; and from side near apex (small, undeveloped, "tip" fruit). In the latter case, a brown-yellow spot marked the place of deposition.
5. From side, 1 inch from base. Round about were a dozen hatching sites, all within brown specks as was the first.

6. From middle of side, 2 inches from base—from a round, brown speck. Similar specks were dotted all over the fruit (a young "white-tip," badly infested with adults) but densely so only upon this (flat) side.

7. Two from middle of side, 2 inches from base.

8. From side of ripe fruit towards middle from base. No pustule but a discoloured spot.

From these chance observations, it seems that most of the eggs are within the basal half of the fruit as would be expected. They show also that the egg site may be unmarked, or within a pustule or within a brown spot. The pustule is small, round, brown, usually surrounded by a narrow, irregular rim of lighter brown (dead tissue). The emergence hole is toward the margin. The brown spots on the surface from which larvæ have hatched have no rim. When ovipositing the female leaves no perceptible mark.

DURATION OF THE STAGE.

A large amount of data in regard to this were gathered, but, owing to the fact that the eggs are concealed and the insect so shy, it was necessary to resort to keeping lots of infested bananas and, after recording the date they were picked, make frequent observation of them until all hatchings ceased. The instar was then taken to be the period between the date of picking and the date of last hatching. As it sometimes happened that fruit used for this purpose bore eggs some days old, a very much shorter period was obtained than usual and these cases were not recorded. Usually several lots were run together, and the data may therefore be considered as accurate as it is possible to obtain them. The data are tabulated as follows :—

DURATION OF PERIOD OF EMBRYONIC LIFE.

Lot.	Fruit Picked.	Hatchings.	Duration, Days.	Average.
1	Oct. 14 (♀ on fruit)	Oct. 30	16	..
2	Oct. 17	Oct. 23, 27, 31, Nov. 3	17	..
3	Oct. 29	Nov. 3, 4, 6, 12	14	..
4	Oct. 29	Oct. 31, Nov. 3, 6, 10, 12	14	..
5	Oct. 29	Nov. 10, 12	14	..
6	Oct. 29	Oct. 31, Nov. 3, 7, 8, 10, 14	16	15·1
7	Nov. 3	Nov. 6, 8, 10, 11, 14, 17, 18, 19, 21, 22	19	..
8	Nov. 3	Nov. 12, 14, 17	14	..
9	Nov. 3	Nov. 4, 10, 12, 13, 14, 16, 21	18	..
10	Nov. 3	Nov. 17	14	..
11	Nov. 20	Nov. 28, 29, Dec. 1,2, 3, 5, 6	16	..
12	Nov. 24	Nov. 25, 29, Dec. 10	16	..
13	Nov. 24	Nov. 26, 27, Dec. 1, 2, 3, 5, 8, 10, 11, 13	16	..
14	Nov. 24	Dec. 9	15	..
15	Nov. 26	♀ confined. Larvæ out Dec. 10	14	..
16	Dec. 1	Dec. 4, 9, 11, 12, 15	15	15·6
17	Dec. 1	Dec. 13, 14, 16	16	..
18	Dec. 2	Dec. 4, 8, 10, 11, 12, 13, 15	13	..
19	Dec. 2	Dec. 15	13	..
20	Dec. 2	Dec. 17	17	..
21	Dec. 4	Dec. 11, 19	15	..
22	Dec. 4	Dec. 11, 13, 20	16	..
23	Dec. 4	Dec. 6, 8, 9, 11, 15, 16, 19	15	..
24	Dec. 8	Dec. 24	16	..
25	Dec. 8	Dec. 15, 19, 22, 23, 24, 26	18	..
26	Dec. 10	Dec. 12, 15, 18, 19, 24	14	..

DURATION OF PERIOD OF EMBRYONIC LIFE.—*continued.*

Lot.	Fruit Picked.	Hatchings.	Duration, Days.	Average.
27	Dec. 10	Dec. 25	15	..
28	Dec. 11	Dec. 26	15	..
29	Dec. 12	Dec. 7	15	..
30	Dec. 12	Dec. 29 approx. (reared)	16	..
31	Dec. 15	Dec. 19, 22, 26, 29, 30, 31 ..	16	..
32	Dec. 20	Dec. 26, 29, 30, 31, Jan. 1, 2, 4, 5 ..	16	..
33	Dec. 23	Dec. 25, 26, 31, Jan. 2, 5, 7, 8, 9 ..	17	..
34	Dec. 31	Jan. 10, 12, 14, 16	16	..
35	Dec. 31	Jan. 2, 5, 6, 7, 8, 10, 12, 14, 16 ..	16	..
36	Dec. 31	Jan. 10, 14	14	..
37	Dec. 31	Jan. 16	16	15·4
38	Jan. 6	Jan. 8, 12, 14, 16, 17, 19, 20, 21 ..	15	..
39	Jan. 7	Jan. 10, 16, 17, 19, 21	14	..
40	Jan. 7	Jan. 12, 16, 17, 19, 20	13	..
41	Jan. 8	Jan. 10, 12, 14, 19, 20	? 12	..
42	Jan. 8	Jan. 19, 21	13	..
43	Jan. 8	Jan. 12, 14, 16, 17, 19, 21	13	..
44	Jan. 8	Jan. 12, 14, 16, 17, 21	13	..
45	Jan. 9	Jan. 12, 14, 16, 17, 19, 21, 22	13	..
46	Jan. 13	Jan. 17, 21, 22, 24, 26	13	..
47	Jan. 13	Jan. 16, 17, 19, 21, 22, 23, 24, 26, 27..	14	..
48	Jan. 15	Jan. 21, 23, 24, 26, 28, 30	14	..
49	Jan. 16	Jan. 22, 26, 28, 30	14	..
50	Jan. 23	Jan. 24, 25, 26, 27, 28, 29, 30, 31, Feb. 3, 4, 5, 7	15	..
51	Jan. 23	Jan. 26, 28, 30, Feb. 1, 3, 5	13	..
52	Jan. 29	Jan. 30, Feb. 1, 3, 5, 7, 9, 11	13	..
53	Jan. 29	Jan. 30, 31, Feb. 1, 3, 5, 7, 9, 11, 12 ..	14	13·5
54	Feb. 4	Feb. 17	13	..
55	Feb. 5	Feb. 17	12	12·5

Average of the whole, 14·4 days.

There is a decided decrease in the period as the summer advances. It varies from 12 to 19 days. The majority of the data was taken from the fruit.

EGGS NOT DEPOSITED INTO CORMS.

As this has considerable practical bearing, in view of the fact that suckers are transferred from one place to another, the following observations in reference to it were made.

In the first place, the corm as a rule is under ground and larvæ have never been found under ground upon the plant. Nor have pupæ been found upon the plant, nor do adults resort to underground parts of the plant.

In the second place the tissue of the corm is much tougher than that of the fruit or stem.

As it was thought unnecessary to make extensive observations, the following data were considered sufficient to establish that the insect did not breed in or upon the corm.

1. Twelve suckers were dipped for thirty minutes in Black Leaf 40, 20th September, 1924, and the pseudostems removed. They were dried and after a day wrapped in paper and frequently examined. Up to 26th September, when the experiment had to be discontinued, nothing had hatched, but living mites and coleopterous larvæ were found within and upon the corms. A single control gave similar results.

On 3rd October three pieces of corm were cut from a badly infested stem and kept for observation. There were no hatchings up to 24th

November, the pieces then dry ; as a control, pieces of the stem yielded 40 larvæ up to 22nd November.

On 27th October fourteen slices of corms were made from infested stems and kept for observation, with negative results, up to 24th November. A similar result was obtained from three more slices taken the same date but kept as a separate lot.

On 29th October three slices of corm from infested stools were kept until 24th November with negative results.

On 23rd January, 1925, three more slices of the corm were made from badly infested plants. No hatchings resulted up to 16th February. And so with ten more pieces of a separate lot, same date.

These lots were all controlled by pieces of infested stem which always produced larvæ.

It is noticeable that, when larvæ are confined with fresh pieces of corm and stem mixed together, they choose the latter and remain upon it.

OVIPOSITION IN REGARD TO AGE OF FRUIT.

Larvæ have been hatched from every size and age of fruit, and the female will attack the Cavendish banana as soon as the bracts are loose enough for it to gain entrance.* Even those fruits which set but do not develop and which are present upon the end of the bunch receive eggs. The mature fruit also receives them but the younger fruit is the most favoured, as are also the basal hands. There seems to be no favoured place upon the pseudostem.

THE LARVA.

HATCHING.

This is quite an ordinary act. The nymph simply pushes its way through the skin of the stem or fruit, erect, casting the very delicate amnion as it does so. It remains erect until its appendages are freed, whereupon it drops to the surface and by the aid of its legs gradually withdraws the remaining few segments of the abdomen and crawls off. The time taken is about twenty minutes. The cast amnion remains to mark the hatching site, as a minute, hairlike, semi-prostrate white thread ; it is sometimes erect. There is also a minute cross-slit, the exit hole. Thus the minute slit with projecting amnion indicates where eggs have been and can be recognised in the colony.

Hatching occurs at any time of the day or night, but, as the following observations show, usually it is regular and confined to a definite period. This is between the hours of 6 and 11·30 a.m. Of separate observations, the following were noted in the morning and afternoon :—

Chance Observed Hatchings—Time.

A.M.	P.M.
48	2

Thus, out of 50 chance observations, 48 were in the morning, classified as follows :—8 a.m., 1 ; 8·30 a.m., 5 ; 9 a.m., 11 ; 9·30 a.m., 7 ; 10 a.m., 5 ; 10·30 a.m., 2 ; 11 a.m., 10 ; 11·30 a.m., 7. Of the two P.M. observations, one was at 1 o'clock and one at 12·30 p.m.

*After the first bract is loose, access to the rest of the bunch is possible as Mr. S. Ukran demonstrated. This will be understood by examination. Adults have been found, at this stage, to have penetrated to the fourth hand.

The following observations were made particularly in reference to the time of hatching and are tabulated :—

TIME OF HATCHING AS OBSERVED FROM TWENTY FRUITS. JANUARY 1925.

Hour:	6 a.m.	11 a.m.	6 p.m.	10 p.m.
Larvæ	10	228	8	8
Total	..	.. 254		

The observations were continuous over a week and were made at the four hours indicated. Thus 228 out of 254 hatchings occurred between 6 and 11 a.m. This is 89 per cent.

DURATION OF THE STAGE.

The larvæ take less time to develop than do the eggs, as the following table shows. This records but the actual growth of the larva, which is more rapid than one would suppose.

DURATION LARVAL STAGE, DAYS.

Hatched.	Number of Larvæ.	Mature.	Left Fruit.	Duration, Days.
Oct. 25	5	Oct. 31 ..	Nov. 1 ..	8
Oct. 25	2	Nov. 3 ..	Nov. 4 ..	10
Oct. 29	4	Nov. 4 ..	Nov. 6 ..	7
Oct. 31	4	Nov. 8 ..	Nov. 9 ..	9
Oct. 30	2	Nov. 4 ..	Nov. 6 ..	7
Nov. 5	3	Nov. 10 ..	Nov. 12 ..	9
Nov. 10	2	Nov. 17 ..	Nov. 18 ..	8
Nov. 13	Many	Nov. 19 ..	Nov. 20 and later	7
Nov. 29	5	Dec. 5 ..	Dec. 6 ..	7
Dec. 4	4	..	Dec. 13 ..	9
Dec. 18	Several	Dec. 26 ..	..	8
Jan. 12	2	Jan. 17 ..	Jan. 20 ..	8
Feb. 14	5	Feb. 19 ..	Feb. 20 ..	6
Feb. 3	2	Feb. 9 ..	Feb. 10 ..	7
Averages	3⅓	..	..	7·8

The rapidity of growth is shown by the following instances. Of the five larvæ hatching 14th February, four were submature four days later ; a larva hatching 22nd October was five-sixths grown on the 27th. Four larvæ hatching 31st October were submature 6th November and one-third grown on 3rd November. Growth, of course, is uneven. Thus, five hatching 29th November were half-grown on 3rd December but by the 5th two were mature, two were two-thirds grown, and one only half-grown. This unevenness is due largely to delay at the moult.

DURATION OF PREPUPAL STAGE.

This was taken as commencing from when the larva leaves the frui to enter the soil. Not many records were obtained, owing to the fac that after entering the soil the larvæ are most frequently lost sight of. Two larvæ entered the soil 19th November and pupated 23rd November, the period being in this case four days. In a second instance a larva matured

and left the fruit on 3rd February. The pupa was present on the fifth, a period of two days. In a third case, four larvæ entered the earth on 20th November and three of them were observed to pupate on 23rd November, the fourth on 24th November, periods of three and four days respectively. A fourth case: Larva entered soil 20th November, pupated 24th November, or in four days. A fifth case was unusual in that the larva did not enter the earth. It left its food on 6th November and was still present on the surface 10th November, pupating the 11th or after five days. Sixthly: Left food 27th November; 28th November against glass of container, two inches below the surface; pupa on 1st December or after five days.

A seventh observation was obtained from four larvæ reared from the egg. On 10th November they left their food and one remained in view, pupating 14th November, or after four days. The average period is: (4, 2, 3, 4, 4, 5, 5, 4, plus two 3's of case 3), 3·7 days, and ranges from 2-5.

DURATION OF THE ENTIRE LARVAL PERIOD.

This is obtained by adding the averages of the aerial and underground lives of the larva and is found to be 11·5 days. The larval period is therefore considerably less than that of the egg, usually the contrary in most insects.

ECDYSIS.

This has never been observed except in one instance and very likely takes place at night. As with most or all of the species of its order there is but the single moult. The instance observed was this: A female was taken from a banana plant on 26th November, 1924, and kept in confinement with an uninfested fruit. Larvæ from this mother commenced hatching on 10th December. On 13th December, the female was transferred to a separate vial and the larvæ over soil. Larvæ continued to hatch from the fruit which was rather crowded with them. On 29th December, a colony of them (10) which had hatched on 26th December were found to have just moulted into stage II. They were then about half-grown. The moulted skins were long white threads scattered amongst the young and they have never been observed before or since as recognisable objects.

LARVÆ—DESCRIPTIVE.

The larvæ of the three species differ considerably when closely examined. The following table will not only describe them but also allow them to be identified:—

1. Colour red. Spines both simple and capitate, not numerous, elongate. Antennæ 7-jointed, blackish, also the legs and apical segment. Eyes near base antennæ, of latter 3-4 longest, clavate. Several slender, very elongate spines from apex abdomen. No transverse joints in antennæ. Mature. *Black sp.*

2. Colour white or pale yellow. Antennæ 10-12-jointed, with 6 more or less transverse joints.

   Spines numerous, simple, elongate, several on head; colour pale yellow; joints of antennæ distad of the mass of 6 transverse, solid, acuminate, subequal to the six preceding. Antennæ 10-jointed. Spines usually in cross-rows. Leg setæ longer. Antennal 2 dusky. Eyes dark. Like next. Mature, *bilongilineatus* Girault.

Spines sparser, mostly lateral, dorso- and ventro-lateral lines, mostly funicular or clubbed; opaque white, eyes dark red; joints of antennæ distad of the six transverse, 3, antennæ 12-jointed, 1 wider than long, 2 a bit longer than wide, 3 cup-shaped, united equal next 6 which compose an ovate mass equal to 3 distal; 10-12 a long acumination; of 6 transverse joints, first and last (4 and 9) are longest; 10 a bit wider than long, 11 twice longer than wide, narrowing; 12 is twice 11. Setæ sparse; elongate distad (antennæ), on abdomen short and funnel-shaped or subcapitate, on lateral line 1 per segment, but at apex becoming elongate and simple. Young, first stage, *signipennis* Bagnall.

In the mature larva of *signipennis* the eyes are closer to middle of side of head and it otherwise differs from stage I. in size, funicle 3 is ovate and distinctly longer than 2. In both stages there is a disk-shaped, cellular, dotted area on thorax II., cephalo-laterad just behind a single funnelform, long hair on I. Another of these is just in front of the antepenultimate lateral funnelform hair. A third is upon the dorso-lateral aspect of abdomen just mesad of the first lateral capitate hair; the other two are lateral. Of the lateral line of funnelform or subcapitate hairs on the abdomen there are 8, one to each segment, lengthening in succession.

Observation upon Migrating Form.

On 15th January, many young were observed at 10·30 a.m. exposed in the open upon the pseudostem. Some were stationary, others crawling about (in shade). There were no adults. Their movements were leisurely and apparently without direction; it is local, that is, confined to the plant and not from one plant to another.

THE PUPA.

This is found within the ground as the following observations show:— Quite a large amount of digging was done before 16th December when the first pupa was found in red earth surrounding an infested stool. Here four were located after some time, three short-winged and one long-winged, all from 4½-6 inches below the soil surface, taken as being level with the stool; but, as the soil sloped away from the base of the plants, the actual depth from the surface was only about 3 inches. The distance from the nearest plant was about 3 inches. These pupæ were "loose" within the soil, i.e., not in cells.

On 23rd January, 1925, a second successful hunt for pupæ was made. There had been several days of steady rain, the soil therefore wet to the surface. Digging was first done under an infested bunch on a hillside (and some distance away from the plants) to a depth of 4 inches but without success. Then under an infested stool, near its base, also unsuccessfully. Then under the base of a smaller infested stool, the soil sloping from it and covered with ¾-inch of rock fragment. Under these stones the earth was wet, black (much dead vegetable matter), and scanty since much rock was also within it. Here within 1–2 inches of the surface four pupæ were uncovered; these were from 3-3½ inches below the level of the soil through base of stool and but several inches from the plant. The pupa (long-winged) is free and can crawl slowly.

On 6th February, 1925, a third successful hunt. It was then raining. A pupa was found as soon as digging was started, as usual, loose within the soil. It was within an inch of the surface and 2 inches from base of stool.

Pupæ have never been found upon any part of the plant, but, as they occur in the soil, suckers might possibly carry them, and it is conceivable that they might frequently be found adhering to the corm. But, as with hundreds of larvæ in confinement, only one ever transformed outside of the earth, and, as they have never been seen in "nature" outside of the earth, this is not likely, more especially as they seem to require at least an inch of soil.

DURATION OF PUPAL STAGE.

This includes the time from actual pupation to transformation to the adult.

Lot.	Date Pupated.	Number.	Date Adult Disclosed.	Duration, Days.
1	(The black species) Nov. 11 ..	1	Nov. 17 ..	6
2	Nov. 11	1	Nov. 17 ..	6
3	Nov. 24	2	Dec. 2 ..	8
4	Nov. 23	5	Dec. 1 ..	8
5	Nov. 27	3	Dec. 5 ..	8
6	Nov. 24	1	Dec. 2 ..	8
7	Dec. 1	1	Dec. 11 ..	10
8	Dec. 11	5	Dec. 18 (avg.) ..	7
9	Dec. 7	4	Dec. 15 (avg.) ..	8
10	Dec. 24	3	Dec. 31 ..	7
11	Feb. 5	1	Feb. 13 ..	8
	Average	..	..	7·6

DURATION OF THE POST-PUPAL ADULT STAGE.

After transformation, the adult remains a short period within the soil. Not many records of this were obtained, as to obtain them would require very close watching. However, at 3 p.m. on 1st December, a pupa in the soil and visible through the container was noted to be colouring up (pale yellow, ocelli pink, eyes ruby) as when ready to transform. It did so at about 6 a.m. 2nd December, and left the soil at 3 p.m. or after 9 hours. In a second case, the pupa transformed on 11th December and left on 12th December. This period rarely, I think, exceeds 24 hours; at least it is much shorter than the prepupal larval period.

DURATION OF THE PERIOD OF UNDERGROUND EXISTENCE.

This is obtainable by adding together the prepupal, pupal, and post-pupal stages and is 12·3 days on the average. The following observations have also been made:—

Larvæ Entered Soil.	Adults Emerged.	Days.
Dec. 18	Jan. 2	13
Nov. 6	Nov. 17	11
Nov. 28	Dec. 12	14
Nov. 24	Dec. 5	11
Dec. 4	Dec. 14	10
Nov. 20	Dec. 2	12
Dec. 6	Dec. 18	12
Feb. 3	Feb. 13	10
Average: (Variation 4 days) ..	..	11·6

The average of the two results is 11·9 days.

DURATION OF THE TWO PUPAL STAGES.

This was also rarely observed :—

Pupated.	Moulted.	Adult.
Dec. 11	Dec. 13	..
Dec. 24	Dec. 26	Dec. 31
Jan. 4	Jan. 6	Jan. 11
Feb. 5	Feb. 7	Feb. 13

Thus, the short-winged or first pupal stage seems to be the shorter of the two by some days, occupying, in these few cases, 2 days out of 7 or 8.

DESCRIPTIVE.

The pupa is white and has two distinct stages, a long- and short-winged. When it is about to moult into the second stage, it turns yellowish, and again when it is about to transform to the adult, when the wing-cases also darken and the eyes and ocelli are more or less reddish. In the first stage, the antennæ are directed forward as in the larva, but in the second they are drawn back over the frons and directed caudad between the eyes, not quite reaching the caudal end of the pronotum. The elongate, narrow wing-pads then reach to about apex of segment 6 of the abdomen, and the apex of the latter at dorsal margin bears four semi-erect spines directed dorso-caudad.

THE ADULT.

The adult stage is the longest, then the egg.

COURTING AND MATING.

On the banana plants, when colonies are uncovered, occasionally mating pairs are observed, and these crawl away as rapidly as do the others, the larger female dragging the smaller male after it. Less frequently, a female is observed with a male clinging to its abdomen with the forelegs, the head over the abdomen's dorsum, and both bodies in a straight line. This is the position of courting and, of course, precedes mating. It lasts at least 15 minutes and very likely much longer. During the latter, the pair are end to end and the union is at the base of the ovipositor.

After emergence from the soil, the adults at first pay attention to themselves *per se* and engage in feeding. How soon mating and oviposition commence is a bit uncertain, but the following observations upon colonies in confinement probably show the actual state of things :—

(1) A pair emerging 12th December were confined upon a green banana (fruit) and kept under observation. Courting was observed on 19th December or after a week.

(2) On 16th December, in a tube, four adults emerged ; on the 22nd 11 had emerged; 26th, 25 were out; on 29th, a pair was observed mating, or within 13 days.

(3) On 6th December 4 adults emerged. Three days later, a female was ovipositing !

(4) Adults emerging 6th December were courting on the 12th, or within 6 days.

(5) Adults which emerged 3rd December were courting 8th December and mating 11th December ; mating occurred within 5 days, since it follows courting.

(6) On 22nd December in a tube 5 adults emerged and by the 29th there were 10. Courting was observed not until 6th January.

(7) In another tube adults emerged 20th December and a courting pair was observed on 31st December, or within 11 days.

(8) Fifteen males and females emerged on 8th February, and on the 13th two pairs were observed courting.

(9) On 31st December three adults emerged and by the 12th 63 were out, including two courting pairs.

It appears from these observations that courting and mating usually occur within the first week after emergence from the soil, but mating is not necessary so that oviposition may occur within less than that time. For other observations see next section.

PARTHENOGENESIS.

This was suspected in view of the paucity of males as shown later. The following observations seem to prove it :—

(1) On 1st December, 1924, a female emerged in a tube, the sole adult. Larvæ appeared 18 days later. Oviposition, then, occurred within 3 days.

(2) On 2nd December a similar case occurred in another tube and larvæ appeared after 20 days.

(3) On 3rd February two females emerged in another tube and were confined together with a banana picked that day. Larvæ commenced to hatch from the fruit on 16th February and continued until the 21st, when the cage was broken up. So far as is known no males were present with the females. Oviposition must have commenced within 3 days. The fruit was uninfested.

(4) A female was reared from a number of larvæ on 1st December, the only adult to emerge. It was kept under observation. The first larvæ appeared on 18th December and continued until 13th January, or until the fruit rotted away. Virgin oviposition commenced within 3 days of emergence, and the adult continued to reproduce until it died on 30th January.

PROPORTION OF THE SEXES.

The males are considerably less in number than the females, as the following two tables show :—

PROPORTION OF THE SEXES, PSEUDOSTEM. SEPTEMBER 25, 1924.

Number Counted.	Males.	Females.	Per Cent.	
			♂	♀
100	44	56	44	56

The following table is given for comparison :—

PROPORTION OF THE SEXES, PSEUDOSTEM AND FRUIT. FEBRUARY 18, 1925.

PSEUDOSTEM.			FRUIT.		
Number Counted.	Per Cent.		Number Counted.	Per Cent.	
	♂	♀		♂	♀
100	34	66	100	32	68

Thus, later in the season, the males were even more scarce but the relative number on the fruit was about the same as that on stem. During July 1924, of 751 adults taken at random (J.H.S. and A.A.G.), 80 per cent. were females; at the same time, of 338 adults noted from the fruit, 77 per cent. were females. In another lot of 152 adults, 87 per cent. were females. This upon the fruit.

DURATION OF THE STAGE.

The adults live a much longer time than was expected. The following table gives the time they lived in confinement, but as their food sometimes dried up, despite frequent attention, some of the records are incomplete. Accidents were also rather frequent, due to the nature of the insect and the difficulty of (always) keeping the containers dry.

TABLE SHOWING DURATION OF THE ADULT STAGE.—LABORATORY.

Date Confined.	Remarks.	Sex.	Died.	Duration, Days.	Maximum.	Minimum.	Average.
1924.							
Oct. 14	..	♂	Nov. 4	21	..	..	..
		♀	Nov. 12	29	..	..	..
	Drowned ..	♂	Nov. 19	36	..	..	..
Oct. 17	..	♂	Oct. 20	3	..	3	..
		♂	Oct. 24	7	..	..	..
	..	♂	Nov. 7	21	..	..	..
		♀	Nov. 23	37	..	..	..
		♀	Dec. 24	68	..	..	..
Oct.29	..	♂	Nov. 21	23	..	..	..
		♂	Nov. 21	23	..	..	..
Nov. 4	Killed by accident	♂	Nov. 25	21	..	..	..
Nov. 6	Food dried ..	♀	Dec. 8	32	..	..	..
Nov. 12	Escaped ..	?	Nov. 27	15	..	..	..
		♀	Dec. 7	25	..	..	..
Nov. 12	..	♂	Nov. 26	14	..	..	..
Nov. 13	Escaped ..	♀	Nov. 27	14	..	..	..
Nov. 26	..	♀	Jan. 13	48	..	..	..
Dec. 1	Drowned ..	♂	Dec. 26	26	..	..	..
	Escaped, reared	♀	Jan. 30	61	..	..	..
Dec. 6	..	♀	Jan. 8	33	..	..	..
Dec. 5	Reared ..	♀	Feb. 3	60	..	..	..
Dec. 6	..	♀	Dec. 24	18	..	..	..
Dec. 6	Terminated ..	♀	Feb. 16	72	72	..	..
Dec. 10	Reared, drowned	♂	Jan. 20	41	..	..	..
	Reared ..	♂	Dec. 15	5	..	..	..
Dec. 9	Escaped ..	♀	Dec. 29	20	..	..	..
	Escaped ..	♀	Jan. 21	43	..	..	..
Dec. 12	..	♂	Dec. 22	10	..	..	..
		♀	Dec. 22	10	..	..	..
Dec. 11	..	♀	Jan. 21	41	..	..	..
		♀	Feb. 5	56	..	..	..
	Killed by accident	♂	Jan. 19	39	..	..	..
		♀	Feb. 6	57	..	..	..
Dec. 15	Terminated Black Sp.	♀	Feb. 16	63	..	..	..
Dec. 15	Food rotted. ..	10 ♂♀	Jan. 12	28	..	..	..
Dec. 16	*bilongilineatus*	♀	Jan. 22	37	..	..	..
Dec. 14	Escaped ..	?	Jan. 28	48	..	..	..
Dec. 15	Reared ..	♂	Dec. 24	9	..	..	..
	Reared ..	♂	Dec. 28	13	..	..	..
	Reared ..	♂	Dec. 28	13	..	..	..
Dec. 16	Terminated ..	♀	Jan. 12	27	..	..	..
Dec. 21	Reared ..	♀	Jan. 6	16	..	..	..
Dec. 22	Terminated ..	♀	Feb. 16	56	..	..	..
		♀	Jan. 7	16	..	..	..
		♀	Jan. 11	20	..	..	..
		♀	Jan. 12	21	..	..	..

TABLE SHOWING DURATION OF THE ADULT STAGE.—LABORATORY—*continued.*

Date Confined.	Remarks.	Sex.	Died.	Duration, Days.	Maximum.	Minimum.	Average.
Dec. 25	Reared ..	1 ♂ ♀	Jan. 14	20	..	..	..
	Reared ..	♀	Jan. 15	21	..	..	..
	Reared ..	♂	Jan. 15	21	..	..	..
1925.							
Jan. 3	..	♂	Jan. 18	15	..	..	..
Jan. 14	Terminated ..	♀	Feb. 16	33	..	..	..
Jan. 16	Terminated ..	♀	Feb. 16	31	..	..	..
Jan. 17	Terminated ..	♀	Feb. 16	30	..	..	..
Jan. 20	..	♀	Feb. 1	12	..	..	..
		♂	Jan. 30	10	..	..	..
Jan. 22	..	♀	Jan. 30	8	..	..	..
		♀	Feb. 13	22	..	..	..
Jan. 24	Terminated ..	♀	Feb. 16	23	..	..	..
Jan. 26	Terminated ..	♀	Feb. 13	18	..	..	..
Feb. 3	Reared ..	♀	Feb. 21	18	..	..	..
	Reared, terminated	♀	Feb. 16	13	..	..	..
Feb. 4	Reared ..	♀	Feb. 21	17	..	..	..
				2,008			27·8

From the above it is seen that the average length of life is about four weeks but it is no doubt somewhat greater, since the real length was not obtained (but shortened) due to accident and so forth in many cases, as is duly noted above. The adults always have to have food as the next shows. Of those adults taken from bananas, the length of life was certainly greater than recorded, at least by a day or two.

DURATION OF ADULT LIFE WITHOUT FOOD.

Only a few records were obtained, for the reason that they invariably showed the same result—namely that, without food, life is very short. This applies as well to the larval forms.

On 14th October, a number of young (larvæ) and adults were taken from the pseudostem of a banana plant, 11 a.m., and placed into a dry, corked vial. By 2 p.m. most of them were dead.

On 3rd November in the morning, 4 adults were taken from plants and each confined within a dry vial plugged with cotton. They were dead by p.m. 4th November.

TABLE SHOWING DURATION LIFE SANS FOOD, MOIST AND DRY ATMOSPHERES, 1924.

Conditions.	Date Confined.	Died.	Length, days.	Average.
Dry. No. 1 ..	4 p.m., Nov. 17	7 a.m., Nov. 18	½ +	..
	7 a.m., Nov. 18	8 a.m., Nov. 19	1 +	..
	8 a.m., Nov. 19	8 a.m., Nov. 20	1 +	..
	8 a.m., Nov. 20	8 a.m., Nov. 21	1 —	—1 day
	3 p.m., Nov. 21	8 a.m., Nov. 22	½ +	..
	8 a.m., Nov. 22	7 a.m., Nov. 23	1 —	..
	4 p.m., Nov. 24	3 p.m., Nov. 25	1 —	..
Moist. No. 2 ..	4 p.m., Nov. 17	8 a.m., Nov. 19	1½	..
	8 a.m., Nov. 19	p.m., Nov. 20	1½	..
	3 p.m., Nov. 21	8 a.m., Nov. 23	1½	1·4 days
	4 p.m., Nov. 24	3 p.m., Nov. 25	1 —	..
Food, control. No. 3	4 p.m., Nov. 17	7 a.m., Nov. 18	½ +	..
	7 a.m., Nov. 18	3 p.m., Nov. 25 (terminated)	7¼	3·87 days (up to time of termination)

Thus, for a number of cases life ceased within a day after food was withdrawn or within a day and a-half, according to the state of the atmosphere. Dryness seems to be as fatal as lack of food, or rather dryness makes the lack of food the more quickly fatal. Adults kept with slices of tender corn plants lived for several days, but they did not seem to establish themselves upon this food.

DURATION OF LIFE ACCORDING TO SEX.

This may be computed from the foregoing table, and is as follows :—

In the case of the male, 21 lived a total of 391 days or 18·6 days ; 38 females lived a total of 1,209 days or 31·8 days each. The female lives a considerably longer time. In respect to this it is noteworthy that most of the records of longest life are of females. Thus of all records over 40 days, amounting to 12, all except one were females.

DURATION OF THE LIFE CYCLE.

This is obtainable in two ways: (1) By rearing or (2) by computation—adding the stages together. The latter will be done first. The sum of the averages of all developmental stages is 33·9 days. (This includes the average egg stage, the average larval existence above and below ground, and the pupal and postpupal stages.) The maximum is 40 and the minimum 24 days.

The maximum length of life was 112 days and over half of this was adult ; the minimum was 27 days.

The following observations were made in regard to the second method :—A female was depositing eggs on 26th November. These hatched 10th December, emerged 31st December as adults, a cycle of 35 days.

Two adults were ovipositing on 12th December, 1924 ; these eggs hatched on 29th December, 1924, pupæ were present on 14th January or earlier, and adults on 19th January 1925, a cycle of 38 days.

On 16th December, four adults emerged having been reared from larvæ confined on 1st December. These were given fruit and confined over soil. The second generation of adults commenced emerging on 14th January, 1925, or a cycle of 29 days. These were males, as were all of the rearings, in confinement, to the second generation.

On 3rd November, 1924, a banana was confined and larvæ commenced to hatch at once. Adults appeared from these on 2nd December, 1924, or after 29 days.

Eggs deposited about 8th December, 1924, by reared adults yielded a male on 13th January, 1925, a cycle of 36 days ; several other males of the second generation emerged the next day.

