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Security in Broad Acres.

LAND values are increasing remarkably in Britain. Agricultural land particularly is going up in value because of the demand for increased food production. Some calculations show that farm land has increased in value by 10 per cent. since the war started. In some districts, farms are said to be practically unobtainable. This is the result, of course, of investors coming into the market to speculate, but deep down in the national consciousness, no doubt, is the feeling that in days of stress and social change there is no better security than broad acres. After all, the very basis of our national existence rests on the land. The land is a lasting asset, and there is no finer or more useful citizen than the farmer who intelligently works it.

The Valuation of Land.

ALTHOUGH the buying of a farm may be one of the most important events in a man's life, it is remarkable how few give full consideration to all the factors affecting the venture and the value of the land to be acquired. Generally, apart from soil fertility and suitability, it is the neighbourhood and local community services which determine the level of land values, and that is the reason why land valuators are usually influenced in their valuations by prices previously obtained for land in a locality.

Factors and circumstances which influence values are, however, very involved. The main factors to which the intending buyer, as well as the valuator, should give attention are:—The average net income

which may reasonably be expected from a well-worked property from year to year. This is, admittedly, not easy, but it can be estimated by working out the probable average yields from the principal crops after allowing for seasonal and pest risks. Carrying capacity, cost of labour, prices of machinery and implements, transport, roads, accessibility, distance from railway, cream and service car routes should all be considered carefully. An estimation of the probable trend in prices of the main products of the farm also is warranted. No matter how difficult it is to form such an estimate, by attempting it a farmer will appreciate more fully the uncertainty of the factors to be considered when buying land. It also will help him to avoid the mistake of paying too much for land during a period of peak prices for the crops he plans to grow. When times are prosperous, there is always that optimistic feeling that prices will remain at the high level prevailing or rise even higher. By thinking hard over all these points, the buyer should be able to form a fair idea of the average annual returns to be expected from the property under offer. The probable net income is, as a rule, the basis of the value of a farm.

Health conditions and social amenities of a locality in which it is proposed to settle also are matters of prime importance to a prospective farm purchaser. Other contributory factors to be taken into consideration before a final valuation can be arrived at are the improvements and their condition and the cost of repairs, replacements, and of any further improvements necessary to obtain or maintain the estimated net annual income to be derived from the farm. The important fact that should not be overlooked is that there is no such thing as a fixed or an absolute value of land. Finally, a buyer should bear in mind that provision should be made for redemption of his capital outlay.

To try to reduce land valuation to an exact science, however, is "to pursue the uncatchable and to define the indefinable." To put the position accurately, land valuation cannot be made a certainty, but, on the other hand, it is no mere guess. At its best it is a careful estimate by an expert who applies to his work certain recognised principles. Regarded generally, the value of land is that given to it by the community. With country or farming land, the chief point is productivity. Productivity would be quite a sound basis if prices of products remained stationary; if drought, grasshoppers, and other plagues would take the same percentage of profit every year; and if it were certain that the profit actually earned was the highest that could be got out of the land. Actually, the value of a property is what a buyer would pay for it as it stands, including land, buildings, fences and cultivation; in short, everything except livestock, furniture, implements, and other movables.

On Buying a Property.

IN buying a farm ordinary prudence should, of course, govern the business. The first thing to do is to study the conditions in every district where the class of farming in which it is proposed to engage predominates. In every country centre there are reputable and reliable agents who possess a fund of local knowledge, and who are ready to assist anyone looking for land with sound information.

Having decided tentatively on a location, it would be wise to investigate every local circumstance on which successful farming is based—the climate, rainfall, soil, class of crops grown, productivity, suitability for other crops, and so forth. In fact, no condition likely to influence profitability should be overlooked.

Railway returns of inward and outward consignments and butter factory payments may be accepted as indexes of local prosperity. There are many other obvious ways of assessing the value of any farming property under offer and which are sure to be dictated by caution and commonsense. In matters of business, however, we should not forget that we still live in a hard, cold, covetous, unrelenting world, and when it comes to selling land, like selling a horse, not everyone of us can keep within the bounds of grace, piety and good works, wherein sin and subsequent penitence have no place. What has been said about buying a farm applies, more or less, to leasing or renting a property. In share farming, in which the personal equation is so important, other obvious factors have to be considered. In all business matters, however, when it comes to a hard and fast bargain it is well to remember the old maxim—the man who is his own lawyer has a fool for a client.

As for farming partnerships, it is wise to walk warily. Temperamental differences between farming partners have wrecked many a promising enterprise. The only real farming partnership that is known to endure is that found in the bond of matrimony—as distinct, of course, from matrimonial bondage.

The Empire and Trade.

ONE of the essential factors in winning the war is the maintenance of British overseas trade, both for its war value in providing purchasing power abroad, and also for its permanent and necessary contribution to national life and prosperity. Every man mobilised for war is immobilised for industry. Every industry mobilised for war is immobilised from the self-supporting enterprises which maintain the flow of trade and create the national wealth on which the enterprises which are not self-sustaining must draw. Great as are the resources of the Empire they are not so great that we can disregard any means, great or small, which contribute to those resources. And every organised effort should be made in Australia and every other Dominion towards the development of greater trade with Britain and among themselves. It is most important to keep the wheels of industry revolving and money circulating, unless much that makes life worth while may come to an end.

Britain, like the Commonwealth, has set a policy against profiteering, in order, chiefly, as a matter of fair dealing, but also to avoid inflation and to foster trade.

The very existence of the nation is rooted in the land industries, and it is regarded as a first principle in Empire policy that the provider of food, clothing, and shelter—that is the primary producer—should be ensured a reasonable price for essential commodities, a price providing a reasonable margin over cost of production.

When the War is Over.

FOR farmers and graziers it is not out of place to give consideration now to post-war problems of production and distribution which must inevitably arise. Already producers' organisations in Queensland are making commendable moves in this matter. As a matter of fact, it is of paramount importance to the land industries.

War production comes first, of course, but it is easy to visualise post-war problems which will, unfortunately, dwarf those which we face to-day. Obviously, we must be prepared for them.

Parasites of the Horse.

F. H. S. ROBERTS, D.Sc., Animal Health Station, Yeerongpilly.

ALL domestic animals harbour parasites, but in no case are they seen in such large numbers as in the horse. Numerous bots and roundworms are commonly found in the stomach. The small intestine may contain some dozens of large roundworms and tapeworms, while the large intestine may simply teem with some thousands of worms, some lying free among the contents, and others strongly attached to the intestine wall.

One of the first effects of infestation by parasites is a lowering of the animal's vitality. It tires easily and is no longer able to do a normal day's work. A neglected animal loses condition and becomes weak, its coat is rough and staring, and it is subject to fits of colic and diarrhœa. Parasites are particularly damaging to young animals, causing unthriftiness and stunted growth. While the death rate from parasitic diseases is not high, a tremendous loss follows from poor development and stunting of the foals, inability to stand heavy work, increasing costs of feed and maintenance, and loss of working time through debility and colic.

The more important of these parasites occur in various organs and tissues within the horse. These are called internal parasites and include the worms and bots. Other parasites are found living on the surface of the body and are known as external parasites. Fleas, lice, ticks, and biting flies, for example, are external parasites.

INTERNAL PARASITES.

Worms.

Worms may be found in almost every organ and tissue of the horse's body, and nearly 200 different kinds of worms have been found in this host. Many of these are not known to occur in Australia, but, unfortunately, those that are here include nearly all the more serious forms.

How Infestation Occurs. (Plate 100.)

To appreciate the various measures of control recommended in this article the horseowner must understand how a horse becomes infested with worms. Worms are unable to breed and increase inside an animal, and infestation occurs only when the horse swallows worm eggs or larvæ which are present in the soil, water, or grass. The female worms in the horse lay eggs which eventually reach the exterior in the manure. From this point the life histories of the various species differ, but follow one of three main types—

(*a*) In the case of the large roundworm and pinworm, the egg continues to develop outside the horse, and eventually contains a tiny larval worm. Should such an egg be swallowed it hatches inside the horse and the larva is liberated to grow to maturity.

(*b*) The egg of other species, such as the red worms, hatches outside the horse and the tiny larva is liberated. The larva grows and eventually crawls up the grass blades and is swallowed as the animal grazes.

(*c*) Other worms such as the large stomach worms and tapeworms complete the life history only after the egg, passed as usual in the manure, is eaten by some small animal such as a fly, or possibly a mite. The small animal is known as the intermediate host. The larva reaches a certain stage of development in the intermediate host and then is ready to infect the horse.

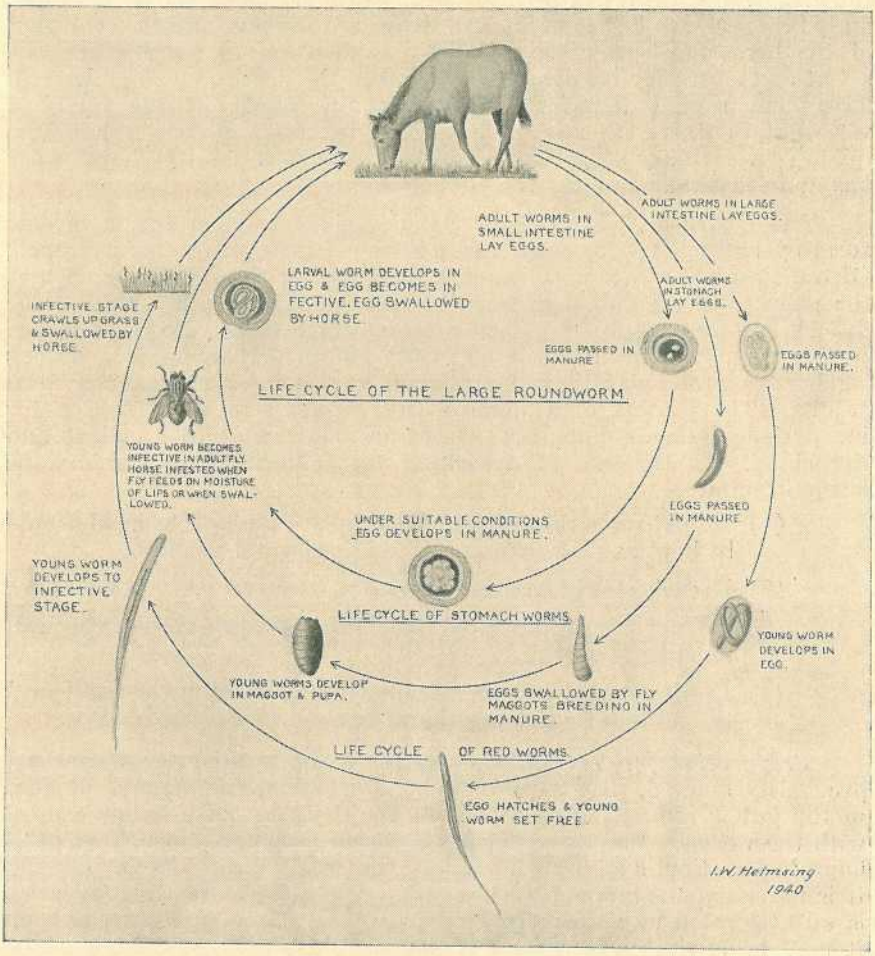


Plate 100.

How Horses Become Infested with Worms.

1. Manure not removed regularly.
2. Flies breeding in manure.
3. Food and water contaminated with manure.
4. Permanent pastures.
5. Swampy pastures.
6. Overstocking.
7. Young horses run in contaminated pastures.
8. Unsanitary stables and yards.

Control of Parasitic Worms.

The control of parasitic worms may be accomplished by a judicial combination of medicinal treatment and preventive measures.

Medicinal Treatment.—By medicinal treatment is inferred the use of certain drugs to kill and remove the worms from the horse's body.

Fortunately, this field has been given considerable attention and efficient remedies are available.

In selecting a drench for the horse several factors must be taken into consideration. The drug must be effective and it must be safe. Unfortunately, there is no single drug which is effective against every kind of worm, and in selecting a drug one must make certain which of the many kinds of worms present is the cause of the animal's condition, and is therefore to be removed. All drugs are poisons, and the condition of the horse must be given careful consideration in ascertaining the safest and most effective drug to employ and the dose to be administered. Treatment should therefore be left in the hands of the qualified veterinary surgeon as far as possible. In many districts, however, qualified veterinary surgeons are not available, and here the horseowner has no option than to treat the animals himself.

The drugs advised in this article may be given either (*a*) in capsule form by balling, (*b*) by means of a stomach tube, or (*c*) as a drench. Of these the use of a stomach tube is undoubtedly the safest. It ensures the passage of the full dose into the stomach without any risk of the drench entering the lungs. Carbontetrachloride should always be given in this way. A capsule breaking in the mouth or portion of a drench "going the wrong way" may be followed by serious and frequently fatal results. The passing of a stomach tube is not an easy operation for inexperienced hands, but most owners are conversant with balling and drenching. In the case of drenching the following points should be borne in mind:—

(1) Do not force the animal's head up too high. The head should be kept as near as possible to a horizontal position.

(2) Drench slowly and carefully.

(3) Do not continue should the horse struggle or cough; wait until he is quiet.

(4) Don't attempt to assist swallowing by holding the hand over the nostrils or tickling the throat.

Preparation for Treatment.—Horses to be treated for worms are previously starved. By a preliminary starvation, the amount of food in the gut is reduced and so permits the drug to make better contact with the worms. For the removal of worms from the stomach 18 to 24 hours' starvation is advisable, but for those worms in the large intestine it is necessary to starve up to 36 hours. This long period of starvation is well tolerated by animals in good condition. For debilitated animals it may be advisable to reduce it, but for best results against worms in the large bowel, the nearer the period of starvation to 36 hours the better. Water may be given during the pre-starvation period. It is also advisable to starve for a further 4 to 6 hours after treatment.

Preventive Measures.—Prevention of infestation is much more important in the control of parasitic diseases than medicinal treatment. While medicinal treatment may be depended upon to remove most of the worms and thus assist in promoting a return to good health, it is apparent that its value is considerably diminished if conditions are such that reinfestation can occur immediately afterwards. While medicinal treatment has its place in any well-considered plan of control, the use of drugs should be reduced to a minimum by employing preventive measures as much as possible. Prevention as it can be practised under

normal farm conditions does not keep an animal entirely free from worms, but it does assist in maintaining the number of worms at such a low level that they cease to be of any importance. To this end the following recommendations are made. These are based upon a knowledge of the life histories of the parasites and of the various factors which assist in the development and survival of the free-living stages in the soil, water, and grass.

(I.) Undoubtedly, the chief source of infestation is the manure in which the eggs are passed. If one can prevent contamination of the horse's food with manure and also dispose of it in such a way that intermediate hosts—such as flies—cannot breed in it and so spread infection, very little infestation would take place. Manure cannot, unfortunately, be collected at regular intervals from pastures, but stables and yards can be kept clean. Thorough cleansing of stables is possible only when they have suitable floors. The disposal of the manure may present a problem, but there are several ways it can be treated so that flies are prevented from breeding in it—

(*a*) The manure, as it is collected, may be taken at once to farm land and there spread out as thinly as possible. It thus dries very rapidly and is unsuitable as a breeding medium for flies. During wet weather, however, this method may not be highly effective. Such lands, of course, should not be used for horses.

(*b*) If it is to be stored, it may be beaten into compact heaps with shovels. The heat of fermentation inside the heap kills any larvæ or eggs that may be there. The outer layers of the heap should be turned into the heap at frequent intervals.

(*c*) For large stables various types of fly traps have been devised, and of these, the South African Baber's fly trap is favoured. This trap is composed of four compartments, each large enough to hold a week's manure. The floor of each compartment is of concrete sloping towards each side and surrounded by a gutter filled with a suitable poison. The outer edges of the gutter should overhang slightly to prevent maggots from escaping. The walls of the compartment are built of strongly erected wire netting. The manure is packed as tightly as possible into each enclosure. Fly maggots in the centre are killed by the heat of fermentation, while those on the outer layers eventually drop into the gutter and are poisoned. The manure is left in each compartment for three weeks, when it is no longer attractive to the flies.

Horse manure is the most favoured breeding medium of the common house fly which is a notorious carrier of many diseases such as typhoid fever, infantile diarrhœa, tuberculosis, anthrax, and many others. Too much emphasis cannot therefore be given to the proper disposal of manure.

(II.) Feed-boxes should be raised above the ground, and hay should be fed in racks and not thrown on the ground.

(III.) Bedding should be changed frequently.

(IV.) Good clean water should be provided in troughs. Horses should not be permitted to drink from shallow, stagnant pools.

(V.) Swampy pastures should be avoided.

(VI.) One of the greatest sources of infestation is the permanent pasture. The longer a pasture is in use the more heavily contaminated does it become. By spelling a pasture for three months or more, the longer the better, most of the larvæ there die out. Such pastures whilst being spelled may be grazed by cattle or sheep, as the larvæ from worms infesting horses cannot infest these animals and *vice versa.*

(VII.) Do not overstock. The more horses there are in any given area the more heavily contaminated does it become and the greater the chances of infestation.

(VIII.) Some benefit may be accomplished in the decontamination of a pasture by burning. This, however, is not by any means as effective as spelling.

(IX.) Young animals are much more susceptible to infestation than mature animals. Keep the mares as free as possible by medicinal treatment and by applying the above preventive measures, and transfer the mares and foals to a pasture which has been cleansed by spelling.

(X.) Feed an adequate well-balanced ration. Animals which are well fed are more resistant to infestation and its effects than animals on a poor ration.

DIAGNOSIS OF PARASITIC INFESTATION.

Much can be learnt of the degree of infestation by a microscopical examination of the manure. For this purpose, however, the manure must be comparatively fresh, not more than 18 hours old when examined. This factor, unfortunately, does not permit the majority of horseowners any opportunity of submitting samples to a laboratory for examination. In such cases diagnosis must depend, therefore, chiefly on the presence of symptoms. Frequently, some information may be secured by roughly examining the manure, in which large roundworms, redworms, pinworms, and tapeworm segments are passed. Owing to the fact that best results depend upon the use of the correct drug, great care should be taken in making a diagnosis. Symptoms of parasitic infestation are dealt with in detail as each species of worm is considered. As a general guide, however, the following table is appended:—

Name of Worm.	Diagnosis.
Stomach Worms ..	General debility with a history of stomach disorders.
Tapeworms	Digestive disorders; general unthriftiness; blood in manure; tapeworm segments in manure.
Large Roundworms ..	Young animals mainly; stunted growth; rough coat; colic; cough; worms in manure.
Redworms	Emaciation; weakness, rough coat; membrances of mouth and eyes pale or white; manure soft or diarrhœric and evil smelling; colic; sometimes swellings on legs and abdomen; worms in manure.
Pinworms	Anal irritation; tail rubbing; creamy masses around anus; worms in manure and protruding from anus.

TAPEWORMS.

Tapeworms are flat and elongate in shape. At the anterior end of the body is a tiny head which is furnished with four suckers. Behind the head are a number of segments, which become progressively broader towards the posterior end. One interesting feature about tapeworms is the entire absence of a mouth and intestine, the food being absorbed through the body.

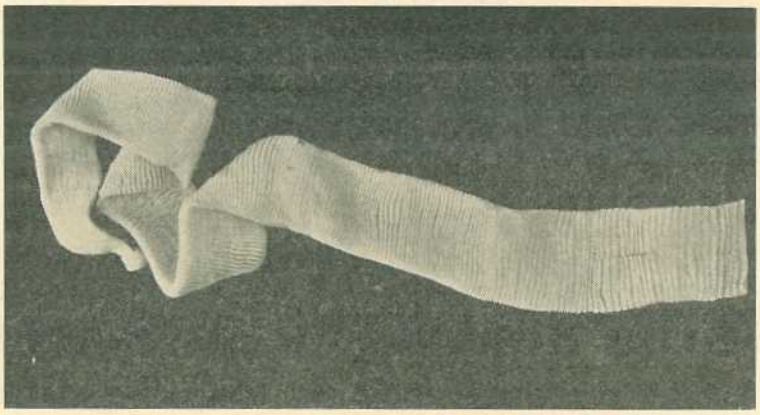


Plate 101.
The Large Tapeworm of the Horse (*Anoplocephala magna*). (Natural size.)

Tapeworms can complete their life-cycle only through the assistance of an intermediate host, such as an insect, a mite, or a slug. Each kind of tapeworm has its own special intermediate host or hosts .

Three different kinds of tapeworms are found in the horse. The largest and most common of these (*Anoplocephala magna*) (Plate 101) measures up to 30 inches in length and 1 inch in width. The smallest species (*Paranoplocephala mamillana*) measures ¼ inch to 2 inches in length; whilst the third species (*Anoplocephala perfoliata*) (Plate 102) is about 2 inches to 3 inches long. They are most frequently found in the small intestine, though *A. perfoliata* is of common occurrence in the large intestine also.

Their life history is unknown.

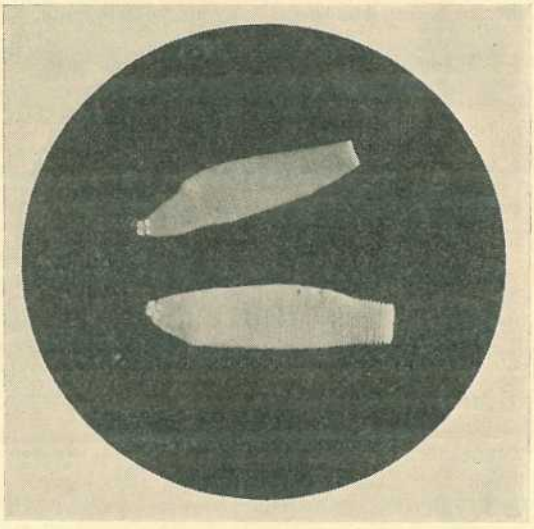


Plate 102.
The Lappetted Tapeworm of the Horse (*Anoplocephala perfoliata*).
(Natural size.)

Effect on the Horse.

Few tapeworms are of little consequence, but when the infestation is heavy they are said to cause general unthriftiness, rough coat, and digestive disorders. Probably the most important species is *A. perfoliata,* which is known to cause ulcers in the large intestine, wherever it attaches. The presence of this species may be suspected if the manure contains blood-stained mucous.

Treatment and Control.

Very little is known of treatment for tapeworms in horses, but the following alternatives are recommended. Starve twenty-four to thirty-six hours, then administer—

(1) 60 cubic centimetres of turpentine and 4 cubic centimetres of male fern extract in 2 pints raw linseed oil; or

(2) 30 grams kamala; or

(3) 30 to 45 grams freshly-ground areca nut; or

(4) 2 doses each of 3 drachms of tartar emetic in a gruel of linseed meal at an interval of twelve hours.

All the above doses are for a horse weighing about 1,000 lb. or more, and should be reduced accordingly for younger and lighter horses.

As the life histories of these tapeworms are unknown no special preventive measures can be recommended. Those measures already discussed should be carefully considered.

ROUNDWORMS.

Roundworms, as the name implies, are elongate, cylindrical worms; generally speaking, of the same shape as a pencil, though they taper at both extremeties. They are not segmented and are provided with a mouth and intestine. Most of them have a direct life-cycle—that is, infestation occurs by swallowing an egg or a larva, but some require an intermediate host, in much the same way as tapeworms.

THE LARGE STOMACH WORMS (*Habronema* spp.). (Plate 103.)

There are three speciees of large stomach worms—namely, *Habronema muscae, H. microstoma,* and *H. megastoma.* Both *H. muscae* and *H. microstoma* grow up to about an inch in length and are usually found lying along the stomach wall covered with a clear mucous. *H. megastoma* is only about half this size and occurs in nodules or tumours of varying sizes in the stomach wall.

Life History. (See Plate 100.)

These worms deposit eggs containing tiny larvæ in the stomach, which are eventually passed out in the manure. Before any further development can occur, the eggs must be swallowed by the maggots of certain species of flies which breed in horse manure. The larvæ are still present in the adult flies into which the maggots eventually transform. The larvæ then make their way into the proboscis or sucking organ of the flies, and when the flies feed on the moisture around the horse's mouth the larvæ break free from the proboscis into the mouth and are swallowed. Reaching the horse's stomach they settle down and grow to maturity. The horse can also, of course, become infested should it swallow flies containing larvæ.

Both *H. muscae* and *H. megastoma* may be spread by a number of different flies which breed in manure. The most important of these is the common house fly, *Musca domestica,* though in the bush most of the infestation occurs through the agency of the bush fly, *Musca vetustissima.* The third species of stomach worm, *H. microstoma,* is carried by the stable fly, *Stomoxys calcitrans.* This is the common biting fly everyone is familiar with owing to its preference for the lower parts of the body, such as the legs and ankles.

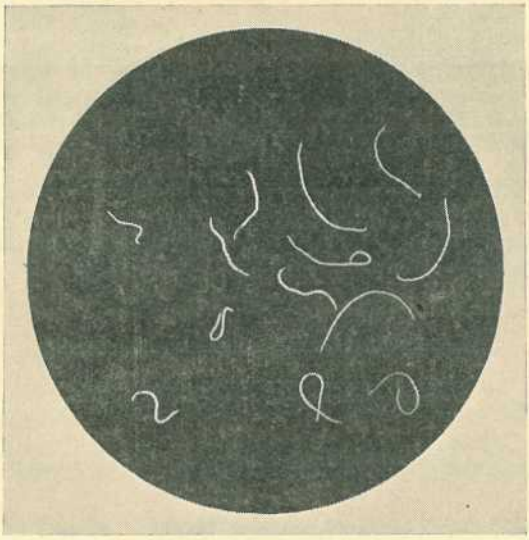


Plate 103.
Large Stomach Worms (*Habronema* spp.). (Natural size.)

Effect on the Horse.

The smallest species, *H. megastoma,* is the most serious, for it burrows into the stomach wall, destroys the gastric glands, and causes the formation of fibrous nodules. These nodules at times may be so numerous and so large as to interfere seriously with the passage of food. The other two species may, if sufficiently numerous, be responsible for severe irritation of the membrane lining the stomach.

The disease associated with these stomach worms is very common and very widespread. There do not appear to be any marked symptoms, but the continued interference with digestion ultimately leads to a general debilitated condition.

Should infested flies happen to feed on sores or moist places the larvæ are set free and burrow into the skin. As a result affected sores will not heal. In India, "summer sores" as they are called are extremely common and are regarded as serious. In Australia, growths in the corner of the eye and on the penis and sheath have been shown to have been brought about in this manner. "Swamp cancer" may be a similar condition.

Treatment and Control.

Owing to its location in nodules in the stomach wall there is no effective treatment for *H. megastoma.* The other two species, however, may be removed by treating with carbonbisulphide. The animal is

starved for from eighteen to twenty-four hours. The stomach is then washed out with 8 to 10 quarts of a 2 per cent. solution of sodium bicarbonate. This removes the mucous in which the worms lie. The bicarbonate solution may then be siphoned off, or fifteen to twenty minutes allowed to elapse before giving the carbonbisulphide. This is given at the rate of 6 cubic centimetres for every 250 lb. of weight.

Carbontetrachloride as used against redworms is also recommended.

Control is only possible providing the manure is so stored as to prevent flies breeding in it. In stables, horses may be protected from flies by screening or by using sprays, lures, or traps.

For horses running on pasture one would have to rely chiefly on treatment as a means of control. One treatment should be given during the winter as soon as the flies have disappeared, another in early summer, and a third in the autumn.

THE SMALL STOMACH WORM (*Trichostrongylus axei*).

This is a very small and slender hair-like worm, no more than about ¼ inch in length. It occurs in the membrane lining the stomach wall.

Life History.

Eggs laid by the female worms are passed in the manure, and under suitable conditions of temperature and moisture eventually hatch to give rise to tiny larvæ. These larvæ undergo further development and finally reach a stage when they are capable of infecting the horse when swallowed. On reaching the stomach they settle down and grow to maturity.

Effect on the Horse.

The small stomach worm has been found in horses in Australia only recently, so its importance here is as yet unknown. In other countries heavy infestations are said to injure the stomach wall, causing masses of small nodules or areas which resemble ringworm in appearance. Such injuries are responsible for digestive troubles, leading to weakness and wasting.

Treatment and Control.

The carbonbisulphide treatment recommended for the large stomach worms should be used here also. Infestation may be prevented by applying the general measures already discussed.

THE LARGE ROUNDWORM (*Ascaris equorum*). (Plate 104.)

This is a large conspicuous worm, yellowish-white in colour and attaining up to 12 inches in length. The anterior end of the worm, usually spoken of as the head, is provided with three lips and is marked off from the rest of the body by a constriction. This species is most frequently found in the anterior half of the small intestine.

Life History. (See Plate 100.)

The eggs laid by the female worms reach the exterior in the dung. Under favourable conditions of temperature and moisture a larval worm appears inside the egg in about fourteen days, and in this stage the egg is ready to infect the horse. When swallowed the egg hatches in the intestine, and the tiny larva that is set free immediately bores into the intestine wall, reaches the blood vessels, and is carried to the liver. From

the liver it is eventually taken to the lungs in the blood stream. After a certain period of development in the lungs, the larva then migrates into the trachea or windpipe, crawls up into the mouth, is swallowed, and reaches the small intestine again, where it settles down and grows to the adult stage.

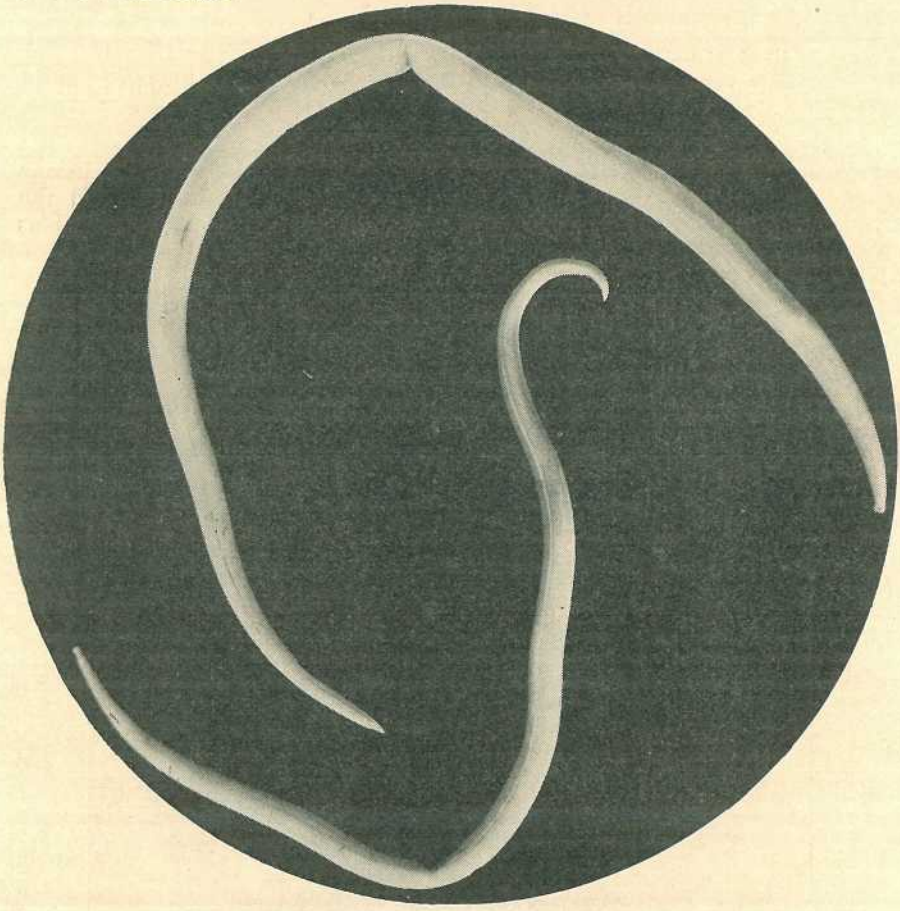


Plate 104.

The Large Roundworm (*Ascaris equorum*). (Natural size.)

Effect on the Horse.

The large roundworm is harmful chiefly to young animals, and heavy infestations may be responsible for general unthriftiness, stunted growth, rough coat, digestive troubles, and colic. These effects are due firstly to the damage caused to the liver and lungs by the migrating larvæ. Destruction of the lung tissue is particularly serious, as it may lead to pneumonia. The adult worms in the small intestine may be responsible for serious digestive troubles and sometimes by bunching together hinder the free passage of food. Cases are known of the intestine wall being ruptured as a result of this obstruction with fatal effects. Furthermore, the waste products given off by the worms are absorbed into the body. These products are poisonous, and as a result serious illness and even death may follow.

Treatment and Control.

The animal is starved for from 18 to 24 hours and then given either one of the following treatments:—

(1) Carbonbisulphide at the rate of 6 cubic centimetres for every 250 pounds of weight.

(2) Carbontetrachloride at the rate of 25 cubic centimetres for every 500 pounds of weight, given in 1 to 2 pints of liquid paraffin.

Of these two treatments, carbonbisulphide is the more efficient. The eggs of this parasite are highly resistant to adverse conditions and capable of surviving for very long periods. Sanitation and the other principles of prevention already discussed should be enforced as strictly as possible.

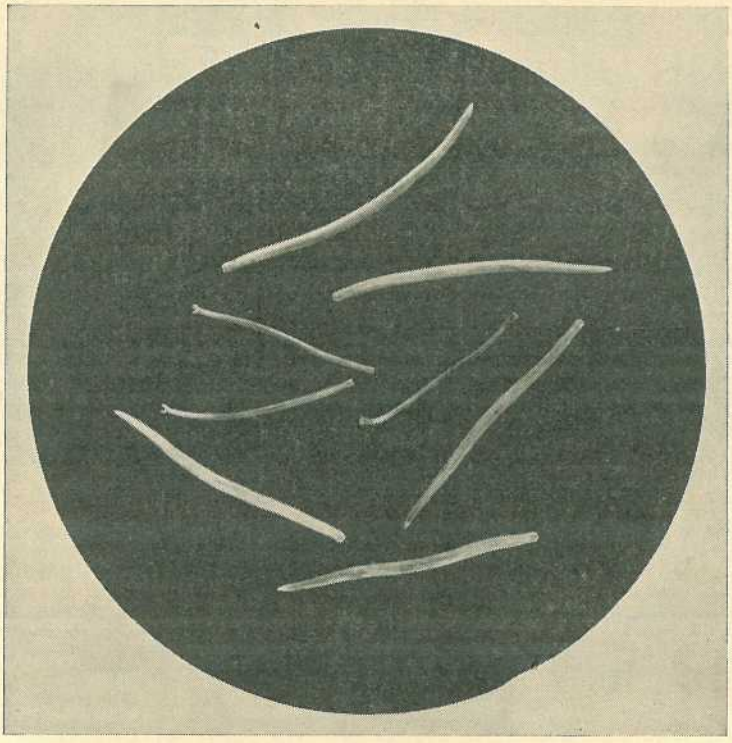


Plate 105.