Direct rearings give an average cycle of 33·4 days, ranging from 29-38 days. An additional record was from 6th January to 7th February, 1925, or 32 days.

NUMBER OF PROGENY.

Observations upon this were necessarily broken owing to the impossibility of giving very close continuous attention to the indoor work and to the quantity of the latter. Also, it frequently happened that the fruit containing many eggs would rot away before hatching occurred, and thus the records came to be but fragmentary. They are tabulated for convenience in the following table :—

TABLE SHOWING PARTIAL RECORD OF THE DESCENDANTS OF ONE FEMALE.

Dates.	Larvæ Hatching.	Total.	Average.	Remarks.
Oct. 29-Dec. 6 ..	44	44	..	34 adults.
Nov. 26-Dec. 28 ..	102	102	..	63 adults.
Dec. 6-Feb. 16 ..	84	84	..	At least one fruit full of eggs rotted away.
Dec. 1-Feb. 13 ..	55	55	..	Average 2 ♀'s. Some young killed by decaying fruit.
Dec. 11-Jan. 28 ..	26	26	..	..
Dec. 11-Feb. 3 ..	55	55	..	At least many lost by decay of fruit.
Dec. 12-Jan. 30 ..	67	67	..	..
Dec. 12-Jan. 16 ..	45	45	59	Average 2 ♀'s.

LENGTH OF THE PERIOD OF OVIPOSITION.

This is about as long as the life of the adult and continues to a day or so before death. The following actual observatiols were made :—

DURATION PERIOD OF OVIPOSITION.

Lot.	First Eggs Deposited.	Last Eggs Deposited.	Duration, Days.	Average.
1	Oct. 30	Dec. 3	34	..
2	Oct. 14	Nov. 12	29	..
3	Nov. 26	Dec. 13	17	..
4	Dec. 1	Feb. 3	64	..
5	Dec. 6	Feb. 3	59	..
6	Dec. 11	Jan. 13	33	..
7	Dec. 7	Jan. 3	27	37

THE RATE OF OVIPOSITION.

Several lots of adults were confined especially to determine the average number of eggs deposited daily, and some observations were obtained incidentally. The first are tabulated and were as follows :—

ARRANGEMENT TO SHOW AVERAGE DAILY NUMBER EGGS DEPOSITED. ADULTS EMERGING AND CONFINED, 3RD FEBRUARY, 1925.

Number.	Hatchings.						Totals.	Average per diem.	Maximum.
	Feb. 16.	Feb. 17.	Feb. 18.	Feb. 19.	Feb. 20.	Feb. 21.			
1	1	1	1	2	4	2	11	1·8	..
2	0	1	2	1	4	3	11	2·2	..
3	0	2	10	Fruit	rotted		12	4·0	10
4	0	5	4	5	4	3	21	4·2	..
Average ..	..	..	..		..	..	..	3·0	10

From this table the approximate number of progeny can be calculated.

The average period of oviposition extends over 37 days, thus it is apparent that there will not be distinct generations of the insect. By presupposing distinct generations, however, and postulating a life cycle of 45 days as that which will allow most nearly for the approximation, the total number of descendants possible from one fertile female may be calculated.

The average oviposition is at the rate of 3 eggs per day so that the approximate number of eggs laid in the life of one female is 111, and of these approximately two-thirds are female (*see* proportion of sexes). For one year the number of hypothetical generations, each taking 45 days, would be 8. The progeny of each generation then would be as follows :—

1st generation	111
2nd generation	8,214
3rd generation	607,836
4th generation	45,046,464
5th generation	3,333,438,336
6th generation	246,674,436,864
7th generation	18,253,908,327,936
8th generation	1,350,789,216,267,264
Total	1,369,293,178,133,025

In regard to oviposition, the following observations will aid (to show daily rate of egg-laying, continuity of same and so forth). The observations were made toward the end of the period and are comparable with those made from the very start of the period, when the female was vigorous.

Date Confined.	No. 1, Dec. 12.	No. 2, Dec. 6.	No. 3, Dec. 11.	No. 4, Oct. 14.	No. 5, Dec. 3.	No. 6, Dec. 3.	No. 7, Dec. 11.	No. 8, Dec. 12.
Date 1st Descendants ..	—	Dec. 19.	Dec. 26.	Oct. 30.	Dec. 18.	Dec. 18.	Dec. 31.	Dec. 29.
Day No. 1	3	3	4	3	3	2	6	6
Day No. 2	7	3	2	3	2	1	5	1
Day No. 3	5	2	0	3	2	1	4	2
Day No. 4	6	3	1	3	4	1	4	4
Day No. 5	3	2	1	3	2	2	2	4
Day No. 6	3	3	2	..	2	3	2	4
Day No. 7	1	1	..	..	2	2	0	2
Day No. 8	2	2	..	..	1	3	1	2
Day No. 9	..	2	..	..	2	4	2	3
Day No. 10	..	1	..	..	2	5	2	0
Day No. 11	..	3	..	..	2	2	..	1
Day No. 12	..	3	..	..	3	3	..	2
Day No. 13	..	4	..	..	2	1	..	2
Day No. 14	..	3	..	..	2	..	..	2
Day No. 15	..	3	..	..	2	..	..	1
Day No. 16	..	3	..	..	2	..	..	1
Day No. 17	..	1	..	..	2	..	..	0
Day No. 18	..	1	..	..	1	..	..	1
Day No. 19	..	2	..	..	1	..	..	..
Day No. 20	..	1	..	..	1	..	..	..
Average per day	3·7	2·3	1 6	3	2·0	2·3	2·8	2·1
General average	..	..	..	..	..	..	..	2·4

It may be seen from the above tables that oviposition is almost continuous over a rather long period, and, seemingly, the rate per day is small, declining as the female ages. But, after oviposition commences, rarely does the female rest even for a day.

Number of Young per Fruit.

A rather large number of fruits were kept under observation from 14th October, 1924, to about the middle of February 1925. The hatchings from these were carefully counted, resulting as follows :—

TABLE SHOWING THE AVERAGE NUMBER OF LARVÆ HATCHING FROM ONE FRUIT.

Number of Lots.	Number of Fruits.	Total Number Hatching.	Average per Fruit.	Dates.
38	186	1,221	6·5	Oct.-Feb.

This gives some notion of the number of insects hatching from any particular fruit but does not represent the entire number which may have hatched, since further oviposition could have taken place in most instances. To show how the number increases as the summer advances the hatchings are arranged by the month.

TABLE SHOWING AVERAGE NUMBER OF LARVÆ FROM ONE FRUIT AND INCREASE SEASONALLY.

	OCTOBER.			NOVEMBER.			DECEMBER.			JANUARY.			FEBRUARY.		
No. Fruits.	Total Young	Average.		No. Fruits.	Total Young	Average.	No. Fruits	Total Young	Average.	No. Fruits	Total Young	Average.	No. Fruits	Total Young	Average.
38	43	1·1		29	39	1·3	58	139	2·4	50	334	6·6	14	230	16·4

Thus, there is a gradual increase. The small number of fruits for February probably somewhat unbalances the ratio, more especially since the fruits were more or less selected for infestation.

HATCHING FROM SUBMATURE, DRYING AND ABORTS.

Larvæ have been hatched frequently from submature and even ripe fruits and shrivelling of the fruit does not kill the eggs. Decay, however, does. Larvæ have also been hatched from the aborts or minute "tip fruits" and in numbers. Thus from 31st December-16th January, from 19 of them, 41 larvæ hatched; 13th-27th January, from 11, 75 hatched; and 8th-19th January, from 9 aborts, 16 larvæ. These aborts are usually infested and even the ovary is often "silvered."

NUMBER OF YOUNG RELATIVE TO YOUNG AND OLD FRUIT.

For the most part, the fruits for this purpose were selected for infestation, but the two lots are equal in respect to this as the selection was quite random. The following scheme shows that infestation is greater with the younger fruit. The latter includes all normal fruit up to two-thirds grown; by "old fruit" is meant all over two-thirds grown up to that which is ready to be harvested and is practically mature.

SCHEME TO SHOW ABUNDANCE RELATIVE TO AGE OF FRUIT.

YOUNG FRUIT.			OLD FRUIT,		
Number of Fruits.	Total Young.	Average.	Number of Fruits.	Total Young.	Average.
41	291	7·0	108	32	3·3
Winter, collection ..	64	..	..	38 (Adults, larvæ.)	

DISTRIBUTION OF THRIPS UPON THE BUNCHES.

Observation soon showed that as far as the fruit was concerned it was that first opened, the oldest or the basal, which was invariably the first and usually the most infested. To show this clearly the following observations were made on 13th February, 1925, thus tabulated :—

DISTRIBUTION UPON THE BUNCH, CAVENDISH.

——	Basal Hand.	Middle Hand.	Tips or Aborts.	Total.
Number of thrips	302	130	66	498
Percentage	61	26	13	100

Sixteen bunches of all ages were taken at random ; in each site (basal, middle, and tip), three infested "rings" or sides were taken each count. The number per bunch is 31·1, which is much lower than what the entire bunch would bear, and the number per colony is 3·4 average.

DISTRIBUTION WITHIN THE COLONIES.

The number of individuals within a colony varies considerably, usually from several larvæ to 40-50 larvæ and adults, the larvæ nearly always much in excess ; but on very young fruit the adults are occasionally numerous and much in excess (*see* later). Occasionally the number may be more. The largest colonies ever seen contained 115 and 171, all larvæ and crowded upon two sides of single young fruits. The reason that, despite the obvious increase in numbers, the colonies do not increase greatly in size is believed to be due to the fact that these insects do not like contact and as soon as crowding commences some of them move away to other sites. In confinement, the descendants from about 40 adults on one fruit soon became so numerous that the adults literally appeared to be harassed to death ; for having no escape and being constantly kept on the alert they soon died (much before their natural span and from no other apparent reason).

The following data were obtained from forty colonies upon the fruit, 13th February, 1925. The counts were made quite at random from every part of the bunch and from young and old fruits :—

NUMBER OF INDIVIDUALS PER COLONY. LATE SUMMER.

Number of Colonies.	Number of Young etc. Total.	Maximum.	Minimum.	AVERAGE.			Number of Adults in whole.
				Larvæ.	Adults.	Both.	
40	337	60	1	7·8	0·6	8·4	24

Variation :—33, 4, 1, 2, 2, 2, 7, 2, 4, 1, 4, 1, 1, 4, 2, 5, 2, 6, 3, 3, 2, 11, 5, 14, 2, 5, 13, 1, 7, 4, 18, 7, 1, 2, 2, 53, 27, 60, 9, 5.

The incidence of adults was thus, e.g., 33 (1) ; 4 (1) ; 1 (0) ; 2 (1) ; 2 (0) ; 7 (0) ; 2 (0) ; 4 (1) ; 53 (0) ; 60 (0) ; 9 (1) ; 5 (0), &c. In winter the average number per fruit colony was 3.

In July 1924, Mr. Simmonds and the writer found that of 1,531 specimens observed upon the fruit 73 per cent. were larvæ, the rest adults. And of 2,185 specimens noted from the entire plant, 1,309 or 59 per cent. were larvæ.

RELATIVE NUMBERS OF THE THREE SPECIES.

The data in the table just given were also utilised to gain a notion of the relative abundance of the species *bilongilineatus* and the black species, both in reference to *signipennis*. Thus, of the 337 units in these 40 colonies, 4 were of the black species (1 adult, 3 larvæ) and 8 *bilongilineatus*. Thus, the species *bilongilineatus* made up but 2·37 per cent. and the black species but 1·18 per cent. of the whole. This is about the true ratio at which the three species occur upon the banana in the Gympie area. So the one species *signipennis* is responsible for practically all rusting of the fruit.

HISTORY OF A GENERATION.

Two males and one female were taken from banana plants on 29th October, 1924, and confined with food. The males died on 17th and 21st November respectively. The female evidently began laying eggs soon after capture, for the first of her progeny since confinement hatched on 17th November, and mature larvæ were noted a week later (24th November). The fruit bearing the female and her young was then transferred over soil. On 26th November there were many larvæ of all stages, and on 27th November larvæ were noticed entering the soil. On 28th November, 34 young were counted upon the fruit.

On 2nd December the parent was slowly crawling about, apparently laying eggs, the sheath-like ovipositor out and down, its tip dragged along the surface of the fruit. On 4th December the parent died. On the 11th 4 adults emerged from the soil and one was in the soil near the surface (on the 6th, a black adult had emerged). On 12th December, 2 more adults emerged and another was in the soil against sides of the glass tube. Old and recent young still on the fruit, latter very mouldy. On 3rd December, 2 males emerged and on the 15th, 2 more. Emergences then followed :—

December	16	.. ..	7
,,	17	.. ..	1
,,	19	.. ..	7
,,	22	.. ..	6
,,	26	.. ..	9
,,	29	.. ..	3
,,	31	.. ..	2
January	3	.. ..	6
,,	6	.. ..	a pair
,,	7	.. ..	9 adults.

The period of emergence of adults ought to be about equal to the period of oviposition. The latter was from 29th October to 4th December, or 36 days ; emergence occurred between 11th December and 9th January, or 29 days.

GENERAL DESCRIPTION.

Adults.—The species *signipennis* is yellow in colour with two black wing-scales, these in conjunction with the black base of the wings forming two roundish black spots about the apex of the thorax (somewhat before middle of body). This golden colour and the two spots are characteristic. The antennæ are dusky toward apex and the fore wings are black with two clear areas, a longer one near base and the other at apex. The species *bilongilineatus* is of a more greenish yellow, has wholly black forewings, dark antennæ, and black lateral margins of the pronotum. The adults of both species are visible to the naked eye but magnification is necessary for recognition.

When just transformed, the wings and wing-scales are white, fringes dark, ovipositor pale, general colour paler, other colours usual. This refers to *signipennis*.

SECONDARY SEXUAL DIFFERENCES.

The male is smaller and in the female the wings usually do not attain to the apex of the abdomen. The male bears a characteristic which makes identification tolerably easy. This is a short erect jet-black tooth above on the abdomen near apex. On the venter both sexes bear a dark-red median line from apex abdomen ; this is twice longer in the female and is, with it, the ovipositor. The apex of the abdomen in the female comes to a point like the apex of a wedge ; it is somewhat more obtuse in the male.

SEASONAL INCREASE.

No data were collected to show this, but in general the insect increases very imperceptibly. Thus in the last week of September 1924 it was noted that, since last July, there had been no change in the apparent numbers of the insect. And no migration, a symptom of overcrowding, was noted until the last several days of November. At this time and during December an increase of the insect was obvious, and through January and February the colonies were undeniably more abundant throughout the infested plantations. These observations refer solely to one site and three plantations. The species remained scarce elsewhere (as far as known), or at least in those plantations of the same area.

OCCURRENCE IN REFERENCE TO THE SUN.

No distribution on the pseudostem in reference to direct sunlight was observed. On 27th October, 1924, special notice of this was taken when banana plants along a roadside were examined. The stems of these were exposed to the full morning sun for at least four to five hours, but under the sheaths so exposed full colonies of young adults were found. These were normal and under the direct rays.

Later observations were made upon isolated stools. These were always fully exposed to the sun (whereas in a plantation the stems of the plants are much in the shade) and had no large leaves as yet. They were examined from time to time and the colonies were quite normally distributed. Nor did the insects fail to increase upon these plants as the summer advanced. When migrating, the young have been observed in direct sunlight.

INCREASE UPON THE FRUIT.

It was thought that, if a colony occurred in October upon a bunch of fruit that was young, two months later it (the fruit) ought to be full of the insects but such is not the case. For example, on 13th October, 1924, a bunch of young fruit was marked for observation. The fruit was black-tipped, about 5 inches long, angular, bearing "rust" in the "powdery" form (irregular rings or lines near base), and scattered young in both stages. The rust was mostly upon the basal hands, occasionally present on the apical fruit. The thrips were rare, several here and there ; they were also scarce upon the stem (pseudostem) of the plant bearing this bunch. By 5th November there was no change, the fruit half-grown. On 1st December, or after seven weeks, the fruit was submature and practically clean, but the "powdery" rings or chains of rust were rather more extensive. There were only a few thrips here and there. Where an extensive change was expected, none occurred.

On the same date a second bunch was marked and for the same purpose. This was very similar to the first but also bore a few adults. No change could be noticed on 29th October and on 1st December ; like the first, it was submature and practically as it. (For additional data, *see* Sulphur, Field Experiments, No. 1, 4th December, and the details of the field experiments with pyrethrum).

DISTRIBUTION UPON VERY YOUNG AND OLDER FRUIT.

These few data were gathered from Cavendish bananas. The two groups comprised young fruits whose tips had not yet darkened and those older whose tips had darkened. The incidence of adults is marked. The table shows this :—

Number Counted.	White Tips.	Old, Dark Tips.
100 fruits (Dec. 1924) ..	20 (all adults)	69 (mostly larvæ)
? Winter*	71 (all adult except one)	124 (28 adults only)

* Counted by J. H. Simmonds.

In the white-tips, the adults are more abundant than the young, for the reason that it is at this stage that the fruit is attacked (or as soon as it is loosed by the bract—the insect cannot enter beneath the bract when the latter is closed)* and young have not had time to hatch. However, they do occur upon the fruit at this stage. Adults and the powdery form of the rust have been observed upon fruit with not more than the first six hands open, all yet beneath the bracts where the thrips like to shelter. They have been observed when only the first bract was loose (May).

DISTRIBUTION UPON SUGAR BANANAS IN REFERENCE TO AGE.

Sugar bananas do not become infested with thrips, as far as I could ascertain, until the fruit are about one-third grown. This gives this variety a great advantage over Cavendish, which is attacked as soon as the fruit is accessible. The reason for this immunity lies in the fact that the thrips do not like light and, as the fruits of the sugar bananas are well spread when they are young, no concealed or dark places are present for them to hide in. The fruits diverge shortly after they are disclosed.

Most of the fruit of this tall-growing banana was out of my reach, but the writer was unable ever to detect even the first traces of rust upon them before they have closed up, nor has he ever found a thrips upon them at this stage of their development. However, the older, closely applied fruit was almost invariably infested. Examination of this variety for this purpose was made when thrips were abundant, that is, 10th February, 1925.

Mr. Robert Long, who grows more sugar bananas than Cavendish, also concluded as above, and he had taken particular pains to make inquiries.

MANNER OF INFESTATION OF THE BUNCH.

Some experimental work in reference to this had been planned but was overlooked. Whether the adults fly to the fruit or crawl to it is not known, but from the data given elsewhere, showing that it is the basal hand (or hands) which is invariably the one infested (if there is infestation), it is likely that they crawl from the pseudostem, down the stem of the bunch and so on to the first hand of it. The same argument may be used in favour of flight of the adults to the bunch.

EXPOSURE TO HEAT OF SOIL FATAL.

At 2 o'clock p.m., 29th December, 1924, in succession, there were placed larvæ (just taken from a plant near-by) onto the bare soil in the direct sunlight. They immediately died and were shrivelled after five minutes. No movement took place after the insects touched the soil though

* But as already stated, from the first hand they can, and do, penetrate to the interior whether the remaining bracts are loose or not.—A.A.G.

they were struggling just previous to that instant. The soil surface was so hot that the hand could barely be left in contact with it. The stems of the plants (isolated stools) from which the insects were taken were warm, nearly hot.

A slice of infested stem was then taken, bearing 20 larvæ of all ages and 3 adults; this was placed outside up upon the soil. All but 9 young had reached the under (shaded) side after 7 minutes. One fell off onto the soil and died. The 9 above were then pushed off onto the soil, one after the other, and, as they touched, each died instantly. The remainder, now upon the lower side, were treated the same way and each died as it touched the soil. Not one attempted to leave the piece of plant.

As a marked contrast to this fatal effect of the heated soil, large and small mites and numerous small ants were crawling over the earth at this spot, engaged, and in a portion of their natural habitat.

This effect of the heat of the sun has some bearing upon control. It insures death to all thrips dislodged from the fruit at least during the heat of the day in summer, and possibly many of the pupæ could be exposed to it by means of cultivation.

DISTRIBUTION IN REFERENCE TO MATURE AND YOUNG PLANTS.

The following data were gathered early in July 1924 by Mr. J. H. Simmonds and the writer :—

——	Number.	Number of Insects.	Average.
Stools or young plants	13	349	27
Mature plants—			
Bearing	8 } 12	374 }	47 } 31
Not bearing	4 }	60 }	15 }

The insects were at that time most abundant upon mature plants with bunches of fruit and least abundant with non-bearing mature fruits. On the former they varied from 0 to 151, and upon stools from 0 to 102.

THE SAME IN REFERENCE TO PARTICULAR PLANT PARTS.

The data is tabulated. The plants were, of course, bearing :—

Part.	Number of Plants.	Number of Insects.
Stem	16	176
Fruit	16	979

FLIGHT.

Flight has never been observed though very likely it takes place. The following observations were made in reference to it :—

(1) On 22nd September a male was captured and placed upon the hand. It crawled about amongst the hairs of the skin for twenty minutes without making the slightest attempt to leap or fly, even if urged. A second adult at once leapt 4 inches and was lost. A third, a male, crawled about for ten minutes.

(2) Later, four adults of mixed sexes were taken upon the tip of the finger. They merely crawled about making no attempt either to leap or to fly. All in the morning.

(3) In three or four instances, separate adults were taken onto the finger-tips and in no case did they attempt to leap or fly. This at 4 p.m.

(4) On 14th October, while capturing adults by means of a camel's-hair brush, several were observed to leap several inches. Later, adults confined in a vial were seen, on exposure to light, to extend their wings and hop from one side to the other.

(5) When adults, confined within small vials, were removed from them onto white paper, they frequently erected their wings and "hopped" a short distance.

(6) A male upon the pseudostem was uncovered at 11 a.m., 22nd October, and watched. It crawled about for ten minutes, making no attempt to fly. A second male did the same thing. This is their usual habit, and no actual flying has ever been observed.

ENEMIES.

The only one so far observed was a red mite seen occasionally fastened to both adults and young. Its relation to the thrips is unknown.

PART II.—REMEDIAL.

PRELIMINARY EXPERIMENTS.

When this species recently attracted attention, application was made to the Fijian authorities for remedies; it was at first thought to occur in that country. From thence, the application of dry pyrethrum powder was recommended, and the first experiments had to do with that, tobacco dust, and sulphur. Other likely sprays were subsequently tested.

TOBACCO ELIMINATED.

On 24th September one young larva was dusted (using a hand blower) with tobacco dust. The insect remained inert for twenty minutes, the powder adhering to it and apparently having no effect. Then an adult female on stem under a leaf was similarly treated. It continued to crawl about as if the powder had had no effect. Then another larva was treated; it acted as did the first one.

Then a nearly grown larva was powdered thoroughly. It crawled slowly about as formerly and through and through the dusted area. After three minutes, the treatment was repeated. It continued as before for fifteen minutes and apparently without anything unnatural about it. A control acted similarly. Tobacco dust apparently has no effect upon either young or adult. The experiment was repeated a week later with similar results. (*See* later, under Snailend.)

PYRETHRUM EFFECTIVE.

The following experiments were performed as a preliminary test of this insecticide (25th September, 1924):—

(1) Pseudostem of old plant—pulled sheath down and counted 3 adults, 6 young which were dusted at once and the sheath put back. 25th September, 4 p.m.

On 26th September, 7 a.m., upon examination, found 2 apparently dead adults in the moist bottom of the sheath, no others present.

(2) Adjoining sucker, similar process, 3 adults, 14 various young. Same hour as before 26th September, nothing was found under the sheath.

(3) When adults on a pseudostem were powdered, the powder adhered to them and after running for a minute or so they dropped off onto the ground.

(4) Powdered 2 young, 2 adults on pseudostems. All had dropped off on to the ground after two minutes, though they attempted to keep hold of the plant. They seemed to lose control of their legs.

(5) The same with 3 adults, 4 young of various sizes.

(6) The same with 3 larvæ.

(7) The same with 2 adults, 1 young.

(8) The same with 1 adult, 3 young.

(9) The same with 10 adults, 2 young.

These experiments proved that pyrethrum powder was almost instantly effective in clearing the plant of the thrips.

It was here used mixed with finest wood ashes, 50 parts of each.

It now remained to find if the powder was fatal to the insects and at what strengths. The first experiments toward this end were undertaken on 21st October. A nearly grown larva was removed from a sucker and placed onto a piece of white paper. With a camel's-hair brush dipped into fresh powder of the same strength (50 per cent.), the insect was lightly daubed. It continued crawling, but soon showed visible disturbances. After a minute it was upon its back and after forty minutes it was still kicking upon its back and had been unable to regain its feet. Died.

A male was similarly treated. It was upon its back after two minutes. The powder seems to act even though but a particle or two adheres to the insect. This adult continued struggling to regain power of locomotion, but after three-quarters of an hour this ceased. At an hour and a-quarter the wind blew it upon its feet, upon which it became agitated but was unable to move. By half-past 11, or after two hours and a-quarter, it was to all appearances dead. It had not moved a quarter of an inch after convulsions began. Did not recover.

With a grown larva the experiment was repeated. The larva was upon its back by 10·18 a.m. or after two minutes, having crawled but several millimetres. Later, it regained its feet and remained with its legs in constant agitation but unable to progress in any direction. Still struggling at noon and had moved an inch and a-half. An hour later it was inert upon its back. Died.

At 2 p.m., 21st October, 3 larvæ of the two stages were similarly treated. Upon treatment, two of the larvæ crawled 2 and 3 inches respectively before toppling over. At 4 p.m. these two were still upon their backs, hard struggling. At 3·45 p.m. the third had slowly regained its feet and began to move about slowly. However, by 4 p.m. it had another paralytic stroke. All were dead, shrivelled, a.m. 22nd October.

At 4 p.m. another II. was treated. It ceased movement at once and was still inert (though kicking slowly) at 6 p.m., and was dead by the following morning.

Thus it appears to be abundantly proved that this powder, at the above strength, causes death.

At 11 a.m. 24th October a female was touched with the brush dipped into this powder. It continued to crawl rapidly, but after two minutes came to a halt as if walking upon a sticky surface. Then for six minutes it continued spasmodic movements of the legs, finally landing upon its back. After twenty-three minutes it was still upon its back. By noon, although lifted onto its food at intervals (whereupon it managed to crawl feebly its own length), it was practically paralysed. By 2 p.m. dead and shrivelled. Pyrethrum seems to be a specific poison for this insect, paralysing

the nerves. The insect can stand a long while in convulsions but cannot, as a rule, move forward or backward.

On 10th November, a slightly infested bunch of fruit was treated with the powder, usual formula, and a coat was placed upon the ground under it. After several minutes had elapsed, small beetles and minute Hymenoptera, a large psocid, 3 adult thrips, and 1 grown nymph fell upon the coat. The thrips were more active than usual, the adults opening their wings and hopping an inch or two, but this movement was very erratic. The young was in convulsions.

It now remained to find the required strength at which this insecticide must be used in order to be effectively fatal. To that end the following experiments were proposed and performed :—

THE EFFECTIVE STRENGTHS OF VARIOUS ADULTERATIONS OF PYRETHRUM. ADULTERANT, WOOD ASHES.

Lot No.	Strength.	Number Insects Treated.	Per Cent. Killed.	Average.	Remarks.
	%				
1	33 (1 in 3) ..	2 ♂, 1 ♀ ..	100	..	..
2	33 ..	1 larva, 3 ♀'s	100	..	Powder mixed 4 days before
3	33 ..	2 larvæ, 2 ♂'s, 1 ♀	60	86	1 ♂ ♀ survived and mated
4	25 (1 to 4) ..	4 larvæ ..	100	..	All paralysed after 2 minutes.
5	25 ..	3 larvæ ..	100		
6	25 ..	1 ♂, 1 ♀ ..	100	100	Both died after severe convulsions.
7	25 ..	1 ♂, 2 ♀'s, 3 larvæ	100		
8	25 ..	2 ♂, 2 ♀ ..	75	..	1 ♂ recovered.
9	16·6 (1 to 6) ..	3 larvæ, 1 ♂ ♀	100	..	1 of the larvæ walked considerably.
10	16·6 ..	1 ♂, 2 ♀'s ..	33	66	
11	12·5 (1 to 8) ..	1 ♂, 2 ♀'s ..	66	66	
12	10 (1 to 10) ..	3 ♂ ♀ (3) ..	0	..	All crawled away and escaped.
13	10	1 larva, 2 adults	0	..	Had convulsions but recovered.
14	10	1 larva, 3 adults	0	..	ditto
15	10	2 larvæ ..	100	25	Died after 4 hours.

There is an obvious decrease and variation in effectiveness as the adulteration is increased. It is safe to recommend the powder at 50 per cent. strength, but good results will be obtained at half that strength—that is, at 25 per cent.—and this adulteration should be used in case the treatments have to be increased. The insecticide is more fatal to the adult. (For further note, *see* (2) under Snailend.)

THE AMOUNT OF PYRETHRUM PER BUNCH.

By actual trial it was found that when adulterated with wood-ashes to half, with a hand-bulb blower, 1 lb. of the powder pyrethrum would treat 230 bunches. Reckoning the cost of the powder at 5s. per lb. (it ought to be cheaper), the cost of materials would be a farthing a bunch. This is reasonable enough providing the treatments do not have to be repeated too many times. During the trial, the treatment of each bunch was thorough, as is necessary. If the treatments have to exceed four, it would be well to adulterate to 25 per cent. of the powder and increase the thoroughness of treatment.

PYRETHRUM EXTRACT.

This is merely the powder of pyrethrum put into water and allowed to seep for an hour or two. The following experiments were performed in order to find the strength necessary for it to become effective against this species of thrips. The powder was at first thoroughly stirred into the water and then left for about half-an-hour. This made a brown fluid, which if allowed to stand longer would gradually clear, as the powder is merely in suspension and slowly settles. The essence of the powder, however, is soluble in water. The following table summarises :—

VARIOUS STRENGTHS OF PYRETHRUM EXTRACT.

Lot No.	Dilution per Quart.	Number of Insects.	Per Cent. Killed.	Remarks.
1	28·5 grs. (·066 oz. avoir.)	3	66	
2	57 (doubled)	6	50	
3	85 (or trebled) ..	8	25	Standing 24 hours.
4	85	6	30	Standing 40 hours.
5	114	11	100	
6	142	6	100	
7	171 (six times) ..	6	50	
8	228	4	50	
9	228 (eight times) ..	7	14	

The experiments seem to be inconclusive. Perhaps they were not carried far enough but it seems that the stronger the infusion was made the less effective it became. Very likely it was not strong enough. However, even so, this infusion is as effective as many of the insecticides used, as shown later. The unit of 28·5 grains apothecary's is equivalent to ·066 of an ounce avoirdupois. Therefore in Lot No. 1 the powder was used at the rate of 0·26 oz. per gallon of water ; in Lot Nos. 8-9, at the rate of 2 oz. per gallon or 1 lb. to 8 gallons. At this rate, at 5s. per lb., a gallon of the extract would cost about 7d.

SULPHUR A DETERRENT.

(1) On 24th October, 1924, flowers of sulphur purchased from a chemist in Gympie was made the object of experiment. As with pyrethrum, wood-ashes were used as an adulterant, using half of each. When an adult was treated, it crawled about for several minutes unharmed, and continuing this was soon lost to view, escaping. A grown nnmph was then daubed with it, using a camel's-hair brush. It crawled away unhurt and was kept in view for five minutes, when it was re-treated. This neither had any effect. This larva would not crawl through a field of the substance, but if ordinary flour was placed in its way it would not avoid that but crawled through it (not, however, without mechanical difficulties). After twenty minutes it crawled away and was lost.

(2) On the same date a grown healthy larva was daubed with the brush, the latter bearing the same substance at the same strength. The insect struggled through the powder in three minutes and crawled off at its normal gait, the powder adhering to it. It refused to enter a fresh field, turning aside upon approach and crawling around instead of through it. The larva lost to view after thirteen minutes and during that time had shown no adverse symptoms. It was afterwards found and confined with food, and was in good health twenty-four hours after the experiment.

(3) The same experiment was repeated with an adult female. It hopped vigorously out of the powder, crawled away, refused to enter a fresh field placed in front of it, and was then lost. Fine particles of the powder were adhering to it as with pyrethrum.

Subsequently one field experiment was performed with this substance; *see* later. The sulphur has no direct deleterious effects upon the thrips but they avoid it.

THE EFFECTS OF PYRETHRUM AND SULPHUR UPON HATCHING.

The following experiment was performed to see if, when the fruit had been treated with either pyrethrum or sulphur, these latter would have any effect upon the thrips other than merely killing or driving away the active forms then present upon the fruit. Would either of them have a more prolonged action, killing or preventing the next several days' hatchings ?

At 8 a.m., 11th February, 1925, fifteen recently picked and apparently infested bananas were divided at random into three lots : No. 1, control ; No. 2 treated with sulphur (half wood-ashes) ; No. 3, treated with pyrethrum half, wood-ashes half. The treatments were made with a rubber blower the same as that used in the field, and the treated lots were given a good coating of the two insecticides. All of the lots were then laid side by side upon separate pieces of white paper. They were in the open air.

The following results were shown by records kept :—

EFFECT OF PYRETHRUM AND SULPHUR UPON HATCHING.

Lot.	HATCHINGS, FEBRUARY 1925.					Totals.
	11th, Noon.	12th, 2 p.m.	13th, p.m.	14th, p.m.	15th, *11 a.m.	
Control, 1 ..	1	8	3	5	(6)	17
Sulphur, 2 ..	2	2	0	0	(1)	4
Pyrethrum, 3	0	0	0	0	(4)	0

* Fruits were washed after counting hatch of 14th and hatching at once recommenced.

Thus pyrethrum prevented hatching and sulphur prevented most of it. After washing the fruits, recent larvæ were found upon both treated lots the following morning (15th), but sulphur was still present in places on Lot No. 2. The lots were re-treated 7 a.m., 12th February, but not on the 13th and 14th. Thus, the pyrethrum was effective from 8 a.m. 11th to 7 a.m. 12th, or 24 hours ; and from 7 a.m. 12th to p.m. 14th, practically forty-eight hours. This experiment shows that, providing there is no rain, treatment with these insecticides will keep the fruit clean for several days, besides killing the hatchings over several days.

As regards the sulphur it may be possible that new hatchings occurred and the larvæ left the fruit as soon as hatched, but this is not likely.

On 6th October, 1924, a slice from a badly infested stem was powdered with 50 per cent. pyrethrum. No emergences occurred up to 21st November, although from a control nineteen larvæ hatched. This experiment was repeated but no larvæ hatched from either lot.

With the extract of pyrethrum these experiments with fruit were performed :—

RESULT OF LABORATORY TREATMENT OF INFESTED BANANAS. PYRETHRUM EXTRACT.

Strength.	Number of Fruits.	Treatment.	Hatchings.
57 grains (0·13 oz.)	4	Dipped ..	10
Control	4	None ..	8
114 grains (0·26 oz.)	3	Soaked 1 hour	1
Control	3	None ..	5

These results are not very conclusive. The amount of pyrethrum used in each case was to the quart of water as 0·52 oz. and 1·04 oz. per gallon.

EXPERIMENTS WITH SNAILEND.

This is a preparation obviously composed of tobacco dust and manufactured by W. D. and H. O. Wills (Australasia), Ltd., Sydney. The few experiments performed with it will be given in connection with the above. It is a rather coarse, strong-smelling powder.

(1) Two females emerging 22nd December, 1924, were treated 30th December at half-strength, the adulterant being wood-ashes. The insects were then confined with food and showed no symptoms of having been affected. They lived until 12th January and 13th February respectively. The first one died because the food dried up.

(2) Two adults were treated successively on the same day. No effect was produced. In this experiment, the powder was used unadulterated. As a control, a third adult was treated with the 50 per cent. pyrethrum, and it had the characteristic convulsions though this powder had been mixed a month previously and was standing exposed to the air (it had lost nearly all odour).

The Snailend was then mixed with its bulk of wood-ashes and a fourth adult was treated. It was thought the added fineness of the powder would make it more effective. However, it had no effect and the specimen was confined with food and kept alive one week, then discarded.

FIELD EXPERIMENTS.

SULPHUR.

At 2 o'clock, 17th October, 1924, on a clear, warm, breezy afternoon, ten bunches of young bananas (dark tips) were selected and marked.

With the hand bulb they were then treated with flowers of sulphur mixed with half its bulk of wood-ashes. The latter was sifted and was very light and fluffy. The fruit was free of rust but showing the usual infestation and "rings" near base.

The lot were examined for the first time on 22nd October, or after 5 days. The powder was still present despite heavy rain. It was lodged just where it was wanted, i.e. where the rust commences, down between the fruits where they touch. No injury and no thrips.

On 4th to 6th November it was raining more or less each day, sometimes heavily.

On 10th November, a second examination was made (after 3 + weeks): Bunch No. 1, adults and young on fruit; No. 2, mature young amidst the powder; No. 3, mature, no insects but "rings," as 9; No. 4, as No. 9; No. 5, adults amongst the powder; No. 6, submature, much powder; No. 7, less powder, no insects; No. 8, uprooted by storm, young on fruit and 1 adult *bilongilineatus*; No. 9, some powder, living insects, no thrips; No. 10, powder gathered about the "rings," adults present.

Thus, a little after 3 weeks the bunches were as badly infested as before treatment. Doubtless this reinfestation took place earlier.

A third and final examination was made on 4th December, as follows :—

No. 1.—Submature, no increase of thrips nor of rust except that the rest of the upper row of the basal hand now bear "rings" (formerly on 10th November, of these upper bananas, the most basal, only 1 and 2 from the left bore rings and thrips; now all bear them. Also of the lower or next row of four fruits, the fourth or right was free of "rings") and a thrip or two each. Of the lower, no increase but the rings of 1-3 were more leathery; fruit No. 4 bore a small ring.

No. 2.—Submature, clean. Rings now often elongated, thrips present.

No. 3.—Mature. Powder present. Clean. Rings and thrips. Powder down in the rings.

No. 4.—As 3.

No. 5.—Two-thirds grown. As 3 but cleaner, rings more rare. Adults in the powder.

Nos. 6 and 7.—Harvested.

No. 8.—Rotted away. Had been uprooted as noted before.

No. 9.—Powder still present. Rings fairly common, thrips present. Fruit two-thirds grown.

No. 10.—Fruit submature. Rings and a few thrips.

These ten bunches were compared with ten bunches of similar age selected at random, and there were no differences. The insects were not abundant enough to cause rusting and the experiment was therefore inconclusive. The treatment did no injury and temporarily cleaned the bunches, but did not prevent such slight increase of the rust as did occur.

FIELD EXPERIMENTS WITH PYRETHRUM.

All the experiments in the field with this insecticide were made at half-and-half strength. The experiments are herewith given at length. Before each treatment the powder was tested upon insects on the pseudostem and only fresh powder was used.

(1) 24*th September*, 1924.

At 4·30 p.m. to-day, with the blower, six half-grown bunches of bananas were powdered; dry, clear and warm, more or less windy. The treated plants were then plotted for identification. A shower of rain fell 12 hours later but did not remove the powder, which, of course, had had ample time to be effective.

After 22 hours an examination of the bunches was made as follows :—

No. 1.—No living insects	Control : No thrips, a few psocids living.
No. 2.—Much rust at base of bunch. No living insects	Control : 4 young and mites and psocids, all alive.
No. 3.—3 dead psocids	Control : 1 living mite.
No. 4.—1 living mite only	Control : 3 living mites.
No. 5.—Nothing	Control : 2 young and 3 psocids, alive.
No. 6.—Nothing	Control : 2 young and 3 psocids, alive.

Thus the fruit was practically clean. On the treated bunches, only one living mite was found, whereas on similar random bunches selected as controls, 8 living thrips, 11 psocids, and about 7 mites. Although insects were rare, the result is striking enough.

A second examination was made upon 13th October, or after 3 weeks :—

No. 1.—Young and adults but scanty. Rust just apparent.

No. 2.—No thrips. Rust well advanced upon bottom hand.

No. 3.—Broken. No thrips. Traces of powder and rust.

No. 4.—Few young. Rust evident on side, basal fruit.

No. 5.—Powder evident. No insects nor rust.

No. 6, the same as No. 5.

Controls examined were about the same.

A third examination was made on 5th November, or after about 6 weeks :—

No. 1.—Mature. Fruit clean of thrips but the ring-like powdery patches have since become square inches of typical leathery cracked rust. Lower fruit clean of all.

No. 2.—Blown down by storm and fruit removed (about 29th October).

No. 3.—Rust present where ring-like spaces had been. A few basal fruit ripe. Occasional young thrips. Mature.

No. 4.—No thrips. Rust upon the basal fruits where the rings were. Nearly mature.

No. 5.—Two-thirds mature, powder still showing, clean.

No. 6, the same as No. 5.

The controls were about the same. This experiment was inconclusive because the infestation of the fruit was not heavy enough to make a contrast between the treated lot and the control.

The final examination was made on 1st December, 1924 :—

Bunches Nos. 1-4 had been harvested. No. 6 was submature with small leathery patches where the rings had been. A few larvæ present. No. 5 was the same as 6 as to age but a splendid clean bunch ; ring-like form of rust present and a few adults and larvæ. The pseudostems were only slightly infested.

(2) 14*th October*, 1924.

Experiment with " White-tips" and " Dark-tips."

Ten bunches of each lot were selected and marked on 14th October, 1924, and then treated. The white-tips or youngest lot will be described first. There was no rust or only the first ring-like form in places.

The first examination was made on 2nd December :—

No. 1.—Half grown, clean. Thrips and rings but moderate.

Nos. 2, 3 as No. 4. No. 4.—Half-grown, nearly clean.

No. 5.—Two-thirds grown. No change.

No. 6.—Half grown, clean but several long powdery patches with young and adults.

No. 7 as No. 5, but rings pronounced and more thrips.

Nos. 8, 9 as No. 4, but on 9 an occasional powdery patch and thrips.

No. 10.—One-third grown but cleaner.

Before this, however, an examination had been made on 5th November. All the fruit was practically clean and unchanged though a few young were present (*see* end of (2)).

The first examination of the dark-tipped young fruit lot was made on 5th November :—

Nos. 1, 2.—Clean, rings present.

Nos. 3, 4.—Clean. Nos. 5-7, Clean.

Nos. 8, 9.—Clean, powder well sifted into the ring patches.

No. 10.—One mature young ; clean, slight rings.

The second examination was made on 2nd December :—

No. 1.—Submature ; clean, no rust nor thrips.

No. 2.—Missing.

No. 3.—Half-grown ; clean but adults and larvæ present, also elongated powdery patches on inner side of basal fruit.

No. 4.—Submature ; clean but ring-form common ; adults and young in small numbers.

Nos. 5-7.—Three-fourths grown ; clean but with rings and adults and young, the latter rather more abundant than usual.

Nos. 8, 9.—Two-thirds grown, clean, ring-form and a few thrips.

No. 10.—Submature, clean.

Thus, here again the insects were not abundant enough for results to show. The controls were about the same. The experiment shows how slowly the insects cause the "disease" and how slowly they increase and that it is useless to treat for them thus early in the season. The final examination was upon 6th January, 1925 :—

Mature, clean, sometimes one angle of fruit rusted to tip, thrips rather abundant in the rings. This refers to both lots. The "white-tips" were submature.

(3) 15*th October*, 1924.

This is another early experiment and there were two treatments. It consisted of ten bunches of young dark-tips with rust showing only in the ring-form and this only upon the basal hands. The treatment to be repeated after 3 weeks. Day clear, warm and with breezes. Time, 10 a.m.-noon.

The first examination was made on 5th November, and the plot was then re-treated. The powder of the first treatment was still showing. There was no change and only an occasional grown larva and one male was seen upon the fruits.

An examination was made on 4th December, 1924 :—

No. 7.—Submature, clean, usual rings, few thrips and rarely a rust area along one angle to apex of fruit.

No. 5.—Three-fourths grown. Occasionally rings very distinct, with adults and young, clean.

No. 1.—Mature ; clean, occasional small patch of rust where ring was and blotched, rings with few thrips.

No. 8.—Submature ; clean, usual rings with adults and young.

No. 2.—Three-fourths grown and as No. 8.

No. 9.—Clean and as 8 but thrips rare. Mature.

No. 10.—Mature and as 8 ; clean.

No. 3.—Submature ; practically clean.

No. 6.—Fruit stunted save basal row ; these two-thirds grown with usual rings.

No. 4.—Two-thirds grown, clean. Usual rings and thrips.

This experiment nearly parallels the second lot of Experiment No. 2. The second treatment made no material difference and did not prevent a slight increase of the rust but the bunches were not disfigured in any way.

The final examination of this experiment was made on 6th January, 1925. For the most part, the bunches were clean, rings very distinct, fruit mature ; sometimes quite a few adults and young were present but not enough to hurt now. One basal fruit bore a large patch of rust toward tip.

(4) *20th November*, 1924.

This experiment is similar to No. 3. The fruit was the same and was but little infested although the usual rings were present. However, two lots were marked out, the one to be treated once and the other twice. This treatment was intended for a rather late one, but as it turned out it was too early and the same inconclusive results were obtained. The first lot—treated twice—was powdered on 20th November ; the other on 24th November. The first, designated A, was examined for the first time on 8th January, 1925. It had been re-treated on 20th December. The fruit was then clean, with rings bearing a few thrips (young and adults).

No. 1.—Submature with rings but scarcely infested.

No. 2.—The same.

No. 3.—Three-fourths grown ; as No. 1 but adults and young present (0-5 to each fruit).

No. 4.—Two-thirds grown ; some elongate powdery patches. Insects not as abundant as in No. 3.

No. 5.—As No. 4 but no elongate patches.

Nos. 6, 7, as No. 1.

No. 8.—Three-fourths grown, clean, rings rare, no thrips.

No. 9.—Nearly as No. 8 but rings more common and a few thrips.

No. 10, about as No. 4.

On the whole, the fruit was about as before treated and as controls. So the treatment merely cleaned the fruit temporarily and the "disease" was not yet increasing. The above was the final examination.

The second lot, or B, was examined for the first and last time on 8th January, 1925, as follows :—

No. 1.—Submature ; a few rings and thrips, clean.

No. 2.—Submature ; thrips rather abundant on basal fruit but latter and whole bunch clean. Splendid full bunch.

No. 3, as No. 2.

Nos. 4, 5.—Two-thirds grown, clean rings and these infested, 0-9 thrips each.

No. 6.—Submature and clean, a few rings and thrips.

No. 7.—Two-thirds grown. A few elongate powdery patches rather badly infested, rest with some rings, mostly clean.

No. 8, as No. 4.

No. 9.—Two-thirds grown ; small bunch infested in some rings. Clean.

No. 10.—Three-fourths grown, clean, rings and a few thrips.

On the whole all as clean as when first treated and not differing from controls.

(5) 13*th January*, 1925.

A late treatment, young dark-tips. To be repeated. Eleven bunches. In No. 6, the bunch was nearly two-thirds grown, many thrips and elongate, wide, rusty patches, not leathery. Five minutes after powdering the fruit was clean. One adult and 1 young were found, the latter bearing powder particles. See if patches of rust, which are cracked in places, turn brown and leathery. The second treatment was given on 6th February, 1925.

On 15th January, examination of a few of the bunches showed recent young and an occasional adult and mature larva (either migrants or escapees).

Nos. 1-4 were treated (6th February) just before a rather heavy shower but the powder had had time (5 minutes) to work. After half-an-hour, treatment of the rest was resumed because they had sufficiently dried (were not dripping, only moist).

Nos. 1-4 were dirty in places with the powdery forms of the rust.

No. 5 had some of the basal fruit a dirty red with rust but only in splotches ; it was worse in the second row from base. Fruit submature.

No. 6.—Now mature, only a few thrips ; the badly rusted patches on basal fruits (latter very large and full) have leathered only in streaks here and there but the purple "powdering" gives them a diseased appearance. Young were present.

No. 7.—Considerably discoloured in places by a purplish splotching, especially basally, but even small tip fruit is dirty. No thrips.

No. 8.—Two-thirds grown ; many of the fruits purplish around the apices and sometimes along one side ; no thrips nor leathering as yet.

No. 9.—Two-thirds grown ; clean but "rings" increasing ; thrips common in places (colonies) but not abundant (in the sense of space, they do not cover the fruit along one side).

No. 10.—Picked.

No. 11.—Submature ; a few "rings" now elongate and a lot of purple end but fruit has a clean appearance.

Untreated adjacent bunches are about the same. The treatment has not prevented "dirtying" of the bunches, but in adjacent controls no leathering is present and but few thrips.

On 9th February the bunches were examined, more especially to obtain further data in reference to the effect of the pyrethrum.

No. 1.—Bunch clean but 1 adult was found and 4 recently hatched young on about eight fruits (this A.M.'s hatch). Also No. 2, six fruits examined bore no thrips, basal hand. Also No. 3, seven infested rings showed but 1 young (this morning's hatch). A control bunch of younger, quarter-grown dark-tips yielded 60 thrips upon four fruits. Thus from twenty-one fruits of the treated lot, only 6 thrips were found and five-sixths of them had just hatched ; moreover, it was raining off and on. In great contrast, from but four random fruits taken from an untreated bunch, 60 thrips were obtained.

No. 4.—In seven rings only 1 thrips, this hatching from a papilla upon the ring ; there was no powder just near it but much around it and this had been rained upon. In contrast, on a control, on seven places upon fruit of equal age, 31 thrips of all stages were found.

No. 6.—Mature bunch, one side of several basal fruits badly blotched with purple, from six places, 2 just-hatched larvæ. As a contrast, six control places yielded 10 of all stages.

No. 7.—No larvæ in six rings.

No. 11.—One recent young in six places ; this young had just hatched. It was watched, the fruit being picked. There was a lot of powder scattered about and the larva soon had some adhering to it. However, no effect followed and the powder had evidently lost its strength (through exposure to rain, etc.). A control of similar age, six places, 4 larvæ (3 mature, 1 new).

This examination showed how effective the treatment had been in cleaning the fruit ; also that hatching was prevented on 7th-8th February, as on the 9th only that day's larvæ were present (it has been proved that the powder actually prevents hatching).

(6) *9th February*, 1925.

A late treatment, to be repeated four times (every ten days) and begun with the youngest fruit. The experiment consisted of four bunches of young "white-tips" infested with adults and occasionally showing elongate patches of powdery rust and with about eleven hands out of the bracts. On bunch 4 considerable larvæ were present, besides the adults. The first examination and second treatment were made on 18th February, 1925. Before the second treatment, the fruit was as follows (after 9 days) :—

Bunch No. 1.—Only a few recent young found here and there. However, on one fruit of basal bunch, with elongate patches on each side, 77 young (+ 1 male), mostly recent, were found ; a few of these larvæ were mature. On the other side of this fruit were 92 (+ 1 female), a total of 171.

Bunch No. 2.—Practically free of thrips.

Bunch No. 3.—One mating pair observed ; very few thrips.

Bunch No. 4.—Very few, if any, thrips.

All bunches still full of the powdering.

This experiment was completed by Mr. B. F. Schmidt of Chatsworth and he reports on 16th April, 1925, that two more of the treatments were given and now very few thrips could be found. The fruit is not mature enough to forecast its final state but are considerably cleaner than untreated bunches. However, he considers several more treatments necessary but with longer intervals between.

ILLUSTRATION OF THE PRACTICAL EFFECT OF PYRETHRUM.

On 9th February, 1925, an infested bunch was selected for the purpose of showing the effective cleaning-power of pyrethrum. At first six infested places were selected for examination (six colonies within their rings), finding 34 thrips. The bunch was then thoroughly powdered, using the bulb-blower, and a coat was placed upon the ground beneath it. The powder had first been tested and found effective. Soon, upon the coat were found a few submature larvæ, inert. The insects were therefore falling from the fruit. An hour later, six rings were examined, finding but 3 submature larvæ. The infestation had been reduced from 34 to 3.

OTHER FIELD EXPERIMENTS.

(1) BORDEAUX MIXTURE.

This well-known fungicide was recommended for trial as a deterrent. Accordingly, on 10th December, 1924, ten bunches for this purpose were marked off, the fruit all young, dark-tips, clean save for occasional rings and a few thrips. More highly infested fruit could not be obtained. The substance was used at the rate of 1 lb. to 30 gallons water.

On 16th December, 1924, the first examination was made. The fruit had the usual appearance of foliage sprayed with this substance and the rings had the bluish deposit all around them. Despite this, occasional young and adult thrips were found within them.

A second examination was made on 8th January or after a month. Fruit now from two-thirds to three-fourths grown and clean, but with infested rings quite as with untreated bananas of this time and of the same age. Sometimes there were elongate, powdery patches. The spray still persists in the well-known spots ; no injury was done.

As a control to this not only were genuine controls examined but a laboratory experiment was performed on 15th December. Three adults, 1 male, 2 females, were placed into a drop of the mixture and allowed to crawl out. They were then confined with food. A fourth adult crawled out of the liquor and escaped. They lived until 22nd December, or for a full week after treatment, death being due to accidental causes (food dried up).

(2) BLACK-LEAF 40 (NICOTINE SULPHATE).

This is now a well-known commercial insecticide. It was used in two field experiments and in a number of laboratory tests. The details of the field experiments are as follows :—

A. Spraying Pseudostem.—On 15th October, 1924, six infested banana plants in bearing were thoroughly sprayed with this liquor at double the recommended strength and with a little soap. The fruits were young, not rusted but with the powdery ring-form. A first examination was made upon 22nd October, or after a week as follows (only the stems had been treated) :—

Tree No.	Insects: Treated.	Control.
1	0	2 (psocids)
2	3 (1 thrips)	1 (mite)
3	1 (thrips)	6 (thrips)
4	2 (psocids)	8 (thrips 6)
5	0	0
6	0	0
Totals	6	17

There is a marked difference in infestation between the two lots but the insects were not abundant.

On 10th November a second examination was made :—No. 1, barely infested. Of the fruit (not treated), second hand from base (above) upper row, Nos. 2-11 bear the ring-form of rust. No. 1 (left to right, facing the bunch) has none. Will any of these be rusted on maturity ? No. 1 on the lower line has none but the rest in its line have. Will these be rusted and 1 not ?

(On 4th December, Nos. 1-11 have the ring, elongated in a few. Of lower line, all now bear the ring ; none were rusted at maturity).

No. 2, infested but not badly. No. 3, the same.

No. 4.—Adults common. Practically all basal fruit show ring-form but only a rare thrips.

No. 5.—Adults fairly common. Also on the fruit, with young ; basal bunches showing rings.

No. 6.—Occasional adult. Fruit mostly clean but with occasional young and the rings present on basal fruit, sometimes toward the tip.

On the 4th December following, a final examination was made :—

No. 1.—Both stem and fruit infested but not badly. Fruit submature, with rings.

No. 2.—Both stems and fruit slightly infested.

No. 3.—As No. 1 but fruit younger and only slightly infested.

No. 4.—Stem moderately badly infested. Fruit two-thirds grown, rings and a few thrips.

No. 5.—Submature, an occasional patch of genuine leathery rust at the former rings, thrips not abundant. Stem " badly" infested.

No. 6.—Stem moderately infested. Fruit submature, insects rare but rings present. After the first examination, the controls did not differ materially from the treated lot.

B. Spraying Pseudostem and Fruit.—On the same date as with A, six plants were similarly sprayed, including the fruit. The latter were similar to those in A.

The first examination was not made until 4th December, 1924, as follows :—

No. 1.—Fruit submature, clean but ring-like and elongate powdery rust frequent, larvæ and adults more numerous than usual. Stem rather badly infested (say 40 specimens to a colony, sometimes).

No. 2.—As No. 1 but stem less infested. No. 3, as No. 1 but fruit two-thirds grown, the rust not quite so extensive.

No. 4.—Mature ; stem infested rather badly. Fruit as in No. 1.

No. 5.—Two-thirds grown ; clean. Stem with numerous thrips, fruit as in No. 1 but rust less developed.

No. 6.—As No. 5. Controls were very similar.

The final examination was made on 6th January, 1925. The plants were about as in the first examination but most of the fruit had been harvested, only two bunches remaining. The experiment shows that, despite the treatment, the insects increased about at a normal rate.

Dipping Experiments with Black-leaf 40.

(1) Three infested suckers dipped 27th August in the liquid double recommended strength. After drying they were examined and nothing living found upon them. Same on 20th September.

(2) Six adults, 1 nymph kept immersed for thirty minutes in Bl. 40, usual strength, i.e. recommended strength, 20th September, 4 p.m.

21st September, 7 a.m., 4 adults, 1 young remaining, all dead. Same 22nd September. Remainder escaped.

(3) 20th September, 1924, 11 a.m. Normal or recommended strength :

Lot No.	Insects.	Time.	Result.
		Minutes.	
A ..	2 adults	10	Dead.
B ..	1 young	10	Alive (escaped after ½ hour).
C ..	1 young	5	Alive at 4 p.m.
D ..	10 adults	5	Alive at 4 p.m. 22 Sept., a.m. 70 per cent. dead, or 7.

(4) 24th September, 1924.—Took two 3½-foot suckers showing infestation by observation (and the dark colour of the pseudostem, as then supposed, a symptom of infestation) and at twenty to 9 a.m. submerged them for thirty minutes in the liquor at double strength. After drying, the plants were carefully examined and 8 living adults (kicking but not walking) were found and 1 small young. These were put aside for observation.

On the following day at 8 a.m., 1 young, 6 adults dead ; one of the latter alive and able to crawl but it died on 24th September.

(5) At noon, 21st September, a large number of young and adults were submerged for twenty minutes, same strength as in (4). Seven adults 2 young were obtained for observation. Two of the adults were crawling a bit. All subsequently escaped except one which died.

(6) On 21st September, noon, a small sucker was dipped for twenty minutes in Bl. 40, double strength. The following day, at noon, the sucker was examined, finding 2 young and 7 adults all dead.

(7) Two dozen young dark-tips were dipped into the same solution as in (6), dried and wrapped in paper, 22nd September. Nothing hatched from them up to 26th September.

EXPERIMENTAL DIPPING OF FRUITS.

These experiments were performed in order to see if insecticides would kill the eggs within the fruit. They are tabulated as follows. Each lot was taken at random from a unit lot of fruit. The treated lots were drained off, allowed to dry, and spread in the open air. Some of the treated lots were kept after drying, wrapped in paper.

TABLE SHOWING EFFECT OF DIPPING INTO BLACK-LEAF 40 UPON HATCHING. DOUBLE RECOMMENDED STRENGTH.

Lot No.	Number of Fruits.	Duration of Treatment.	Hatchings.		Difference in favour of Control.	
			Treated.	Control.		
						%
1 ..	4	1 minute	1	8	7	88
2 ..	5	1 minute	0	7	7	100
3 ..	5	45 minutes	6	3	−3	33
4 ..	4	1 hour	0	4	4	100
5 ..	4	1 hour (2 weeks old) ..	6	7	1	54
6 ..	5	1 hour (78 hours old) ..	5	14	9	73
7 ..	5	1 hour	2	9	7	81
8 ..	6	1 hour	6	21	15	78
9 ..	5	1 hour (5 days old) ..	1	4	3	75
10 ..	4	1 hour	0	4	4	100
11 ..	5	2 hours (old solution) ..	1	39	38	97
12 ..	8	1 minute (nicotex 1-1000) ..	1	7	6	87
		Total	29	127	104	81

Failing Lot No. 3, there is a decided difference between the treated lots and the controls. Of all the hatchings, 82 per cent. were from the control. If the insecticide is so effective with eggs in the fruit it ought to be equally so upon those within the stem, but actual tests of this were not made except in the case of the tests with infested stools, given above. In these, no hatchings were observed. *See* below, Kerosene Soap.

A few additional experiments of this nature were made with Kerosene Soap and Black-leaf 40, the following formula :—One tenth bar of Campbell's Soap Mixture to each one gallon water and the nicotine added at the recommended strength. All treated lots in open air.

TABLE OF ADDITIONAL DIPPING EXPERIMENTS WITH FRUITS.

Lot No.	Number of Fruits.	Treatment and Duration.	HATCHINGS.		Difference in favour of Control.
			Treated.	Control.	
					%
1	5	Dipped only	13	9	40
2	4	Dipped (same solution, 48 hours old, reheated)	41	85	67

The smaller quantity of the nicotine seemed to be less effective, but *see* below. This mixture upon standing some hours gelatinised. To re-use, it was but necessary to heat gently.

LABORATORY EXPERIMENTS.

(1) 29th October, 1924, 11 a.m. *Usual or recommended strength.*—Ten young of various ages were dipped into a drop and then removed after they were thoroughly wet. They were at once stupefied. However, after a few minutes, two of the largest crawled off, rest curled up, inert. After twenty minutes, one young crawled off, then another youngest (four minutes later), then two larger ones crawled off (five minutes later) ; rest (four) removed shortly and confined with food in open air. After twenty-four hours three healthy larvæ remained. Thus there was no fatal effect.

(2) At the same time three adults were similarly treated. They seemed to have cramps for a short time, then crawled off. Confined on a banana in cotton-plugged tube. After twenty-four hours one male dead, others alive and normal. This was repeated ; one male lived until drowned 17 days, later ; a second lived until it died three weeks later ; and the third, a female until 1¼ months had elapsed. Per cent. killed for both, 17.

(3) 30th October, 1924. *Double strength plus a little soap.*—One youngest, two grown nymphs dipped into the fluid. All crawled a short distance and then became inert. One crawled off after forty minutes, other two perished. All had convulsions. Sixty-six per cent. killed.

(4) Three young, two adults similarly treated. After an hour, one adult crawled off ; after two hours, one youngest crawled off. Rest died. Sixty per cent. killed.

(5) 31st October, 1924.—Six young were similarly treated. Remained as if dead. Two youngest recovered after an hour and a-half, another after two hours. Rest died. Fifty per cent. killed.

The experiment repeated. One youngest crawled off after an hour, one mature after three hours, and one youngest after three and a-half hours ; a fourth crawled away after five and a-half hours. Thirty-three per cent. killed.

(6) 4th November, 1924. Two males and three larvæ were dipped so as to wet, then removed to surface of white paper. All were at once stupefied. After one hour, one youngest, one mature crawled off. They were tubed with food. The remainder did not move but died where they were.

On the following 48-hour end, one of the two living nymphs was still alive, the other could not be located and very likely died and shrivelled. 12th November, larva mature. The mortality here was 80 per cent.

The effective mortality of the above experiments was as follows :—

1. Usual or recommended strength, 16·5 per cent. or less, average.
2. Double strength, 57 per cent. average.

OTHER LABORATORY EXPERIMENTS.

(1.) *Kerosene Soap (Campbell's Soap Mixture).*—This is a common laundry soap and was prepared for use by taking one-tenth of the usual bar as it comes from the grocer and, after finely dividing it, boiling in a small quantity of water until in solution. The water was then diluted up to a gallon, and, after the solution was cool, the experiments performed.

1. On 2nd January, three adults were wetted in a drop of the fluid ; two had to be assisted out of the fluid after waiting five minutes, the other crawled out. They soon became quite normal and were at once confined with food, dying as follows :—14th January, one male ; 15th January, two females. Non-effective. The experiment was repeated with similar result.

2. Since the above experiment proved so decisively negative it was decided to try the effect of the addition of Black-leaf 40. As the latter is more or less effective according to strength, it was hoped that when combined with a nearly saturated soap solution its strength would be so much greater. The following experiments are tabulated (the strength of the solution was as in No. 1) :—

Lab. No.	Number of Insects.	Remarks.	Per cent. Killed.
1 ..	3 adults	All inert at once. Placed with food ..	66
2 ..	3 adults ..	ditto ditto ..	100
3 ..	2 half-grown larvæ, 3 ♀'s	All inert at once. One ♀ recovered ..	80
4 ..	3 larvæ, 3 adults ..	All inert at once	90
5 ..	2 mature, 2 young larvæ	ditto	100

From these experiments, this insecticide appears to be highly effective. However, owing to a temporary lack of time in which to watch the insects in the open they were all confined and the result may have been due to this. This is unfortunate because nicotine gives off fumes for at least several hours. The above dipping experiments were also jeopardized by using paper wrappers. In both lots of experiments allowance must be made for this. So there is doubt here, unfortunately. The nicotine was used at the usually recommended strength.

(2.) *Nicotex.*—This is an English proprietary insecticide similar to Black-leaf 40, and was used 1-1000 parts water.

1. Dipped a half-grown young. It crawled away and continued crawling for five minutes. It was then re-dipped and after similar actions soon became paralysed and died.

2. Dipped a female. It crawled off but seemed more or less uneasy, as it kept striking the antennæ at intervals with the forelegs. After ten minutes it began to show erratic movements, slowly pacing from side to side. However it regained normal and after some time escaped. Further experiments would likely show this preparation to be as effective as Black-leaf 40, especially with strong soap solution.

(3) *Gympie Solution.*—This was a carbolic solution prepared by a local planter (Mr. Ukran) and given two tests :—

1. Two young, one male were dipped into it. They crawled off and were captured and confined. The male escaped five days later and the larvæ lived until two weeks had elapsed.

2. Two adults dipped. They crawled off, were captured and confined, and lived for five days or until their food dried up.

The solution was wholly ineffective and had the odour of CN (a commercial deodorant).

(4) *Lime-Sulphur Solution.*—Used at the rate of 1 to 8 of water. Two adults and a grown young one were dipped into it. All crawled off at once and were captured and placed upon a banana. As one of the adults and the young escaped from this after forty minutes the remaining adult was tubed. This lived until, by an accident three weeks later, it was killed.

Later, two grown young were dipped ; this treatment had no apparent effect and they escaped before they could be tubed. The same thing happened in reference to another larva. Further experiments were abandoned.

(5) *Miscellaneous.*—The remaining laboratory tests are tabulated. It is unfortunate that more extensive trials of each were not possible under the conditions of the present investigation, but the nature of the insect and the difficulty of keeping those the subject of experiment under control, made this impossible in the limited time.

TABLE OF MISCELLANEOUS LABORATORY EXPERIMENTS.

Lot No.	Insecticide.	Strength.	Number of Insects Used.	Per cent. Killed.	Remarks.
1	Katakilla (powder)	1½ oz.-2 galls.	2 larvæ, 2 adults	10	Ineffective
2	Benzole Emulsion	1-4 galls.	4 larvæ. 3 adults	57	Stupefied at first
3	Ditto	ditto	3 adults	0	Crawled at once
4	Harbas	1-25	2 larvæ, 2 adults	50	Inert at once
5	Ditto	ditto	1 larva, 1 adult	0	Crawled at once
6	Ditto	1-40	3 larvæ, 1 male	75	Inert at once
7	Ditto	ditto	4 larvæ, 1 female	40	ditto
8	Katakilla (powder)	1½ oz.-2 galls.	3 larvæ, 2 adults	15	Ineffective
9	Derrisine	Normal strength	4 larvæ, 2 adults	60	Crawled slowly.

Katakilla is manufactured by McDougall and Robertson, Manchester. The Benzole Emulsion was of the Vallo brand. The former at the strength used was wholly ineffective ; the emulsion was also ineffective and Derrisine seems to be the only one of the lot likely to succeed.

TESTS UPON BANANA PLANTS.