REDWORMS (*Strongylus* spp.). (Natural size.)

RED WORMS (*Strongylus*). Plates 105 and 106.)

This name is given to a large number of different species of worms which are found in the large bowel and blind gut, many of which have a reddish colour. They vary in length from about half an inch to nearly 2 inches, and are the most common worms infesting the horse. The larger species (*Strongylus* spp.) (Plate 105) attach themselves firmly to the gut wall by means of their mouths, but the smaller worms (*Trichonema* spp. and others) (Plate 106) lie free in the gut contents.

Life History. (See Plate 100.)

The life history of all the species of red worms is only incompletely known. The initial stages, however, are similar for all. The eggs laid by the females pass out in the manure. If conditions of temperature and moisture are suitable, the eggs hatch in about a day. The larvæ that emerge undergo further development, and in about a week are ready to infest the horse. The infective larva, as it is called, is provided with an outer envelope or sheath which completely covers it and helps to protect it against such adverse conditions as dryness. These larvæ are capable of surviving for very long periods in a pasture, though the majority die in about three months. When the grass is wet with dew or rain, they are able to climb up the grass blades and are thus swallowed by the horse as it grazes. As might be expected, dull showery weather is particularly favourable to infestation.

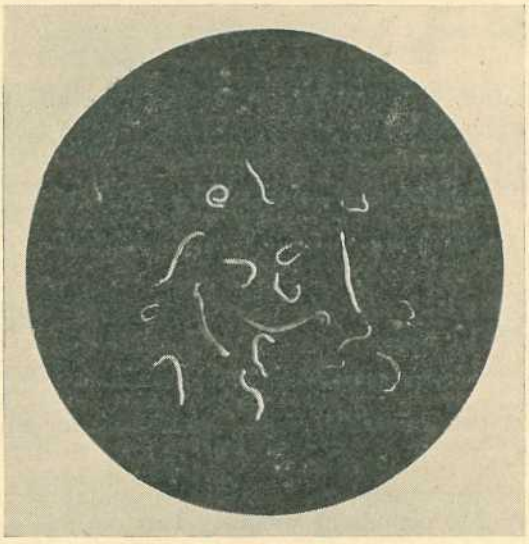


Plate 106.
Redworms (*Trichonemidae*). (Natural size.)

After the larva is swallowed by the horse, the course followed by it within the horse's body depends upon the species of worm to which it belongs. In the case of the large species of *Strongylus*, the larvæ apparently migrate through the body and so may be found in later stages of development in such places as the liver, lung, spleen, pancreas, mesentery, certain lymph glands, and in the walls of various blood vessels. They eventually return to the large bowel along an unknown route, where they settle down and mature.

The larvæ of the smaller worms, on the other hand, burrow into the wall of the large bowel. They remain here for some time, eventually returning into the bowel and grow to the adult stage.

Effect on the Horse.

Redworm disease or strongylosis is probably the most common and most serious of all parasitic diseases affecting the horse, and is especially injurious to young animals. It is particularly prevalent in the coastal districts of this State.

The adults of the large species feed on the gut wall, causing serious injury. These worms suck blood and the injured gut wall may be attacked by bacteria. Some species cause the formation of ulcers. The loss of blood, in the case of a heavy infestation, is considerable, and as a result anaemia is a prominent symptom. In such instances, the mucous membranes of the eyes and mouth lose their healthy pink colour and are bleached white. The animal becomes very weak and swellings may be evident on the lower parts of the body. There is also extensive damage to the liver and other organs into which the larvæ may wander.

The larvæ of the smaller species when they burrow into the gut wall cause the formation of nodules. The presence of nodules and the accompanying damage to the gut lining brought about by the larger worms leads to serious digestive disorders. The manure becomes soft and evil smelling, and later diarrhœa becomes conspicuous. The appetite is diminished and in advanced cases may become depraved. As a result the animal loses condition rapidly and becomes very weak. The coat is rough and a pitiful, dull, dejected appearance is presented.

The larvæ of one species invade the walls of certain arteries, causing their walls to enlarge to such an extent that the flow of blood is interfered with. One of the favoured sites of these larvæ is in the walls of the artery supplying blood to the large bowel. As a result of the decreased blood supply, the large bowel becomes weakened and flabby and attacks of colic may be prevalent.

Long before any of the above symptoms become prominent, a heavy infestation may be suspected in any animal which shows a decreased capacity for work.

Treatment and Control.

The animal to be treated should be starved for up to 36 hours. It may then be given either one of the following treatments:—

(1) Oil of chenopodium at a dose rate of 4 cubic centimetres for every 250 pounds of weighs. This drug is given in 1 to 2 pints of raw linseed oil. Large doses of raw linseed oil cause superpurgation in some horses. This may be overcome by using equal parts of linseed oil and liquid paraffin. When employing oil of chenopodium, if the bowels have not moved within 24 hours, another dose of oil should be given. Oil of chenopodium should not be used for pregnant mares.

(2) Carbontetrachloride at a dose rate of 25 cubic centimetres for every 500 pounds of weight in 1 to 2 pints of liquid paraffin.

Animals which have been treated should be well fed for some few weeks afterwards until recovery is complete. It is advisable to mix ferrous sulphate with the feed at the rate of 2 grams daily in order to assist the animal to recover from the loss of blood.

While the above treatments may be depended upon to remove most of the worms from the large bowel, they have no effect upon the larvæ wandering in the body. A second treatment about three months later is then necessary in order to remove these worms after they have returned to the large bowel.

In areas of high rainfall, such as the coastal areas of Queensland, four treatments a year are recommended, in January, April, July, and October.

The preventive measures discussed earlier in this article if carried out will do much to keep the infestations small and obviate the necessity for frequent treatments.

Plate 107.

Pinworms (*Oxyuris equi*). (Natural size.)

PIN WORMS (*Oxyuris equi*). (Plate 107.)

These worms are a very common parasite of horses. They occur in the large bowel. The males and young females are whitish in colour. The female may be recognised by the pointed tail. Older mature females are greyish or brownish in colour and measure up to 6 inches in length, three-quarters of the body being occupied by a long narrow tail.

Life History.

When the female is mature, she wanders down the intestine and usually deposits her eggs in creamy-coloured clusters around the horse's anus. Sometimes she passes right out in the manure and lays her eggs there. A tiny larva develops inside the egg, but the egg does not hatch until swallowed by the horse. The larva, on being set free, then makes its way into the large bowel and grows to maturity.

Effect on the Horse.

The most noticeable symptom of pinworm infestation is the irritation caused by the female when she is depositing her eggs around

the anus. The horse attempts to relieve the irritation by rubbing the base of the tail against any convenient object. It is also claimed that pinworms may be responsible for digestive disturbances.

Treatment and Control.

Treatment for pinworms involves the following steps:—

(1) An enema of strong quassia infusion to remove the mature females from the lower part of the bowel.

(2) The use of mercuric or carbolic ointment around the anus after washing away the egg clusters to relieve the irritation.

(3) A dose of oil of chenopodium as for redworms to remove the pinworms from the anterior portion of the large bowel.

The preventive measures already discussed should be enforced as much as possible.

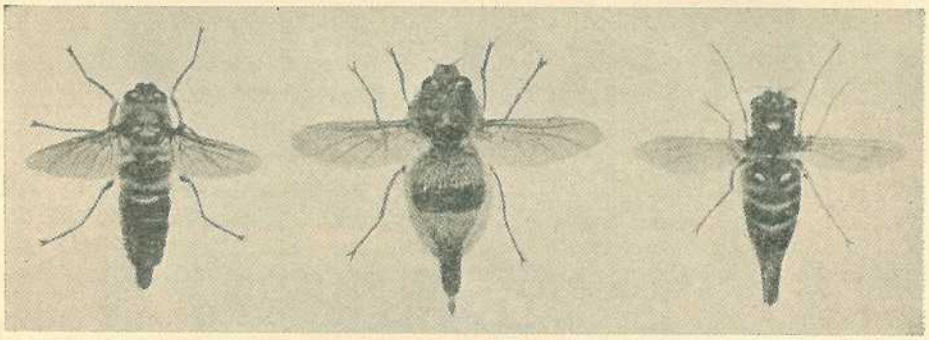


Plate 108.

ADULT BOTFLIES.—(*a*) The Common Botfly. (*b*) The Throat Botfly. (*c*) The Nose Botfly. (After Hadwen and Cameron.)

BOTFLIES AND BOTS.

There are three species of botflies known to attack the horse, the common botfly, *Gastrophilus intestinalis*, the throat botfly, *Gastrophilus nasalis*, and the nose botfly, *Gastrophilus haemorrhoidalis*.

The adults are all two-winged insects, bee-like in appearance, each species differing somewhat in colour markings, size and habits. The common botfly (Plate 108 (*a*)) is a brownish-grey species with mottled wings and a white face. The female deposits her eggs on the hairs of the mane, chest, shoulders, and legs, most usually on the long hairs of the forelegs, inside and below the knee. During egg-laying the female hovers around the animal, curving the abdomen beneath the body in order to facilitate the deposition of the eggs, each of which is laid and fastened to the hair in about a second. The position of the abdomen at the time of egg-laying has given the impression that the fly stings the horse, but this is erroneous. This species is apparently confined to Southern Queensland and is seen on the wing during the late summer and autumn.

The throat botfly (Plate 108 (*b*)) is somewhat smaller than the common botfly and has a reddish thorax and a prominent black band across the abdomen. The wings are clear. The eggs are deposited by the female on the hairs under the jaws. The female fly is usually seen

hovering near or between the forelegs of the horse and then quickly darting at the throat to lay her eggs. One to four eggs may be laid at the one time, each attached singly to the hairs. The presence of this fly causes the animal to nod its head violently and sometimes to strike with the forelegs. This fly has a wide distribution throughout the State and is most prevalent during the late spring and early summer.

The nose botfly (Plate 108 (*c*)) is the smallest of the species under discussion, and chooses the hairs of the lips for egg-laying, particularly those hairs on the edge of the lip which are moistened by the saliva. The flight of the fly is very rapid, the insect darting at the lips to deposit a single egg and then withdrawing for a few seconds to repeat the process.

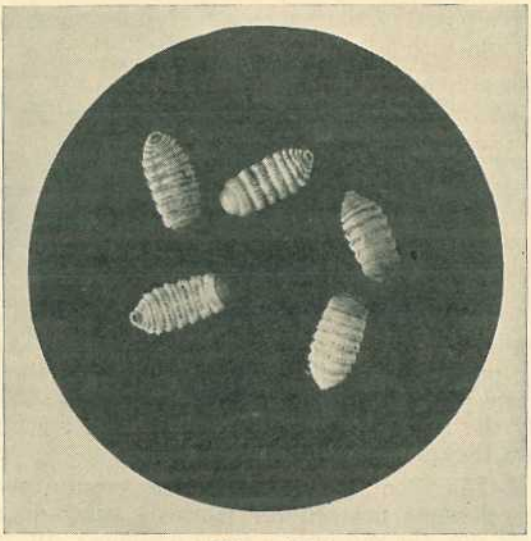


Plate 109.
Bots. (Natural size.)

Of these three species the throat botfly is most frequently seen in Queensland. The common botfly is not uncommon, but the nose botfly is regarded as being rare, if present at all.

As the mouth parts of the adult flies are rudimentary they cannot feed and are therefore comparatively short-lived. The common botfly has been known to live as long as twenty-one days, but the average life is not thought to extend much beyond a week. The two other species live only about three to twelve days, the throat botfly surviving the longer period.

Life History.

The Egg.—The eggs of these three botflies are glued to the hairs of the horse and differ considerably in shape, colour, and manner of attachment. The egg of the common botfly is yellowish in colour and is attached to the hair for about one-third of its length, the free portion of the egg forming an angle with the hair. Frequently more than one egg may be attached to a single hair, especially if the hair is long. The eggs do not hatch until they are rubbed or licked by the horse. The minute, spiny maggots are ready to hatch in about seven days, though they may remain unhatched and alive for months.

The eggs of the throat botfly are slightly different in shape to those of the common botfly and are fastened to the hair for about two-thirds of their length. These eggs do not require friction to cause hatching, which takes place normally.

The eggs of the nose botfly are black and stalked, the stalk being corkscrew-like and continued to the follicle from which the hair arises. Here, again, hatching does not require friction; the eggs nearest the moist edges of the lips hatch first, usually in five to six days, while those an inch away may take as long as eighteen days, and those some distance from the lips may not hatch at all.

The Larva or "Bot" (Plate 109).—On hatching, the larvæ of all species enter the mouth. They then bore their way beneath the membrane lining of the mouth and of the tongue, where they remain for some time, and eventually make their way to the stomach.

Once in the stomach, the larvæ or bots attach themselves to the wall by means of a pair of strong mouth hooks. The common bots are reddish in colour and are found attached to the white covering of the left sac and along the ridge between the right and left sacs. The larvæ of the throat botfly occur most usually near the pyloric or exit end of the stomach and in that portion of the intestine leading out of it. Those of the nose botfly may occur attached to various parts of the stomach, but are more usually located near the pyloric end. Bots are all provided with rows of spines on the anterior border of the majority of the segments, the number and arrangement of the spines differing in each species. After living in the stomach for about eight to twelve months they are fully grown and are passed out with the dung. Those of the common botfly and throat botfly pass out without any reattachment; but in the case of the nose botfly the larvæ fasten themselves to the rectum and again to the anus before they finally reach the ground.

The Pupa.—As soon as they reach the ground the bots at once commence to seek some protection. However, they do not crawl very far, and burrow into the soil only a short distance. In one to four days the outer skin hardens and forms a protective coat, known as the puparium, inside which the transformation from the bot to the adult fly takes place. The puparium is brown to black in colour, but is otherwise similar to the bot. At the end of about three to ten weeks the transformation is complete, and the adult fly emerges.

Injuries Caused by Botflies.

Possibly the greatest damage among horses through botfly presence is self-inflicted. Extreme annoyance and worry is caused during egg-laying by the females, as the horse recognises its enemy and makes desperate efforts to protect itself.

The common botfly appears the least irritating of the three species, probably because of the varied situations in which its eggs are deposited. Even so, its presence keeps the animals in a continuous state of annoyance and prevents them from resting. The throat botfly causes the animal to throw its head about violently, and makes it difficult to manage in harness. The nose botfly appears to be the most annoying species, for the insect in depositing its eggs on the hairs of the lips causes a severely irritating tickling. The actions of horses while the insects are about are very characteristic. The throat botfly causes them to stand together with their heads over each other's back, and if the nose fly is about they protect their lips by placing them against each other's body.

Should the insects be numerous, and the protections abovementioned be inadequate, the animals keep up a continuous movement, occasionally breaking into a gallop, in attempts to prevent the insects alighting and laying eggs.

It is commonly considered that the bots in the stomach are of little importance. It should be remembered, however, that the larvæ are developing for from eight to twelve months in the horse's stomach, and during this period considerable harm may be done. The spiny armature and the large mouth hooks cause inflammation of those parts with which they may come into contact, which results in an interference with digestion. Large numbers of bots may bring about obstructions and seriously interfere with the passage of food. The nature of the food taken in by bots is not known, but they certainly live at the expense of the horse, and the pinkish hue of some of the larvæ suggests that they may be blood suckers. As a result of heavy infestations the horse may eventually become markedly debilitated.

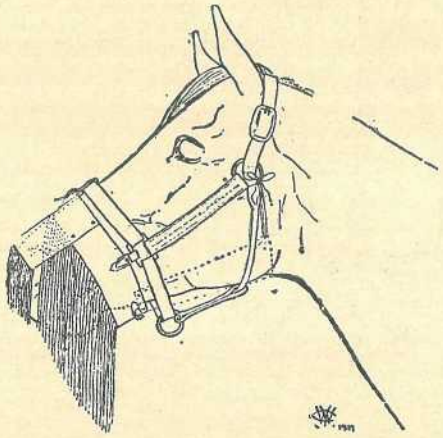


Plate 110.
Leather Nose-Fringe as Protection against the Nose Botfly.
(After Hadwen and Cameron.)

Protection and Treatment.

Various devices have been recommended for the protection of the horse against botfly attack. For the throat botfly a piece of ordinary canvas attached to the nose band and tied to the headstall will completely cover the region between the jaws. As protection against the nose botfly, the Canadian authorities recommend a leather band cut into thin strips and encircling the nose (Plate 110). In the United States good results have followed the use of a mouth guard constructed from ½-inch hardwood boards. For protection against the throat and nose flies it is recommended that the throat be covered by a piece of canvas which is attached in front to the wooden mouth protector (Plate 111). Furthermore, this combination device is said to prevent the animal from taking into the mouth the larvæ of the common botfly while attempting to bite or scratch itself. The hardwood guard completely protects the lips when the head is up, and the block beneath causes the guard to fall back when the head is lowered, and does not interfere in any way with the animal's grazing.