On 11th February, 1925, some of the above solutions were sprayed upon banana stools in order to see if the latter were injured. The weather remained uniformly clear and hot to the end of the experiment, 19th February, 1925. Benzole Emulsion at the above strength, Derrisine recommended strength, and Harbas 1-40 were the ones used. No injury resulted. The plants had some foliage and were given a good drenching.

SPRAYING INFESTED STOOLS WITH PYRETHRUM EXTRACT.

On 19th January, 1925, three badly infested stools were drenched with this solution at the strength of 1·32 oz. per gallon water (equivalent to Lot No. 6 in the table on a previous page). The purpose was to see if the fluid penetrates to the larvæ under the sheaths. The following results :—

There were still many young and adults upon the plants and occasionally dead ones were seen. The fluid seeped well down under the sheaths. As

the liquid had not been strained the plants were more or less coated with a thin deposit of the powder. Such larvæ as were struck had the characteristic convulsion.

STRIPPING EXPERIMENT.

Some attention to the treatment of the pseudostem was given and it was hoped that the infestation here could be greatly lessened by stripping off the sheaths and then spraying. However, stripping was attempted with five bearing Cavendish plants and it was found to be impracticable on account of the nature of the plant. The plant itself would be torn away.

RECOMMENDATIONS.

The nature of this pest is more or less diabolical. It is always present and always breeding. As it occurs in all four stages at once and in three or four separate places (namely, upon the fruit and stem as larva and adult, in the fruit and stem as egg, and in the soil as pupa and recently emerged adult), no single treatment can be made to act upon the population of any plant. Thus no sooner would the stem and fruit be cleaned of their external population of young and adult than on the morrow they would be reinfested from the hatching eggs and from the pupæ in the soil. For adults are daily emerging from the soil and eggs are daily hatching from the stem and fruit.

However this may be, the writer was surprised to see how slowly rust developed in the worst-infested plantations, namely those at Chatsworth. Also that it was not until February that treatment became necessary or even effective. Up to that time the colonies seemed to be gradually disseminating without causing a corresponding dissemination of the rust. The recommendations, therefore, are simple enough in view of the foregoing observations and experiments :—

(1) That late treatment is indicated and of the fruit only.

(2) That pyrethrum powder, half and half with sifted wood-ashes, is the most effective insecticide to be used (it kills, is easily applied without carrying or transferring bulky material, and is effective for several days).

(3) That treatment with pyrethrum should be repeated at least four times at 9-day intervals and the powder not adulterated below 25 per cent. ; treatment to begin when the fruit is opening or somewhat later (this in order to kill the first parents).

(4) That all tip fruits be removed and destroyed.

(5) That in the case of suckers to be sent off the plantation, the "stems" (composed of leaf-sheaths) should be removed and destroyed, and the corms (the remaining portion) be cleaned of all adhering soil.

(6) That, as alternative insecticides, Black-leaf 40 at double the recommended strength or Nicotex, or especially either in strong kerosene soap solution should be used. The stronger the soap conveying the nicotine the better, and the less of the nicotine it is necessary to use ; thus it might be reduced by half the quantity. And as an alternative powder flowers of sulphur may be used, mixed with half its bulk of wood-ashes ; but sulphur is not recommended.

(7) That, as far as possible, hand-hoeing about the banana plant should be done ; this for the purpose of exposing the pupæ to the heat of the sun and thus killing them.

SUMMARY.

1. *Anaphothrips signipennis* (Bagnall), described from Ceylon, occurs on the North Coast of Queensland and feeds upon the pseudostem and fruit of bananas. The effect of this feeding is, upon the fruit, a powdery blotching of the skin which, as it increases and ages, turns leathery and becomes more or less cracked. This final effect is Banana Rust.

2. The insect is present through the seasons, never ceases to reproduce, and all stages occur at one time. The egg is deposited under the epidermis of stem or fruit and hatches not until from 12-19 days, the shorter period during the summer. The larva is active, grows to maturity in about a week, crawls to the ground and transforms to the pupa in the soil. The resultant adult ascends from the soil in about another week and commences to feed. It lives a month or more, if a female, laying eggs daily until its death, and in both sexes feeding daily for hours at a time.

3. Each generation develops in about 34 days, so that in continuity about ten generations occur during a calendar year. Actually, there are less.

4. The thrips diminish in number during the winter and gradually increase during the spring and summer, so that by February treatment of the fruit becomes necessary in order to prevent leathering.

5. The Cavendish banana is attacked as soon as the fruit is loose from the bracts ; but the Sugars not until the fruit is a third or more grown.

6. Treatment, owing to the facts set forth in 4, should not commence until late in the season.

7. It should consist of regular powderings of the fruit made with a bulb-blower, using pyrethrum powder half, wood-ashes half, bulk measurement. The time of commencing treatment must be left to the judgment of the planter, but the interval between them ought to be not more than from 8-9 days and the number four or more. If still more treatments are necessary, the increased cost may be compensated for by adulterating the powder to a quarter of the whole bulk.

8. In the meanwhile, all tip-fruits should have been removed and destroyed in whatever way is most convenient or practicable.

9. If a spray is desired, Black-leaf 40 or Nicotex in a strong soap solution should be used and at double or single strength. Suckers sent out from an infested plantation should be cut back to the corm, the stems destroyed, and the corms freed of adhering soil (because pupæ may, by chance, be in this soil).

ACKNOWLEDGMENTS.

The writer is indebted for assistance in the field especially to Messrs. T. P. Reynolds and B. F. Schmidt of Chatsworth. These two gentlemen's plantations adjoin and experiments and observations were freely allowed at all times and without interference. As practical planters they also freely offered advice and suggestions. The Messrs. Long Brothers of Chatsworth are also worthy of mention in this connection for their kindly assistance in various ways. For special assistance I am indebted to Mr. J. H. Simmonds, formerly of this Office, and to the Director, Queensland Museum.

LITERATURE REFERRED TO.

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1914. BAGNALL, R. S.—Annals and Mag. Nat. Hist., series 8, XIII., p. 22.

PLATE 87.—BANANA THRIPS (*Anaphothrips signipennis* Bagnall).

Fig. 1.—Larvæ, second stage. 1*a*—Portion of side of abdomen of same, showing the funnelform hairs, one to each segment ; greatly magnified. 1*b*—Antenna of same, greatly magnified.

Fig. 2.—Adult female, the wings slightly extended. 2*a*—Antenna of same, greatly magnified. 2*b*—Wings of same, greatly magnified. 2*c*—Greatly magnified scale over the base of the wings. 2*d*—Apex of the abdomen of the female, greatly enlarged, showing the saw-toothed ovipositor.

(All figures enlarged. Drawn by I. W. Helmsing from actual specimens.)

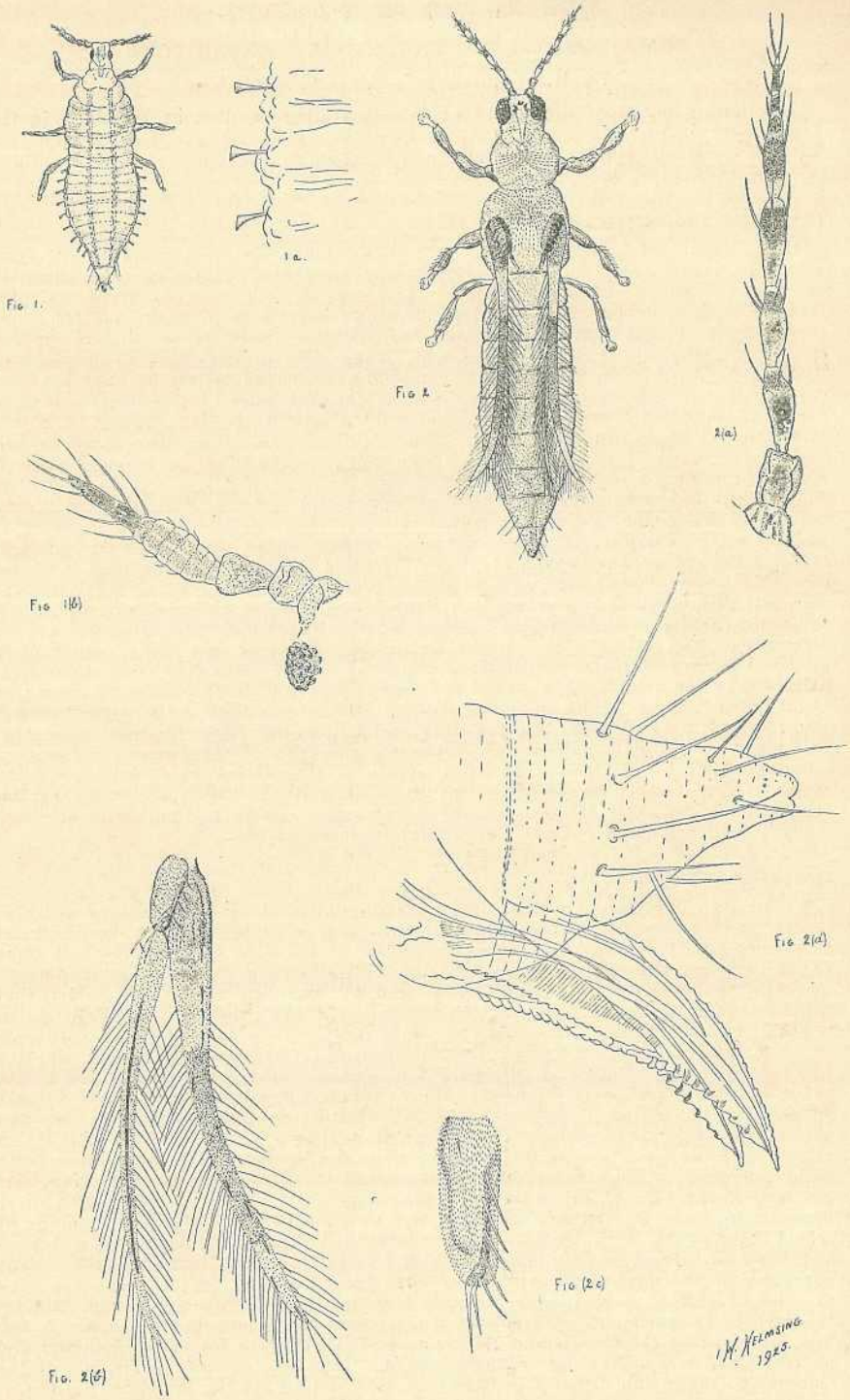


PLATE 87.

(*For description of Plate, see page* 516.)

QUEENSLAND AT WEMBLEY.

SOME LESSONS OF THE EMPIRE EXHIBITION.

BY H. W. MOBSBY, F.R.G.S., F.R.S.A.

Following my general remarks of the Australian pavilion at Wembley in the April issue of the Journal, it will, perhaps, be of interest, to Queenslanders at least, if we briefly review a visit to the Australian pavilion in search of something to be learned from the exhibition.

The Sugar Industry.

The sugar exhibit, as well as space would allow, depicted the industry from an educational point of view. Strikingly presented statistics and displays of various grades of sugar, from the raw to the refined, were valuable features. A photographic diorama showing sugar-cane cutting in the field was also a bright feature. Below the diorama were three similar panels, the centre one, the map of Queensland, being cut to shape out of a piece of "cellotex" board made with megass (cane fibre residue left after the juice has been expressed), and a piece of whole sugar-cane. On both sides of this panel a map of Australia in white refined sugar symbolised "White Australia." Each map was surrounded with brown moist sugar from Babinda mill. The floor space in this section (occupied by a Melbourne confectioner) was intended for trophies (one of which I was able to set up later) displaying the sugar industry from the "field to the table," and embracing the stages of manufacture in sequence; also the several uses to which sugar is put. Opportunity was taken to describe the industry to visiting school children. General inquiries for cane sugar and statements, such as "Can I buy any cane sugar here?" or "What is going to be done with it at the close?" clearly showed that cane sugar is preferred for its sweetening economy; also probably because it is grown in a British dominion by white labour. When our mills are greater in number and output, and the by-products turned to account by machinery made in Queensland, a greater number of people will find employment in all the branches of the sugar industry. Men of science from the Universities were attracted to the exhibit, and several have already arrived in Queensland to enter on sugar cultivation scientifically and generally. The cinema film of the sugar industry was received in London too late for 1924, and no one will be there from Queensland this year to explain it, as did each State representative at the Panama Exposition, where each of us had two afternoons weekly in the cinema room with films and slides of our respective countries and their industries. The whole sugar exhibit stimulated widespread interest in our cane sugar enterprise, and brought forth many inquiries from important Continental business houses.

Queensland Cotton.

Although our cotton exhibit was originally intended to be of a very different design to that now shown, very good use was made of it to illustrate the efforts of the Queensland Government to obtain or evolve, by scientific methods, the best types for the growers, and to demonstrate its possibilities to those interested—the spinners. Those in the trade who saw the cotton in seed and lint were not slow in saying that we were producing the quality and staple that they desired, that they liked our cotton because it could always be relied on for uniformity each year, and that our system, as explained, of guarding against the introduction of any pests by annual planting was the right one. Panels of combed Durango seed, showing the quality and length of staple, attracted keen interest. Many sound suggestions were made by the spinners in the matter of spinning and manufacture in Queensland from our own grown raw material, especially as Queensland produces 91 per cent. of the cotton grown in Australia. The manufactured calico and sheeting displayed called forth many a remark, "Why doant tha spin tha own?"* The by-products on view, too, got a good measure of attention. All phases of the industry, as illustrated, were much appreciated by visitors, and kept one busy lecturing to the many groups of school children and their teachers. What interested them particularly was a demonstration with a hand-ginning machine which I had obtained on loan from the makers for showing the method of taking the fibre from the seed, and the children took samples of cotton in seed, also the lint, for their own or school museum, labelled "Grown in Queensland." There was a cinema at the Australian pavilion. A fine film, prepared by the Queensland Department of Agriculture for use in England and at Wembley, was, unfortunately, not screened. This film, as well as the film of the Queensland sugar industry, would have been most useful for the Wembley lectures.

*Clothing made in Australia—mixture of cotton and wool—displayed at the Australian Natives' Association Exhibition at Melbourne.

A PEST OF THE SILVER WATTLE.

BY DR. JEFFERIES TURNER, M.D., F.E.S.*

A phyllode of the silver wattle (*Acacia podalyriæfolia*) had been recently received from a well-known Sydney entomologist, showing a round bleb of epidermis detached by some larva, together with several tiny cocoons spun by larvæ after leaving the blebs. It was stated that these wattles had been so badly defoliated

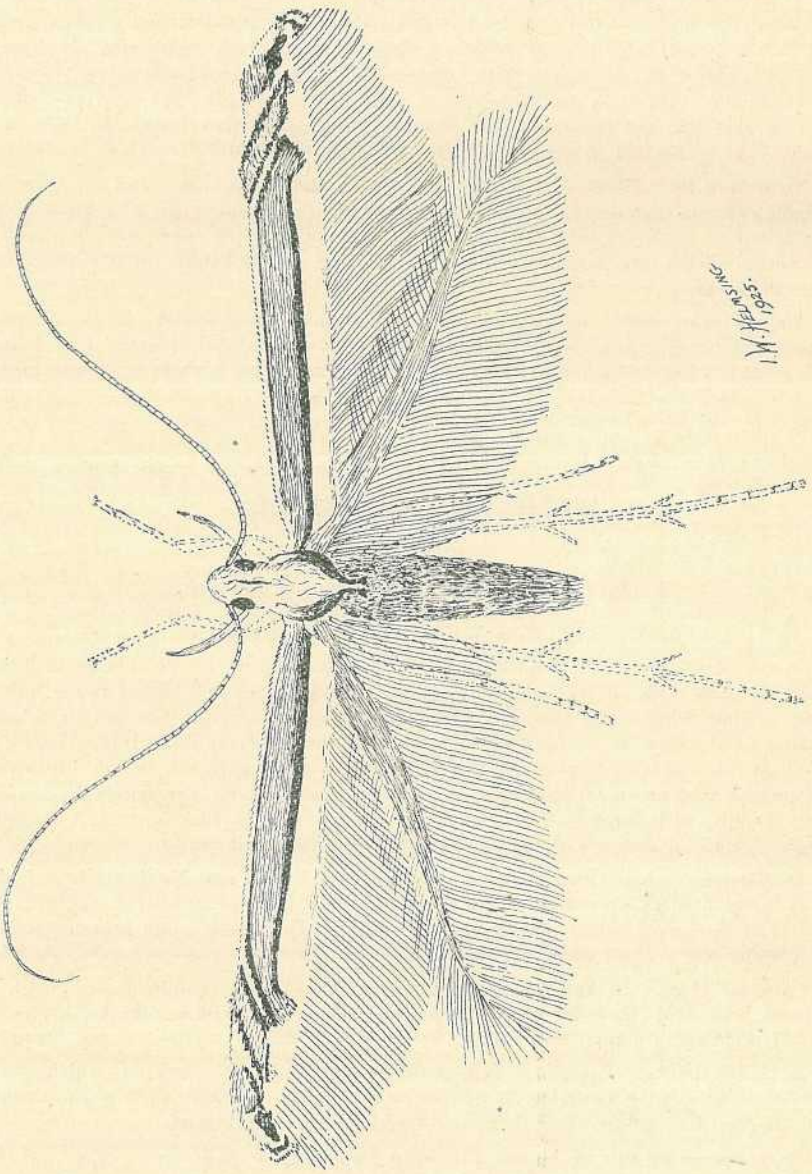


PLATE 88.—A PEST OF THE SILVER WATTLE.

in the Sydney gardens this season that the future cultivation of this beautiful species in that locality was seriously threatened. The specimens sent were recognised as the work of a little moth belonging to the family Gracilariadæ. Subsequently about thirty dried specimens of a tiny moth, each about one-fourth the size of an ordinary

* A Note read at a meeting of the Entomological Society, Brisbane, 18th April, 1925.

mosquito, were received, which fully confirmed the surmises previously made. It is a species described by Dr. Turner in 1894, Gracilaria (Acrocercops) plebia. Though probably not a rare species in Brisbane, I have seen less than a dozen specimens since that date. It has never been found abundantly here, nor have our silver wattles been observed to suffer from its attacks. This is explained by the fact that wattle grows wild in the country within fifty miles of Brisbane, so with the moth here is probably associated its natural parastic enemies.

What one imagines has happened is this: *A. podalyriæfolia* is easily raised from seed. Consequently Sydney gardens are stocked with trees free from the moth and its parasites. All went well with them until a large bunch of the golden blossom was taken from Brisbane to Sydney, and with it, unwittingly, was conveyed some larvæ in the blotched leaves. These escaped, and being free from their peculiar enemies have multiplied so enormously as to threaten the existence of their foodplant.

To restore the balance of Nature seems here a simple problem. Let some young Brisbane entomologist devote some of his spare time to searching for blotched leaves. If sufficient of these are collected and sent to Sydney, some of them may reasonably be expected to liberate parasites, which in their turn will multiply rapidly and keep the moth in check.

Though this wattle is not, perhaps, of economic importance, it is a great ornament of our gardens, flowering very early in the season, and it would be a great pity to see it exterminated in Sydney, where it grows almost as well as it does here.

WEEDS OF QUEENSLAND.

No. 40.

By C. T. WHITE, F.L.S., Government Botanist.

AMERICAN DOG WEED (*Verbesina encelioides*).

Description.—An annual much-branched sunflower-like weed, densely clothed in almost all parts with rather long white hairs. Leaves green and rather rough hairy above, densely white-hairy beneath, 1½ to 4 inches long, margin toothed or lobed, tapering at the base to a short stalk, the stalk dilated at the base into a pair of small leaf-like expansions (auricles). Flower-heads 1 to 2 inches broad, involcure hemispherical composed of numerous lanceolate-toothed bracts; ray florets 12 to 15, bright yellow, disk-florets very numerous; achenes of the disk obovate, winged, pubescent, those of the ray thick, rugose, and irregularly triangular.

Distribution.—A native of the Southern United States and Mexico. where it is widely distributed as a weed. It has been naturalised in Queensland for some years. and has of late spread over many parts of Southern Queensland, and asserted itself as an aggressive and noxious weed pest.

Common Name.—In America known as "Dog Weed" and "Golden Crownbeard." In Queensland most commonly called "Daisy Weed," also "Wild Sunflower," names, however, applied to a number of other weeds in the State.

Botanical Name.—Verbesina, supposed to be altered from Verbena, which some of the species roughly resemble in general appearance; *encelioides*, from *Encelia*, a genus of North American compositæ, and Greek *eidos*, resemblance.

Properties.—So far as known the weed possesses no poisonous properties; it seems, however, to be very rarely touched by stock.

Eradication.—Being an annual and an abundant seeder efforts should be aimed at the prevention of seed production by hoe-chipping or—in small patches—hand pulling.

Botanical Reference.—Verbesina encelioides, Benth and Hook f. ex. A Gray in Bot. Calif. 1. 350.

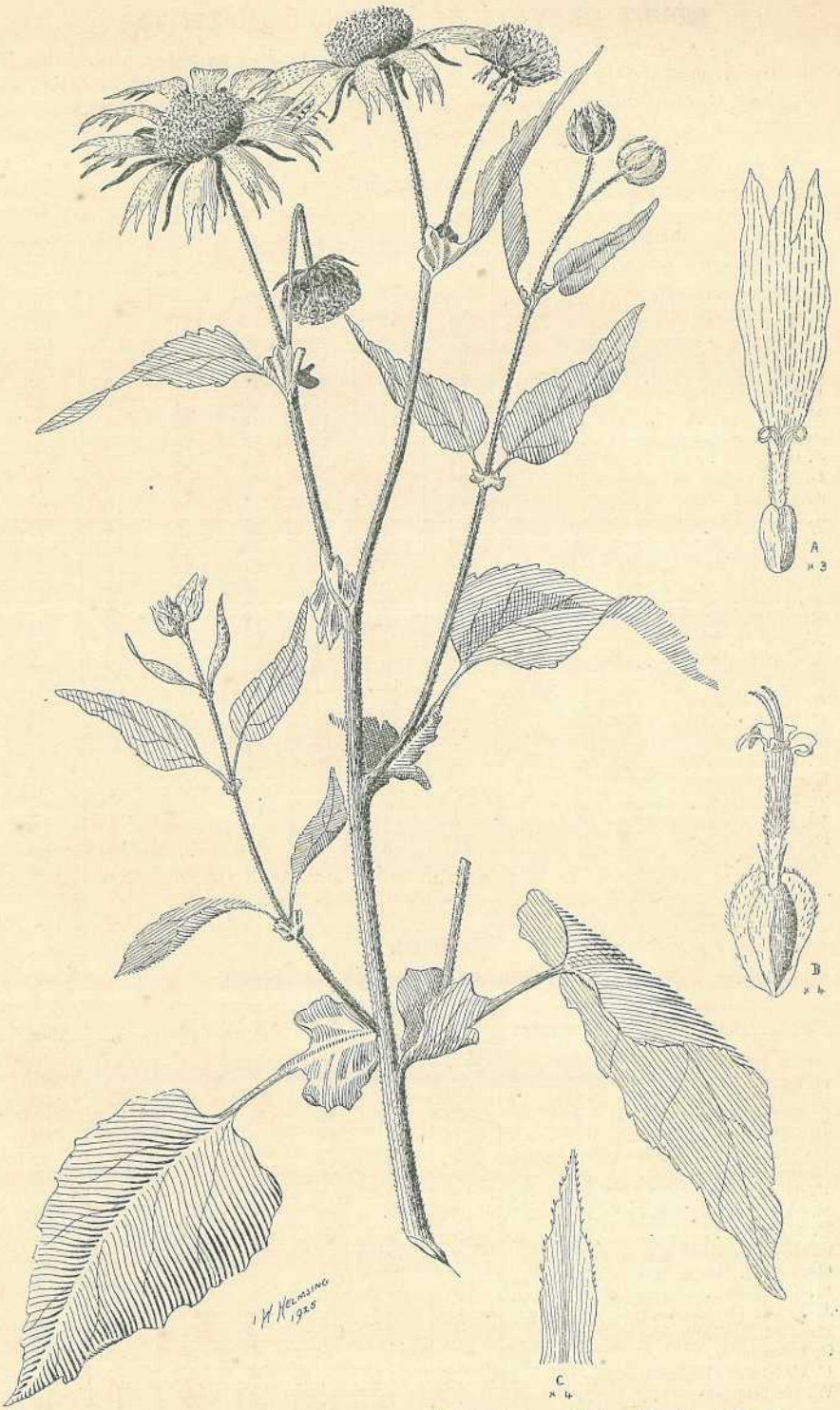


PLATE 89.—DOG WEED OF AMERICA (*Verbesina enceliodes*, Benth. et Hook.
A.—Ray floret. B.—Dish floret. C.—Involucral scale.

MOUNT GRAVATT EGG-LAYING COMPETITION.

During April 2,804 eggs were laid, an average of 10·4 eggs per bird. This is an improvement on the average for April in the last test. With the exception of about six cases of mild chicken pox, the birds have been free from sickness.

SECTION 1.

White Leghorns.

Name.	A.	B.	C.	D.	E.	F.	Total.
W. E. Woodward	22	16	23	11	18	17	107
E. J. Stilton	21	18	17	16	21	14	107
B. Driver	20	8	24	10	18	23	103
Eclipse Poultry Farm	24	22	17	14	23	2	102
G. W. Cox	19	17	20	21	19	3	99
Mrs. R. E. Hodge	22	15	8	20	11	19	95
M. F. Marsden	16	13	13	6	20	23	91
John J. McLachlan	19	14	17	18	16	7	91
S. Grenier	21	10	20	4	17	8	80
L. Bird	22	9	..	7	21	18	77
J. Hutton	15	11	10	8	14	19	77
J. E. G. Parnell	12	12	17	15	9	12	77
R. C. J. Turner	14	11	12	13	9	18	77
M. F. Newbury	17	18	17	17	3	3	75
Jas. Earl	19	20	5	8	11	11	74
W. Wakefield	17	13	5	19	17	2	73
E. Anderson	8	10	1	14	16	20	69
W. and G. W. Hindes	11	18	12	10	7	10	68
J. Harrington	9	6	8	15	12	12	62
H. P. Clarke	3	18	2	3	15	10	51
A. S. Walters	8	17	1	5	..	16	47
H. Fraser	..	18	16	4	2	2	42
George Marks	6	10	6	1	12	6	41
T. W. Honeywell	3	..	19	1	11	4	38
Mrs. Clarke	..	8	7	10	8	..	33
T. H. Craig	..	11	7	14	1	..	33
W. D. Melrose	9	13	..	..	2	5	29
Chris. A. Goos	11	3	4	2	..	8	28
Mrs. Lindley	2	6	..	10	..	..	18

SECTION 2.

Black Orpingtons (except where stated).

Name.	A.	B.	C.	D.	E.	F.	Total.
E. Walters	19	11	8	14	19	23	94
Eclipse Poultry Farm	13	18	23	21	7	6	88
James Potter	21	8	19	8	17	15	88
W. and G. W. Hindes	23	3	8	8	18	21	81
James Hutton	20	1	16	14	1	8	60
R. Burns	12	5	7	13	18	3	58
E. Ward	8	7	10	7	16	10	58
T. Hindley	12	8	18	2	17	..	57
Carinya Poultry Farm	16	11	5	4	15	1	52
George E. Rodgers	..	9	13	9	19	1	51
H. Cutcliffe	17	6	9	2	10	6	50
J. Pryde (R.I.R.)	4	14	2	13	5	6	44
Mrs. A. E. Gallagher	..	..	6	2	1	10	19
C. Dennis	..	..	8	..	1	5	14
E. C. Stead (Wyandottes)	..	3	..	..	11	..	14
W. D. Melrose	..	1	..	8	2	1	12

THE VALUE OF GOOD LAYING HENS AS COMPARED WITH MODERATE PRODUCERS.

P. RUMBALL, Poultry Instructor.

The following figures which are taken from the Mount Gravatt egg-laying competition for 1924-25 illustrates in no uncertain way the advantages of keeping good producers.

In compiling this table it was only possible to take into consideration the average cost of feeding, although it must be admitted that heavy layers would consume proportionately more food, but the extra food consumed would not be sufficient to make any material difference in the results.

It will be noticed that the good layers produce eggs during the period of high prices, while the moderate layers perform best when eggs are of low value.

During the period of low values the general farm flocks produce at their best, consequently the returns to the farmers are not great. Systematic breeding and feeding are the only means by which a better regulated egg supply can be obtained.

RESULTS OF TWO PENS OF SIX BIRDS.

GOOD LAYERS AND MODERATE.

Month.	Average Market Values.	Eggs Laid (good layers).	Eggs Laid (moderate).	Value Eggs Laid (good).	Value Eggs Laid (moderate).	Average Cost of Feed.	Profit over Cost Feed (good).	Profit over Cost Feed (moderate.
	s. d.			£ *s. d.*	£ *s. d.*	£ *s. d.*	£ *s. d.*	£ *s. d.*
April ..	2 3	104	52	0 19 6	0 9 9	0 5 9	0 13 9	0 4 0
May ..	2 7	111	106	1 3 10	1 2 10	0 5 9	0 18 1	0 17 1
June ..	2 0	125	73	1 0 10	0 12 2	0 5 9	0 15 1	0 6 5
July ..	1 8	125	116	0 17 6	0 16 1	0 5 9	0 11 9	0 10 4
August ..	1 1	151	105	0 13 7	0 9 6	0 5 9	0 7 10	0 3 9
September	1 0	154	85	0 12 10	0 7 1	0 5 9	0 7 1	0 1 4
October	1 0	157	100	0 13 1	0 8 4	0 5 9	0 7 4	0 2 7
November	1 1	151	72	0 13 7	0 6 6	0 5 9	0 7 10	0 0 9
December	1 4	145	76	0 16 1	0 8 4	0 5 9	0 10 4	0 2 7
January	1 4	115	75	0 12 9	0 8 3	0 5 9	0 7 0	0 2 6
February	1 7	117	56	0 15 5	0 7 4	0 5 9	0 9 8	0 1 7
March ..	2 1	107	58	0 18 7	0 10 1	0 5 9	0 12 10	0 4 4
Total ..	..	1,562	974	9 17 7	6 6 3	3 9 0	6 8 0	2 17 3

	£ *s. d.*
Profit over cost of feed, 6 good layers ..	6 6 3
" " " 6 moderate layers	2 17 3
" " " 1 good hen ..	1 1 0½
" " " 1 moderate hen ..	0 9 6½

CUT WORMS AND CABBAGES.

Writing under date 6th May, the Metropoliton District Council of the Queensland Producers' Association brought under the notice of the Department a matter that had engaged the attention of its members on the previous Saturday, namely—the serious ravages wrought amongst all small crops by cut worms throughout the district, and more particularly to the members of the cabbage tribe. The injuries have been particularly severe, some farmers having lost almost their entire crops of both cabbages and cauliflowers, and accordingly the Council submitted that a special investigation be ordered. The Government Entomologist has supplied the following note to the Minister (Hon. W. Forgan Smith):—

The cut worms that—as I am aware—are those implicated in damaging cabbage and cauliflower plants in Queensland are two species of *Agrotis*, viz., *A. radians* and *A. spina*, and they are therefore not only among the cut worms of other parts of Australia but are also closely related, both systematically and by habit, with those of American, European, and Asiatic countries—not to mention those of the Islands of the Sea.

As may be expected, therefore, investigations regarding the best methods generally for dealing with the cut worm pest have been fully exploited.

Considering the most prevalent of these pests in its injurious relationship to the cabbage tribe—to the members of which, however, it is not confined—there are evidently four broods each season, during the period usually devoted to the growth of plants that it affects—say from September to May; and unless some factor naturally operates to prevent numerical development, or effective repressive measures are pursued by the end of the term—*i.e.*, by May—the insects have become so numerous as to be well-nigh beyond the reach of ordinary methods of control.

Again, I have discovered here evidence of the occurrence of cut worm parasites—especially in the existence of a formidable enemy to the pest, a Tachinid fly; so that we have in this not only a serviceable insect operating in abetting human efforts to reduce the pest, when exercised, but one that is always operating naturally to lessen its numbers—and does so occasionally almost to the limit of its extermination.

Hence it follows that to secure material results in dealing with these cut worms one must search for its presence early in the season of its occurrence, and attack it then—this presence being at this time revealed most readily by the occurrence of the moths, the parents of these depredators, that are to be made to assemble for our observation by means of special appliances involving the use of bright lights, or attractive lures, the nature of which can be specified.

It is now too late in the season to prosecute effective procedures for subduing this natural enemy of plant-life. It will be soon passing into the soil to metamorphose into the chrysalis state, and thus in this non-injurious condition pass the winter through, unless disturbed.

But without going into particulars I may point out what are the methods usually found effective in view of cut worm occurrence. They are these:—

(1) Frequent tillage of the soil, so as to expose the insects therein—caterpillars and chrysalises—to the fatal influence of untoward weather conditions, native birds, and predatory insects.

(2) The use of moveable fowl-houses conveyed over the ground whenever it is being subjected to any preparatory treatment, poultry being partial to this class of insect when once trained to feed upon it.

(3) Trap lanterns (such as are especially used in India) to capture and reveal the presence of the parent insects—the cut worm moths—so also with regard to lures.

(4) Close scrutiny of the soil where turned up in the spring (or at any time of replanting a first crop) in order to detect any cut worms if present; and the avoidance of planting as long as any remain to be dealt with by 1 or 2 or by poisoning.

(5) Laying poison over the whole land whenever cut worms are known to be present in it—to consist of bran or other meal or bunches of favoured fodder to which, after being moistened with sweetened water, an arsenic salt has ben added; or, in the case of fodder, that has been steeped in water in which, say, Paris Green has been mixed.

(6) Trapping caterpillars by placing objects on the ground, under which concealing themselves they may be hand picked.