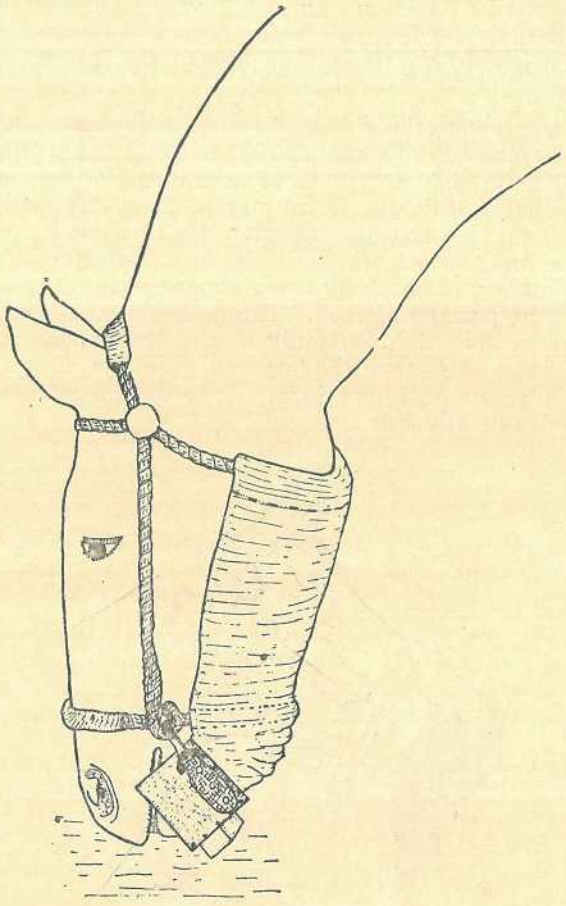


Plate 111.
DEVICE FOR PROTECTION AGAINST THE THROAT AND NOSE BOTFLIES.
(After Hadwen and Cameron.)

Another effective protector for use against the nose botfly when the horse is in harness consists of a piece of leather 4 to 6 inches wide attached at each side to the bit ring so that the entire lips are covered.

As the eggs of the common bot are not confined to any particular region of the horse, it is difficult to recommend any good means of protection. In other parts of the world the provision of deep sheds or brush shelters is said to give some protection, for when the flies are bad the animals may retire into the sheds, into the shady interior of which the flies will not venture.

Frequent grooming and clipping of the hairs of the areas on which eggs are laid will aid in control. The eggs of the common botfly may be destroyed simply by washing them with water heated to about 120° F. This treatment, however, is not effective against eggs of the throat botfly or nose botfly, and here it is necessary to use a 2 per cent. carbolic wash.

For the removal of the bots from the stomach, carbon bisulphide will be found very efficient. The animal should be fasted for from eighteen

to twenty-four hours before treatment. The drug is given in a capsule or by stomach tube, the dose rate being six cubic centimetres for every 250 lb. weight, horses of 1,000 lb. weight or more therefore requiring a dose of twenty-four cubic centimetres. No food or water should be given for three or four hours after treatment. For best results treatment should be given each year about June. At this time, egg-laying has ceased and the larvæ migrating in the tissues of the mouth have all reached the stomach. Before treatment it is wise to destroy any eggs which may not have hatched by the measures mentioned above.

EXTERNAL PARASITES.

The term external parasites includes all those parasites which live and obtain their food on the body surface. The term is a very broad one, and takes into consideration not only those forms which live permanently on the skin, such as lice and mange mites, but also many others, such as the mosquitoes, march flies, and sandflies, which visit the animal only when they require food.

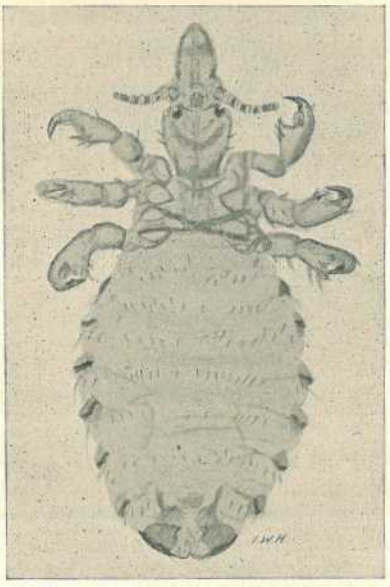


Plate 112.
Haematopinus asini × 24.

External parasites are capable of causing harm in many ways. They pester and irritate their hosts, permitting it to neither feed nor rest sufficiently for normal growth. Some species are capable of abstracting considerable amounts of blood, and many of them, particularly those species which feed on blood, transmit serious diseases.

Horses in Queensland act as hosts to many different kinds of external parasites. Mosquitoes, sandflies, march flies, and stable flies all extract their toll, but, in general, are not as serious as the more permanent forms, such as the lice and mange mites.

LICE.

Three different kinds of lice are found on the horse. The largest species is the sucking louse, *Hæmatopinus asini* (Plate 112). This louse is yellowish-brown in colour, and measures about $\frac{1}{8}$ in. in length. The head is long and narrow and terminates in a blunt point. Sucking lice live on blood and other body fluids, which they obtain by piercing the skin with their mouthparts. The other two species of lice are biting lice. They are very similar in appearance to each other, each having a broad flat head only slightly longer than broad and semi-circular in front. Their technical names are *Bovicola equi* (Plate 113) and *Bovicola pilosus*. These biting lice live on scales, scurf, and other débris on the animal's skin. Sucking lice are most common on the neck, flanks, and under the jaw, while biting lice prefer the regions at the roots of the mane and butt of the tail. In heavy infestations, lice may occur anywhere on the body.

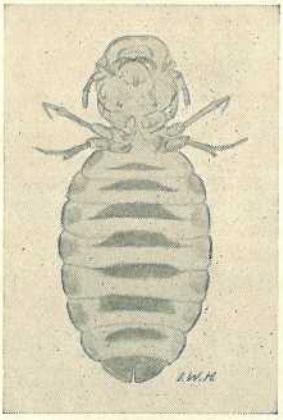


Plate 113.
Bovicola equi × 24.

Life History.

The life histories of all lice follow the same general lines, and differ only in detail. The female louse lays eggs which she attaches by means of a sticky secretion to the hairs of the animal's coat. The eggs hatch in time, and from each of them emerges a tiny louse which differs from its parents chiefly in size. These tiny lice gradually grow, passing through different stages of growth, each of which is preceded by a moult or casting of the skin, until they reach the adult stage.

The eggs of the sucking louse of the horse hatch in twelve to fourteen days. In another eleven to twelve days the young lice are mature, and if females commence laying eggs. The eggs of the biting lice hatch in eight to ten days.

Effect on the Horse.

One has only to watch a heavily infested horse to understand how irritating and annoying these pests can be. The animal will rub, scratch, and bite in an attempt to relieve the irritation. The hair is damaged and falls out, and the skin becomes bruised and broken.

Lice are most prevalent during periods when the animal's condition is poor and its vitality is low. Such may be due to disease, or simply

brought about through the pastures drying-off and losing their nutritive value, as they do in this State in the late winter and early spring or in times of drought. Horses which are stabled for any length of time and not groomed or exercised also frequently become heavily infested.

Treatment and Control.

Lice are spread chiefly by contact, but it must be remembered that clean animals can become infested through the careless use of harness, currycombs, blankets, &c. As sucking lice may remain alive off the horse for two or three days, and detached eggs may retain their vitality as long as twenty days, there is also a possibility that an infestation may be picked up in stables which have housed lousy horses. Control measures therefore involve—

(1) Treatment of infested animals to kill the lice infesting them. Biting lice may be eliminated by washing or spraying with arsenical cattle dip. This treatment is, however, not very effective against sucking lice, and for these it is necessary to employ a solution of nicotine sulphate (40 per cent. nicotine) at the rate of two teaspoonfuls of nicotine sulphate to one gallon of water. This nicotine sulphate solution is also very effective against biting lice. Oils such as Diesel oil and sump oil are also very effective, but the horse's skin is not very tolerant to such oils, and blistering may result.

The fluids mentioned above, whilst effective against lice, do not kill all the eggs. A second treatment is therefore necessary in order to eradicate any lice that hatch from the eggs that survive. Best results will be secured if the interval between the two treatments is fourteen to sixteen days.

(2) Disinfect all harness, brushes, &c., used on infested horses.

(3) Clean out the stables thoroughly and wash them out with a strong disinfectant solution.

MANGE.

Horses are subject to three different types of mange—namely, sarcoptic mange, psoroptic mange, and chorioptic or foot mange. These diseases are brought about by tiny mites which attack the skin, causing severe irritation, as a result of which the hair falls out and the skin becomes thickened, leathery, and covered with crusts or scales.

Neither sarcoptic nor psoroptic mange occur in Queensland. There exists, however, a skin disease known as Queensland itch, which closely resembles psoroptic mange. This itch usually commences at the root of the mane and butt of the tail, and from there spreads to other parts of the body. Its cause is not known.

CHORIOPTIC OR FOOT MANGE (*Chorioptic equi*).

Foot mange is by no means uncommon, particularly among stabled horses. As its common name implies, it is confined principally to the lower portions of the limbs. The mite responsible for this mange is very tiny, measuring at most about one-fiftieth of an inch in length. (Plate 114 (A) and (B).) This parasite lives on the skin surface, which it punctures to obtain its food. This results in inflammation and the formation of papules. Eventually the affected area loses its hair and becomes thickened and leathery and covered with crusts.

Effect on the Horse.

The irritation causes the horse to rub, bite, and stamp the affected parts. An otherwise docile horse may suddenly become restless and kick for no apparent reason. Some authorities regard foot mange as of primary importance, as they consider that the stamping and kicking may lead to serious injury to the limbs, thus shortening an animal's working life.

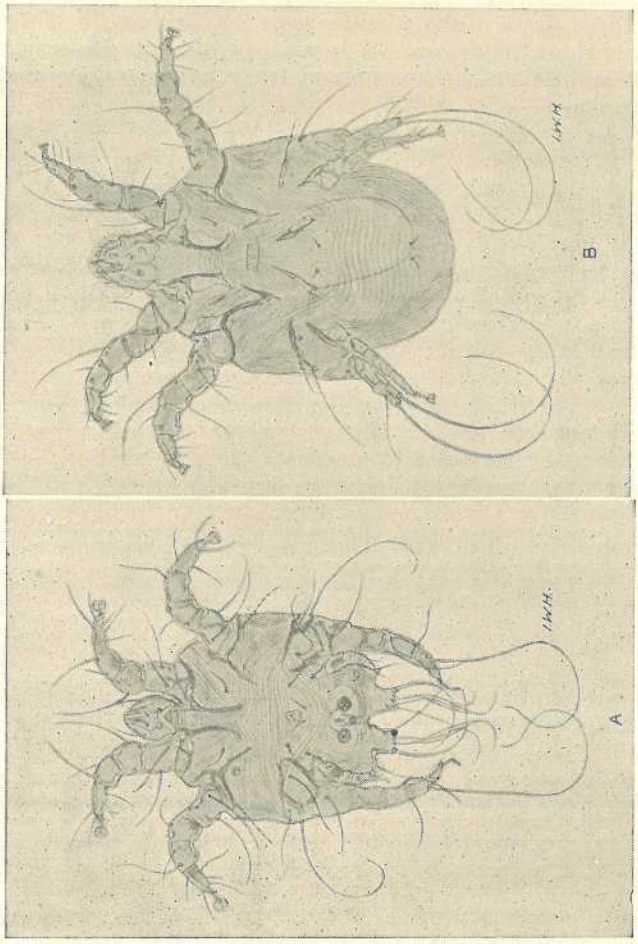


Plate 114.

Chorioptes equi × 100.
Fig. B. Female.

Chorioptes equi × 100.
Fig. A. Male.

Treatment and Control.

The affected limbs should be clipped and bathed in the nicotine sulphate solution recommended for lice or in a warm lime sulphur solution. The clippings should be burnt and treatment repeated every ten days until recovery is complete. Sump oil or crude oil may also be employed against foot mange. Oils, however, are inclined to remove the hair and blister, so must be applied very carefully. Brushes, &c., used on infested horses should be disinfected, and stables should similarly be treated.

To make an efficient lime sulphur solution, take 1 lb. of slaked lime and 1½ lb. flowers of sulphur. Add sufficient water to the lime to make a thin paste, then sift in the sulphur, stirring and, if necessary, add water till a mixture of the consistency of mortar is secured. Pour into this mixture about 2 gallons of boiling water, and boil until the sulphur disappears from the surface, keeping the mixture well stirred. When the mixture becomes a dark amber or chocolate colour (about two to three hours) the boiling should be discontinued, and the contents allowed to stand till clear. Pour off the clear liquid to which is added sufficient warm water to make 6 gallons. Before using, seven parts of warm water should be added to every three of the prepared concentrate.

A CHANGING AGRICULTURE—ELECTRICITY ON THE FARM.

In every country in the world agriculture is changing in a remarkable way, as an effect of the application of new forms of machinery and of new discoveries in agricultural science. But from a technical point of view, perhaps, one of the most remarkable developments is the application of electricity to farming in an ever widening field. Under these technical influences, the whole character of agriculture is changing increasingly and to an extent which in time will certainly modify the whole structure of rural life.

Until very recently the power required on the farm was practically limited to man power and animal power. The internal combustion engine is undoubtedly a chief factor in this technical development. Then comes electricity, by which has been demonstrated what can be done with a fixed source of power. Where natural water power is available, there we have the gradually extending electrification of the farm. A notable instance of this is the Nymboida electricity supply scheme in New South Wales. Many farms in the surrounding district are now served by electric light and power through the development of this scheme, and what that means in a dairying district, like the Northern Rivers of New South Wales, is easily realisable.

Rural electrification has reached a very high level in European countries, notably Belgium, Denmark, Holland, and Switzerland. New Zealand also is well in the van of this development.

Electricity is acquiring an increasing importance in the supply of power for irrigation. Where irrigation cannot be made a permanent practice by using the natural slope of the land, and where water must be lifted, the electric motor has proved itself better than all others for driving a pump.

Electric dairy equipment has already become a commonplace in many countries, and it has the advantage over all other types of power because of its simplicity and cleanliness. Electrically charged fences also are becoming common, likewise the use of electricity on the poultry farm for brooders and incubators. In many countries threshing is done by electricity. Attempts also are being made to develop the use of electric ploughs.

In the farm home, electricity is lightening the drudgery of domestic work. In fact, no scientific advance is more capable of changing the whole domestic outlook so effectively as electricity.

In combination with modern transport and better rural roads, electricity with its wide range of technical application is already lessening the differences between town and country, and may even be destined to be the chief influence in a movement back to the land.

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

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

(*Continued from p. 315, March, 1940.*)

PART B.—THE MYCORHIZAL THEORY REGARDING THE CAUSE OF FUSED NEEELE DISEASE.

I. INTRODUCTION.

REFERENCE was made in Part A of this paper to the early consideration of the hypothesis that some upset in the mycorhizal equipment of the pine tree was probably responsible for the fused needle condition. As a result much of the experimental work was planned from this point of view. The idea had its origin in the close correlation which was noted between the occurrence of fused needle disease and the presence of abnormal mycorhizas on the trees. From observations and experiments carried out chiefly at Beerwah, and a general survey of the available literature on mycotrophy, a scheme of investigation was drawn up and the experiments described in Part A carried out. As a general working hypothesis it was thought that, if suitable conditions for mycorhiza formation were made available, the trees would be provided with satisfactory growth conditions, and physiological upsets such as fused needle and its related symptoms would not appear. In order to determine the factors necessary for the satisfactory development of healthy mycorhizas a survey of the knowledge available concerning the subject had to be made, as well as of the conditions in healthy and unhealthy pine plantations.

The survey indicated that an essential factor in the development of plantations of *Pinus* in Queensland is the presence of a suitable supply of raw organic matter. The significance of this factor in the growth of a healthy pine tree was deduced partly from direct experimental work and partly from the available literature as being connected with the supply of carbohydrate material to the tree through its root system. The carbohydrate is obtained from the breakdown of the organic matter in the plant débris, in and on the soil surface, by the mycorhizal fungi in the course of their normal metabolism. The presence of a mycorhizal complex on the roots of the pine tree thus allows the tree access to this carbohydrate supply. The fact that this aspect of the significance of mycotrophy in *Pinus* has hitherto escaped general recognition is surprising when one considers the saprophytic nature of the fungi concerned. The other aspects of mycotrophic significance which are now generally accepted—that is, the supply of nitrogenous materials and inorganic salts by the mycorhizal complex—are not contradicted. It is considered, however, that this view should be modified so as to include the carbohydrate hypothesis herein discussed.

The results achieved by phosphate applications can be satisfactorily explained by this theory, as can the occurrence and successful treatment of fused needle disease.

The mycotrophic habit of plants is by no means a modern discovery, although the understanding of the relationship between the fungus and the plant root has been considerably widened by the advances

made during the present century. Adequate historical résumés of the development of this habit have be n made by Rayner (1927) and Hatch (1937), but for the purpose of clarifying the concept embodied in this paper it is considered that the salient points in the literature which are relevant to the present investigations should be briefly mentioned. These points are classified in two sections; one deals with the morphology and distribution of mycorhizas and the other with their physiological rôle.