(7) Further, insomuch as plants other than members of the cabbage or cotton tribe, even certain weeds, are attacked, not to fail to overlook the presence of these either, as affording breeding-grounds for the cut worms, or as complicating general repressive measures directed against them.

(8) It may be possible that cut worm parasites exist in other parts of the world that are capable of destroying the plant-depredators under consideration more generally than do those already present in our own cultivated lands. This is a matter for inquiry, with a view to their introduction if they do exist. However, it does not appear that any one of the numerous countries throughout the world in which destructive cut worms are assertive rely at all on the use of introduced parasites for their subjugation, but rather depend on their own persistent efforts intelligently pursued as the outcome of a well conceived co-operative effort opportunely pursued.

FIELD REPORTS.

(*Continued from page* 470.)

Diseases.—Leaf Scald is the principal disease in this area. The writer was agreeably surprised not to find more of it in ratoon paddocks of N.G.15, where it was noticed previously, probably the very favourable growing period experienced for some months past may have something to do with this, and the ratoons may develop it later on with drier conditions. Such, however, was not the case with the Gorus, particularly with 24B (Green Goru). In nearly all cases where this variety was grown the disease was noticed, but in very few cases had the whole stool perished, a number of apparently sound stalks, even in second ratoons, being left. H.Q.426, where seen, was also looking very well, and did not seem to have suffered so badly.

Mosaic was also noticed to a small extent in some B.208, but the owner intended ploughing this out. It is astonishing to learn of the great proportion of growers who cannot recognise the symptoms of Mosaic.

Hambledon.

At the mill overhauling work has been carried out preparatory to what then looked like a record crushing season for 1925. The mill accounted for the fine total of 160,847 tons of cane for an average of 22·1 tons per acre. Freshwater, with its new rich land, was responsible for the remarkably high yield per acre of 31·1 tons. Its plant gave 40·5, first ratoons 32·2, and other ratoons 25·3 tons per acre.

The seasonal outlook was most promising. All through the area very fine crops of plant and ratoon cane were noticed, all growing luxuriously. In the vicinity of Woree, White Rock, Kamma, and right through the Sawmill Pocket very heavy crops of cane, mostly D.1135, were noticed.

At Freshwater the growing conditions up to then had been ideal, and wonderful growth was observed in all classes of cane. In a couple of places second ratoons Badila five and six months old looked nearly ready for cutting, while some magnificent crops of plant cane promised a 50-ton crop. Although the land is comparatively new throughout Freshwater, it was gratifying to learn that several growers were using beans or cowpea for green crops, while a few growers whose soil was inclined to be stiff were talking of using a dressing of lime.

Owing to the crops being so forward a certain amount of cane had fallen, the effect of wind and the very sodden nature of the ground, and in many cases it was noticed that this cane had "shot" rather badly from the "eyes."

Varieties.—Among the newer ones some extremely good second ratoons H.109, belonging to Messrs. Stewart and Sons of Woree, were noticed, seemingly very healthy. Near by some second ratoon Q.855 also carried a healthy growth. Both of these were growing upon medium to poor ground.

At Edge Hill some August plant H.Q.458 carries very good growth and has stooled out better than this variety generally does. Adjoining is a paddock of first ratoons looking equally well, and present indications would point to about a 40-ton crop.

Oba Badila (first ratoons), carrying its characteristic dark colour, presents a very even crop, both as regards length of cane and stooling qualities.

Mulgrave Area.

Here, as at Hambledon, a proportion of the cane had fallen. With so much continuous wet, cultivation had to be neglected, and naturally a very heavy weed growth was to be seen upon farms that are usually conspicuous for their well cultivated appearance. Naturally, preparations for early planting are very backward.

The season just closed a record crushing of 175,255 tons went through the rollers. Of this total, 46 per cent. was burnt, against 59 per cent. for the previous season, whilst the tonnage per acre worked out as 20·4 tons. For the coming year there is a larger area to be handled, and the cane seems to be well ahead of that for the same time last year.

Principal tramway work under construction:—Clarke's to O'Neill's, 46 chains; W. Trivin's to S. Kene's, 62 chains; Mount Sophia to Fishery Creek, 1 mile 60 chains. Total, 3 miles 8 chains. Whilst up the Little Mulgrave another 20 chains of engine line are also being laid down at end of present terminus.

Away beyond this point two bridges capable of carrying loco. traffic are being put across the Mulgrave River, but this year they will carry temporary rails only.

Varieties in the Cairns District.—Mainly Badila, Clarke's Seedling, D.1135, Goru, Q.813, M.1900, Q.855, E.K.28, B.147, H.Q.458, H.109. The proportion of same at the Mulgrave Mill was as follows:—Badila, 70·4 per cent., averaging 22·8 per acre; D.1135, 23·8 per cent., averaging 16·1 per acre; others, 5·8 per cent., averaging 16·3 per acre. Total, 100.

In several parts of the area it was noticed that some paddocks formerly under D.1135 were growing excellent crops of H.Q.426 this season. In particular, one grower at Wah-Won has a beautiful crop of this cane upon a very poor and shallow low-lying paddock. After each of three deep ploughings he disc-harrowed, picked out the best plants that he could, and used 4 cwt. of Howe's Special Mixture in drills, and obtained a splendid strike. Judicious drainage, very much needed in this 21-acre block, also helped the crop along wonderfully.

This farm is a leasehold, and the way it is worked reflects the greatest credit upon the holder. Several crops of plant B.147 were growing, generally upon medium to poor ground, and so far looked green and healthy, and smaller plots of H.Q.458, E.K.28, and H.109. Q.813 was represented in several places by good paddocks of healthy-looking cane, but they had mostly suffered rather badly from the effects of heavy wind. One of the few faults of this variety is that it is a fairly shallow rooter and thus likely to go over under wind pressure or grub attack. A peculiar thing about H.109 is that among particularly healthy-looking stools a stalk or two may be found with the leaves showing slight markings suggestive of Mosaic. Growers are reminded of the absolute necessity of watching closely for any form of disease and at once eradicating the source of infection.

Diseases.—Although found in most places where seen last season, the subsequent ratoons have so far not suffered as far as expected from Leaf Scald. It may be that the marvellously good growing season has enabled the cane to withstand the influence of the disease to some extent. Drier conditions may cause its reappearance. Top Rot in Badila plant was noticed to a slight extent at Freshwater.

Grubs.—These were seen in several parts of the district, but had not then done general damage. Some farms had suffered severely, both plant and ratoons showing loss alike. Probably the worst part of the Cairns area would be in the vicinity of Meringa, where several paddocks have suffered very heavy loss.

Green Crops.—Quite a number of plots of green manure were noticed, probably to a greater proportion around Aloomba than elsewhere.

Mossman. 18th May, 1925.

83·92 ins. of rain were registered up to the 14th April; Saltwater for the same period had 100 ins. The average for Mossman for the past fifteen years amounts to 96·48 in.

Cultivation was practically impossible, and it looked as if there would be very little early cane planted in 1925. Finer weather set in about the middle of April, and growing conditions improved wonderfully. The crop outlook is very promising.

More green manure has been planted in the area this year than at any other time, but ploughing-in operations were only becoming possible towards the end of April.

The very heavy cost of lime now makes its use nearly prohibitive in this area, but it is manifest that the stiffer soils, especially in some of the low-lying portions, would benefit immensely by its use.

Extensive additions to the mill plant are being carried out.

With such facilities as the Mossman Mill now offers, growers should see that the full supply of cane is provided—a point emphasised by the manager in his last annual report.

The following particulars of last season's crop are interesting:—

Variety.	Percentage of Crop.	C.C.S.	Price.
			s. d.
Badila	19·04	13·81	47 0
H.Q. 426	22·70	13·66	46 6
Q. 813	0·41	13·53	46 0
Innis	1·19	12·48	42 5
Goru	4·24	12·31	41 11
M.Q. 1	2·95	12·25	41 8
B. 147	12·03	12·22	41 7
D. 1135	31·89	11·81	40 2
Mixed	5·55	11·84	40 3

The average c.c.s. was 12·64, whilst the average tonnage per acre was 17·08 tons.

The c.c.s. was 2·43 lower than the previous year, and clearly shows that such figures are the result of last season's abnormally wet ending, and emphasises the advisability of growing sweeter varieties of cane wherever possible, more especially when the density figures of Badila, H.Q.426, and Q.813 are compared with the other canes shown in the list.

Variety Plots.—Among the second ratoons at Messrs. Crees Bros., Boondarra Farm, were Nanemo, Orambo, E.K.28, E.K.1, H.Q.409, H.109, 7 R.428 (Pompey), and H.Q.458. Of these, E.K.28, H.109, and H.Q.458 made the best showing. A small plot of the last-mentioned cane, planted in November upon probably the lowest-lying part of the farm, was showing 6 or 7 feet of cane, and stooling well, despite the fact that it had been flooded many times. Its erect growth under such conditions was most marked.

Diseases.—Leaf Scald in N.G.24 B and H.Q.426 was the most noticed, whilst Leaf Stripe in B.147, D.1135, and M.Q.1 was seen; but the very wet state of the paddocks made it nearly impossible to examine them closely. Growers are again cautioned to be very careful of their seed selections.

Pests.—Rats and pigs were also doing their share of damage in the area, the excessive weed growth everywhere giving them every cover.

Grubs.—Grubs were noticed to be doing considerable damage upon a block of plant Badila in new scrub land at the end of the new Whyanbeel tramline. Finer weather conditions may possibly accentuate the damage already done.

Proserpine.

This locality had also experienced far too much continuous rain for several months, consequently the late cut and late planted cane was decidedly backward. Cultivation of all kinds had also been impossible, and practically hardly any early planting had been done. At Banana Pocket conditions were better, and one promising paddock of early N.G.15 was seen upon Mr. Glasson's new area. This farm also has some fine M.1900, H.Q.426, and Q.813 standover. Referring to the latter cane, the growers locally consider that it is a very good cane to retain its density, even when lying down badly.

The ratoons seen in this area were also more forward than most seen elsewhere. The fact that the Pocket is said to be far drier than Proserpine proper, and is, of course, virgin soil, helps to account for this.

Most of the Pocket farmers are ex-army men, and it is a pleasure to see how well they are flourishing.

Upon Quod Bros.' (Up River Farm) a magnificent crop of ten months old E.K.28 was noticed, of a great length and good diameter, and carrying a good stool. This had been manured, and certainly looks a picture.

The ratoons from which the plants came also look a long way ahead of the average. Near by some H.Q.458 upon Mr. E. Moloney's river bank looks mighty well.

At Kelsey Creek some good crops were also seen. One block of plant B.208 upon Mr. Thoroughgood's farm showed really good growth upon medium soil. The following figures of cane crushed during the past two years are of interest:—

1923.			1924.		
Variety.	Percentage of Crop.	C.C.S.	Variety.	Percentage of Crop.	C.C.S.
N.G. 15	8·3	14·4	H.Q. 426 ..	21·0	15·4
H.Q. 426.. ..	28·3	14·0	M. 1900 ..	13·6	14·9
Q. 813	17·9	13·8	Q. 813 ..	21·2	14·6
M. 1900	9·1	12·8	N.G. 15 ..	13·1	14·1
S. Singapore ..	3·6	13·9	Goru	5·4	13·2
Others	10·1	13·7	Q. 1121 ..	2·0	13·6
Malagache ..	8·8	13·0	Malagache ..	6·8	12·9
D. 1135	11·4	12·9	D. 1135 ..	4·1	12·6
			S. Singapore ..	1·7	13·1
			Others	..	..
			Q. 116, Q. 114..	..	..
			Violet, &c. ..	11·1	13·4

giving an average for the two years of—

Variety.	Percentage of Crop.	C.C.S.
H.Q. 426 ..	24·5	14·7
N.G. 15	10·7	14·2
Q. 813	14·5	14·1
M. 1900	10·7	13·9

Pests.—Grub damage seems to be rather more apparent this year, for, despite wet conditions, several farms in the Kelsey Creek area are badly hit, plant and ratoons suffering alike. Q.813, M.1900, and N.G.15 are all affected, the first-named probably showing the most damage. Growers in this area are advised to read up the monthly report on pests published by the entomologist at Meringa; and who is at all times ready to give any information in his power. Opossums were also doing considerably damage to cane in parts of the Kelsey Creek area.

Cane-killing Weed.—This weed, previously reported as present, was also noticed to be still alive, despite energetic eradication efforts. The weed is at its worst in January, late planted cane suffering much more than the earlier, whose extra vigour and growth enables it to withstand the weed effects better than the former. As small portions of the weed can be seen in plant, first and second ratoons, it seems to be a hard pest to get rid of.

Diseases.—Leaf Stripe was noticed upon one farm at Cannon Valley and upon another up river farm; in the first case in an odd stool of 7 R.428 (Pompey) and in the other case in two stools of the same variety. The utmost care should be continually exercised by farmers in seed selection, for otherwise Stripe may spread.

Gum was also seen upon a stool of cane in the Cannon Valley area, the variety affected being Malagache (plant). An odd stool or two of Badila in the Waterson area was noticed to have scald.

SELECTING A BOAR—POINTS TO REMEMBER.

When selecting the herd boar the best available should be obtained, for during his life he may be the sire of hundreds of pigs, while the sow can only produce a limited number. If the boar is good he will improve the standard of the herd, but if he is a mongrel or crossbred he will limit the profits of the pig farmer. His selection, therefore, is of very great importance.

The boar should come from a large, thrifty litter, and be purchased from a reliable breeder. He should be a little more on the compact side than the sow, not too chunky or short, but showing full development at every point, and of a strictly masculine type, representing the full type of his breed. He must show quality, smoothness, and evenness in every part, a typical masculine head, eyes and ears wide apart, and jowl reasonably full and well laid on to the shoulders, which should be smooth and free from wrinkles; there should be a full heart-girth extending well down to the bottom lines, nearly or quite on a level, with as deep a flank as possible; rather short or medium length legs, with bone of fair size and quality, pasterns short and straight, and the hoofs well set, legs standing square, straight, and well under him; a long, wide, and deep ham, and tail well set up.

The disposition and good behaviour of the boar depends much on how he is handled from a sucker until he is matured. Docility is a great point, and the boar should always be handled quietly and kindly. He should be kept in a securely-fenced yard or small paddock, with grass to graze on, if at all possible, and be provided with a dry shed to sleep in, ample bedding in the winter, and plenty of shade and water for the hot weather.

The boar requires to be well fed, but not kept too fat, and he should be provided with ample exercise to keep him fit. He should be kept by himself, and a record kept of when he is mated with each sow.

His feed should be varied and made up from any of the following:—Peas, barley, wheat, maize, skim milk, and kitchen swill as a morning feed; plenty of lucerne, rape, green barley, or mangolds should be given in the afternoon. Clean drinking water, wood ashes, charcoal, and a small piece of rocksalt should always be provided in his pen. With proper care and attention he will be servicable for about seven years.

SOFTWOOD PLANTATIONS—I.

BY V. GRENNING, Rhodes Scholar, Working Plans Officer, Queensland Forestry Service.

Australia imported softwood in 1920-1 exceeding £5,000,000 in value. Industrial expansion and increasing population is strengthening the demand for softwood supplies. The world's stocks of over-mature softwoods are being rapidly depleted, and already the rate of utilisation exceeds greatly the rate of increment. On account of excessive local demand exports from softwood exporting countries must diminish inevitably, and in thirty years, it is estimated, they will have reached the vanishing point. Australia's softwood resources are very limited. Queensland alone can almost meet her home requirements, but when all her over-mature pine has passed through her mills, the increment of under-girth pine will supply but a small percentage of her demands. There is only one solution—plantations of softwoods. That is Mr. Greening's opinion, and his views on this phase of our forestry problem will be read with interest by all concerned in Queensland's timber future.—Ed.

As an introduction I propose to deal with a plantation system of local interest, *i.e.*, the taungya system, a combination of forestry with agriculture. "Taungya" is a Burmese word, meaning literally "hill cultivation," and is becoming a general term to indicate the system.

Sixty years ago, when the first attempts were made to introduce the elementary principles of forest management into the forests of Burma, Dr. Brandis, the first Conservator of Forests, found the prevailing system of agriculture a most difficult forestry problem. The Burman was essentially a cultivator of the nomadic type. Each year a fresh area would be selected, clear-felled, burned, and after the rains, the crops would be sown. Then, having reaped the crops, the villagers would move on to another part of the forest the following year, and the process would be repeated. The best sites were naturally selected, and as these invariably contained the best stands of teak, immense quantities of valuable teak were destroyed each year. It was pointed out to the villagers that they were liable to prosecution for the destruction of the teak, and as an expiation they were allowed to plant teak trees each year along with their cereal crops. This method appealed to the Burman, but the result was a large number of small teak plantations, scattered sporadically throughout the forest. The difficulties of management were greatly increased. To reduce these, villages were concentrated so that a large compact area was worked each year as directed by the forest officer. The teak is now extracted from an area which is then given over to the cultivators.

Teak seeds are sown at a spacing of 6 feet by 6 feet, after which rice, the chief crop, maize, sessamum, and vegetables are sown. A general rate of 8s. per acre is paid to the cultivators for the successful establishment of the teak plants. The system has proved very successful, solving both the forest and agricultural problems. To date 100,000 acres of plantations have been established in Burma, and the area is being extended annually at the rate of 8,000 acres.

This system has been introduced into many countries where shifting cultivation is prevalent and much valuable timber is destroyed. In India, East Africa, and the Philippine Islands the method has proved eminently successful, and it has been practised in Germany for the last century.

The benefits derived from the practice of this method were found to be—

Firstly, from a silvicultural point of view, an easy and safe reforesting as a result of the thorough working of the soil and the continual destruction of weeds;

Secondly, from a financial aspect, the saving of the costs of plantation by reason of the agricultural returns; and

Thirdly, from a political economy aspect, the complete utilisation of the factors of the locality with a consequent production of a considerable amount of food material and the employment of much labour.

After a careful consideration of this system with a view to its practical application to Queensland conditions it was decided that the Cavendish banana was the crop most suited to the scheme. There are certain areas of scrub contained within the limits of the State Forests, the natural regeneration of which would prove difficult and costly. Felling, burning, and artificial regeneration would also be expensive. From a management aspect these areas could not be alienated, but they are sufficiently fertile to allow the profitable cultivation of a rotation of bananas before the establishment of the timber plantation. Bananas have a short financial rotation, during which they speedily exhaust the fertility of the surface soil. After a period of five to seven years the soil on the slopes is so reduced in available food material that a timber crop will yield a much lighter percentage profit than any other crop. Trees make very moderate demands on the soil, especially conifers (most commonly called "softwoods"), which it is intended to grow on a large scale.

Ebermayer, a German scientist, concluded as the result of his researches—

(i.) The substances required from the soil by forest trees are qualitatively the same as those required by field crops.

(ii.) Broad-leaved species require for the production of leaves and wood nearly as much mineral substances as an average field crop, *but conifers require much less.*

(iii.) Further production of wood alone (excluding the leaves) forest trees require much smaller quantities than field crops, *taking on the average about one-fifteenth of the quantity required by the latter.*

(iv.) Almost any soil can furnish a sufficient quantity of mineral substances for the production of a crop of trees *provided the leaf mould is not removed.*

The surface soil will be so improved by the action of the leaf litter from forest plantation that at the end of the tree rotation it will be possible to introduce another banana rotation, and so make the system continuous.

Establishment of Plantations.

Plantations may be established either by the sowing of the seed *in situ*, or by transplanting seedlings raised in nurseries to the plantation area. Because of the high cost of the seed of most species dealt with and the dangers to which the seeds are exposed it is usually found more satisfactory to create plantations with nursery stock than by broadcasting seed. The erratic weather conditions in Queensland made it necessary to evolve a planting tube which enabled the seedlings to be transplanted from the nursery to the plantation site without disturbing the root system.

The development of softwoods, and hoop pine in particular, in plantation formation is generally misunderstood. Light plays a very important part in tree development by its action on the chlorophyll in the leaves. The leaf is the laboratory of the plant, and without light there would be no production of chlorophyll and no assimilation of carbon dioxide and no life on the globe. The vegetative shapes of plants are greatly influenced by the intensity and direction of light. The duration of the life of the branches depends partially upon the intensity of light. The shade cast by the younger branches retards the assimilatory activity of the leaves on older branches, and thus renders impossible the normal development of buds and the ripening of wood. The branches die, become brittle, and break off. As a result of this early suppression of the lower branches, first class timber is produced. A hoop pine tree standing in the open is conical in shape and bears branches from its summit to its base, whereas one standing in dense stands has only a small green crown with a clean cylindrical bole.

The original spacing of the trees at the establishment of a plantation and the subsequent thinning practice adopted determine the quality of the timber produced. The closer the spacing and the slower the rate of removal of thinnings the better will be the quality of the timber produced. But the rate of volume growth of each individual tree is reduced by close spacing, whilst the time taken to reach millable size is greatly increased. Consideration, however, must be given to the financial aspect. By increasing the length of rotation the per cent. profit earned by a plantation is considerably reduced, and the added cost of establishment of closely spaced plantations has the same effect. By increasing the length of rotation the per cent. profit earned by a plantation is considerably reduced, and the added cost of establishment of closely spaced plantations has the same effect.

In Europe a spacing of 5 feet is considered most economical, whilst for Australia, where thinnings cannot always be disposed of profitably and the rates of growth greatly exceed those of Europe, the spacings should not be closer than

8 feet. Naturally, the spacing varies with the rate of growth of the species and its habit. Kauri pine will produce first-class timber at a wider original spacing than hoop pine, whilst for eucalypts, if planted, a spacing of 15 feet or more will probably be found most economical.

The Practice in Germany.

As an illustration of the thinning practice adopted in Germany, the following example is given. In a first class Scotch pine forest the normal number of trees to the acre at the age of twenty years is considered to be 1,420:—

at 40	years	.. ..	720 trees
at 60	„	.. ..	370 „
at 80	„	.. ..	230 „
at 100	„	.. ..	170 „
and at 120	„	.. ..	140 „

If a rotation of 100 years is adopted, then the final crop will consist of approximately 170 evenly-spaced trees.

Life of a tree in a plantation might be divided into—

(i.) The period of establishment.
(ii.) The period of height growth.
(iii.) The period of volume growth.

For several years the plantations show little growth until the canopy begins to close, and a soil protection is created. Then the rate of height growth increased during which time periodical thinnings are carried out to assist the best trees, by increasing the growing space.

When the maximum height growth is attained, heavy thinnings are made in order to allow of crown development of the trees intended to form the final crop. Diameter increment depends upon the surface of the leaf canopy and its activity, hence the increased crown will cause a greatly increased volume growth on the bole which has been cleaned during the period of height growth. The determination of the correct thinning practice requires careful study of the development of the individual tree, and the crown in particular.

Hoop and Kauri Pine.

There is a popular misconception in Queensland that hoop pine and likewise all conifers must be grown in the scrub. Unfortunately, there are no plantations of hoop pine whose growth is so far advanced as yet to disprove this idea. As mentioned above, conifers do not require rich soil—light is most essential, and the majority are fierce light demanders. They are very sensitive to fire, therefore hoop pine is not found growing in the forest, where the soil and light conditions are favourable to its development. Then why does it occur in the dense scrub? The explanation is obvious! The regeneration accrued on the scrub edges or in openings created in the scrub where the young tree always had its crown in the light. As the tree increased in height so did the surrounding scrub growth. It is well known that the edges of the scrub are continually extending, and by so doing create a fire protection to the hoop pine saplings. At the same time, the upward extension of the scrub canopy provides sufficient shade to cause the death of the lower limbs of the hoop pine, thus producing first-class timber.

The length of clean timber depends upon the height and density of the canopy shading the bole of the tree. The factors of the locality determine the height attained and not a mysterious "drawing up," with which scrubs have been unjustly accused.

If hoop pine is planted under a scrub canopy, light must be admitted continuously. The rate of development will depend upon the amount of light admitted, and unless the crowns of the hoop pine trees are kept in the light growth will be extremely slow. If the shade be too heavy the trees will succumb. This point is well demonstrated by a kauri plantation laid down forty years ago on Fraser Island. Lines were brushed through the open scrub, but the overhead shade was not removed. Many of the trees still survive, but have shown practically no growth for forty years.

The conditions necessary for the optimum development of hoop pine and kauri pine can be reproduced in pure plantation. All other growth on the area to be planted should be destroyed, and the softwood species should then be planted at the economical spacing. For the present 8 feet spacing has been adopted.

Exotic Softwoods.

In addition to hoop pine and kauri pine, several exotic softwoods are under investigation to determine which are the most profitable species to grow. Those expected to give the best results are—

1. *Pinus tæda*, the loblolly pine, from the swampy regions of the south-eastern corner of U.S.A.
2. *Pinus caribæa*, the slash pine, the yellow pine of commerce, the most valuable pinus timber in the world, from the moist parts of Florida, and Honduras, where climatic conditions resemble those of the coastal area of South Queensland.
3. *Pinus echinata*, the short leaf pine from the same locality as *pinus tæda*.
4. *Pinus insularis*, from the Highlands of Luzon, in the Philippine Islands.
5. *Pinus patula* of Mexico.
6. *Pinus longifolia* of the Himalayas.
7. *Pinus radiata*, or insignis of California. This tree has grown very rapidly in New Zealand and in the other States. It has also shown rapid growth in Queensland.

Pinus tæda and *Pinus caribæa* appear to be eminently suited to the afforesting of our waste coastal lands, and an experimental station has been established at Beerwah for the purpose of determining the capabilities of these two species.

(In the second instalment of this paper in the next issue Mr. Grenning will discuss forest finance and other phases of his subject.)

MARKETING PIGS IN QUEENSLAND.

CO-OPERATIVE, PROPRIETARY, AND AUCTION SALES SYSTEMS.

E. J. SHELTON, H.D.A., Instructor in Pig Raising.

The subject of marketing is one calling for considerable attention, for unless the farmer secures the maximum returns for his pigs, his percentage of profit will be narrowed down, until possibly the business becomes a non-payable one.

Six systems of marketing are common in Queensland, all of which possess some one advantage or other, viz.:—

(1) The sale of stores from farmer to farmer, either direct or per the auction sale system in saleyards, &c.

(2) The sale of porkers direct to butchers or by auction to farmers or dealers.

(3) Consigning pigs direct to co-operative or proprietary bacon factories for slaughter; this on the payment by result system.

(4) Selling pigs "over the scales" at country saleyards and railway stations to buyers representing proprietary bacon factories, and receiving payment for the animals (dressed weight) on a basis of allowing approximately 30 per cent. as the difference between actual live and dressed weight (*see* reference to this subject later).

(5) Selling pigs under the pooling system as carried on under the Atherton Tableland Pig Pool.

(6) The sale of stud pigs for breeding purposes.

These several systems demand some added explanation for, as already stated, each has its own particular advantage.

Auction Sales.

1. Auction sales of store pigs are called as opportunity offers in practically every centre where pig breeding is carried on, but in Queensland these sales represent a very small proportion of the actual business of marketing, for most farmers fatten their own pigs, and where purchases are made they are usually on a private sale basis. Some centres, however, do quite a large trade in store pigs, and as many as 300 or more stores have been offered at the one sale. The system is capable of considerable extension; indeed, there is no branch of pig farming which offers more scope for development than breeding store pigs for sale. This is a branch of the industry which could be developed along up-to-date lines by breeding the store

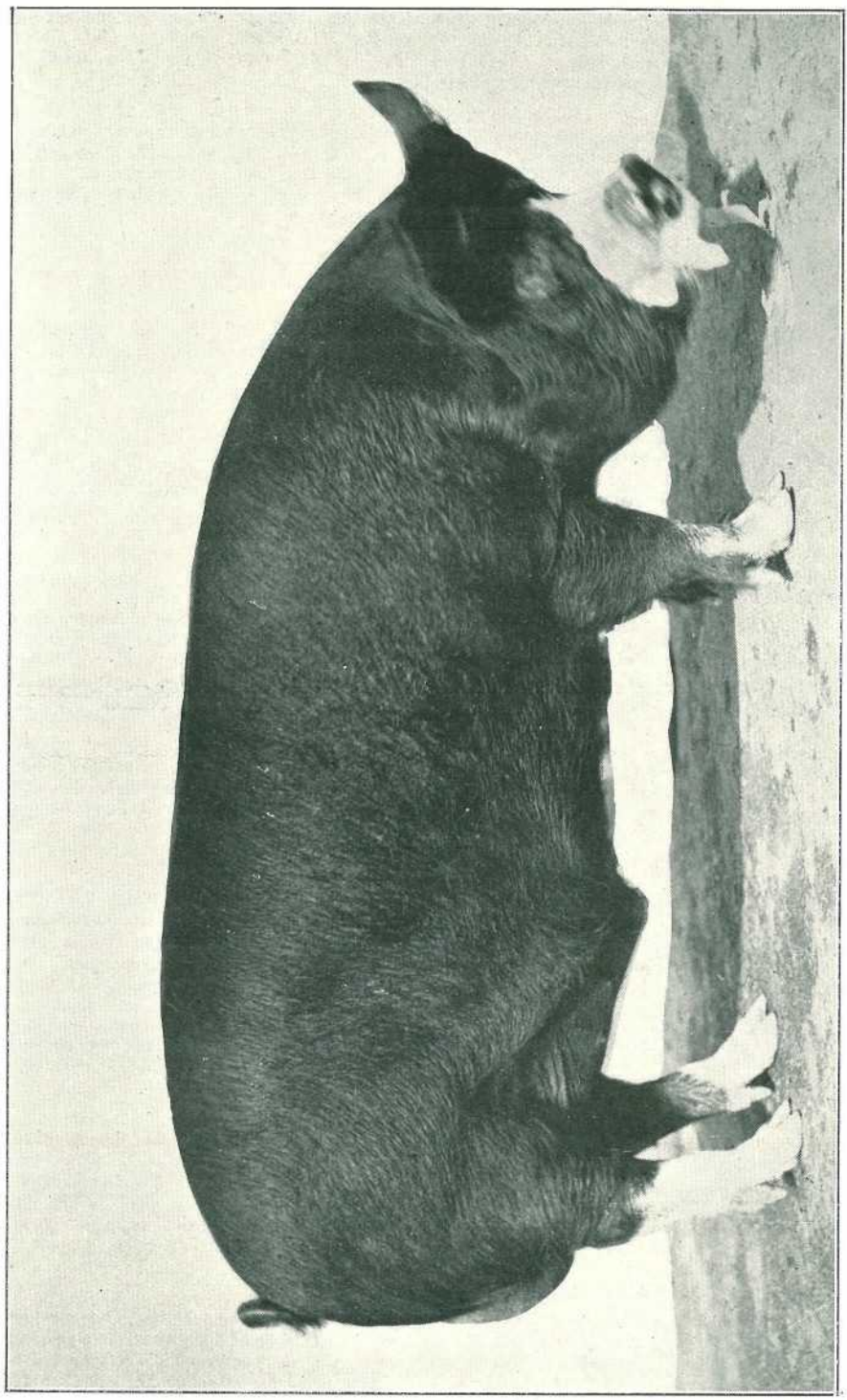


PLATE 90.—D. P. HAYS' FIRST PRIZE BERKSHIRE BOAR, "HILLSIA OTTO," SYDNEY SHOW, 1925.

pigs in districts other than the coastal areas where land is cheaper and where mixed farming is the more profitable vocation. Store pigs produced in these districts and sold for fattening in the metropolitan areas, in the dairying centres on the coast, and in the corn-growing districts here and on the Tablelands, should realise prices showing a reasonable margin of profit to both seller and buyer. This is the writer's ideal scheme of pig production on a large scale.

Farmers in the corn belt are always eager to purchase store pigs at the time their crops are ripening, but many of them are not prepared to breed the pigs throughout the year, claiming that it does not pay—this, of course, on farms devoted almost entirely to corn growing. Dairy farmers are also keen buyers of store pigs during flush seasons, in the spring months, &c. The suburban pig farming business is capable of considerable extension; it is held in check largely owing to the difficulty of securing regular supplies of store pigs. Contractors for receiving the buttermilk from butter factories and surplus whey from cheese factories are frequently on the lookout for suitable lines of stores, and their demands are particularly keen during spring, early summer, and early autumn.

The system of selling store pigs by auction is, however, fairly well understood wherever pigs are bred. In general, store pigs 12 to 16 weeks old and approximately 45 lb. live weight are worth from 20s. to 35s., according to quality, age, weight, &c. Slips, a younger grade, say 10 weeks old and weighing approximately 32 lb. live weight, are worth from 20s. to 25s., while weaners—8 weeks old and weighing 25 lb. to 30 lb. live weight or more—are worth from 15s. to 20s. Younger pigs than this and whilst still in the sucking pig stage, *i.e.*, 6 weeks old or thereabouts, and weighing up to 25 lb. live weight, are worth from 12s. 6d. to 15s. Seeing that breeding sows should, when in full profit, produce two litters per year of at least eight to ten pigs in each litter, of which 70 per cent. should be reared, the business should be a very profitable one.

Sale of Porkers to Butchers.

2. The sale of porkers to butchers direct or by auction is not an extensive one in this State, though it also is capable of considerable expansion. There are certain districts both within the Greater Brisbane metropolitan area, and the suburban areas of the larger country centres, say, Gympie, Maryborough, Bundaberg, Rockhampton, Townsville, Cairns, &c., where the sale of porkers to butchers has become quite a recognised business, though both the Cairns and Townsville butchers draw fairly large supplies of porkers from the Atherton Pig Pool under an arrangement which permits of the sale of porkers in this way. This, by the way, has had a considerable and a beneficial influence on the Northern Pooling System. Closer to Brisbane some of the butchers purchase their porkers by auction at the Enoggera yards, Toowoomba butchers operate largely at the Harristown salesyards, while other centres have their own local arrangements. Some of the bacon factories (the Co-operative Factory at Murarrie, for instance) include porkers on the list of prices paid for pigs each week, for they have a certain demand from local butchers for fresh pork and smallgoods, &c.

The sale of "meat" pigs by auction in Queensland has in recent years been almost entirely superseded by the sale of pigs by actual live weight "over the scales" as is described in the following paragraph, but it is apparent that the demand for fresh pork is becoming more general and prospects point to very considerable numbers of pigs changing hands in these grades. In general, porkers, are quoted as light, medium, and heavy. Light porkers are pigs at from 4 to 4½ months old, say 50 to 60 lb. dressed weight, and valued from 25s. to 45s. or so. Medium weights vary from 4½ months and in weight from 60 to 70 lb. dressed. They are worth from 30s. to 50s., while heavy weight pigs, 95 to 100 lb. dressed and at about 5 to 6 months old, are valued at up to £3 or more.

As to whether it pays better to breed and sell porkers or whether bacon pigs pay best depends entirely upon local conditions, distance from markets, demand, &c. Other conditions being equal porkers pay best, but the demand is far too limited in Queensland to warrant wholesale production of porkers, and at present we do not export frozen pork to markets such as those overseas who draw supplies from New Zealand and elsewhere.

Consigning Direct to Factories.

3. The system of consigning pigs direct to the bacon factory whether co-operative or proprietary has its advantages, and especially in the case of co-operative factories is preferred by a large number of farmers. It is a system in which payment by actual result operates, that is to say—the farmer receives payment for the actual dressed weight of pig received by the factory, the price varying according to the

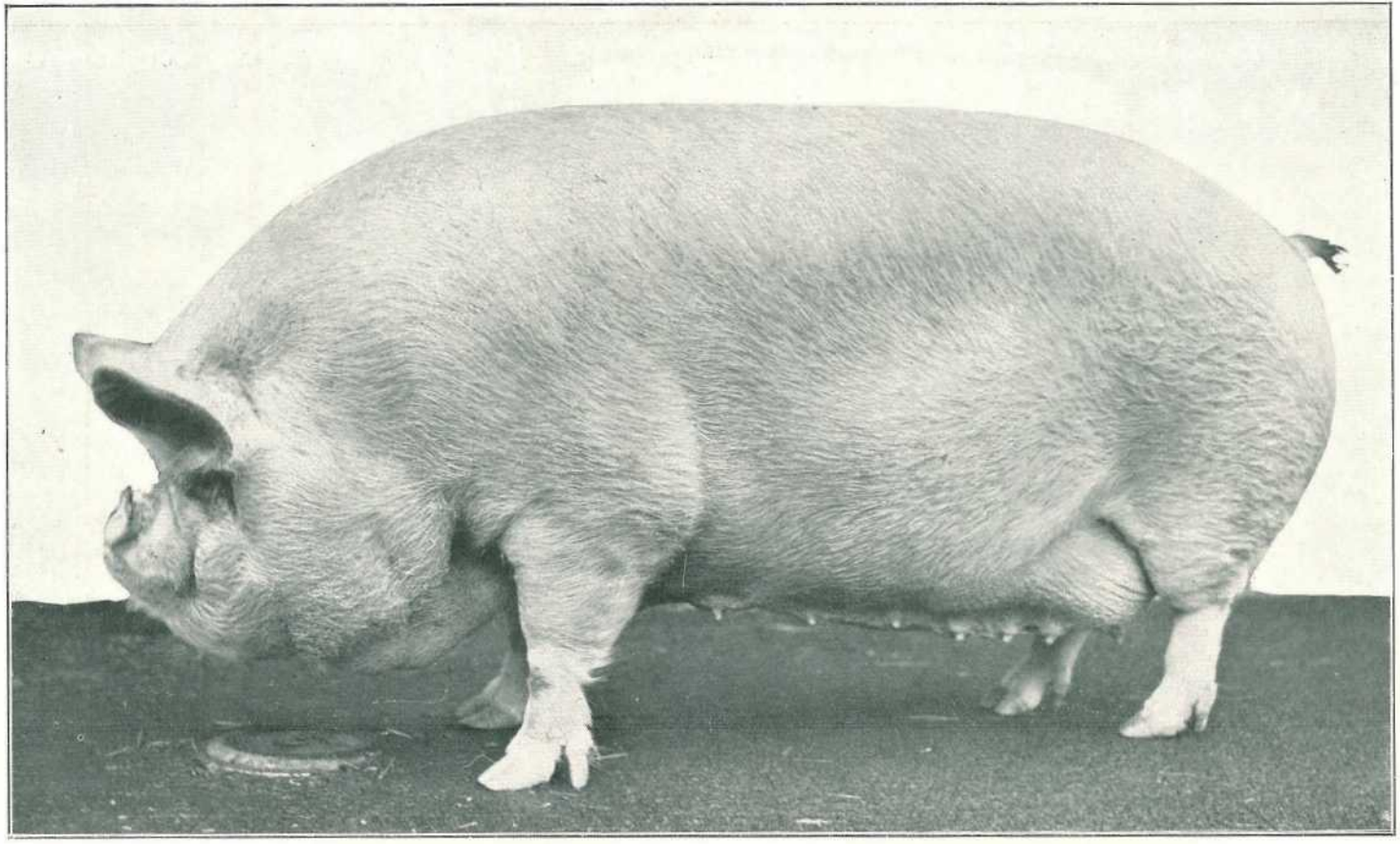


PLATE 91.—MR. JOYCE'S RESERVED CHAMPION SOW, "LEONA," MIDDLE YORKSHIRE, SYDNEY SHOW, 1925.

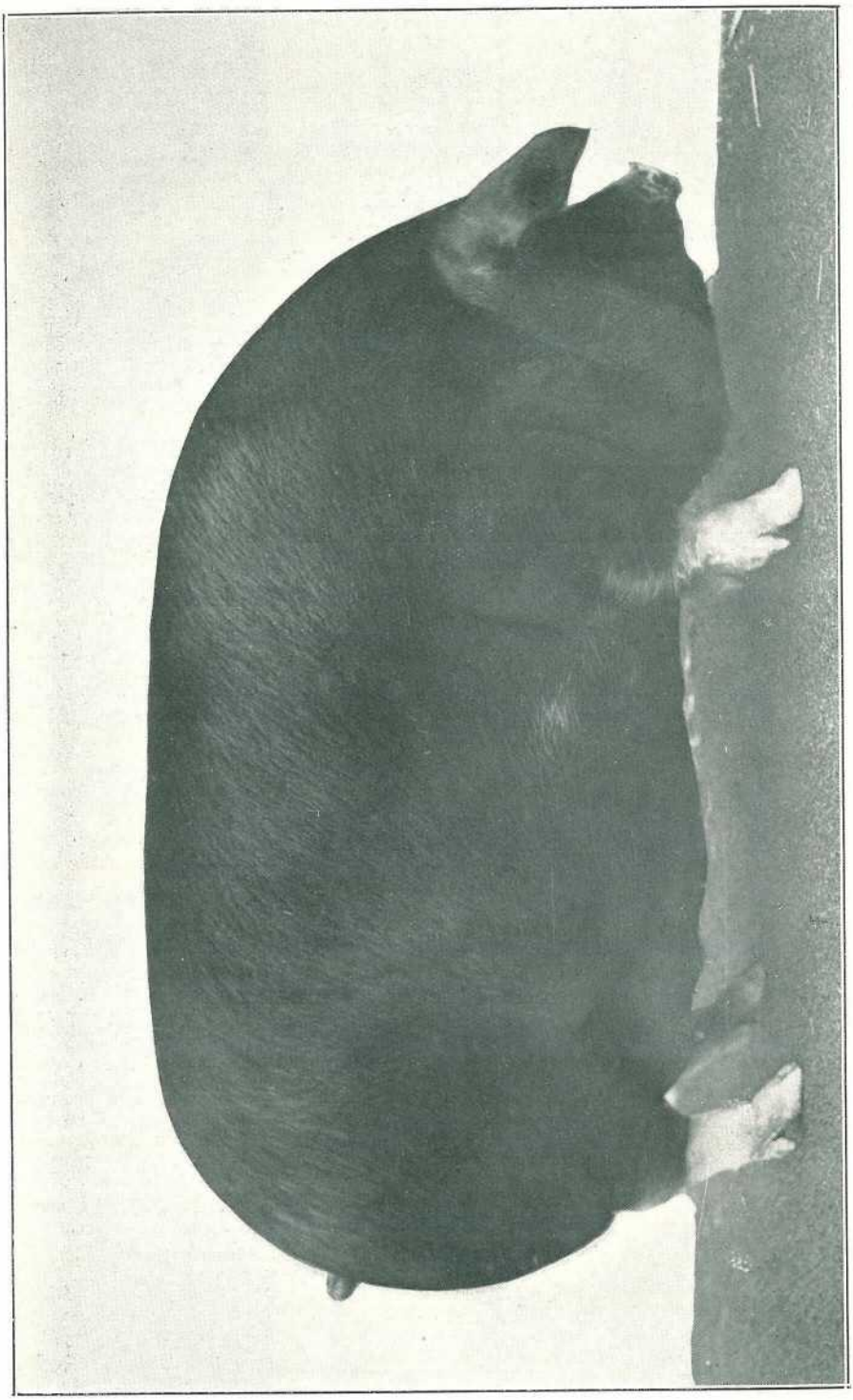


PLATE 92.—MR. T. R. BROWN'S POLAND-CHINA SOW, "DANESBORO' WINIFRED," RESERVE CHAMPION, SYDNEY SHOW, 1925.

grade into which the carcass is classed by the foreman of the slaughter-house, factory manager, or other officer.

In cases where a farmer, who is not a shareholder, consigns his pigs to a co-operative factory, he either receives the full market value of each carcass or he receives an advance payment representing the price per pound the factory is actually paying; other balance (if any) in the form of a bonus at the end of the financial year is paid into share account, thus many co-operative factories automatically enrol new shareholders. The farmer holding shares in the factory receives the advance pay for his pigs and later on his share of bonus either in cash or additional shares or as may be arranged.

Farmers supporting co-operative factories claim this system as the ideal one and certainly from the standpoint of co-operation it has many attractive features. Unfortunately, however, many co-operative factories lack sufficient financial backing, and this coupled with the fact that there are many backsliders amongst those whose money is invested in co-operative concerns, makes the problem of competing on even terms with other factories having a more liberal banking account a very difficult proposition.

Nevertheless the system is a good one and there are not many who would go back to the old days of marketing pigs in Queensland.

The co-operative factories have "Official loading agents" in the various pig-raising centres. These officials are mostly prominent local auctioneers who act as representatives for the companies and receive and truck the pigs to destination. They make all local arrangements *re* trucking, &c., and advise the companies accordingly. They are usually paid a commission—like say one shilling per pig—for this work. They also enrol new shareholders and sometimes act as "commercials" in the sale of bacon, ham, and small goods.

One very important and very necessary part of this system of selling pigs is that the farmer—or the official loader—is compelled (by circumstances in this case) to fire brand, earmark, or otherwise distinguish the pigs before trucking so that on arrival at the bacon factory each individual consignment might be picked out. This is a feature well worth adoption by proprietary factories also, for in addition to indicating ownership in so far as seller and buyer are concerned, it enables the Meat Inspector to trace unmarketable or diseased carcases, and this in turn enables the Veterinary Staff of the Department of Agriculture and Stock to assist the farmer in cleaning up his herd and in culling out unsatisfactory animals and improving the conditions generally on the farm.

Regarding rail freights and incidental expenses, the co-operative factories make the necessary arrangements and the agents and each farmer pays his share of freight and expenses. These factories also have a condemned pig fund, a further reference to which is made in the concluding paragraphs of this article. There are three co-operative factories in Queensland—the Queensland Co-operative Bacon Association, Limited, at Murarrie, the Darling Downs Co-operative Bacon Company, at Willowburn, and the North Queensland Co-operative Company, at Floreat Siding, Mareeba, near Atherton.

Some of the suppliers to proprietary bacon factories prefer to send their pigs direct to the factories for slaughter and for payment by result, but in most instances the pigs are weighed over the scales as mentioned in the next paragraph.

The Weight "Over the Scale" System.

4. The system of selling pigs "over the scales" at country saleyards, railway stations, &c., has in recent years been almost universally adopted by the proprietary interests in Queensland.

For this purpose the proprietary bacon factories install lock-up weighbridge scales at the various trucking centres, the key of the box enclosing the scale bar, weights, &c., being in the keeping of the buyer as well as of the local representative, for most of the proprietary concerns have local representatives looking after their interests. These officials attend to trucking, &c., as in the case of the co-operative factories.

The system operates as follows:—First, in order to reduce expense and limit the number of buyers, the various proprietary factories in Queensland, viz., J. C. Hutton Ltd at Zillmere, Foggitt, Jones Ltd. at Oxley, Reeds Ltd. at Ann street, Maryborough, the Warwick Bacon Company at Warwick, and Conaghan Bros. Ltd. at East street, Rockhampton, are united for the purposes of buying, &c., under the trade name of Stock Agents Ltd., with registered offices at Roma street, Brisbane. Stock Agents Ltd. control the buyers as well as arranging distribution of supplies. Their representatives meet regularly for the purpose of determining upon the price

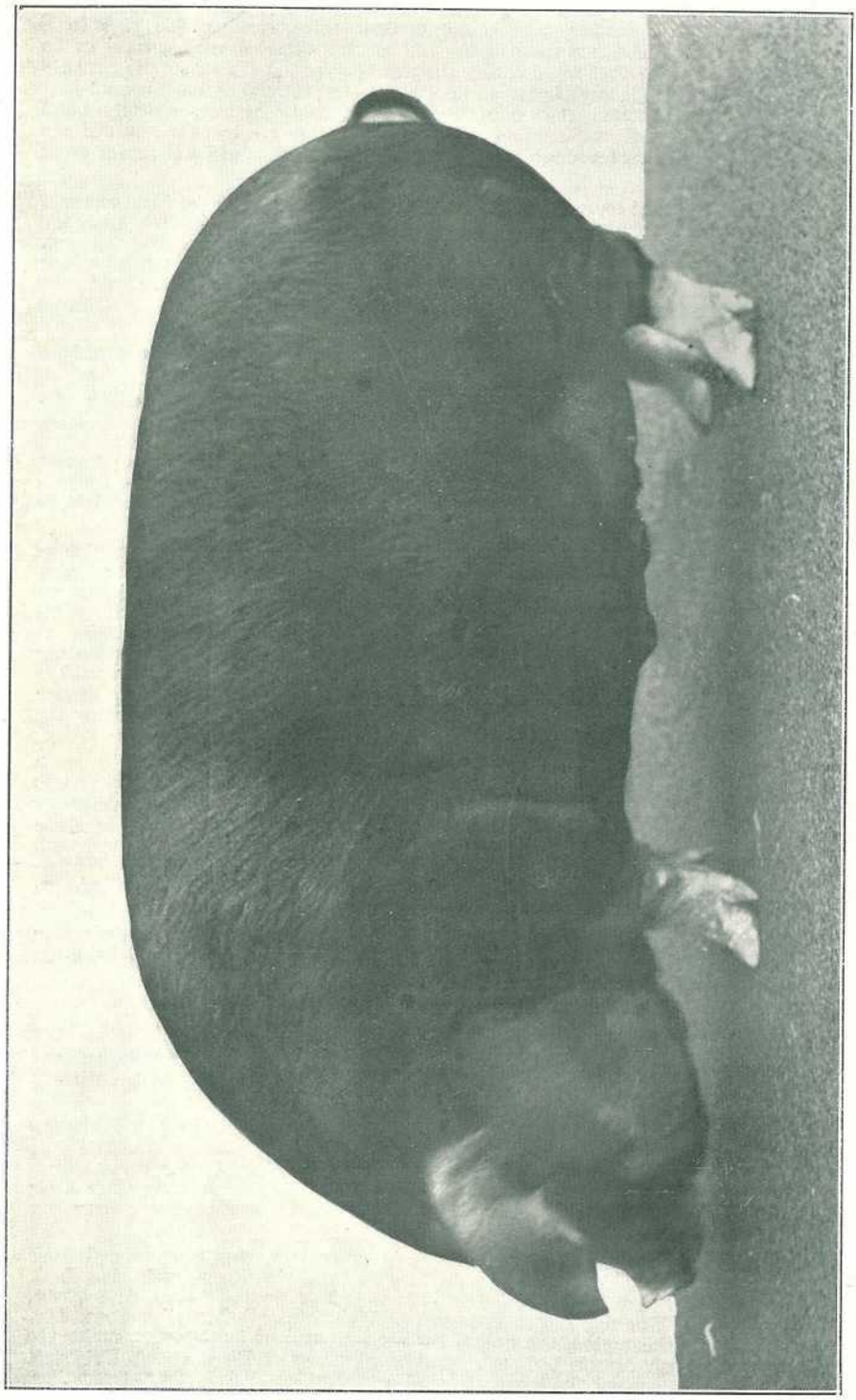


PLATE 93.—MR. T. R. BROWN'S POLAND-CHINA SOW, "DANESBORO' JUDY," CHAMPION, SYDNEY SHOW, 1925.

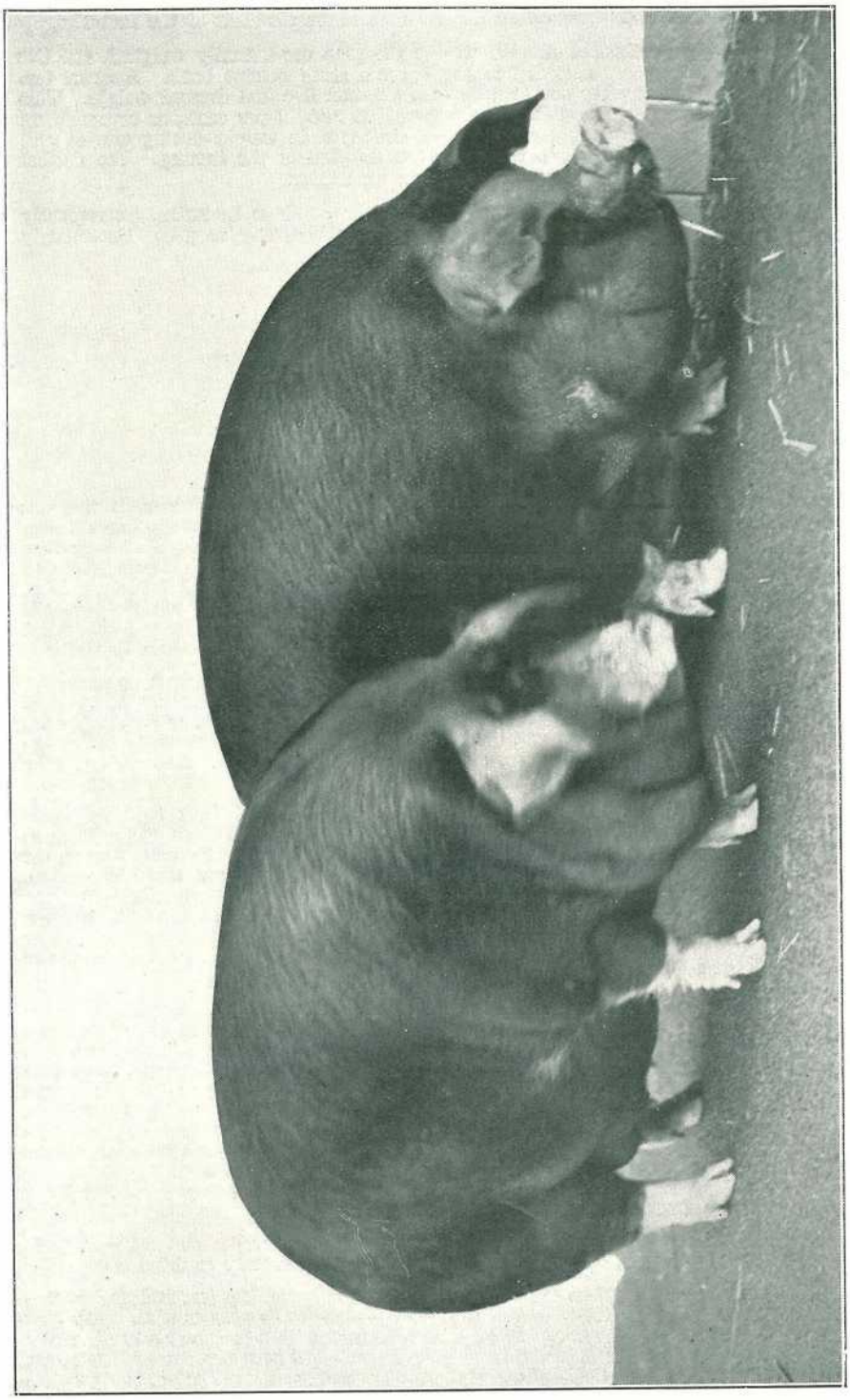


PLATE 94.—A PAIR OF POLAND-CHINA BEAUTIES, SYDNEY SHOW, 1925.

to be paid for the various grades of pigs as weighed "over the scales," payment in this case being for the pigs on an estimated dressed weight basis at the factories.

To arrive at estimated dressed weight the pigs are actually weighed, the live-weight and grade being recorded in the buyer's stock receipt book. A chart has been prepared showing the actual difference between live and dressed weight. This chart allows for a percentage, varying between 25 and 32 per cent., as representing actual loss in offal at slaughter and actual shrinkage in weight during transit and after slaughter up to the time the carcass is weighed at the factory. See further reference to this in concluding paragraphs in next issue.

There is no condemned pig fund in operation at these factories, consequently the companies have to bear all losses both by death and in transit. Fortunately very few pigs actually die in transit.

(To be continued.)

FROST PREVENTION AND CURES.

BY HENRY A. TARDENT.*

The great dangers of a warm, humid winter, like the present one, is that the sap of plants, mistaking the season, sets in motion too early. Buds burst forth, young leaves, flowers, and even fruits appear much too early, with the result that not infrequently a late spring frost causes great havoc in gardens, orchards, and fields. Even wheat, which grows in Siberia and in other very high latitudes, is at certain stages of its growth very sensitive to frost. Many an old farmer still remembers the disastrous frosts of 2nd, 3rd, and 4th October, 1899, which caused great injuries to the wheat crops of the Darling Downs and other western districts.

The question confronting us is: "Can anything be done to prevent or cure such disastrous visitations?" At first sight it seems to be a hopeless task. In spite of all our effort at subduing Nature, meteorological phenomena such as drought, rain, hail, and frosts are still beyond our control. We know of no means by which we could prevent a wave of cold from sweeping over the continent. But we can take many steps to prevent and minimise its ravages."

Meteorology is now in a position of forecasting a frost from twenty-four to forty-eight hours in advance with almost absolute certainty. Even those farmers who are out of reach of the daily forecasts issued by the Federal Bureau of Meteorology can foresee a frost by the exercise of some judgment and observation. Old residents have noticed that a wave of more or less severe cold is nearly every year visiting the State about the first week in October, and not seldom as late as November, when vegetation is in full swing. When at that time the wind blows from the west or south-west, it is a sure sign of a considerable fall of temperature, especially when the sky remains clear.

Repeated observations put beyond doubt that when a farm is situated, say, at the foot of a hill, the temperature is towards the morning much colder in the lower parts of the farm—in the hollow along the bottom of the valley—than it is on the top of the hill. Even dumb cattle have noticed that, for on a cold night they will invariably work their way up towards the top of the hill. This tends to prove that during the night there is a double current of air between the low-lying and the higher situated places; that is, the warm air (during the day the air is warmer in the valley) ascends the hill, while the cold air descends from the top. By establishing living hedges across the declivity we can impede that double current and improve the climate of our farm by at least from 5 to 8 degrees, which is usually sufficient to prevent any harm being done by frost.

In gardens, and even on fairly large plantations, pineapples and other delicate plants may be protected by covering them with a handful of hay or dried leaves.

For reasons too long to explain here, the real damage, the irreparable havoc—namely, the bursting of the vegetable cells—takes place at or near sunrise. This may sometimes be prevented by sweeping off the white frost with a broom or a brush, or by dragging a long rope, held in the hand at both ends, all over the rows of potatoes, tomatoes, beans, or even fields of cereals. Another fairly safe method is to dust lime

* In "The Queensland Magazine."

over the plants or water them with tepid water, both of which means dissolve the frost before it has a chance to burst the cells.

For certain plants, like, for instance, the grape vine, Nature has made provision to neutralise the effect of a late spring frost. There is next to the main bud a spare bud—what the French call "faux bouton"—which will develop and bear fruit when the main shoot has been destroyed. All one has to do is to prune off the damaged wood.

But of all the means of preventing damage from frosts, the safest and easiest to practice is by creating artificial fogs or clouds of smoke. That means is practised from time immemorial in my native country of Switzerland, where late spring frosts are often very destructive to the grape vine and other delicate crops. The communal spirit being there highly developed, the local authorities prepare in advance heaps of firewood and other fuel material in certain suitable places, to be lighted when the barometer indicates danger from frost. My esteemed friend, the late Dr. Olssen-Seffer, who has written a treatise on frost prevention, informed me that similar means are also used in his native country of Sweden.

In California, our American cousins went, I heard, a step further. They connect those heaps of firewood with stretched wires. At a certain degree of frost the contraction of the wires by the cold sets fire automatically and simultaneously to all the wood heaps.

Here in Queensland great losses are occasionally caused by late frosts to sugar-cane growers in certain districts like, for instance, the Isis, the climate of which has lost a few degrees since the disappearance of the scrub.

With a view to prevent those losses, I volunteered to give, a few years ago, a lecture on frost prevention to the Isis canegrowers, who turned up in great numbers to attend it. Some canegrowers, having expressed some doubt about the feasibility, and even the efficiency, of the means I advocated, I offered to give a practical demonstration. Heaps of fuel were prepared in the places which I indicated. On a fairly cold morning about a dozen canegrowers turned up between 2 and 3 a.m. and set fire to the fuel heaps. The manager of the Isis mill, the genial Mr. Elm, if I remember well, a Scandinavian who knew the value of smoke as a preventive of frost, put at my disposal several light locomotives. Those locomotives, dragging small wagonettes loaded with oil drums filled with burning tar—an excellent material, giving dense clouds of heavy smoke—were circulating in every direction on the Isis tramlines. This was probably a world record in frost prevention experiments. At daybreak the whole of the South Isis Valley, the topography of which lends itself admirably to such an experiment, was covered with a dense artificially produced fog, which was spread like a canopy over the whole district, fulfilling the double mission of preventing the evaporation of the soil's warmth and the destructive effects of the rays of the rising sun.

The demonstration was conclusive, and satisfied every person present except one. A wealthy landowner who had taken no part in the experiment appeared at sunrise on the spot. "I can see," he said, "that smoke clouds are an effective preventive of frost; but how could I, for instance, stop the morning breeze from blowing *my* smoke over my neighbour's land?" Such a display of selfishness aroused my indignation and contempt.

"The only way I can suggest," I answered, "is for you to brand your smoke so that you can recognise it anywhere and shepherd it back on to your land. In any case, there is not much of *your* smoke in the artificial cloud spread before us."

If I quote that case it is because it is precisely typical of that individualistic selfishness which has prevented for so long canegrowers and other primary producers from joining their efforts to combat the destructive effects of frost. But now that there are everywhere local producers' associations, those producers may be prevailed upon to act collectively. If they were preparing in advance fuel heaps under the direction and indication of experienced men there would not be a single acre of cane frosted in the Isis, at Gin Gin, Mackay, or any other district where frosts occasionally occur. They could even apply to the military or naval authorities, who would probably supply them, if not free, at least at cost price, with the chemicals now used so successfully to produce smoke screens in both naval and land warfare.

But if collective action is not possible from any cause whatever, that is not a reason why an individual farmer should not make an effort to save his crops. When, in years gone by, I was farming in Western Queensland, where spring frosts are of fairly frequent occurrence, I have many a time saved with smoke clouds my grape vine or early crops of potatoes, tomatoes, curcubitacea, and other products liable to be damaged by frosts. And it is written in the Book: "Thou go and do likewise."

SOME OF THE CAUSES OF LOW-GRADE COTTON.

By E. BALLARD, B.A., F.E.S., Commonwealth (Cotton) Entomolgist.

In this article Mr. Ballard calls particular attention to two insects whose activities often escape observation and whose powers of destruction are not appreciated by cotton-growers. These insects are the harlequin bug or Chinese bug, and the more sombrely coloured large cotton stainer. The author's notes have an especial interest for all engaged in the cotton industry.—Ed.

One of the reasons for cotton being classed in a low grade is the presence of stain.

This stain may be brown or yellow, sometimes black, but the brown or yellow stain is the most usual. It is generally found that these stained samples contain short weak fibres, and in the case of seed cotton, the locks from which they are picked are often hard and inclined to be matted. The seeds are, in many cases, deformed, and if cut open it will be found that their contents are much shrunken or have even disappeared.

If a number of green bolls about three weeks or a month old are examined by being cut open, a certain proportion will be found to contain in one or more locks a yellow slime instead of the white maturing lint. A further examination of the inner side of the boll wall will show excrescences, and the seeds and developing lint in the neighbourhood of these excrescences will be stained yellow or brown. As the bolls ripen the stained locks are often deformed. The lint is very short, weak, and stained. Similar symptoms are displayed by bolls which have been attacked by any of the boll worms, the infection often spreading from the attacked lock to neighbouring locks.

It would be as well to explain at once to what this infection is due. The staining and deformity are due to the action of fungus* and bacterial diseases which enter when the boll wall is punctured or similarly damaged. So long as this has not taken place the fungi cannot enter. These fungi are known collectively as internal boll rots.

These internal boll rots are specially prevalent under humid and warm atmospheric conditions, but have only been very slightly studied in this country. In the West Indies and in West Africa they play an important part as one of the limiting factors in cotton production. Under coastal conditions in Queensland, and to a slightly less extent inland, they are equally important.†

Boll rots following on boll worm attack extend the damage already done by the grubs, and even a small nibble which has penetrated the boll wall but gone no further will be sufficient to make the whole boll worthless. Internal boll rots follow into the boll attacks by (1) maize grub, (2) peach moth, (3) rough boll worm, (4) pink boll worm, and (5) Eucosma (an insect for which we have no common name in Queensland). The damage done by all of these—with, perhaps, the exception of the pink boll worm—is obvious, and in most cases well known to any cotton farmer; but this article is intended to draw attention to two other insects whose activities often pass unnoticed and whose powers of destruction are not appreciated by many cotton growers.

The two insects in question are—The harlequin bug or Chinese bug (6), whose brilliant colouring makes it so conspicuous an object, and the more sombrely coloured large cotton stainer (7), which is usually to be seen running about in couples either on opened bolls or on the ground. The red-coloured young ones or nymphs are to be seen everywhere in open bolls feeding on the seed.

(1) *Heleothis obsoleta*, (2) *Dichocrocis punctiferalis*, (3) *Earias hugelli*, (4) *Platyedra gossypiella*, (5) *Eucosma plebiana*, (6) *Tectacoris lineola* (*banksii*), (7) *Dysdercus sidæ*.

The Chinese bug is often called a beetle. It is not a beetle, but a bug, feeding on plant juices by piercing the plant with its proboscis.

The proboscis of the Chinese bug is very long (⅜ in. to 1 in.) and it is capable of being thrust right through the rind of a boll and into the seed underneath.

* Chiefly *Fusarium moniliforme*.

† There is no doubt as to their importance, but much study is required of their response to atmospheric conditions.

Chinese bugs can often be seen with the piercing stylets of the proboscis plunged into a boll "up to the hilt." When the proboscis is withdrawn, either on account of the insect's being disturbed or because it wishes to feed elsewhere, a little plug of tissue follows the stylets and can be seen sticking up from the wound. Later, on the inner side of the wound a callus or excrescence forms, but in the meantime fungi and bacteria have entered and before the wound is closed they have got to

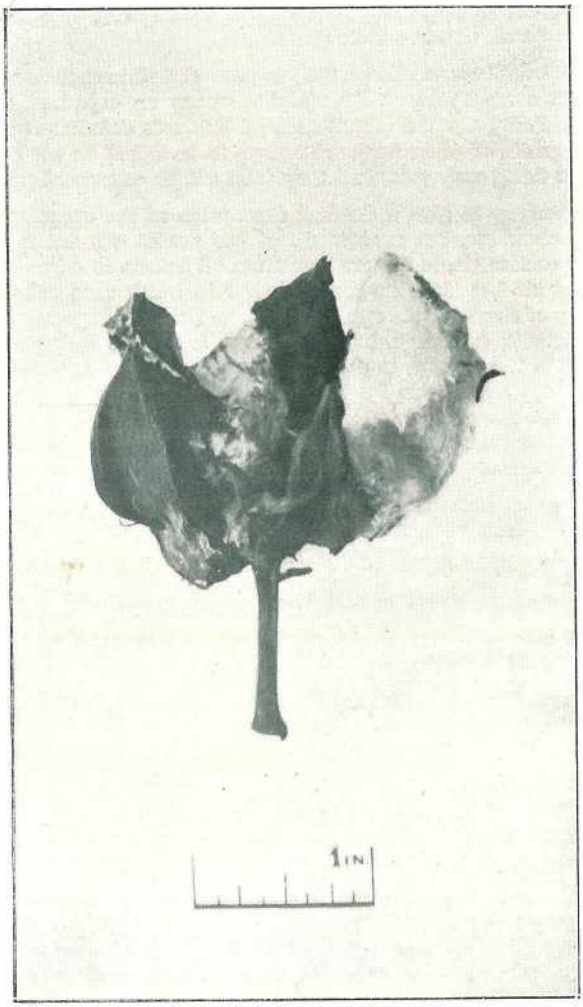


PLATE 95.—COTTON BOLL ATTACKED BY BOLL ROT.

work on the developing lint and seeds. Much indirect damage is done to the seed, but often the bug pierces a young seed as well as the boll wall, destroying the embryo inside it.