II. THE MORPHOLOGY AND DISTRIBUTION OF MYCORHIZAS.

The generally accepted concept of the absorbing system of a plant does not portray the actual conditions which prevail in the case of the majority of forest tree species and the same statement is becoming true of an increasing number of other plants. The usual text-book description gives a picture of growing root tips protected by root caps as they push through the soil. The younger portions of these roots bear numerous fine root hairs growing out from the surface for some distance back from the tip. These root hairs are generally looked upon as the normal absorptive organs in the typical terrestrial plant. In woodland trees, however, the feeding roots are found to be normally invaded by fungi, and in many cases the root hairs are entirely absent and the walls of the root tips are so radically altered that the roots have no direct contact with the soil. The surface of the root ends, through which normal absorption takes place, is often completely enveloped in a sheathing mantle of wefted fungus mycelium which covers not only the lateral portion of the root but the tip also, and the absorption of soil nutrients has to take place by means of complex exchange processes between the fungus and the higher plant. The nutrients are first taken up in solution by the fungus mycelium which branches out from the mantle into the soil. From these hyphae the nutrient solution is conducted through the mantle and into or between the cells of the root cortex, which are enclosed by a continuous network, the "Hartig net," of mycelium. This structure, which comprises plant root and fungus mycelium, is called a mycorhiza, signifying a fungus root, and the mycorhizal method of plant nutrition is known as mycotrophy (Stahl, 1900).

One of the earliest records of the existence of the mycorhizal partnership was made by Theophrastus (372-287 B.C., cf. Kelley, 1937), who noted the presence of the fungus on and near the roots of oaks and other forest trees. Since this time numerous observations on the occurrence of fungus roots have been made, but it was not until the development of microscopic technique occurred that any real study of the relationship was possible. Numerous authors in the latter half of the nineteenth century have made note of the phenomenon.

The first accurate account of the association of a fungus mycelium with the root cells of a higher plant to form the structures known as mycorhizas was made by Reissek in 1847 (cf. Rayner, 1927). In the early period of investigation the majority of the observations were made on orchid roots, and in particular on the roots of those orchids which do not produce chlorophyll—that is, the so-called holosaprophytic orchids such as *Neottia* sp.

The older writers, including the elder Hartig, did not recognize the presence of the fungus as such in what are now known to be mycorhizal roots, but considered it to be an unexplained part of the root's anatomy. The intercellular mycelial network which now bears Hartig's name was

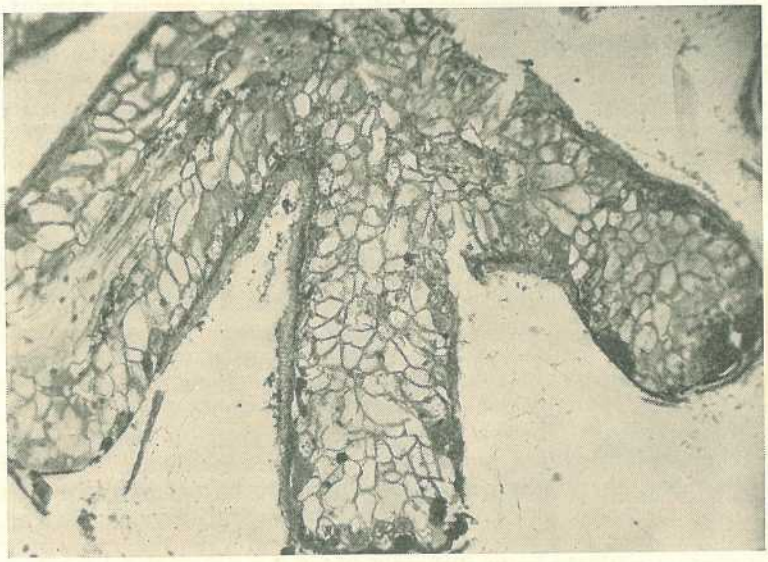


Plate 115.

LONGITUDINAL SECTION THROUGH A NORMAL ECTOTROPHIC CORALLOID MYCORHIZA OF *Pinus tæda*.—Showing the fungus mantle and general structure. (× 70.)

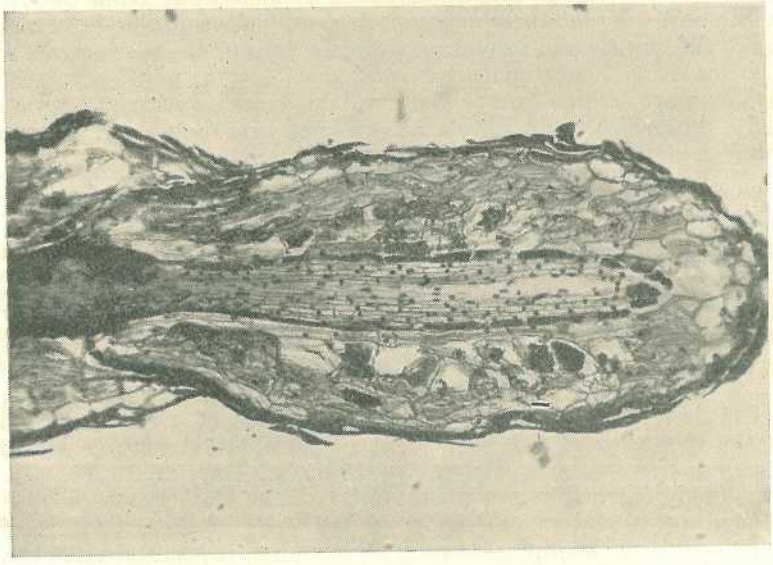


Plate 116.

LONGITUDINAL SECTION THROUGH AN ENDOTROPHIC MYCORHIZA OF HOOP PINE (*Araucaria cunninghamii*).—Showing arbuscules and sporangioles. (× 70.)

thought by him to be a normal part of the root. However, he noted the infrequency of the occurrence of root hairs in forest trees, a phenomenon which was later observed by many others and has now come to be associated with the development of a mycorhizal system.

The knowledge of mycorhiza in the light of a mutualistic relationship really dates from the year 1881, when Kamienski published the results of detailed researches on the roots of plants which showed a constant and peculiar fungal infection. Kamienski was followed by Frank (1885), who contributed largely to the discussion and invented the term "mykorhiza" to describe the fungus root partnership. Frank and his school of workers carried out definite researches on this subject, and their findings led to the recognition of root infection in vascular plants as a constant and common phenomenon. Since this period the work has been continued without interruption until the present day. Later work has been distinguished by the application of modern technique to the elucidation of the problem.

Frank, in 1887, published a classification of the types of mycorhizas in which the two main divisions, ectotrophic and endotrophic, appear and these terms have remained in general use since that time. In the *ectotrophic* form (Plate 115) the fungus constitutes a mantle on the surface of the organ and is also distributed as a Hartig network (Plate 119), consisting of intercellular hyphae in the cortex of the root. The hyphae of the Hartig net are continuous with those of the mantle. In the *endotrophic* form (Plates 116 and 117) the fungus mycelium is typically intracellular in the cortical root cells and the mantle is not present although individual hyphae connect the intracellular structures with the exterior of the root and mycelium in the soil. Ectotrophic mycorhizas are found in the Cupuliferae and Pinaceae, whilst the endotrophic type has been observed in most other plants which have been examined for the presence of mycorhizas. The difference between the two types of mycorhizas is now known to be one of degree rather than of quality. They merge into one another and many intermediate forms are now known. The intermediate forms are said to belong to the ectendotrophic type. Before Frank's time the ectotrophic mycorhizas were considered to be the normal type, but later investigations have shown them to be less common than the endotrophic mycorhizas, typical examples of which occur in the orchids, heaths, and the hoop and bunya pines (*Araucaria cunninghamii* and *Araucaria bidwilli*). It has been shown by the writer (Young, 1940) that the fungus *Boletus granulatus* forms endotrophic mycorhizas with *Araucaria* and ectotrophic ones with *Pinus*. This indicates that the type of mycorhiza formed is determined by the host plant rather than by the fungal associate.

Janse (1897, cf. Kelley, 1937) studied the morphology of mycorhizas in greater detail than did his predecessors and called attention to the terminal swellings, which appear on the hyphae of the endophytic fungi soon after infection and to which he gave the name "vésicules." He observed that they are filled with food products and considered them to be the resting spores of the fungus. The vesicles are of common occurrence on the roots of most plants with endotrophic mycorhizas except the orchids. They are formed both within the cells and in the intercellular spaces and contain much granular material and oil. Shibata (1902, cf. Rayner 1927) regarded the vesicles as being comparable with the swellings formed on vegetative hyphae in culture. The generally accepted viewpoint is that they are vegetative storage organs.

Another type of organ found in an endotrophic mycorhiza is the "arbuscule." This term was applied by Gallaud (1905), who observed that the hyphae in the intercellular spaces sometimes repeatedly branched and that this phenomenon occurred even more frequently within the cells. This branching produces the characteristic bodies in the cells, which vary in detail according to the plant in which they occur. They are terminal structures on the main hyphae. Gallaud considered the arbuscles to be haustorial branch systems which act as absorbing organs for the fungus.

In some cells Gallaud noted the presence of granular masses which have no definite hyphal structure; they are always intracellular and usually occur in the deeper cells of the cortex of the mycorhizas. He convincingly demonstrated that these bodies are degenerated arbuscules in process of intracellular digestion by the roots of the higher plant. He found them to be identical with structures previously observed by Janse and which had been called "sporangioles" by him. Gallaud retained this term for them.

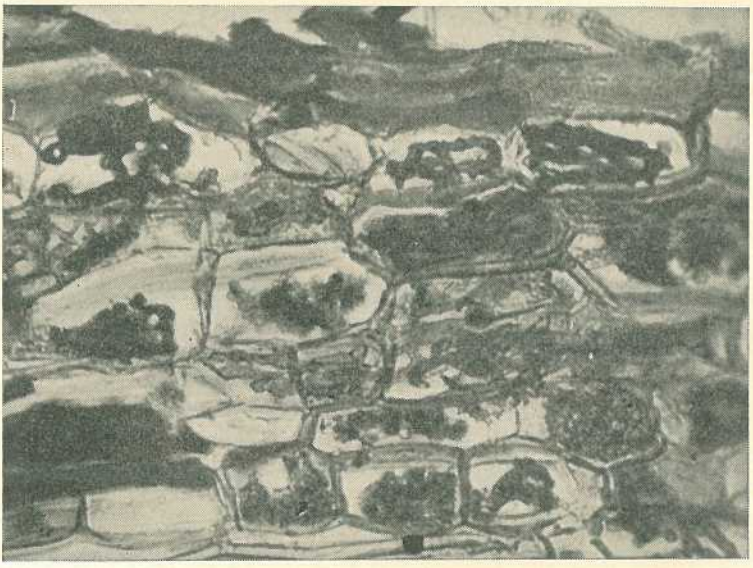


Plate 117.

LONGITUDINAL SECTION THROUGH AN ENDOTROPHIC MYCORHIZA OF HOOP PINE.—Showing detail of arbuscules and sporangioles. The root surface is seen at the top of the photograph with the arbuscules in the outer cortex and the sporangioles further in. (× 350).

Concurrently with the recognition of the normal association of fungi with the roots of forest trees, the apparent relationship of the sporophores of certain fungi to particular tree species had gained general notice. This was particularly so in the case of the occurrence of the truffle in beech forests in Europe and culminated in the employment of Frank in Germany in 1885 to investigate this phenomenon with the object of increasing the production of the fungus. His researches did not succeed in evolving a method for augmenting the truffle crop, but showed that the Cupuliferae are normally and constantly mycotrophic as regards root development. All their short roots are normally mycorhizal.

The nature of the fungi found associated with particular species was given considerable attention during the period of Frank's influence and a number of fungi were, by observational methods, connected with the occurrence of mycorhizas on particular trees, orchids, and other plants without, however, providing any great amount of sound evidence for the conclusions.

At the same time, the list of plants known to be mycotrophic was greatly extended. Johow (1885, 1889, c.f. Rayner, 1927) recorded the presence of mycorhizas in all but one species of the forty-three genera of nonchlorophyllous and nonparasitic phanerogams which he examined, and showed that the mycorhizas in these saprophytic plants were chiefly of the endotrophic type.

In 1894 Groom described the morphology and histology of several holosaprophytic orchids from Indo-Malaya and noted extensive endotrophic fungal infection in the rhizomes and scales. Numerous other observations on the occurrence and form of mycorhizas on nonchlorophyllous orchids chiefly belonging to the genus *Corallorhiza* were made about this time by various authors. In 1897 Janse (c.f. Kelley, 1939) extended the list of mycorhizal plants by recording root infections among seventy-five tropical species which he studied; of these, sixty-nine showed typical endophytic infection without causing damage to the host cells.

Hesselman, in 1900 (c.f. Melin, 1925), recorded mycorhizas in a number of arctic plants growing in poor soils with low amounts of humus and Wulff (1902, c.f. Rayner, 1927) reported mycorhizas in many arctic species, all of which were characterized by the presence of abundant sugar and little starch in the leaves and exhibited feeble transpiration streams.

During the present century numerous additions have been made to the list of fungus species associated with mycorhiza formation in various trees. The main evidence for the inclusion of the majority of the species was the occurrence and the regular association of particular sporophores with the trees concerned and on the continuity of the sporophore mycelium with the mycorhizal structures. Other evidence used was the similarity of the mycelium in the mantle and that in the fructification. In recent work, however, a considerable number of species of fungi and higher plants have been definitely shown to be related by means of pure culture synthesis of mycorhizas.

Melin (1925) synthesized mycorhizas in pure culture of *Boletus luteus* and *Pinus sylvestris*, and also of *Boletus elegans* with *Larix europaea*. He also experimentally demonstrated the formation of mycorhizas by *Boletus*, *Tricholoma*, and *Amanita*, and added *Cortinarius*, *Lactarius*, and *Russula* on birch and aspen to the experimentally proved list of mycorhizal forms.

Syntheses of mycorhizas of *Pinus* with pure cultures of *Rhizopogon* (Plate 118) and *Boletus* have been made by the writer (Young, 1936, 1937).

The work carried out by Melin (1917-1925) signalized a marked advance in the knowledge of ectotrophic mycorhizas. He was able to distinguish between true and pseudo-mycorhizas. In conifers the latter type was found to be thinner and simpler than the normal one, and to be due to a parasitic infection of the short roots by a fungus different from that forming a normal mycorhiza. Melin showed that root infection by fungi to form mycorhizas takes place through the root hairs

and epidermal cells. After infection the root hairs are often discarded. He showed anatomically that the higher plant was benefited and not harmed by the presence of the normal fungus associate.

Three types of ectotrophic mycorhizas were described by Melin; (*a*) coralloid (gabelmykorhiza); (*b*) tuberculate (knollenmykorhiza); and (*c*) simple (einfach). The coralloid type is that usually found in pine and consists of branched short roots produced laterally and terminally on the finer roots, and has a coralloid or witches' broom appearance. The tuberculate form consists of small tuberous structures so crowded that they often grow together. The tuberous character of these is due to the wefting together into one structure of a cluster of dichotomously branched short roots by the fusion of the fungus mantles. The simple form consists of a single mycorhizal short root which is often much longer and finer than the preceding types. In some cases the simple type is a stage in the development of one of the others. The colour of the mycorhizas varies with age and with the species of fungus forming the mantle.

Plate 118.

SPOROPHORE OF *Rhizopogon roseolus* IN ASSOCIATION WITH THE ROOTS OF *Pinus taeda* IN PURE CULTURE.—Showing coralloid ectotrophic mycorhizas and connecting mycelial strands (natural size).

It was later shown by Hatch (1933) that the short roots involved in mycorhiza formation were not roots which had been limited in growth owing to fungus infection, as had previously been assumed. On the contrary, the infected roots are roots of determinate growth—that is, "short" roots which would not grow longer even if not infected. Infection, however, often stimulated branching and swelling. The production of these short roots appeared to be a normal development in trees possessing the mycotrophic habit.

III. THE PHYSIOLOGICAL RÔLE OF MYCORHIZAS.

Previous to Frank's time the significance of the relationship between fungus and root was either unappreciated or was just becoming a subject for argument, and from that period up to the present time much controversy has been and continues to be carried on concerning the rôle played by the two symbionts in mycorhizas. Frank and his colleagues carried out definite researches and experiments into the physiological significance of the mycotrophic habit, and their work has been followed up by later investigators.

The constant occurrence of mycorhizas on woodland trees led Frank to the conclusion that all water and nutrients which were absorbed by the fungus-sheathed roots must be obtained by the tree from the fungus. He also directed attention to the fact that, in both the Cupuliferae and the Ericaceae, the occurrence of mycorhizas was dependent upon the presence of abundant humus and was not dependent on other soil conditions. This humus was derived from fallen leaves and other material from plants growing in the soil in question. He showed experimentally that humus from other than woodland sources was unsatisfactory and that trees planted in soils with this type of humus failed to develop mycorhizas. He concluded that the normal health of forest trees is dependent on supplies of woodland humus. This allowed satisfactory mycorhizal development, without which they could not obtain their proper nutrients. It is possible, of course, that the right type of fungus for the particular trees used in the experiments was not present in the soil obtained from outside sources. On the other hand, from work carried out by Rayner (1934, 1936) it seems probable that the humus in the introduced soil was physiologically unsatisfactory.

Frank deduced from his experimental observations with the Cupuliferae that carbon, nitrogen, and mineral nutrient compounds obtained from the breakdown of the humus were made available to the trees by means of the fungus mantle and osmotic processes in a manner comparable to root hair absorption in non-mycotrophic plants. He concluded that the fungus mantle of the ectotrophic mycorhizas acts as the tree's absorbing system. The experiments leading to these conclusions were largely repeated with *Pinus sylvestris* with similar results. It was also shown that all the mycotrophic plants investigated would not grow well in sterilized soil, whilst non-mycotrophic plants would. The digestion of the included fungus by the cortical cells of the mycorhizas was observed, and Frank came to regard mycotrophic plants either as parasites on saprophytic fungi or as an example of beneficial symbiosis. He extended this theory to include the case of endotrophic mycorhizas such as are present in the orchids.