It will be seen from what has been stated that the Harlequin or Chinese bug constitutes a very real danger. Not only is the cotton lowered in grade by its activities, but there is an actual loss of lint as well. The Chinese bug first comes to the cotton about the time squares are beginning to form, and only leaves it when it is ploughed out or pulled up.

It feeds as readily on the seeds from the open bolls as on the green bolls or the leaves. It differs in this from the next insect I wish to consider—the large cotton

CARE OF HOME-SEPARATOR CREAM.*

CAUSES OF BAD CREAM.	THE REMEDIES.
1. Unhealthy cows	1. Don't separate the milk from a cow which has not been cleansed or is otherwise unhealthy.
2. Feed-flavours	2. Most feed-flavours can be partly removed by cooling and stirring, the exceptions being turnips, garlic, and similar flavours.
3. Dirty sheds and yards	3. Milk absorbs flavours from dirty surroundings. Where machines are used the air is actually admitted into the milk-pipes. Hence unclean surroundings mean bad-flavoured milk.
4. Careless milking	4. Teats and udders must be washed with a clean cloth and clean water from a clean bucket, and then dried before milking. Water must also be provided for washing the milker's hands.
5. Dirty milking-machines	5. Milking-machines must be treated as advised in special instructions issued by the Department.
6. Unclean utensils	6. Buckets, separators, &c., must be rinsed with cold water, scrubbed in warm water with a brush, cleanser to have been added to the water, then scalded with boiling water immediately after separating.
7. Washing separator once daily	7. A separator which is washed only once daily is a direct loss to the owner, as it will not skim clean the second time it is used, and will taint all the cream passing through it.
8. Skimming too thin	8. Skim a cream containing about 40 per cent. of fat; it will carry well, and will not quickly develop bad flavours.
9. Not cooling cream	9. Run the cream over a small cooler as it leaves the separator. Attach the water-inlet hose to the lower end of the cooler. Stand it in cold water afterwards.
10. Not stirring cream	10. Stir frequently with a metal plunger, but don't use a wooden stirrer.
11. Mixing hot and cold cream	11. Never mix hot and cold cream. Use a clean can or bucket for each skimming, and keep them separate if possible until sending to the factory.
12. Holding cream in kerosene-tins	12. Kerosene-tins are not suitable for use in a dairy unless the seam round the bottom and the lap round the top have been properly soldered.
13. Dirty and badly ventilated separator-rooms	13. The separating-room must be kept as clean as a butter factory, and have at least two large ventilators—one at the bottom and the other at the top on opposite walls—and should not be placed near the yard. The engine must not be in this room.
14. Keeping cream too long before sending to the factory	14. Don't fail to send the cream away on the days arranged by the factory, daily if possible.
15. Leaving cream standing in the hot sun	15. Protect the cans from the sun while waiting for the collecting wagon.
16. Rusty cans	16. Rusty cans impart a most objectionable flavour to cream. Have them retinned.

DON'T use the separating-room as a general storeroom. Don't use a cloth to wash tinware; use a brush. Don't use sandsoap for scouring tinware. Don't use a cloth strainer unless you wash and scald it daily. Don't use the cans returned from the factory until you have scalded them. Don't mistake WARM water for BOILING water.

—*Dairy Division.*

* "New Zealand Journal of Agriculture."

TREES FOR SHADE AND SHELTER.

Many stock-owners do not appreciate to the full the value of shade and shelter. A little rough hill on the property, covered with stunted gum-trees, is worth more to the farmer as it stands for shelter purposes than the small amount of grass it will grow should he decide to have it rung. To the settlers in naturally clear country judicious planting is a necessity. Some of our native trees lend themselves for shelter purposes admirably, while some species from other parts of the world adapt themselves to the same purpose.

While the months of June, July, and August are the usual months of the year for general planting, palms, evergreen trees, and shrubs may be planted now, especially on the tablelands and bleak positions on the coast, so that the roots of these newly-planted trees may become established while there is still warmth in the soil.

The benefits of planting early are many. One does not then get the leavings of the nursery stocks, while young trees, the roots of which may have become established by the time they enter their first summer, have a very marked advantage over those planted in chilled soil and compelled to wait for the heat to start them into root growth.

If actual plantings cannot be made at the present time, the ground should at least be prepared and plants ordered, so that plantings may be made directly after any rain that may come.

BALANCED RATIONS FOR FEEDING DAIRY COWS.

The food of the cow must be ready made and composed of such materials and in such proportions as will maintain body temperature, provide for milk production, and make good the waste of tissue that is constantly going on. The nutritive portion of the food may be divided into three parts—protein, carbohydrates, and fat. A well-balanced daily ration for a cow in milk weighing 1,000 lb. without any additional food in the way of grass should contain 24 lb. of dry matter, 2·5 lb. of protein, 12·5 lb. of carbohydrates, and ·5 lb. of fat.

A ration composed of these will give a nutritive ratio of 1:5·4 or 1 lb. of digestible nitrogenous matter to 5·4 lb. of carbohydrate matter. A productive ration, to produce meat, milk, and other products, ranges from 1:4 to 1:7. A maintenance ration simply to keep an animal alive ranges from 1:12 to 1:15.

The following daily rations will be found suitable for cows in milk:—

	—	Dry Matter.	Protein.	Carbo-hydrates.	Fats.	Nutritive Ratio.
1.	15 lb. lucerne hay ..	13·24	1·14	5·67	·195	..
	5 lb. wheaten chaff ..	4·10	·18	2·30	·055	..
	6 lb. bran	5·28	·75	2·64	·17	..
	2 lb. corn meal ..	1·72	·14	1·32	·07	..
	Totals	24·34	2·21	11·93	·490	1 : 5·9
2.	40 lb. silage	10·0	·52	5·4	·24	..
	8 lb. lucerne hay ..	7·12	·99	2·97	·12	..
	2 lb. linseed meal ..	1·78	·52	·77	·13	..
	Totals	18·90	2·03	9·14	·49	1 : 5
3.	40 lb. silage	10·0	·52	5·4	·24	..
	10 lb. lucerne hay ..	8·9	1·23	3·71	·16	..
	8 lb. bran	7·06	·9	3·38	·2	..
	Totals	25·96	2·65	12·49	·60	1 : 5·2

A maintenance ration for cows not in calf could consist of 40 lb. silage. This would give a nutritive ratio of 1:11·4. Where plenty of grass is available a corresponding reduction may be made in the ration of a cow.

No matter how carefully a ration may be prepared cows will not all respond to it alike. Much depends upon their digestive powers, individuality, breed, capacity for producing milk, and the climate will also have a big influence.

Heavy milkers require a ration containing a larger proportion of digestible albumenoids than cows yielding small quantities of milk.—F. Wilkinson, Senior Dairy Instructor, in "Agricultural Gazette of N.S.W."

A GOOD AUSTRALIAN.

Mr. Philip McKenzie Pitt, who has been a member of the staff of the Queensland Agricultural College since its foundation nearly thirty years ago, retired on long leave on the 20th May. Mr. Pitt is the only officer known to every old boy of the College. No man has won more respect, even affection. A kindly, sympathetic, yet shrewd nature, a man by whom one could set his watch, there are hundreds of men scattered over Australia whose lives are brighter and happier for having known him.

A presentation is about to be made to Mr. Pitt, and all old boys are invited to send immediately subscriptions to the Pitt Presentation Committee, Queensland Agricultural College, Gatton.

RAINFALL IN THE AGRICULTURAL DISTRICTS.

TABLE SHOWING THE AVERAGE RAINFALL FOR THE MONTH OF APRIL, IN THE AGRICULTURAL DISTRICTS, TOGETHER WITH TOTAL RAINFALLS DURING APRIL, 1925 AND 1924, FOR COMPARISON.

Divisions and Stations.	Average Rainfall.		Total Rainfall.	
	April.	No. of Years' Records.	April., 1925.	April., 1924.
North Coast.	In.		In.	In
Atherton	4·37	24	5·07	1·56
Cairns	12·21	43	9·30	20·38
Cardwell	9·66	52	4·13	11·35
Cooktown	9·14	49	6·64	10·38
Herberton	4·22	38	3·88	1·17
Ingham	8·83	33	2·96	9 77
Innisfail	21·40	44	20·73	18·34
Mossman	10·31	17	11·74	10·85
Townsville	3·81	54	0·04	5·24
Central Coast.				
Ayr	2·86	38	...	5·18
Bowen	2·94	54	0·40	6·51
Charters Towers ..	1·75	43	...	2 54
Mackay	6·76	54	1·61	7·62
Proserpine	6·60	22	3·01	6·46
St. Lawrence ...	2·83	54	0·68	4·30
South Coast.				
Biggenden	1·86	26	0·35	1·60
Bundaberg	2 93	42	0·56	1·37
Brisbane	3 58	74	0·98	2·67
Childers	2 58	30	0·66	1·59
Crohamhurst ...	5·70	30	2·42	3 22
Esk	2·60	38	0·77	1·94
Gayndah	1·33	54	...	1·04
Gympie	3·17	55	1·17	3·03
Caboolture	3·98	38	0·94	2·66
Kilkivan	2·07	46	0·04	2·45
Maryborough ...	3·43	53	1·72	2·54

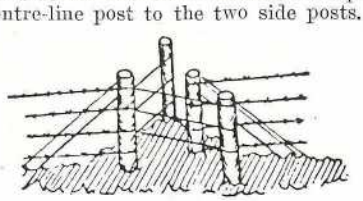
Divisions and Stations.	Average Rainfall.		Total Rainfall.	
	April.	No. of Years' Records.	April., 1925.	April., 1924.
South Coast—continued:	In.		In.	In.
Nambour	5·43	29	4·07	4·88
Nanango	1·80	43	0·23	0·55
Rockhampton ...	2·33	38	0·19	4·71
Woodford	4·16	38	2·05	2·23
Darling Downs.				
Dalby	1·21	55	0·04	1·20
Emu Vale... ...	1·19	29	0 08	2·47
Jimbour	1 23	37	...	0·96
Miles	1·33	40	...	0 21
Stanthorpe ...	1·66	52	0·29	1·39
Toowoomba ...	2·42	53	0·31	1 73
Warwick	1·62	60	...	2·32
Maranoa.				
Roma	1·25	51	...	1·50
State Farms, &c.				
Bungeworgorai ...	0·85	11	...	1·48
Gatton College ...	1·59	26	0·10	1·58
Gindie	1·18	26	...	1·02
Hermitage ...	1·24	19	..	2·01
Kairi	5·13	10	5·34	2·47
Sugar Experiment Station, Mackay	5·29	28	1·69	6·47
Warren	1·43	11	...	2·77

NOTE.—The averages have been compiled from official data during the periods indicated; but the totals for April this year, and for the same period of 1924, having been compiled from telegraphic reports, are subject to revision.

GEORGE G. BOND, Divisional Meteorologist.

A GATELESS OPENING.

In many places it is desirable to have an opening in the fence that a man can easily slip through without bothering with a gate, but through which horses or cows cannot pass. Four posts are set as shown—two in the fence line, which should be braced, and one on each side of one of the centre-line posts. Branch wires are carried from the other centre-line post to the two side posts. These should be made

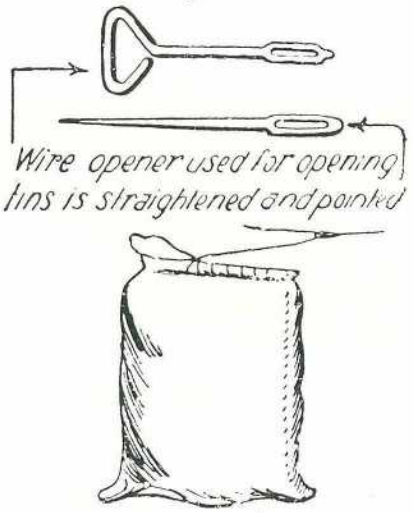


of wire without barbs to catch on the clothes, as it is not desirable to make the openings larger than necessary. If the centre posts are long enough—say, 5½ or 6 ft. above the ground—they can be braced to each other by a piece of strap iron across the top. If this is possible, then the other braces will not be necessary.—"Country Gentleman."

General Notes.

Handy Bag Needle.

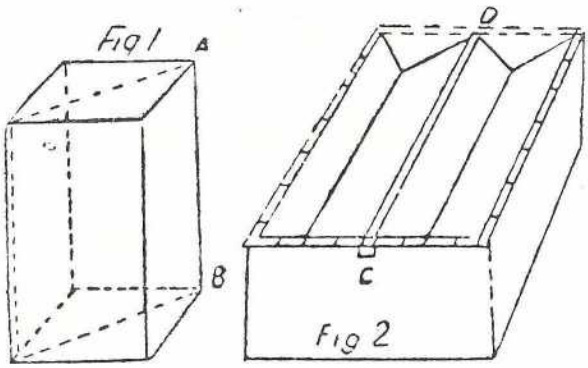
A bodkin or needle suitable for use with string or twine can be readily made from one of the openers that are used to open tin containers. The wire-opener is straightened out and the ends rounded up with a file or on the grindstone, that they



may pass freely through the open weave of the sacking. This simple modification is so easy that a few of the openers can be put aside until such time as the bodkins are needed, when one or more may be straightened up and pointed for use.

A Handy Trough for Pigs.

A very handy trough for feeding pigs or calves can be made out of a kerosene tin. The tin should be cut diagonally (as shown in Fig. 1), leaving the edge AB uncut, and then opened out, forming two wedge-shaped troughs side by side. A box frame should be made of the right dimensions to hold these troughs, and a centre piece let in on the upper edge CD (Fig. 2). The uncut edge of the tin must be placed over CD, the troughs lying on each side of the box frame. By cutting a nick at each corner the edge of the tin is bent over the edge of the box and tacked down.



This class of trough is much to be preferred to wooden or small log troughs or old fruit-case or butter-box troughs, for the reason that it is more permanent and can be scalded out daily, and thus be kept in a clean sanitary condition. If the trough is affixed to a wide board or floor, say, 3 ft. square, it will be impossible for young pigs to upset its contents, and if moved on to a fresh site occasionally will be found exceptionally handy, particularly in wet weather.—E. J. SHELTON, Instructor in Pig Raising.

Virus by 'Plane.

Another of the many boons of our established aerial service has been brought under notice (writes a North Western correspondent). The Stock Department in the course of the past few weeks has been in the habit of forwarding 2,000 doses of natural virus weekly from Townsville to Brunette. This is conveyed by aeroplane from Townsville, a distance of about 900 miles, the whole distance in cold storage. The total consignment will be 12,000 doses, and the benefit of being able to procure natural fresh virus is of wonderful advantage to cattle men in this part of the State.

Feed Value of Damaged Grain.

Shrunken and damaged grain has a relatively low market value, but for feeding purposes (writes the chemist of the Department of Agriculture, New South Wales) it may be nearly equal to the plump sound grain, which commands the higher price. Pinched or shrivelled wheat grains contain, as a rule, a slightly higher percentage of proteins than the plumper grains, and are for this reason a valuable food for poultry.

The feeding value of grain that is "shot" will depend on how far germination has proceeded. A bleached and "shot" sample was lately submitted to the Department with the question whether it was suitable for poultry food, and the reply was that though it would not have the same food value as sound wheat, it was unlikely to have any deleterious effect on poultry.

Cleansing of Milking Machines—An Improved Method.

An article in the New Zealand "Journal of Agriculture" advocates a method of cleansing milking machines which does away with the scrapers and spiral hair-brushes that so damage the inner surfaces of the rubbers. The following are essential to the method:—(1) A suitable plant for boiling water; (2) a stock of caustic soda; (3) an ample supply of clean water; (4) some scrubbing brushes, large buckets, a suitable bath or tub, and a ball of horsehair. The procedure recommended is as follows:—

(1) Before milking, draw cold water through all milk-tubes and the releaser, so as to prevent the adhesion of milk to the pipes, &c.

(2) Immediately after milking wash all dirt off the outside of the teat-cups and rubbers; then draw through each set of teat-cups sufficient cold (or preferably lukewarm) water to flush out the milk system. When drawing the water through the set farthest from the releaser insert a ball of horsehair in the end of the milk-pipe, to cause it to travel through to the releaser with the water.

(3) Next, draw through each set of teat-cups not less than 1 gallon of boiling water, to which caustic soda has been added at the rate of not less than 1 to 1½ tablespoons per 4 gallons of boiling water. Distribute the solution as evenly as possible through each set of teat-cups.

(4) Immediately follow by flushing out the caustic soda solution with 2 gallons of hot water or 1 gallon of boiling water for each set of teat-cups. The flushing with boiling water helps to dry the rubbers, and leaves the milk system dry and sweet.

(5) Then remove or open the plug or flap from the releaser-pipe, to allow of free circulation of air.

(6) Next clean the vacuum system in the same manner as the milk system, by drawing through first the caustic-soda solution, and next the boiling water which has been circulated through the milk system. Pay particular attention to the cleaning of the pipe connecting the releaser to the vacuum tank, by flooding the releaser to cause the water to travel through to the vacuum tank. This is important.

(7) The engine can now be stopped. Disconnect the two long rubbers from downpipes and teat-cups, and hang in a clean, airy place out of the sun.

(8) Next disconnect the releaser, wash, rinse, and place in a clean, dry, sunny place; then disconnect the top or bottom half of the vacuum tank and treat in a similar manner.

To ensure effective cleansing by this method it is essential that it be carried out daily in the manner directed.

Oat Smut—Method of Prevention.

When only a few smutted plants appear in a crop of oats the yield is not affected to an extent which would justify seed treatment. If 5 per cent. or more infected plants occur in the crop, however, the grower is well advised to treat the grain saved from such a crop for seeding purposes.

"Oat smut" can be prevented by pickling the seed. On account of the structure of the oat, formalin has proved to be the most effective fungicide for this purpose. The grain should be dipped for ten minutes in a solution of formalin made up at the rate of 1 pint of formalin to 40 gallons of water. It should then be sown within a period of twenty-four hours from the time of treatment.

Every care should be taken to measure the quantities of solution required, and to see that the grain is not treated for too long a period, or left too long before sowing. It is better to sow such seed moist, rather than allow it to dry. The treated grain should not be placed in dirty bags or it may become reinfected.

Formalin injury occurs especially when the treated grain is sown in a dry seed-bed. Seed injury may be lessened by following the formalin pickle by treatment in lime water (1 lb. lime to 10 gallons water) prior to sowing.

Pasture Improvement.

Now that the values of sheep are higher than has been the case for many years, and as the production of high quality wool and early maturing lambs is receiving considerably more attention than formerly, pastoralists and farmers are paying greater attention to the valuable work of pasture improvement. A summary of the result of experiments (at some fifteen well-distributed centres) comprises a valuable article in the current "Agricultural Gazette" of New South Wales.

The plants which respond most readily to the application of fertilisers are the rapid growing succulent plants, such as clovers, some of the native grasses, and most of the succulent introduced grasses. While some of the native grasses, such as the various species of Star (or Windmill), Panic, and Wallaby respond to the fertiliser, others, such as the spear and Three-awned Spear grasses do not.

The results show that light dressings of superphosphate in dry localities gave the best all-round results, and being comparatively cheap, this is considered one of the most economical fertilisers to use. In these districts the fertiliser should be applied in April or May in order that the herbage may receive the full benefit of the application.

For summer pastures in cold localities it is recommended that the fertiliser be applied in July, while for winter grasses and clovers, such as Toowoomba Canary, Tall Oat, Cocksfoot, Perennial Rye, and the perennial forms of red clover, application should be made in March.

Among the conclusions drawn from these experiments are the following:—

The top-dressing of pastures in most parts of the State is a profitable procedure, resulting in improvement in the quantity and quality of the pastures.

Small quantities of superphosphate of 56 lb. per acre are sufficient in the drier parts of the State, whereas in districts of good rainfall the quantity may be increased.

The residual effect of an application of superphosphate may often be seen for several years.

In coastal districts basic superphosphate has given slightly better results than the more usual form.

Stock evidently do better on top-dressed areas, as they put on more condition and show preference for such areas over untreated sections.

Worn-out pastures, such as those at Crookwell and Jamberoo, benefited greatly from top-dressing. In these two cases the owners intended to plough up and replant, but now the grasses have thickened up to such an extent that replanting is unnecessary.

Weeds disappeared in top-dressed pastures, the vigorous growth of the grasses assisting in choking out detrimental plants.

Top-dressed areas remain green for a longer period, than unmanured sections, thus providing succulent feed for a longer period, and diminishing the danger of bush fires.

Where pastures are poor and thin, stock have to travel over large areas, tracks are worn, and plants destroyed, and animals lose their condition, whereas succulent pastures produce contentment, and animals fatten rapidly.

Worn-out paspalum pastures can be improved by ploughing and sowing seed of suitable plants, and top-dressing. Where it is impossible to plough, a top-dressing of 2 cwt. basic superphosphate applied during the late winter is recommended.

Capacity Production.

Although every attention be given to the working of the soil, it will be found insufficient to make available the large quantities of plant-food required for constant crop production without the aid of fertilisers or manures. No amount of manuring on the other hand will produce good crops if the land is not well tilled. Fertility may be said to depend on a happy combination of the two factors.

Gypsum—Its Use as a Soil Improver.

Gypsum is a naturally occurring lime compound, forming rock masses or deposits consisting of more or less pure sulphate of lime. Unlike other forms of lime, it has no action in sweetening sour soils, but it is of great value in lands which are charged with alkali or irrigated by alkaline water. Its action consists in neutralising the carbonate of soda, which renders the soil or water alkaline or caustic, and converting it into sulphate of soda—a salt which, not being caustic, has not the same injurious effect on the soil or the crops as the original alkali had.

Gypsum, either in a raw or calcined condition, is used in many industries. The following are among the most important of its uses:—(*a*) Fertiliser; (*b*) flux in smelting (particularly for nickel ores); (*c*) paint manufacture; (*d*) as a filler in cotton and paper manufacture; (*e*) as a possible source of sulphur in the manufacture of sulphuric acid; (*f*) for the manufacture of Portland cement, small quantities of gypsum varying from 1½ to 3 per cent. being added to retard setting; (*g*) for the manufacture of plaster of paris.

The ameliorative effect of gypsum on the condition of certain New South Wales soils is interestingly discussed in the course of an article in the current "Agricultural Gazette" of New South Wales. The use of gypsum on the Yanco Irrigation Area, it is stated, has greatly increased in recent years, settlers on the heavy soils especially realising the benefits to be obtained from its use. Soil improvement experiments, using gypsum and lime at various rates of application, and also applications in conjunction with green manuring, have been conducted at Leeton over the last three years, plots of land planted with fruit trees being selected on two local farms for the trial. In both cases, and especially in one, the land was very stiff and hard to work. The surface soil was very shallow, overlying a heavy, practically impervious red clay. The land literally defied permeation by water to any depth, water applied lying on the surface after irrigation for some days, while almost immediately the land was dry enough to carry horses it became so hard that cultivation was almost impracticable, and, if delayed a day, impossible.

It has now been found that after the use gypsum on the land the the soil takes up more water, which under equal conditions moves much faster over the untreated than over the treated areas, owing to more water being absorbed by the latter and the soaking being to a greater depth. After irrigation is completed it is found that the treated plots are ready for cultivation, and will carry the teams one or often two days before the untreated plots, and the soil works up in much better condition, being more friable and mellow.

On examination of the experiment plots on one of the farms on 1st August, 1924, it was noted when holes were dug in the various sections that the section treated with gypsum showed an appreciable effect to a depth of 18 inches, and the section treated with lime to a depth of 12 inches. In each of the untreated sections the soil was hard and dry, while in the dressed portions it was mellow and friable, and crumbled at once to a depth of 18 inches. The subsoil, too, in the dressed sections carried plenty of moisture.

The ordinary wheat drill with a fertiliser attachment is not very satisfactory for the application of gypsum, as the substance is not of a free-running nature, and on the area referred to the use of a shovel is usually resorted to. Special machines for the distribution of lime give satisfactory results when gypsum is used. It has been found that spreading on the surface gives better results than than ploughing under.

Besides being costly, heavy dressings do not appear to be necessary, for lighter applications have so far given equally beneficial results. In both cases if further dressings are given the results will be greater. A dressing of 1 ton per acre is recommended for the heaviest lands of the Area, followed up by applications of half a ton annually. Even when only the half-ton has been given the first year, satisfactory results have been obtained.

The article cautions the reader against regarding gypsum with a too sanguine eye. "The farmer should not allow himself to spoil his land first by injudicious waterings, by the use of too much water, by lack of cultivation, or by permitting stock on the land while it is wet. To resort then to the use of gypsum to remedy matters is to court disappointment. Careful farming right from the start is necessary, and the gypsum must be used not as a 'cure-all,' but in conjunction with green manuring and good and thorough cultivation."

Tractor School at Gatton.

Marked enthusiasm was shown by the seventy-four farmers who attended the recent tractor school held at the Queensland Agricultural High School and College, Gatton. Farmers representing the majority of Queensland's agricultural districts, from Tolga in the North to Canungra on the South Coast, were present. The wheat areas provided a large quota. It was primarily due to the representations of some of the Downs branches of the Local Producers' Association that the school was held at Easter. The Council of Agriculture co-operated with the tractor agents and the Department of Public Instruction in making school arrangements. The course opened on 7th April, and consisted of lectures and practical work, equal periods being devoted to each. The majority of lectures dealt with tractors and tractor operation. Several lectures were given on crops and cultivation, manures, and other items of general interest to the farmer. The practical side consisted of the manipulation of tractors, timing of ignition, valve grinding, &c. In order that students might obtain a working knowledge of each tractor, they were divided into groups of eight, each group operating a different make of tractor each day. The ready co-operation of the tractor agents in this venture was a pleasing feature of the school. The agents, beside sending their tractors, provided mechanics and demonstrators to instruct in driving. There was an entire absence of the competitive spirit. Farmers are quick to see the benefit derived from these courses of instruction. They bring the man on the land into contact with many varieties of tractors under working conditions giving an opportunity of learning how to care for a tractor, how to operate it with understanding and to make field repairs. The farmers and mechanics lived at the college, occupying the rooms of students absent on their Easter vacation.

Wheat and Fat Lambs—The Winter Fodder Problems.

The cultivation of fodder crops for the winter and spring, when natural pastures are usually at a standstill, has not received the attention from the mixed farmer in the past that it warrants. A report of winter fodder trials on farmers' experiment plots in the central west of New South Wales in the current "Agricultural Gazette" of New South Wales is especially interesting.

Now that sheep are recognised as a necessary adjunct to the wheat farm, considerable interest is being taken in the question of fodder supply. The prevalence of fungous diseases in wheat is leading to a change in farming practice, the necessity for systematic rotation in an endeavour to starve out these diseases becoming more realised each year. In view of this change of practice, some definite lines should be adopted by farmers in regard to their sheep. Keeping a few nondescript ewes or wethers just for cleaning weed growth on the fallows is not sufficient, nor is it satisfactory to run a pure line of merinos for their wool, because of the earth which gets into the wool when grazing on cultivated paddocks. The system which appears the most lucrative and easy of adoption in conjunction with wheat-growing is fat-lamb raising. Moreover, it is the one for which a considerable area of the central west is ideally adapted.

Intimately associated with the production of fat lambs is the growing of green fodder crops for winter and early spring. To secure a maximum lambing, strong lambs, and the minimum of trouble with the ewes, it is essential to have such crops on which to run the ewes some time prior to and during lambing. It is just as important to have the right class of feed on which to run ewes and lambs, so that the latter will not be stunted, but can be marketed in the pink of condition and with the much-desired "bloom" upon them.

The experiments have proved conclusively the necessity of winter fodders for all classes of stock, and that they provide an excellent rotation with wheat on the mixed farm.

In the control of fungous diseases the system of rotating wheat with winter fodder crops of barley or oats has proved an excellent one. In this particular oats are the most beneficial. Owing to the early maturing varieties which have been produced in late years—*e.g.*, Sunrise, Mulga, and Lachlan—it is possible they will largely supplant the barleys as winter fodder crops. Barley is much more exacting in its soil and water requirements than oats, and does not provide any bulk of feed in the second growth. If the feed is not required for some time after grazing, the oat paddock may be shut up, and will produce a payable hay crop. Winter fodders should be sown systematically each year. Should the paddocks not be required for grazing, owing to abundance of natural pasture, the crop may profitably be preserved in the form of silage. This is the best insurance against the drought which is bound to come sooner or later.

Where conditions are favourable more mixed farmers should be going in for fat lamb raising. The industry, for which a profitable and steady market exists, appears the most suitable for the wheat farmer, who, by rotating in a systematic manner his wheat and winter fodder crops, is able to produce succulent fodder when he most requires it, and not at the expense of the wheat crop.

How Savings Grow.

The issue of money boxes by the Commonwealth Bank is a comparatively recent institution, but the following figures indicate how popular this branch of the Bank's service has already become:—

During the year ended June, 1924, the Bank sold 119,694 money boxes throughout Australia, and of those returned full the contents averaged £2 3s. 10d. a box, a new box being given free in each case.

The money boxes are attractive replicas of the Bank's head office in Sydney, and are proving a fine incentive to youngsters to cultivate the thrift habit.

Give Children Honey.

Professor Cook says: "We all know how children long for candy. This longing voices a need, and is another evidence of the necessity for sugar in our diet. . . . Children should be given all the honey at each meal time that they will eat. It is safer, will largely do away with the inordinate longing for candy and other sweets, and in lessening the desire doubtless diminishes the amount of cane sugar eaten."

Ask the average child whether he will have honey alone on his bread, or butter alone, and almost invariably he will promptly answer, "Honey." Yet seldom are the needs or the tastes of the child properly consulted. The old man craves fat meat; the child loathes it. He wants sweets, not fat. He delights to eat honey. It is a wholesome food for him, and is not expensive. Why should he not have it?—"Agricultural Journal," British Columbia.

Corned Meat Liquid in a Fowl Yard.

A Goulburn resident with a small yard of poultry utilised the liquid in which corned meat had been boiled the previous evening to feed his fowls. Next morning thirty-one out of the thirty-six fowls were dead or dying.

There was no doubt, replied the poultry expert, that the corned meat water was the cause of the deaths. Any excess of salt, or even small particles of salt, coming in contact with the lining membrane of the bird's crop was likely to cause mortality among fowls or chickens.

At the same time, salt is necessary in their food, and it should be used at the rate of 1 oz. to each 5 lb. of wet mash; the salt should be dissolved in the water used for mixing the mash. If dry mash is fed, only about half the quantity is advisable. This should be finely powdered and thoroughly mixed through the ingredients of the mash.—"Agricultural Gazette" of New South Wales.

Curing the Lemon.

The fruit must be picked carefully—not handled like potatoes, but more after the manner of handling eggs—as decay is liable to set up in any bruised part. The fruit should be stored away in well-ventilated, dry, cool buildings, either in boxes or trays. It is always easier to store small than large quantities; therefore, the larger the quantity the more careful the grower will have to be about the building in which he keeps his fruit. A small closed room may be a capital place in which to keep a few lemons, but, perhaps, not at all suitable if the room is filled with fruit. We neither want the lemon to sweat, nor do we want it to shrivel, and if we can strike the happy medium we are on the right track. It has been demonstrated, both here and in California, that lemons keep best when cut just as they are beginning to turn ripe, and that, on the contrary, they do not keep so well when allowed to hang until quite ripe. They are best cut as soon as they are about 2½ in. in diameter. When they are over 2¾ in. they are over size, except for making lemon peel, when a good thick-skinned 3-in. lemon suits admirably. But we are now talking of lemons for curing, and for this purpose they should be picked when they attain the proper size, even though almost green. They should be allowed to stand for a few days, and then packed away in paper-lined boxes, which may be stacked in blocks in such a manner as to permit a free circulation of air around each case.

The lemons should be cut off (not pulled) in such a way as to leave a small portion of the stalk adhering to the fruit.—W. J. ALLEN, in "Agricultural Gazette" of New South Wales.

Arrowroot Board.

Mr. A. Clark, of Pimpama, and Mr. F. M. Ruskin, of Zillmere, have been appointed chairman and representative of the Council of Agriculture respectively, on the Arrowroot Board, until the 9th March, 1926.

Atherton Tableland Maize Board.

Mr. H. H. Collins, of Atherton, and Mr. J. Brunskill, have been appointed chairman and representative of the Council of Agriculture respectively, on the Atherton Tableland Maize Board, until the 31st March, 1926.

Butter Board.

Messrs. J. L. Wilson, Gladstone; J. T. Mulcahy, Nanango; J. Purcell, Toowoomba; C. H. Jamieson, Tent Hill, Gatton; and T. F. Plunkett, Beau-Pare, Beaudesert, have been appointed as representatives of the growers of butter to the Butter Board as from the 28th April, 1925, to the 27th April, 1926.

The Nightly Challenge of Chanticleer.

Can anything be done to prevent a rooster from crowing during the night?

On the assumption that a bird cannot crow without lifting its head, wire netting is sometimes stretched just over the perches at a height that will allow the birds to get on the perches, but will not allow the cock to crane his neck to crow.

Group Organisation in Agriculture.

The year 1924 will, no doubt, be remembered as a good one. A heavy clip of wool has been produced and a bountiful wheat crop is now being garnered, with satisfactory prices ruling for these and most primary products. But have we done anything to help in this direction? Might we not as easily have been faced with the problem of good returns and poor prices?

The producers have always left the marketing side of their business to chance. It has been a case of "Go your hardest, produce what you can, and trust to luck as to whether it can be sold at remunerative prices." Is it not time we gave the marketing problem very serious thought? I would suggest that the subject be given first place on our programme for the coming year. With the exception of agriculture, practically all commerce and industry is organised on a group capital, group production, and group distribution basis. We may find it difficult or even impracticable to attain to the same high degree of efficient organisation as that enjoyed by some of the other industries, but there is no reason why with more comprehensive organisation and co-operative effort we should not be able to control agriculture in nearly the same way as manufacturers control manufactures. I feel sure the realisation of this can and will be brought about by the various means of co-operative activity provided for under the Co-operation, Community Settlement, and Credit Act.—W. E. Tayler, chairman, Advisory Council, in a recent issue of "Agricultural Bureau Record" (N.S.W.).

Maize for Silage—Southern Enterprise.

Tilba (New South Wales) has already made a name for itself among Southern dairying districts by its progress in the building of silos and by the comparatively advanced methods of feeding dairy cows that are practised. It has now enhanced its reputation as a progressive centre by its agricultural society being the first in the coastal districts of New South Wales to organise a field maize competition for the heaviest yield of the best quality of green fodder or silage maize, and incidentally, by means of the judging, to have the methods of cultivation and general practices in growing the fodder crops assessed with a view to their possible improvement.

With such a worthy object, the Tilba Agricultural, Pastoral, and Horticultural Society departed from the plan of crop-growing competitions previously obtaining, which judged on yield alone, and merely served to bring out as the winner the fortunate individual who possessed the richest soil and grew the heaviest crop, regardless of methods, costs, and quality of crop. The present competition was organised by the society mainly for its educational value, and the New South Wales Department of Agriculture was asked to suggest a score card or scale of points for use in the judging of the crops which would, in addition to points for yield, give credit for cultivation methods, excellence of stand, absence of weed growth, quality

of fodder, freedom from insect pests and diseases, and other characters generally influenced by good farming methods. The educational value of the competition was enhanced by the society requesting the services of a field officer of the Department to act as judge.

The season generally was not as favourable as it might have been, being very dry right up till the end of December, and then setting in very wet. In fact, when the dry season broke the weather was so inordinately cool and wet that the crops matured very slowly, and the task of keeping down weeds was made rather onerous and difficult. These conditions did not favour a heavy entry in the competition, many farmers withdrawing their projected entries because they did not care for only moderate crops to be seen or because they were somewhat over-conscious of the weed growth which was present in their crops.

It was desired that the crops should be judged before the Tilba Show in February, and it was unfortunate that the cool season had so delayed the maturity of the crops that not only was the estimation of the yield of fodder more difficult at that time, but it was also harder to determine the condition and character of the fodder than it would have been at the ensilage stage, which was three or four weeks off still in many of the crops. Under ordinary circumstances, with a normal season, the crops would have been near the best ensiling stage, and the judging would have been easier.

Despite the partly unfavourable season, some surprisingly good crops were seen. It was generally agreed that the season showed definitely that maize crops, even fodder crops, can get too much rain during their growth, for the crops in the district the previous year, with less rainfall, were very much better. It is doubtful, however, whether with all the rainfall there would have been an excess if the accompanying weather had been warmer, and had facilitated the drying of the ground and enabled better cultivation to have been given to keep down the weed growth. A factor not to be overlooked is that the dry winter and spring, combined with cultivation methods which generally did not turn these conditions to the best account, did not give the crop a good start, without which no crop will attain its best growth.

The winning crop (118 points) was grown on drained swamp land which is in the stage of getting over its objectionable excess of peatiness on the surface by cultivation. The yield of the best crop here—two crops were entered, the other scoring 110 points, and securing second place—was estimated at 45 tons per acre, equalling the authentic record yield of green fodder maize for the State, which was also obtained at Tilba several years ago. Although estimated at 45 tons, it is considered that this crop would go even heavier by the time it reached the ensilage stage, as at the time of judging the cobs had not developed very greatly. The heavy yield of green fodder on this class of land in such a season draws attention to the possibility of draining and utilising further swamp areas in this district.

The crop was one of the finest crops of fodder maize ever seen in the State, and its success in this competition was due to its general excellence in yield, character, and appearance, combined with praiseworthy methods of cultivation and attention.

The yields of 25 tons per acre obtained on hill soils of igneous derivation were very creditable. With better methods of cultivation, and the application of methods to increase the soil fertility to make heavier yielding crops, the indications are that some of the crops on the hill slopes in the Tilba district will yet go nearer winning a competition of this kind and incidentally demonstrate not only the capacity but the excellence of these soils under good treatment.

The means by which the fertility of the hill soils in the Tilba district may be maintained or improved are the subject of particular discussion in the report from which these paragraphs have been extracted.

The following improved score card, as recommended for future competitions, will doubtless prove of interest to agricultural organisations generally:—

	Points.
Germination	10
Cultivation methods	25
Freedom from weeds	15
Leafiness and production of ears	15
Character of fodder	10
General appearance, evenness, &c.	10
Absence of insect pests and disease	10
Estimated yield (one point for each ton per acre of green fodder).	

The Cotton Industry.

The Minister for Agriculture (Mr. W. Forgan Smith, M.L.A.) stated recently that he received some time ago a deputation from representatives of the cotton industry, who asked whether the State Government would agree to support a request to the Commonwealth Government that a bounty be paid to the cotton industry. This request also involved State de-control of the industry. Mr. Smith informed the deputation that he would consider the matter provided that the growers themselves intimated that the new proposal was approved by them, and to this end the Minister suggested that a vote be taken of the growers through the Local Producers' Associations concerned. Continuing, the Minister said that on 6th May a further deputation representing the industry waited on him, and informed him that 151 Local Producers' Associations had voted on the proposal, and of this number only 15 were for the negative. The subject was considered by the Cabinet on the 12th May, and it decided to support the growers' request to the Commonwealth Government that the industry be paid a bounty with a view to establishing it on a sound footing. "This means," added Mr. Smith, "that if the Commonwealth agree—and I am given to understand it is favourably disposed towards the proposal—the State will de-control the cotton industry, and the Department's activities will be confined to that assistance which is given to general agriculture."

Staff Changes and Appointments.

The appointments of Messrs. R. L. Prest, H. St. J. Pratt, F. L. Jardine, and S. E. Stephens, as inspectors under the Diseases in Plants Acts, have been confirmed as from the 20th September, 1924.

The officer in charge of police at Mareeba has been appointed an acting inspector of stock.

Mr. Robert Veitch, B.Sc., now of Lautoka, Fiji Islands, has been appointed Chief Entomologist to the Department of Agriculture and Stock in succession to Mr. Henry Tryon, who is approaching the retiring age from the service. Mr. Veitch was born in Edinburgh in 1890, and was educated at the University of Edinburgh, the Imperial College of Science, London, and on the Continent of Europe. In the course of a distinguished University career, he was awarded a number of medals and numerous first-class honours certificates. In 1911 he acted as Demonstrator in Botany to Professor Balfour, and after graduating in 1912, he conducted a Summer School in Forestry and also acted as Zoological Assistant at the Dick Veterinary College. He acted as Assistant Entomologist to the Imperial Bureau of Entomology, British Museum, London, from December, 1912, to March, 1914. In March 1914 he accepted his present position as Entomologist to the Colonial Sugar Refining Company. He was elected a Fellow of the Entomological Society of London in 1914 and of the Linnean Society of New South Wales in 1917.

Officers underlisted have been appointed Cane Testers for the forthcoming sugar season:—

Mr. C. H. Jorgensen, South Johnstone; F. W. Trulson, Babinda; Mr. J. Howard, Mulgrave; Miss C. E. Rowe, Mourilyan; Mr. P. H. Compton, Invicta; Mr. R. J. Rollston, Pioneer; Mr. A. G. Kelly, Kalamia; Miss L. H. Fuller, Inkerman; Mr. P. J. Phelan, Proserpine; Mr. J. Macfie, Farleigh; Miss A. L. Levy, Marian; Mr. F. Jorss, Pleystowe; Miss I. V. Palmer, North Eton; Miss M. T. Smith, Racecourse; Miss I. McGill, Gin Gin; Miss E. Christsen, Plane Creek; Miss D. Marles, Bingera; Mr. C. J. Boast, Millaquin; Miss K. Fauth, Fairymead; Mr. S. C. Bracey, Qunaba; Mrs. K. Dunton, Maryborough; Mr. R. B. May, Moreton; Mr. H. B. Davis, Rocky Point; and Mr. H. Lambert, Mount Bauple.

Messrs. T. Herbert and W. Clacher have been appointed Assistants to Cane Testers at South Johnstone and Proserpine respectively.

Constables J. A. Marr and A. F. Horn, of Evergreen and Canungra, respectively, have been appointed Inspectors of Slaughter-houses.

Mr. T. Welsby, of Brisbane, and Mr. L. H. Maynard, of Bundaberg, have been appointed Officers under and for the purposes of the Animals and Birds Act.

Mr. L. Chadwick has been appointed Cane Tester for the forthcoming season at Cattle Creek Sugar Mill, and Misses S. Riley and F. Parkinson have been appointed Assistants to Cane Testers at Bingera and Inkerman Mills, respectively.

Police Sergeants J. Tuohy and P. W. Cowley, of Innisfail and Charleville, respectively, have been appointed Acting Inspectors of Stock.

The appointment of Mr. Daniel Culhane as Inspector of Dairies and Inspector of Stock, Department of Agriculture and Stock, has now been approved.

Answers to Correspondents.

Questions for reply under this heading should be addressed to the Under Secretary, Department of Agriculture and Stock, Brisbane.

Horse Ailments.

M.H.M. (Mooloolah)—Mr. Rudd, of the Veterinary Staff, advises:—

This horse is apparently suffering from indigestion. He evidently bolts his food. If his teeth are in good condition feeding on long hay will abate this, and force him to masticate his food thoroughly. If fed daily on 30 lb. of good oaten chaff there is no necessity for the addition of maize to the ration, which should be cracked instead of being fed whole.

Stabling at night and a spell away from work should be tried, as there is little nourishment in natural pasture at this time of the year.

Give the following daily in the food for twenty-one days:—Epsom salts, 1 ounce; nitrate of potash, 1 drachm. It should be mixed in the damped food in the morning.

H.B. (Maroochy River)—Mr. Rudd, of the Veterinary Staff, advises:—

The horse is in all probability a natural shiverer, but this condition may be aggravated by lack of suitable surroundings which accentuates the trouble. The only way to help the animal is to feed him on suitable food and keep him stabled, when in all probability he will do all the work which is required of him without much effort.

Clip him trace high and rug him and stable him at night on good bedding. Feed him on oaten chaff three-quarters and lucerne chaff one-quarter. The combined food being equal to 30 lb. per diem plus that which he can pick up in the paddock when not working.

Give him the following powders at the rate of one tablespoonful per day in his food:—Finely powdered bone meal, 1 lb.; sulphate of magnesia, 3 oz.; powdered gentian, 3 oz.; sulphate of iron, 2 oz.; powdered fenugreek, 3 oz.; salt, 3 oz.

If the horse is given a short spell and built up before being put back to hard work, he will in all probability do the work which is required of him.

Pigs—Their Feeding, Breeding, and Care.

H.F.R. (Eumundi)—

The dry feeding system is practised extensively overseas, but so far we do not, in general, follow this system here, for the reason that skim milk forms a very large proportion of the food given to our pigs, and where concentrated meals—pollard, barley meal, maize meal, &c.—is being fed as a slop or mash. However, the Instructor in Pig Raising, Mr. Shelton, advises that you would be quite safe in feeding any of these meals dry, but for a start it would be preferable to accustom the animals to a drier mash before putting them on the meal alone as the cereal portion of their food. If you gave us an idea of the number of pigs you are feeding and the manner in which you suggested feeding the pigs in the future we could help you.

R.E.G. (Townsville)—The Instructor in Pig Raising (Mr. Shelton) advises:—

The Use of Dried Blood.—The use of this meal should be restricted to the feeding of young and growing pigs. Meat meal is to be preferred to dried blood, as it contains more bulk and in general will give better results. Meat meal can be considered a wholesome addition to the large variety of foods in which there is a shortage of protein; thus in balancing rations containing maize, potatoes, wheat, and other foods that show large percentages of starch and sugar, also percentages of protein, meat meal is a suitable addition to the food. The addition of a quantity of dried blood to meat meal would of course increase its protein content, but in general would also increase its cost prohibitively. Both meat meal and dried blood have lavative qualities, and the use of too heavy a supply results in intestinal disorders. In using dried blood alone no more than 10 per cent. should be added to the food you are already using, for your foods are mostly rich in protein.

Lucerne is considered the king of green fodder for pigs, and its use particularly for breeding sows is strongly recommended, as also is the use of any green foods like vegetable garden waste which the pig will consume, but these foods must be balanced with grains, roots (sweet potatoes, &c.).

A pamphlet containing much information relative to feeding the brood sow prior to and after farrowing has been posted to you.

Giving the sow one 3-ounce dose of castor oil about three days before farrowing date is recommended. The oil should first be mixed in about half a bucketful of dry bran, then thin the rest down to the consistency of thick cream with warm water or milk, and give as the first feed of the day. This has a very beneficial effect on the sow, and will relieve the bowels and ensure her being in good order for farrowing. It is customary to wean the young pigs at eight weeks of age, though in the case of a weakly litter it might be advisable to allow them to run with the sow till ten weeks old.

It is customary to mate the sow one week after weaning the young pigs—*i.e.*, at about nine weeks after farrowing. See reference to this subject in pamphlet.

Care should be taken in feeding waste fruit to pigs, particularly fruit like mangoes, for they have a very laxative effect, and may cause a severe diarrhœa. It is for this reason that sows close to farrowing should have a very limited diet of foods of this description.

Fencing for Pigs.—For paddock use there is nothing better than "K" wire-netting or a special grade of heavy netting like Lysaght's 42-in. high by 2½-in. mesh by 14 or 15 gauge. Your storekeeper could quote you for these materials as well as for the fencing materials, like hardwood palings, which are recommended for subdivision fences in small yards.

The use of a concrete wallow is recommended, particularly for the breeding sows. Particulars as to construction, &c., can be supplied if requested.

Porkers *versus* Baconers.—In general it will be found that it pays better, particularly situated as you are, to market your pigs as porkers than to attempt to carry them on to bacon size; but you will find the butchers at Townsville are accustomed to handling fairly heavy porkers. See them and make arrangements accordingly. You cannot do better than that at present.

Troughing.—Concrete or steel troughs are much to be preferred to wood troughs. Your storekeeper could, no doubt, quote for the most suitable class of steel trough.

Returns per Sow.—The sow should produce two litters per annum, and should rear at least eight pigs per litter. You could ascertain the value of porkers per pound from local butchers. One suburban pig farmer at Dundas, N.S.W., makes a comfortable living by running twelve sows and selling their progeny as porkers at the Abattoir Sale Yards, Sydney.

Purchases of Berkshire Pigs.—Your best plan would be to write The Manager, State Farm, Warren, *viâ* Rockhampton. He could quote you for unrelated boars and sows crated on rail, Warren, which is 14 miles west of Rockhampton, and you could depend upon the quality and type of any stock he supplies, and the prices are most reasonable. Stud pigs up to six months old are worth at least 6 guineas each. If you secured a boar and two unrelated sows and managed them properly you would find ample sale for the progeny in your own district as breeding stock at very payable prices.

The subject of castration is referred to in the pig pamphlet. Your local butcher could no doubt give you a few useful hints in this subject if you are inexperienced.

We would strongly recommend your visiting any successful farmer in the district within which you reside to study the methods adopted and observe the general procedure. Practical experience gained in this way, combined with the information you have or can obtain, should enable you to carry on successfully.

Testing Pigs for Tuberculosis.

A correspondent writes:—"Is it possible to test pigs for tuberculosis in the same way as cattle are tested, and if so what is the procedure and what symptoms would indicate the presence of disease or otherwise? Are tests of this description efficacious; what would be the cost of the instruments and vaccine; where can these be procured, and can the test be carried out by a layman or would it be necessary to employ the services of the stock inspector or veterinary surgeon?"

The Veterinary Branch advises that it is possible to test pigs for tuberculosis. The method applied is the eye test, which should be carried out by a qualified veterinary surgeon. The symptoms are inflammation of the eye with a discharge of pus. The average pig's life is so short that this test is seldom or never applied. Instruments are not required for this test. Tuberculin is prepared by Park, Davis, and Co., Sydney, for this operation, and full instructions as to use are sent with each order.

Pigs as a rule contract the disease through being fed on tuberculous milk, and it is therefore advised that if tuberculosis is found in pigs after slaughter the whole herd of cows should be tested, which will be done free of charge on making application to the Chief Inspector of Stock, Brisbane. Cattle reacting to the test must be destroyed.

Pig Feeding.

R.J.R. (Ubobo)—

The secret of success in feeding pigs, says Mr. Shelton, Inspector in Pig Raising, lies in the production on the farm of as much of the food as possible. This is why we advocate the growing of such crops as lucerne, rape, artichokes, sweet potatoes, pumpkins, and a great variety of others.

Of commercial meals we consider barley meal the best, and as skinless barley is usually available at round three shillings per bushel, it is much cheaper and more efficient than pollard. Oaten pollard can also be used in balancing a ration, but it is not usually possible to purchase oaten pollard in our markets, but it would pay you to approach firms like Burrel, Fenton, and Co., of Roma Street, for quotations.

If you could obtain a supply of small and cracked cow peas and have these ground up, they also would be suitable. You will note from the reference to bran in the pamphlet "Pigs for Profit" that we do not advise the use of this product except in very limited quantities, and then principally for breeding sows, at or prior to the farrowing stage. Skim milk, buttermilk, and whey are of course cheap and efficient units in working up a ration.

For quantities per pig per day see page 54 in the pamphlet on "The Pig Industry," which has been posted to you direct.

"The Kidney Worm," *(Stephanurus Dentatus).*

These worms form cysts, varying in size, and often collected in groups, each cyst usually containing two worms, a male and female. The cysts are commonly found in the fat, in the vicinity of the kidneys, and frequently in different solid organs of the abdomen, such as the kidneys, liver, and spleen. Upon *post-mortem* examination these worms are frequently found in considerable numbers, the pigs during life having shown no signs of disease, but when they are present in the liver or kidneys they are liable to set up serious trouble.

The symptoms exhibited by pigs during life are very problematical, apart from indications of liver or kidney disease. Treatment is extremely unsatisfactory, mainly because the worms are encysted in the solid tissues, so that any medicine introduced by the mouth could not be hoped to reach the worms in a sufficiently concentrated form to kill them. Arsenic, in the form of *Liquor Arsenicalis*, can be given daily for a week, in doses (varying according to age of pigs) of from 15 to 45 drops. This treatment can be repeated after an interval of one week.

Prevention is the only reliable method of dealing with this disease. Pigs should be excluded from all ground known to be infested, or on which infested pigs have been. They should not be fed on offal or flesh of other pigs, including scraps from the kitchen, until such material has been thoroughly cooked. The common feeding trough of the pig is a source of infestment, because the animal can get in not only with his nose but also his feet, filthy from direct contact with the urine and fæces of himself and others. The trough should always have a sloping cover, extending forwards and upwards at an angle of 45 deg. from the posterior border, and which will at least exclude the feet from the food. The trough should further be cleansed and disinfected daily.—Major A. H. Cory M.R.C.V.S., Chief Inspector of Stock.

Farm and Garden Notes for July.

FIELD.—Practically the whole of the work on the land for this month will be confined to the cultivation of winter crops, which should be now making good growth, and to the preparation of land for the large variety of crops which can be sown next month. Early-maturing varieties of wheat may be sown this month. The harvesting of late-sown maize will be nearing completion, and all old stalks should be ploughed in and allowed to rot. Clean up all headlands of weeds and rubbish, and for this purpose nothing equals a good fire. Mangels, swedes, and other root crops should be now well away, and should be ready for thinning out. Frosts, which can be expected almost for a certainty this month, will do much towards ridding the land of insect pests and checking weed growth. Cotton-picking should be now practically finished and the land under preparation for the next crop. The young lucerne should be becoming well established; the first cutting should be made before the plants flower—in fact, as soon as they are strong enough to stand the mowing machine, and the cutting of subsequent crops should be as frequent as the growth and development of the lucerne plants permit. Ordinarily cutting should be regulated to fit in with the early flowering period—*i.e.*, when about one-third of the plants in the crop are in flower.

KITCHEN GARDEN.—Should showery weather be frequent during July, do not attempt to sow seeds on heavy land, as the latter will be liable to clog, and hence be injurious to the young plants as they come up. The soil should not be reworked until fine weather has lasted sufficiently long to make it friable. In fine weather get the ground ploughed or dug, and let it lie in the rough till required. If harrowed and pulverised before that time, the soil is deprived of the sweetening influences of the sun, rain, air, and frost. Where the ground has been properly prepared, make full sowings of cabbage, carrot, broad beans, lettuce, parsnips, beans, radishes, leeks, spring onions, beetroot, eschalots, salsify, &c. As westerly winds may be expected, plenty of hoeing and watering will be required to ensure good crops. Pinch the tops of broad beans which are in flower, and stake up peas which require support. Plant out rhubarb, asparagus, and artichokes. In warm districts, it will be quite safe to sow cucumbers, marrows, squashes, and melons during the last week of the month. In colder localities, it is better to wait till the middle or end of August. Get the ground ready for sowing French beans and other spring crops.

FLOWER GARDEN.—Winter work ought to be in an advanced state. The roses will not want looking after. They should already have been pruned, and now any shoots which have a tendency to grow in wrong directions should be rubbed off. Overhaul the ferneries, and top-dress with a mixture of sandy loam and leaf mould, staking up some plants and thinning out others. Treat all classes of plants in the same manner as the roses where undesirable shoots appear. All such work as trimming lawns, digging beds, pruning, and planting should now be got well in hand. Plant out antirrhinums, pansies, holly-hocks, verbenas, petunias, &c., which were lately sown. Sow zinnias, amaranthus, balsam, chrysanthemum tricolour, marigold, cosmos, cockscombs, phloxes, sweet peas, lupins, &c. Plant gladiolus, tuberoses, amaryllis, pancratium, ismene, crinums, belladonna, lily, and other bulbs. Put away dahlia roots in some warm, moist spot, where they will start gently and be ready for planting out in August and September.

Orchard Notes for July.

THE COASTAL DISTRICTS.

The marketing of citrus fruits will continue to occupy the attention of growers. The same care in the handling, grading, and packing of the fruit that has been so strongly insisted upon in these monthly notes must be continued if satisfactory returns are to be expected. Despite the advice that has been given over and over again, some growers still fail to grasp the importance of placing their fruit on the market in the best possible condition, and persist in marketing it ungraded; good, blemished, and inferior fruit being met with in the same case. This, to say the least, is very bad business, and as some growers will not take the necessary trouble to grade and pack properly, there is only one thing to do, and that is to insist on the observance of standards of quality and see that the fruit offered for sale complies with the standards prescribed and that cases are marked accordingly.

Where the crop has been gathered, the trees may be given such winter pruning as may be necessary, such as the removal of broken or diseased limbs or branches, and the pruning of any superfluous wood from the centre of the tree. Where gumming of any kind is seen it should be at once attended to. If at the collar of the tree and attacking the main roots, the earth should be removed from around the trunk and main roots—all diseased wood, bark, and roots should be cut away, and the whole of the exposed parts painted with Bordeaux paste.

When treated do not fill in the soil around the main roots, but allow them to be exposed to the air for some time, as this tends to check any further gumming. When the gum is on the trunk or main limbs of the tree cut away all diseased bark and wood till a healthy growth is met with and cover the wounds with Bordeaux paste.

If the main limbs are infested with scale insects or attacked by any kind of moss, lichen, or fungus growth, they should be sprayed with lime sulphur.

Towards the end of the month all young trees should be carefully examined for the presence of elephant beetles, which, in addition to eating the leaves and young bark, lay their eggs in the fork of the tree. When the young hatch out they eat their way through to the wood and then work between the wood and the bark, eventually ringbarking one or more of the main limbs, or even the trunk. A dressing of strong lime sulphur to the trunk and fork of the tree, if applied before the beetles lay their eggs, will act as a preventive. In the warmer localities a careful watch should also be kept for the first appearance of any sucking bugs, and to destroy any that may be found. If this is done systematically by all growers the damage done by this pest will be very much reduced.

Citrus trees may be planted throughout the month. Take care to see that the work is done in accordance with the instructions given in the June notes. All worn-out trees should be taken out, provided the root system is too far gone to be renovated, but when the root system is still good the top of the tree should be removed till sound, healthy wood is met with, and the portion left should be painted with a strong solution of lime sulphur. If this is done the tree will make a clean, healthy growth in spring.

The inclusion of a wide range of varieties in citrus orchards—and which has been the general practice—is to be deprecated. Even in new plantations there is a tendency to follow the same unprofitable lines. Far too much consideration is given to the vendor's description or the purchaser's appreciation of a particular variety or varieties. Individual tastes must be subordinated to market requirements, and the selection of varieties to the best available kind of early, medium, and late fruits. Amongst oranges Joppa should be placed first, Sabina for early fruit, and Valencia or Loon Giru Gong for late markets.

In mandarins local conditions influence several varieties, and since the introduction of the fungus known as "scab" the inclusion, particularly on volcanic soil, of the Glen Retreat and Emperor types is risky. In alluvial lands, Emperor and Sovereign (an improved Glen Retreat) are the most profitable, though Scarlet in many places is worth including, with King of Siam as a late fruit. This commanded the highest price realised for mandarins last season.

Land intended for bananas and pineapples may be got ready, and existing plantations should be kept in a well-cultivated condition so as to retain moisture in the soil.

Bananas intended for Southern markets may be allowed to become fully developed, but not coloured, as they carry well during the colder months of the year, unless they meet with a very cold spell when passing through the New England district of New South Wales.

The winter crop of smoothleaf pines will commence to ripen towards the end of the month, and when free from blackheart (the result of a cold winter) or from fruitlet core rot, they are good for canning, as they are of firm texture and stand handling. Where there is any danger of frost or even of cold winds, it pays to cover pines and also the bunches of bananas. Bush hay is used for the former, and sacking for the latter.

Strawberries should be plentiful during the month, provided the weather is suitable to their development, but if there is an insufficient rainfall, then irrigation is required to produce a crop. Strawberries, like all other fruits, pay well for careful handling, grading, and packing, well-packed boxes always realising a much higher price than indifferently packed ones on the local market. Where strawberries show signs of leaf blight or mildew, spray with Bordeaux mixture for the former and with sulphide of soda for the latter.

When custard apples fail to ripen when gathered, try the effect of placing them in the banana-ripening rooms, and they will soon soften instead of turning black.

THE GRANITE BELT, SOUTHERN AND CENTRAL TABLELANDS.

July is a busy month for the growers of deciduous fruits, as the important work of winter pruning should, if possible, be completed before the end of the month, so as to give plenty of time for spraying and getting the orchard into proper trim before spring growth starts.

In pruning, follow the advice given in the June number; and if you are not thoroughly conversant with the work, get the advice of one or other of the Departmental officers stationed in the district.

Pruning is one of the most important orchard operations, as the following and succeeding seasons' crops depend very largely on the manner in which it is carried out. It regulates the growth as well as the number and size of the fruit, as if too much bearing wood is left, there is a chance of the tree setting many more fruits than it can properly mature, with a result that unless it is rigorously thinned out, it is undersized and unsaleable. On the other hand, it is not advisable to unduly reduce the quantity of bearing wood, or a small crop of overgrown fruit may be the result.

Apples, pears, and European varieties of plums produce their fruits on spurs that are formed on wood of two-years' growth or more; apricots and Japanese plums on new growth, and on spurs; but peaches and nectarines always on wood of the previous season's growth. Once peachwood has fruited it will not produce any more from the same season's wood, though it may develop spurs having a new growth or new laterals which will produce fruit.

The pruning of the peaches and nectarines, therefore, necessitates the leaving of sufficient new wood on the tree each season to carry a full crop, as well as the leaving of buds from which to grow new wood for the succeeding year's crop. In other words, one not only prunes for the immediately succeeding crop, but also for that of the following season.

All prunings should be gathered and burnt, as any disease that may be on the wood is thoroughly destroyed. When pruned, the trees are ready for their winter spraying with lime-sulphur.

All kinds of deciduous trees may be planted during the month provided the ground is in a proper state to plant them. If not, it is better to delay planting until August, and carry out the necessary work in the interval. The preparation of new land for planting may be continued, although it is somewhat late in the season, as new land is always the better for being given a chance to mellow and sweeten before being planted. Do not prune vines yet on the Granite Belt; they can, however, be pruned on the Downs and in the western districts.

Trees of all kinds, including citrus, can also be planted in suitable situations on the Downs and western districts, and the pruning of deciduous trees should be concluded there. If the winter has been very dry, and the soil is badly in need of moisture, all orchards in the western districts, after being pruned and ploughed, should receive a thorough irrigation (where water is available) about the end of the month, so as to provide moisture for the use of the trees when they start growth. Irrigation should be followed by a thorough cultivation of the land to conserve the water so applied. As frequently mentioned in these notes, irrigation and cultivation must go hand in hand if the best results are to be obtained, especially in our hot and dry districts.

ASTRONOMICAL DATA FOR QUEENSLAND.

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

TIMES OF SUNRISE, SUNSET, AND MOONRISE.

AT WARWICK.

1925.	MAY.		JUNE.		MOONRISE. MAY.	JUNE.
Date.	Rises.	Sets.	Rises.	Sets.	Rises.	Rises.
					p.m.	p.m.
1	6·18	5·20	6·36	5·3	12·45	1·16
2	6·18	5·19	6·36	5·3	1 25	1·50
3	6·19	5·18	6·37	5·3	2 5	2·28
4	6·20	5·17	6 37	5·3	2 42	3·9
5	6·21	5·17	6·38	5·2	3·17	3 53
6	6·22	5·16	6·38	5·2	3·55	4·41
7	6·22	5·16	6·39	5·2	4·34	5·33
8	6·23	5·15	6·39	5·2	5·16	6·32
9	6·23	5·14	6·40	5·2	6·2	7·36
10	6·24	5·14	6·40	5·2	6·53	8·42
11	6·25	5·13	6·41	5·2	7·47	9·48
12	6·25	5·13	6·41	5·2	8·48	10·50
13	6·26	5·12	6·42	5·2	9·52	11·51
14	6·26	5 12	6·42	5·2	10·55	...
					a.m.	a.m.
15	6·27	5·11	6·42	5·3	11·58	12·50
16	6·27	5·10	6·42	5·3	a.m.	1·45
17	6·28	5·10	6·42	5·3	12·58	2·42
18	6·28	5·9	6·43	5·3	1·56	3·37
19	6·29	5·9	6·43	5·4	2·53	4·30
20	6·29	5·8	6·43	5·4	3·49	5·25
21	6·30	5·8	6·43	5·4	4·45	6·17
22	6·31	5·7	6·43	5·4	5·41	7·8
23	6·31	5·7	6·43	5·4	6·35	7 56
24	6·32	5·6	6·44	5·4	7 30	8·42
25	6·32	5·6	6·44	5·4	8·21	9·23
26	6·33	5·5	6·44	5 5	9·12	10·2
27	6·33	5·5	6·44	5 5	10·0	10 39
28	6·34	5·4	6·44	5·5	10·43	11·15
29	6·34	5·4	6·44	5·5	11·23	11.49
					p.m.	p.m.
30	6·35	5·3	6·44	5·6	12·2	12·26
31	6·35	5·3	...	...	12·4	...

Phases of the Moon, Occultations, &c.

The times stated are for Queensland, New South Wales, Victoria, and Tasmania.

1 May	☾	First Quarter	1 20 p.m.
8 ,,	○	Full Moon	11 43 p.m.
15 ,,	☽	Last Quarter	3 46 p.m.
23 ,,	●	New Moon	1 48 a.m.
31 ,,	☾	First Quarter	6 4 a.m.

Perigee, 11th May at 11 48 p.m.
Apogee, 27th ,, at 7 30 a.m.

THE PLANETS.

Mercury will be at its greatest elongation west of the sun at 9 p.m. on the 16th May, and will therefore be visible in the early mornings in the North Eastern sky.

Venus will be apparently too near the sun to be noticeable during this month.

Both Mars and Neptune will be in conjunction with the moon before the end of the month, but in such positions with regard to the sun as to be practically unobservable.

Jupiter will be stationary on the 11th May at 4 a.m., after which it will apparently move westwards amongst the stars of Sagittarius, till 10th September. On the 13th Jupiter will seem to be very near the moon soon after sunset in the N.W.

Saturn will be in opposition to the sun and at its nearest distance from the earth, about 750 millions of miles, on 1st May. On 8th May it will be in conjunction with the moon about 11 a.m. when it will be two and a half degrees to the southward. When the moon rises it will have advanced about three degrees further east, and the apparent distance between the planet and the moon will be slightly increased.

7 June	○	Full Moon	7 48 a.m.
13 ,,	☽	Last Quarter	10 44 p.m.
21 ,,	●	New Moon	4 17 p.m.
29 ,,	☾	First Quarter	7 43 p.m.

Perigee, 8th June at 1 54 p.m.
Apogee, 23rd ,, at 6 24 p.m.

THE PLANETS.

The Australian Waiter Solstice will occur on the 22nd June when the sun will reach its greatest Northern latitude, and the shortest day will occur. It will be interesting to notice at what points on the horizon it will rise and set.

Mercury will be in superior conjunction with the sun on the 20th June, that is, on the farthest side of its orbit beyond the sun, and therefore invisible for a week or two.

Venus will be still apparently too near the sun to be noticeable.

Mars is getting still lower towards the Western horizon soon after sunset, and becoming less and less noticeable. It will be in conjunction with the moon on the 24th. Jupiter will be in conjunction with the moon on the 9th at 5 p.m., and the two will therefore present an interesting spectacle soon after the moon rises, especially after 8 p.m.

Saturn will be in conjunction with the moon on the 4th at 5.49 p.m., when both will be well above the Eastern horizon.

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 somewhere 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.