The findings of Frank received much criticism and a great deal of argument took place in connection with his conclusions. One of his chief opponents was Robert Hartig, who regarded mycorhiza in general as a diseased root condition caused by the attack of parasitic fungi. He was supported in this contention by Tubeuf. Both of these investigators, however, eventually changed their opinion and at length came to regard mycorhizas as a normal healthy occurrence in many plants.

At the close of the nineteenth century Johow (1898, cf. Rayner, 1927) greatly extended the knowledge of the habits of nonchlorophyllous plants and showed them, when not parasitic, to be mycotrophic. He

regarded the existence of hemisaprophytes as being established and included the epiphytic orchids in this group. Johow observed that non-chlorophyllous, non-parasitic phanerogams as a whole grow in moist, shady, humus-rich situations, and that in all but one doubtful case these plants were mycotrophic. Johow based his arguments for the existence of hemisaprophytes on the fact that they use soil humus directly as a source of organic food material.

Janse (1897, cf. Kelley, 1937) conducted researches and advanced a new hypothesis for the physiological significance of the mycorhizal relationship, and concluded from indirect evidence that the fungi were nitrogen fixers and that they provided the host plant with inorganic salts and nitrogenous and other inorganic materials, whilst in return they obtained carbohydrates from the host.

MacDougal (1898, 1899, cf. Kelley, 1937) was also of the opinion that ectotrophic mycorhizas were adapted to nitrogen fixation. This idea, however, has now been abandoned by most workers.

MacDougal supported Frank in his contention that in the symbiotic relationship the fungus supplies the host with nutrients, and considered that this, together with the determined fact that all plants can use organic substances of some complexity, was the most important result of research in mycotrophy in the last decade of the nineteenth century.

At the beginning of the twentieth century, in spite of the favourable evidence already brought forward, little importance was attached to Frank's opinions respecting ectotrophic mycorhizas, although the theory of symbiotic relationship was not abandoned. Sarauw (1893, cf. Hatch, 1937) regarded the fungi as harmless and useless to trees, whilst Moller (1902, cf. Rayner, 1927) disputed Frank's view that *Pinus sylvestris* does not come to maturity on normal soils if mycorhiza formation is hindered owing to the lack of humus and the appropriate fungus.

One of the most important publications on the mycorhizal relationship at this time was that of Stahl (1900) (cf. Rayner, 1927; Kelley, 1937; Hatch, 1937). He contradicted Frank's idea as to the absorption of organic nitrogen from the soil. In his opinion mycotrophic plants were distinguished from non-mycotrophic ones by their weaker transpiration, smaller root development, and the absence of root hairs and the presence of fewer vascular vessels. In their leaves more sugar than starch was formed. The deficient water circulation, and hence the deficiency in mineral salts, is compensated for, according to Stahl, by the mycorhizas, thus explaining why there are no mycotrophic plants in soils rich in salts. Mycotrophic plants, according to him, grow in soils rich in humus and poor in mineral salts. Stahl considered that because the fungal hypae could absorb the nutrient salts of the soil with much greater ease than could the roots of the higher plants, there is a struggle in the humus between the vascular plant and the hypae. In the struggle only mycotrophic plants can survive.

Petri (1915) (cf. Rayner, 1927) considered that Stahl's conclusion in regard to the compensatory factors of sluggish transpiration and root infection by mycorhizal fungi was erroneous, and that mycorhiza formation was an aggravating circumstance, since there was a slower root development the more intense the infection. Modern work has indicated moreover that a rapidly absorbing and rapidly transpiring plant is not for this reason specially favoured in the competition for

mineral salts. Stahl's experiments with plants growing in sterilized soil are open to criticism on account of his conclusion that the increased growth in sterile soils was due to the elimination of fungal competition. Russell (1921) has shown that sterilization has a manuring effect by making more nutrients available. Stahl's conclusions are, however, still held in general by most workers.

Following Stahl's paper in 1900, interest was mainly directed to endotrophic types of infection, and much interesting research during the first twenty years of the century was carried out. Little work was done in connection with forest trees, but the information gained concerning the carbohydrate nutrition of the orchid may have a direct bearing on the mycorhizal relationship of pine trees, as will be discussed later.

From the above brief outline it will be seen that all views regarding the significance of the mycotrophic habit in trees have had their supporters. Some authors, including MacDougall (1922), Koki Masui (1926), and Burges (1936), have regarded all root fungi as parasitic, whilst Frank, Stahl, Muller, and Tubeuf believed the association to be a beneficial symbiosis. There is no unity of opinion concerning the form of the nutrients supplied by the mycorhizas; carbon, nitrogen and mineral salts are all suggested, with emphasis on the latter. Rexhaussen (1920, cf. Rayner, 1927; Kelley, 1937) was of the opinion that the relation between fungus and root in ectotrophic mycorhizas was not fixed, but varied with the soil conditions. If these were unfavourable to the fungus it was likely to parasitize and injure the tree; if too favourable infection was feeble and mycorhizas badly developed. He thought that beneficial symbiosis existed, particularly when a carbohydrate supply exterior to the roots was associated with a deficiency in mineral salts. Rexhaussen's views are closely similar to modern conceptions.

It was left to Elias Melin (1925) to provide reliable evidence concerning the nature of the association between certain trees and fungi, and the publication of his results signalized a marked advance in the knowledge of ectotrophic mycorhizas. He showed that in freshly-drained moor soils in which only pseudo-mycorhizas were previously present the appearance of mycorhizal fungi must occur before successful growth could be obtained in conifers. The fungus which he constantly isolated from pseudo-mycorhizas did not form true mycorhizas in culture, but lived parasitically in the plants. He showed that mycorhizal fungi grow very slowly when separated from the tree roots, and in culture organic substances are better food sources than inorganic ones. The most favourable pH value for the development of a fungus symbiont was found by Melin to be 5·0, and he linked this fact up with the occurrence of well developed mycorhizas in acid forest soils of pH 4-5. Similar results were obtained and adapted to practical use by the writer (Young, 1938) in Queensland forest nurseries.

In one of his papers (1925) Melin described a long series of experimental cultures which were designed to investigate the nutrition of both symbionts in coniferous mycorhizas and to throw light upon their inter-relationships. He developed a simple but effective technique for growing pine seedlings in pure culture with and without infection. The

stimulated growth of mycorhizal fungi when in contact with tree roots was attributed by him to the effect of phosphatide excretions by the roots. He could obtain no evidence of nitrogen fixation by the fungi concerned.

The main theme of Melin's work was that mycorhizas are of vital significance to trees and other plants growing in acid humus.

Since the publication of Melin's work (1925) interest in mycotrophy has become more general, particularly in regard to tree mycorhizas. This is probably due to the importance now attached to the artificial propagation of softwoods. Many cases of the failure of coniferous nursery seedlings to make satisfactory growth have occurred in various parts of the world, including Australia, and investigations have shown that these failures have been due to the absence of appropriate fungi in the soil, resulting in the lack of mycorhizal development (Rayner, 1938). Artificial inoculations with these fungi have resulted in the successful growth of the plants.

In recent years two important contributions were made to the knowledge of the mycotrophic phenomenon by Rayner (1934, 1936) and Hatch (1933, 1937). In 1934, Rayner as a result of her work with *Pinus pinaster, Pinus radiata,* and *Pinus laricio* expressed the opinion that different soil environments caused the development of different types of mycorhizas. This was in agreement with the previously noted opinion expressed by Rexhaussen. In her investigations carried out on Dorset Heath soils at Wareham, Rayner showed that soil factors inimical to the growth of mycorhizal fungi were capable of causing poor growth in some of the sowings. In 1936, Rayner described a number of composts developed with the object of changing the biological direction of activity in these inimical soils by causing a difference in the course of humus decomposition, resulting in the formation of healthy mycorhizas and the production of vigorous plants. The composts were not added in quantities sufficient to have any manurial value, but acted as a means of altering the biological status of the humus.

Hatch (1933) expressed the opinion that it was from the increased absorbing surface provided for the tree by the development of mycorhizas, that the tree received the benefit of the symbiotic habit. In a later work (1937) he considered that where there is a high nutrient salt concentration no mycorhizas are formed, but that mycorhizas occur when one or several of the nutrient salts were relatively scarce. Under the latter conditions the pine trees did not grow satisfactorily unless in the presence of an appropriate mycorhiza forming fungus. This agrees with Rexhaussen's opinion that mycorhizal development in rich soils was feeble. Hatch supported the mineral salt theory of Stahl and considered that the provision of nitrogenous compounds by the mycorhizas was non-essential. Rayner, however, is of the opinion that a wider significance is attributable to the phenomenon and considers with Frank and other writers, that nitrogenous and mineral compounds obtained from the breakdown of the humus, as well as mineral soil salts, are provided for the higher plant by means of the mycorhizas. The evidence obtained in the experiments described in this paper support the latter view, with the addition of carbohydrates to the substances supplied.

IV. THE CONDITION OF THE MYCORHIZAS OF PINUS IN QUEENSLAND.

In Part A of this paper it has been postulated that the fused needle condition of Pinus and certain other abnormalities discussed were due to an incorrect balance between the trees and their root associates. The work on which these conclusions are based will now be discussed. Before considering the abnormal type of mycorhizas it is first necessary to be familiar with the normal balanced association.

For the purposes of comparison the structure of mycorhizas on the roots of *Pinus tæda* and *P. caribæa* growing under favourable conditions at Beerwah were taken as a standard. The trees from which these roots were collected were growing vigorously in healthy closed stands, with an average stem height of 30 to 35 feet at the age of eight years. A litter of pine needles clothed the soil, and no abnormal appearance as regards health was to be observed. Specimens taken from other healthy pine trees of the same or different species have shown similar root characteristics when grown in the same soil type.

The mycorhizas are plentifully developed in the surface layer of the soil and also in the litter horizon. The colour of the living structures is yellow-brown, becoming darker as they age. Newly formed mycorhizas are white. The coralloid type is most frequent with few once forked short roots being observed except in the case of newly developing organs. Mycelial mantles are to be seen on the mycorhizas, and the mycelium is usually so well developed as to weft together the branches of any one organ. According to these external characters the mychorizal type falls into the ectotrophic class. Hyphal strands can be seen branching out amongst the leaf litter and other plant detritus in the litter horizon from the mycorhizas present there. The proportion of living to dead mycorhizas is high at any time of the year.

For the purpose of microscopic examination mycorhizas were preserved in a formalin-acetic acid-alcohol mixture which was suggested in correspondence by Dr. M. C. Rayner. This preservative is made up according to the following formula:—

Fixative for Tree Mycorhiza.

Glacial acetic acid	9 c.c.
Formalin (comm.)	51 c.c.
50 per cent. alcohol	540 c.c.

This formula has proved during several years of extensive use to be eminently suitable for the purpose. Material has been left in the mixture for months without deterioration. During the paraffin embedding process the fixative is removed in the dehydration process by the various dilutions of alcohol. In embedding it has been found convenient to place several mycorhizas in the one mould so that, on cutting with the microtome, sections in the desired plane are found in the mounts. For longitudinal sections single-forked roots were picked from mycorhizas and laid flat in the melted paraffin wax. A convenient thickness of section was found to be from twelve to fifteen microns. Thinner sections usually resulted in the partial destruction of the mantle and intracellular characters.

A number of staining techniques were used for differentiation purposes, and the most satisfactory one so far used is a cotton-blue

procedure. The strain was made up as a 0·5 per cent. solution of cotton-blue in lacto-phenol. For rough preparations the sections were mounted directly in the stain. For other preparations the surplus stain was removed after five minutes by washing in lacto-phenol, and the sections were then dehydrated and mounted in Gurr's mounting medium. By this method all fungal mycelia were coloured blue in contrast to the absence of staining in the cellulose of the root itself. Another method sometimes used was to stain in carbol thionin blue and differentiate in orange G. The former method, however, was the more satisfactory for general purposes.

The sections of normal mycorhizas revealed:—

(*a*) A mantle of septate fungus mycelium about five layers thick, which invested the majority of the short roots (Plate 119);

(*b*) The coralloid structure of the individual mycorhizas the branches of which were frequently wefted together by mycelium;

(*c*) The presence between both the epidermal and the cortical cells of the mycorhizal roots of a continuous network of fungal hyphae, the Hartig network, which separate the individual cells of these tissues (Plate 119);

(*d*) The continuity of the hyphae of the Hartig network with those of the mantle;

(*e*) The absence of any vigorous hyphal material inside the cells of the cortical region (Plate 119);

(*f*) The presence of products of hyphal degradation within some of the cortical cells and the remains of empty hyphae. This had apparently resulted from the so-called "phagocytic" action which is characteristic of unsuccessful attempts at mycelial establishment within the cells.

On microscopic examination the mycorhizas proved to be of the ectendotrophic type. They are assumed to be normal, because they were abundant on healthy, vigorous trees. Similar mycorhizal material, along with a selection made from other situations, was forwarded to Dr. M. C. Rayner for examination in 1935. Dr. Rayner's report was in agreement with this viewpoint concerning the healthy state of the association.

The Characteristics of Mycorhizas on Fused Needle Sites.

It was noted quite early in the investigations at Beerwah that where the soil is bare of a vegetational cover and the actual soil surface can be seen, as described in Part A of this paper, the mycorhizal system of the pine trees (*Pinus tæda* and *Pinus caribæa*) is present only in the surface soil, and in bad cases within the top inch, with the actual mycorhizas often protuding through the soil surface. Where more litter is present the mycorhizas extend more deeply into the soil and are more abundantly developed. Under poor stands of pine in which any large amount of fused needle occurs such as those previously described, the former condition prevails, and the majority of the mycorhizas are dark in colour and of a more simply branched type than in the case of the normal coralloid condition, although occasional normal ones are present. Whenever a small accumulation of vegetable detritus gathers on the ground, such as under a log or in a depression,

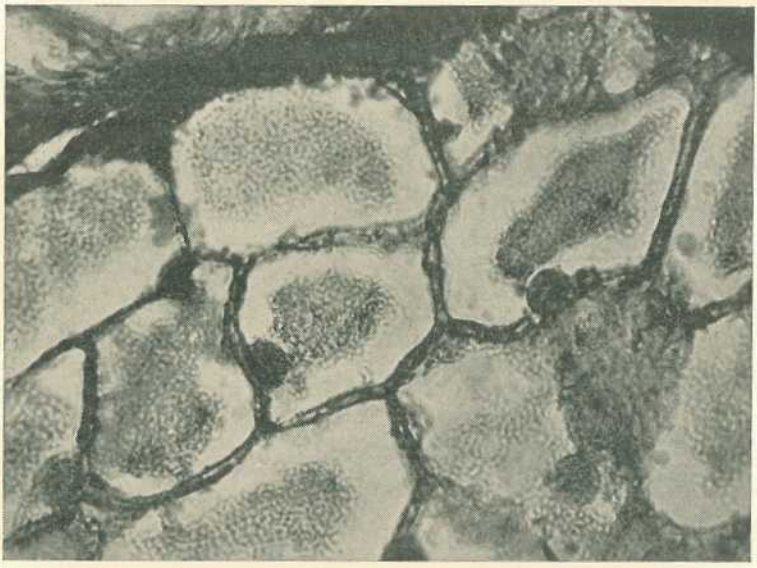


Plate 119.

Longitudinal Section through a Normal Ectotrophic Mycorhiza of *Pinus tæda*. Showing intercellular Hartig net of fungus hyphae and the absence of intracellular haustoria. The mantle is visible in the top left-hand corner. (× 900.)

Plate 120.

Longitudinal Section through a Fused Needle Type of Mycorhiza of *Pinus tæda*. Showing development of intracellular haustoria from the overdeveloped intercellular Hartig net. A parasitic condition. (× 900.)

a few normal mycorhizas are found, although the trees to which they belong are in many cases badly affected with typical fused needle disease, or are otherwise poverty stricken, and have the great majority of their mycorhizas of the abnormal type.

Microtome sections of fixed and embedded material from poor stands showed the following characteristics:—

(*a*) A very thin and sometimes lacking mantle;

(*b*) A large proportion of unbranched and simply branched mycorhizas and no wefting together of the branches with a fungal network in these cases. Occasionally more normal mycorhizas are present;

(*c*) A very vigorous development of the Hartig network, the network often being two or more strands thick instead of the usual one (Plate 120);

(*d*) The continuity of the Hartig network with the mantle;

(*e*) The presence of haustorial invasions of the cortical cells from the Hartig network (Plate 120);

(*f*) The absence of hyphal degradation products in the cortical cells;

(*g*) The presence of tannic material in a considerable number of the cortical cells.

It is considered that the above symptoms represent an abnormal condition. A number of specimens of mycorhizas from fused needle trees were forwarded to Dr. M. C. Rayner in 1935 for an opinion, and the resulting report confirmed the author's views concerning their abnormality. Specimens forwarded from the roots of ten months old plants growing in the nursery at Beerwah and not showing fused needle symptoms were also thought by Dr. Rayner to exhibit an abnormal aspect. At this time 0·5 per cent. of the nursery plants (*Pinus caribæa*) were affected by fused needle disease. Dr. Rayner at that time considered from the mycorhizal evidence that the organic matter supply of the nursery was possibly below the optimum.

The abnormal type of mycorhiza was abundant on trees which did not have typical needle fusion symptoms, although they were obviously affected with some form of impoverishment, such as thin crown or short needle. The actual proportion of normal to abnormal mycorhizas appears to be definitely correlated with the vigour of the tree and the occurrence of needle fusion and other diseased symptoms. In normal healthy plantation areas the proportion of normal mycorhizas to the dark abnormal type is high, and this relationship is directly reflected by the vigour of the trees.

Many dead mycorhizas are present on the roots of trees growing in comparatively naked soils. It is thought that this low proportion of functional short roots is to a large extent due to the effects of heat and drought. The bare soil surface in summer at Beerwah frequently reaches a temperature of 140 deg. F., which must have an adverse effect on the small roots in the affected soil. When temperatures such as this prevail the soil is dry, and it is considered that the desiccation and heat kill many of the fine roots. It is possible that these conditions also result in the death of the mycorhizal fungi in the affected soil. The presence of vegetation and litter on healthy sites prevents the occurrence of excessive heating and drying.

It appears that the response to malnutrition by the aboveground parts is often variable in different individuals of the same species of *Pinus* although the mycorhizal structures show similar characteristics, indicating that the cause of the upset is fundamentally the same. In this connection it has been shown by Rayner (1934) that at Wareham, in England, "unthrifty growth of pine seedlings is directly related with defective mycorhiza formation and that the latter is associated with inimical soil conditions rather than with the absence of mycorhiza-forming fungi suitable for the trees." It is of interest to note here that since detailed descriptions of fused needle disease were published in Australia (Young, 1935; Ludbrook, 1937), the disease has been recognized in England, at Wareham, by Jones (1938). Previous to this, in correspondence in 1935, Rayner considered that a certain unthriftiness in conifers in that area was identical with our fused needle disease.

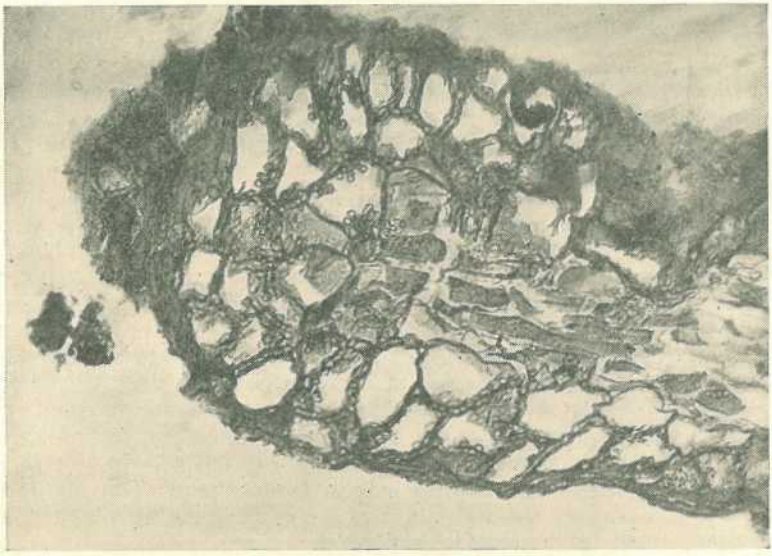


Plate 121.

Section through an Abnormal Mycorhizal Root Typical for a Fused Needle Affected Tree (*Pinus tæda*). Showing general haustorial development of the Hartig network. (× 200.)

Specimens of mycorhizas of *Pinus radiata* received from New Zealand by courtesy of the Bureau of Plant Industry at Auckland and collected from plants suffering from fused needle disease were found to be affected with a condition similar to that found in the inferior pine stands of southern New South Wales and Queensland.

The Form of Mycorhizas Under Various Soil Treatments.

The pot experiments carried out at Beerwah and the field plots involving the application of litter (Blocks K, L, M, NC, and ND) already described in Part A support the view that a supply of suitable raw organic matter is essential for normal mycorhiza development and consequent healthy pine growth. Plants grown in soil deficient in this material exhibited the typical symptoms of malnutrition as exemplified by fused needle, thin crown, and chlorosis, whilst plants in the

same soil but with the addition of raw organic matter grew healthily. After two years without the addition of fresh organic matter all the plants became typically dwarfed and malformed. Even trees planted in cow dung without any other material and which at first showed exceedingly vigorous growth became diseased, although the material left in the pots at the end of the period was still organic in nature. This latter occurrence emphasises the need for the presence of the essential organic matter in a raw form.

The mycorhizas of those plants grown in soil deficient in organic matter and those grown in soil in which organic matter was present, but in a broken down condition proved to be similar when examined microscopically. These mycorhizas were of identical structure to that of specimens obtained from beneath plantation trees growing under typically badly nourished conditions as described previously. Mycorhizas obtained from pots to which fresh organic matter had been added and in which the plants were still growing vigorously were of healthy normal type.

In a case at Pechey, in South Queensland, complaints were received concerning the state of health of the plants in several of the nursery beds. On investigation, the plants showed a purplish tint of the newer foliage, and had ceased growing well after being quite satisfactory for approximately six months. Some signs of fused needle were evident. On examination of sections of the mycorhizas it was found that an unsatisfactory root-fungus balance existed and that the condition previously found at Beerwah was present in a more marked degree. On analysis, the soil was shown to contain over 3,000 p.p.m. of total phosphate. Enquiries showed that the beds had received organic manure in the form of cow dung, but it was found that this manure was old, rotted, and structureless, and apparently past the stage of optimum usefulness to the mycotrophic plants in the beds. It was accordingly advised that a supply of fresh undecomposed organic matter be applied to the affected beds. This was carried out in the form of addition of leaf litter from beneath local forest trees. The plants after this made a complete recovery. It was found from this and the pot experiment already described that when animal manures are applied to a pine nursery they should, as far as possible, although not fresh, be in a condition in which the structure is still visible.

The state of the mycorhizas produced by trees growing in the various soil treatment plots involved in the fused needle experiments at Beerwah were also investigated.

In the case of the plots receiving superphosphate the mycorhizas became normal. At the time of treatment the mycorhizas were abnormal and similar to those in typical fused needle areas. It was a very well emphasised fact that on areas very subject to fused needle the fruiting bodies of the mycorhiza-forming fungi, *Boletus granulatus* and *Rhizopogon roseolus,* were only produced on these phosphate-treated plots. Sporophores were produced on clean chipped and on otherwise untreated areas to which phosphates had been applied. A notable feature of phosphate-treated plots is the abundance of bandicoot (*Isoodon obesulus* Shaw.) burrows. This animal digs for the subterranean sporophores of *Rhizopogon roseolus,* which it eats. This production of sporophores by the fungus fits in well with Melin's hypothesis (1925) that the fungus receives from its association with the higher plant phosphorus, in the form of phosphatide, which enables it to complete its life cycle.

On partially affected sites, plots under a natural ground cover and which were used for controls showed a distribution of normal and unhealthy mycorhizas, varying with the health of the stand. Normal mycorhizas occurred in situations where there was an accumulation of litter, and abnormal in humus deficient situations. When an area affected by fused needle disease (not of the exceptionally severe form) receives normal tending and is subject to the accumulation of a natural ground cover it usually recovers with age. The presence of abnormal mycorhizas then becomes infrequent. At this stage a constantly replenished supply of litter is present supplying the necessary type of raw organic matter with its combined phosphorus.

The condition of the mycorhizas in plantation plots kept clean of vegetation since 1934 by chipping and raking was almost wholly abnormal. Very few healthy mycorhizas were to be found, save an occasional one in some small local humus accumulation. The mycorhizas were in the surface of the soil and very dark in colour. The simple (einfach) type predominated. The condition of the trees is such that all were affected by malnutrition, the majority of them being in a typically needle fused state. From this it seemed evident that the absence of a supply of vegetable detritus is correlated with the appearance of the abnormal type of mycorhizas described and with the onset of malnutrition in pine trees, as evidenced by the manifestation of fused needle disease in its various forms.

Mycorhizal development in the plots treated with forest litter was very plentiful. The roots of the trees ramified through the litter on the soil surface and bore numerous coralloid mycorhizas with wefts of hypae extending out into the litter. The mycorhizas on section proved to be normal and healthy. With the advancement of time, however, the general character of the mycorhizas altered until, two years after the application of the litter, the abnormal parasitic type had made its appearance in great numbers. The fused needle condition and general growth of the trees improved until that time, as is evident from the figures supplied in connection with these treatments earlier in this paper, but became worse after two years and is still on the down grade. In the case of plots where additions of fresh litter were made at intervals, this retrogression did not occur and the mycorhizas remained normal, and the plants continued to grow well.

The degeneration of the mycorhizal type with the ageing of the litter would seem to be bound up with the decreased usefulness of the litter as a fungal food. It is probable that some essential constituents, probably cellulose and phosphorus, are depleted during this time, and that for vigorous and normal mycorhizal development a continual replenishment of these by the addition of fresh material is essential. The possible accumulation of toxic break down products may be having an inimical effect on the root systems.

No cases of fused needle disease recorded have yet occurred which do not appear to be associated with an unsatisfactory humus supply and incorrect mycorhizal equipment. The peat soils at Wareham, in England (Jones, 1938), on which the species of *Pinus* planted have developed fused needle disease appear to be a similar case to that of a peat soil examined at Twofold Bay, Southern New South Wales, where *Pinus radiata* twenty years of age has yet failed to form trees and exhibits typical fused needle disease, together with the other

aberrant symptoms usually found with the species in question. In peat soils it is considered that the same factor is operating as in the case of the old littered plots at Beerwah. That is, although there is an abundance of vegetable compost, fused needle occurs simply because this organic matter is in the wrong state to support normal growth of the mycorhizal fungus. The appearance of fused needle disease under swampy, water-logged conditions in humic bogs in Queensland would also fit in with this hypothesis. The work of Rayner (1936) has shown that addition of substances to activate the peat soils at Wareham and start biological activities in a different direction is capable of producing healthy pine growth. Another possible factor operating is the accumulation in these peat soils of harmful products of metabolism in old raw humus, so that the growth of the mycorhizal fungi, and mycorhiza formation, is endangered (Melin, 1925).

[TO BE CONTINUED.]

QUEENSLAND SHOW DATES FOR 1940.

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

MAY.

Miles	1st
Monto	1st and 2nd
Yarraman	3rd, 4th, and 6th
Millmerran Rodeo	6th
Longreach	6th to 8th
Mundubbera	8th and 9th
Beaudesert Show	8th and 9th
Beaudesert Campdraft	10th and 11th
Nanango	9th to 11th
Blackall	13th and 14th
Roma	14th to 16th
Gayndah	15th and 16th
Mitchell	15th and 16th
Murgon	16th to 18th
Warrill View	18th
Ipswich	21st to 24th
Goomeri	23rd and 24th
Biggenden	23rd and 24th
Baralaba	23rd and 24th
Baralaba Rodeo	25th
Kalbar	25th
Gympie	30th and 31st and 1st June
Lowood	31st May and 1st June

JUNE.

Wowan	6th and 7th
Maryborough	6th to 8th
Blackbutt	7th and 8th
Childers	10th and 11th
Boonah	12th and 13th
Bundaberg	13th to 15th
Gin Gin	17th and 18th
Gladstone	19th and 20th
Kilcoy	21st and 22nd
Rockhampton	25th to 29th
Toogoolawah	28th and 29th

JULY.

Mackay	1st to 4th
Esk Show and Campdraft	5th and 6th
Proserpine	5th and 6th
Bowen	10th and 11th
Ayr	12th and 13th
Rosewood	12th and 13th
Cleveland	12th and 13th
Townsville	16th to 18th
Maleny	18th and 19th
Charters Towers	23rd to 25th
Gatton	23rd to 25th
Innisfail	25th, 26th, and 27th

AUGUST.

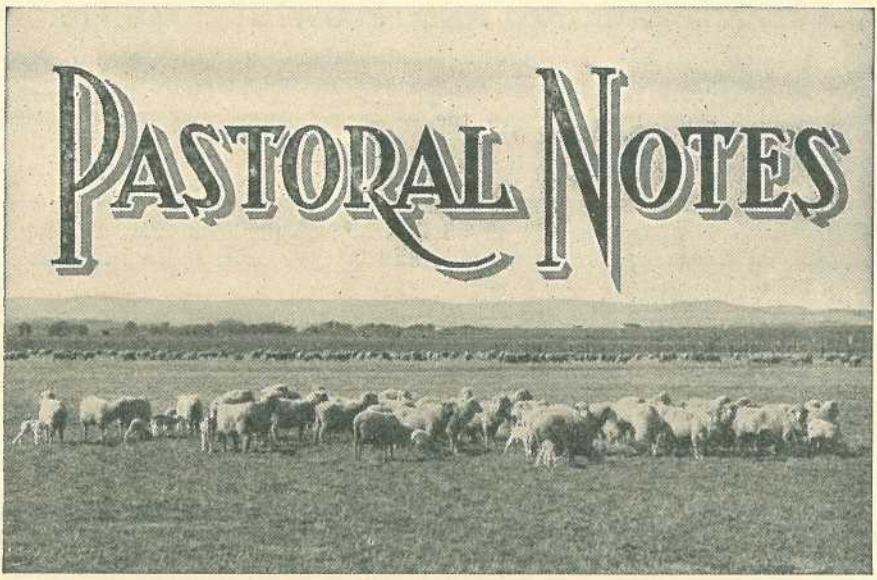
Home Hill	2nd and 3rd
Pine Rivers	2nd and 3rd
Atherton	6th and 7th
Caboolture	8th and 9th
Royal National, Brisbane	12th to 17th

SEPTEMBER.

Imbil	6th and 7th
Rocklea	14th
Ithaca	28th

OCTOBER.

Warwick Rodeo	5th and 7th



Sheep-Drenching.

REPORTS have been received from sheep owners at various times of ill-effects following the use of the nicotine sulphate and bluestone drench, which is advised for the removal of hair worms from sheep. This drench is perfectly safe providing the sheep owner knows when and how to use it. Where it is followed by ill-effects these are usually due to—

1. *Careless Mixing.*—Nicotine sulphate is a highly poisonous drug, therefore the mixing of the drench should be given every care. The nicotine sulphate is measured in fluid ounces and not in ounces weight.

2. *Careless Administration.*—The majority of ill-effects which have followed the use of this drench are due to careless administration. The dose given depends, not only upon the age, but also upon the condition of the sheep. The recommended doses are for sheep of various ages in fair to good condition. If the condition of the sheep is low, the dose should be reduced about one-fourth.

If the drenching is hurried, a portion of the fluid may enter the lungs of the animal with fatal results. It requires only a very small quantity of nicotine sulphate to kill a sheep should it reach the lungs. In hurried drenching, which is most frequently the case where automatic drenching guns are used, the tissues of the mouth and throat may become cut or bruised. The nicotine sulphate is rapidly absorbed through these wounds with frequently disastrous results.

While the nicotine sulphate and bluestone drench is highly effective against stomach worm, it should not be employed where a heavy stomach-worm infestation is present. Under such circumstances this drench becomes dangerous, as it may be rapidly absorbed into the body.

In sheep which are suffering from stomach worms, bluestone alone should be used.

It is always wise, before drenching a flock, to find out which species of worm is responsible. This can be readily determined by killing and examining one of the most affected sheep.

A LAMB-MARKING AND BLOWFLY SPECIFIC.

A lamb-marking and blowfly specific should be an antiseptic as well as a healing agent, and, besides killing the maggots present, it should give some protection to the sheep or lambs against maggots developing from a future strike, and should be easily washed from the wool during the scouring process.

A mixture recommended for use is made up as follows:—40 per cent. Shell dieselene oil or Vacuum 28-38 fuel oil; 55 per cent. fish, herring, or cod oil; 5 per cent. cresylic acid; and 0·1 per cent. sodium arsenite, or 1 lb. to 100 gallons.

For convenience in making 5 gallons of the mixture, take 22 pints fish oil, 16 pints fuel oil (not more than 875 specific gravity), 2 pints cresylic acid, and 1 oz. sodium arsenite.

To Mix.—Place the fish oil in a 5-gallon drum and add the sodium arsenite; shake well, and then add the cresylic acid and fuel oil. Should the weather be cold, heat at least some of the fish oil, and add the sodium arsenite and shake to secure a good suspension, and then add the other ingredients as above. The mixture should be well shaken before using, and shaken up occasionally to keep the sodium arsenite in suspension while in use. Apply with a clean brush or swab. In purchasing in quantities to make 100 gallons of the specific, the approximate price per gallon, including the container, has worked out at 3s.

DISINFECTION.

The object of disinfection is to destroy organisms and ultra-visible viruses which cause disease. It is a job which should certainly be done after the occurrence of one or more cases of contagious disease—such as tuberculosis, contagious abortion, swine fever, and influenza.

Periodical disinfection of stables, milking sheds, piggeries, and poultry runs is highly commendable as a measure of disease prevention.

The extent and thoroughness of the work would depend on the nature of the disease which had occurred, and would not need to be so extensive or intensive when merely carried out as a routine measure.

A common error in disinfecting premises is to first remove accumulations of excreta, discharges, dirt, and dust. Otherwise, the causal organisms and viruses contained in the accumulations are disseminated throughout the building, and may lodge in places which cannot be easily covered by the disinfecting solution afterwards.

The proper way is first to apply liberally to all parts of the premises a suitable disinfectant in solution, and to leave it in contact for twenty-four hours.

After the disinfectant has been allowed to act for that period, the walls and floors should be scraped (or scrubbed), and the scrapings soaked with kerosene and burnt.

Suitable solutions are phenol or other coal-tar preparation (1 pint to 4 gallons water), chloride of lime (1 lb. to each gallon of water), or crude carbolic acid (1½ pints to 4 gallons water), to be sprayed on all surfaces.

If shearing sheds and yards are disinfected before shearing commences, losses of stock through infection of wounds may be avoided.

"TICK WASHING" AND TICK FEVER.

Young cattle possess a natural resistance to tick fever, but this gradually grows weaker until at the age of twelve months for all practical purposes it ceases to exist. The foregoing applies to calves reared in clean areas and also (and this is the important point) to calves reared in ticky areas if such calves are sprayed so often and so regularly as to keep them entirely or almost entirely free of ticks. Under such conditions, the resistance to tick fever of calves in ticky areas at the age of twelve months will be little better than that of calves reared in clean areas.

The matter is worthy of close attention, as some farmers definitely overdo the treatment of calves for tick infestations. The belief is, of course, that the growth rate of the calves will be increased and their general wellbeing bettered, but although this is true enough, it is, notwithstanding, a dangerous course to pursue, as mortality from tick fever is likely to follow at the age of eighteen months to two years or older.

Calves should be allowed to carry a reasonable number of ticks from a few weeks old onwards. In this way their natural resistance to tick fever will be continually reinforced, so to speak, so that at the age of twelve months it will be just as strong as it was during the first few weeks of life. In normal circumstances, this resistance will, if the animal is continually exposed to moderate numbers of ticks, be retained throughout life.

TO PREVENT BRUISING IN TRUCKING YARDS.

Some bruising of stock occurs in the trucking yards, and it is quite commonly held that this is unavoidable. Suitable design of yards and races and quieter working of stock are the answers to this fallacy.

In moving cattle from yard to yard or pen to pen, there is some congestion just before, during, and just after passing gate or race. It is obvious that at such places rails should be flush with the posts and padding used where the fences make sharp angles. It is equally obvious that working must be very steady to avoid jamming and, consequently, bruising—more particularly with the outside beasts. To prevent undue crushing at the approach, it is best to have the fences funnel—or V-shaped. If the wings are long and the gate wide the working is not slowed up and the number that can pass through is regulated well back, so that a jam does not occur at the actual place of passage. After passing through, there should be no obstructions to prevent fanning out. For this reason, a straight fence forming a side of two yards is not desirable when a corner gate is used.

When working cattle through one yard to another, gates should be opposite each other—i.e., in a direct line with the direction in which the beasts are streaming. The wings to a crush should both converge. It is bad practice to have one wing in a direct line with one side of the crush. This is often the case when an existing fence is used for one wing. As cattle work better uphill, the loading-out race or crush should be slightly inclined upwards to the truck.

Cleanliness in Cow Bail.

OBSERVATIONS at milking time on some dairy farms reveal carelessness which is dangerous from a viewpoint of infection from bacteria. Bacteria in milk and cream are well-known causes of low-grade, inferior products, and safeguards against their introduction are essential.

The milking bucket should on no account be used as a washing utensil, either for the udder and teats of the cow or the milker's hands. The act of washing the udder transfers innumerable bacteria with the dirt and loose hair to the bucket, and a simple rinsing in cold water is not sufficient to remove them all. The need for separate milking buckets and washing buckets is therefore very obvious.

A bucket and cloths for washing the udders and a wash basin for washing the hands before milking each cow are hygienic necessities in the bails. The dairyman may well ask himself the question: "Would I take my meals with hands unwashed after completing milking operations?" The answer would be an emphatic "No!" Yet the cleanliness of his hands during milking is at least as important, for milk and cream are foods which may be easily contaminated.

Clean hands are just as essential during milking as at the dining table. It is therefore remarkable that many people who are scrupulously clean in the home are lamentably careless in the cowyard and dairy.

Another very common practice is the wiping of soiled, milky hands on the clothing. These same clothes, if worn throughout the day, soon acquire a most objectionable smell and attract flies. Sugar-bag aprons—which are easily made, inexpensive, and long-wearing—are suggested for use by all milkers. The aprons should, of course, be washed frequently.

The protection of milk against flies is also a matter of consideration. Most dairymen have in use a large, shallow milk vat, and this should be provided with a lid on which an opening has been left for the milk strainer, or, if milking machines are in use, for the releaser. This lid keeps out dust and vermin, and also is a help in maintaining the temperature of the milk before separating.

Hand milkers frequently moisten the cows' teats during milking from the milk in the bucket. This practice cannot be condemned too strongly, as the hands are usually soiled, and bacteria from the udder of the cow are transferred to the bucket.

The following points are all practised by the most successful dairymen:—

Wash the udders in buckets used only for that purpose.

Wash the hands after milking each cow.

Wipe the hands on a clean cloth, not on the clothes, and wear either an apron or overalls.

Aprons and overalls are easily boiled; so keep them clean.

Don't use an uncovered vat. Under the Dairy Regulations a cover for the vat *must* be provided.

A COMMON WINTER DEFECT IN MILK AND CREAM.

Now that cooler weather is approaching, a flavour defect which is likely to be a frequent cause of trouble in milk and cream is tallowiness —a defect which, depending upon its intensity and stage of development, is usually described as metallic, oxidised, oily, mealy, cardboard, and "cappy" taint. Although tallowy and related flavours may be brought about by other influences, they are usually traced to the exposure of milk products to metallic contamination, notably copper from factory appliances and iron from dairy farm equipment.

The more common occurrence of these faults in winter depends upon the ability of minute traces of metals in solution in milk and cream to accelerate chemical changes between the oxygen normally present in these liquids and a certain constituent of butterfat, with the formation of compounds which impart the characteristic flavours. Such low concentrations as 0·2 part per million of copper and 1·5 parts per million of iron will impart an objectionable taint. In summer, when microbial development is most active in milk, the dissolved oxygen is rapidly used up by the organisms for their own growth, and so they actually help to prevent the onset of tallowiness. Their action in this single instance in retarding rather than promoting the deterioration of milk and cream is in striking contrast with their usual behaviour, as they are responsible for almost all the major faults which occur in milk products.

The most up-to-date factory processing is quite unable to renovate tallowy cream, which, therefore, is always classed as second or pastry grade. Dairy farmers should look over all metal utensils with which milk comes into contact, and any from which the tin coating is worn off, or which shows signs of rusty patches, should be retinned if their condition warrants the expense. Any piece of equipment which is too old or in a state of disrepair which does not justify the cost of retinning should be immediately dumped. The continued use of such unsatisfactory utensils during the winter months will almost certainly mean de-graded cream and substantial monetary loss.

DRY MILKING IS CLEAN MILKING.

Milking with hands which are moistened with milk at the beginning of and during milking is known as wet milking. Dry milking—which is used always by the cleanest and most efficient milkers—means commencing with clean, dry hands, which are kept as dry as possible during milking.

The method of milking with unwashed udders and teats and moistening the unwashed hands with milk is an objectionable and dirty habit and seriously contaminates the milk, as well as chapping the teats. To anyone who doubts this no further evidence is necessary than a glance at the accumulation between the fingers of a person who practises wet milking. In some countries where milkers' competitions are held at agricutural shows and elsewhere, deliberate wet milking disqualifies a competitor.

It should be remembered by the dairy farmer producing milk for city or town requirements that wet milking causes loss of keeping quality, a serious disadvantage in a warm climate.

It is often claimed that dry milking is difficult for anyone unaccustomed to it, and in attempting a more hygienic method, vaseline is used as a lubricant to make stripping easier and to help keep the teats soft and flexible. This is certainly to be preferred to careless wet milking, but if the teats are washed before starting to milk and the milker also washes and dries his hands frequently during milking—as required by the Dairy Regulations—both are generally sufficiently pliable and the use of vaseline should be unnecessary.

Injured or chapped teats should be protected during milking by placing round them a piece of cotton wool and afterwards applying a suitable ointment. The ointment hastens healing and softens the teats for the succeeding milking.

LOW PRODUCTION COST.

Many dairy farmers supplying milk have cows capable of giving more than the one or two gallons they produce, but an owner is often sceptical as to whether the extra food required will be paid for out of increased production.

A simple trial lasting a fortnight will show how to rearrange both feed and production. Arrange for those cows which can be reasonably expected to produce more to get the extra feed. It should take the form of concentrates. A simple mixture for the production of an extra gallon is 3 lb. of maizemeal and of high-quality meat meal. Gradually bring the animals under test on to the full feed—usually a week is adequate. Test over a further week.

The cost would not exceed 7d. daily per cow. The increased yield in terms of cash then determines whether the particular cows under test are worth the extra feed. If they are, then it may pay to pension off low producers and apply the cost of their food to the purchase of concentrates for the proved animals.

In practically all cases, the food for two ½-gallon cows or one 1-gallon cow costs more than the extra feed which is to produce an extra gallon from a better milker.

The saving in labour also is worth consideration.

COMFORT FOR COWS IN WINTRY WEATHER.

The dairy farmer who rugs his cattle during wintry weather usually reaps the advantage of an undiminished cream return. Many other farmers would like to follow suit, but are deterred by the cost of buying a good warm rug. There is no reason, however, why a farmer so placed should not make his own cow rugs. All that is required are the necessary number of corn sacks, a ball of twine, a packing needle, and ordinary ingenuity.

A warm rug can be made out of two corn bags, but for a big beast three bags might be necessary. Split the bags down the seams, sew them together, and place on the cow. After getting the right fit, cut off a strip of bagging so that the rug will not hang too low. This strip cut off may then be folded and sewn to the rug as a thigh strap. The front of the rug is then fitted by turning up the corners and sewing them to the sides of the rug. This strengthens the rug and obviates the necessity for cutting off the spare portion, which the cow would otherwise tread on. Neck and other fastenings may be easily fashioned to make the rug complete.

This home-made rug will keep the cow warm, and after a few days' wear will become practically waterproof. The rug can be slipped off and on quite easily, and it is advisable to remove it every day, except in bleak or rainy weather. Each cow's name may be painted on its own rug. Rugging will certainly increase winter milk production.

FLUSHING THE SEPARATOR.

The test or percentage of fat required in cream should be not less than 38 per cent. during the hot summer months and not less than 34 per cent. during the cooler months of the year. Whatever make of separator is used, during the process of separating satisfactory results can only be obtained when the cream screw is adjusted so that the driven speed of the separator conforms with the corresponding number of resolutions per minute recommended by the maker of the machine.

At the completion of separating, flushing with cold or warm water so as to remove the last of the cream from the patties is an undesirable practice. If the cream bucket is not removed during the process some of the impurities and slime adhering to the bowl may be removed and deposited in the cream. This applies particularly if warm water is used. When separated milk is used for flushing, excessive milk solids are introduced into the cream, and these will have a detrimental effect on quality, as well as lowering the fat test. Thus the proceeds of flushing should be fed to the pigs or calves on the farm. The maintenance of cream quality is too important to be impaired by laxity in this respect.

TO CHECK A BAD HABIT IN CALVES.

Skim milk-fed calves are often seen sucking each other after the buckets have been emptied. This bad habit should be stopped. Septic conditions, malformed teats, distorted udders, and early lactation in heifers may be traced to the habit of calf sucking calf. Either keep the calves away from one another by leg-roping until the taste of milk has dissipated, or feed them with meal—e.g., crushed or ground grain, pollard, bran, &c.—immediately after they have finished the milk.

Care of Weaners.

TO obtain best results from pigs, they should be kept growing steadily from the time they are born until they are marketed. As about half the pig's ration is used to maintain body heat and physical energy, fast-growing pigs will ultimately require less food for maintenance than the slow-growing ones. Hence the practice of growing weaners slowly up to store stage and then feeding heavily for a few weeks is not recommended, particularly when food is plentiful.

Weaners should not be forced to experience sudden changes in diet after their dam has been removed; such changes will check their growth, and weaners so treated usually require extra time and food to prepare them for market.

Heavy weaning weights at eight weeks are evidence of good sows and proper management. At this time, the young pigs should be practically independent of the sow, if they have been trained to feed from a trough, and so there is little or no check to their growth when weaned. Pigs which weigh 40 lb. to 50 lb. at weaning time usually reach market weights sooner and on less food than weaners weighing 20 lb. to 30 lb. Therefore, proper attention to the weaners is important in any effort to market pigs quickly and economically. One of the rules of the piggery should be *heavy, healthy weaners.*

SALT FOR PIGS.

Salt is harmful to pigs only when fed in excess. In tests to determine whether salt has any toxic effect increasing amounts up to 2·5 oz. of salt a day were fed to pigs, without any harmful result, and the animals gained normally in weight. This result was obtained under conditions in which the pigs had free access to water, for if pigs are fed increasing amounts of salt without water the result will be disastrous.

OILING PIGS.

In cool weather, pigs do not wallow in mud holes as they do in the warmer months, and so they do not have their natural protection from body lice.

The pig louse is fairly large—about $\frac{1}{8}$ inch in length—and easily seen if the pig's hair is turned back, or if sucking pigs are examined around the thighs and under the belly.

Pigs which are heavily infested with lice are unthrifty and slow-growing, become debilitated, and are more susceptible to diseases.

The control of lice should receive the attention of pig raisers, for it is uneconomic to have lice-infested stock. Treatment with oil is practicable and inexpensive. Any oil applied to the pig's skin will destroy lice which come in contact with it. An oil in common use is crude petroleum oil. An efficient method of application is by spraying a very thin mist of oil through a pump spray, so that the pigs are completely covered with a thin film of oil. The oiling should be done in the late afternoon so that the sun will not cause the oil to "burn" the pigs. The pigs should be congregated in a race or pen or at the feeding trough, so that time and oil may be saved.

Three thorough oilings given at weekly intervals should assure complete control of pig lice.

PIG FEEDING.

With good prices for pigs, it usually pays the farmer to purchase some concentrated foods to feed in conjunction with home-grown foods, which are relatively inexpensive, but insufficient to feed all his pigs properly. It rarely pays to keep pigs in store condition.

Given good weather conditions during the winter, the milk supply may not fall to any great extent, as forage crops would be available for dairy cattle. Forage crops could also be grown for pigs. Good green forage may be used to replace one-third of the growing pigs' ration and two-thirds of the dry sow's ration; hence, when weather conditions are favourable, an effort should be made to provide a succession of forage crops for pigs, and thus save an appreciable amount of grain, meal, and milk.

Crops suitable for autumn and winter planting include rape, field peas, and oats. Rape is a very quick-growing crop under favourable conditions, and is usually ready for grazing eight to ten weeks after planting. If the pigs are removed from the crop when most of the leaves have been eaten, the crop should make fresh growth, and in this way three or more grazings may be obtained. Field peas are best grazed by pigs when the seed pods are well formed, while the plant is still green; oats should be grazed off by pigs when about 10 inches high.

Wherever practicable, grazing is more satisfactory than cutting the crop and feeding it to pigs in their pens. If the regular pig paddocks can be cultivated, cropped, and fed off, the soil fertility will benefit, much labour and food will be saved, and the sanitation of the piggery will be improved.

Name and Address.	Name of Hatchery.	Breeds Kept.
G. Adler, Tinana	Nevertire ..	White Leghorns, Australorps, Rhode Island Reds, and Langshans
F. J. Akers, Eight Mile Plains ..	Elmsdale ..	Australorps
E. J. Blake, Rosewood	Sunnyville ..	White Leghorns, Australorps, White Wyandottes, and Rhode Island Reds
A. F. Buchler, Milman	Pincrow ..	White Leghorns
R. H. and W. J. Bowles, Glenmore road, North Rockhampton	Glen	White Leghorns and Australorps
J. Cameron, Oxley Central ..	Cameron's ..	White Leghorns and Australorps
M. H. Campbell, Albany Creek, Aspley	Mahaca ..	White Leghorns and Australorps
J. E. Caspaney, Kalamia Estate, Ayr	Evlington ..	White Leghorns
J. L. Carrick and Son, Manly road, Tingalpa	Craigard ..	White Leghorns and Australorps
N. Cooper, Zillmere road, Zillmere	Graceville ..	White Leghorns
R. B. Corbett, Woombye ..	Labrena ..	White Leghorns and Australorps
T. G. Crawford, Stratford, via Cairns	Rho-Isled ..	Rhode Island Reds
Dr. W. Crosse, Musgrave road, Sunnybank	Brundholme ..	Australorps, White Leghorns, and Rhode Island Reds
Dixon Bros., Wondecla ..	Dixon Bros. ..	White Leghorns
F. G. Ellis, Old Stanthorpe road, Warwick	Sunny Corner ..	Australorps
Elks and Sudlow, Beerwah ..	Woodlands ..	White Leghorns and Australorps
W. H. Gibson, Manly road, Tingalpa	Gibson's ..	Australorps and White Leghorns
Gisler Bros., Wynnum ..	Gisler Bros. ..	White Leghorns
G. Grice, Loch Lomond, via Warwick	Kiama ..	White Leghorns
J. W. Grice, Loch Lomond, via Warwick	Quarrington ..	White Leghorns
Mrs. M. Grillmeier, Mount View, Milman	Mountain View	Australorps, Minorcas, and Rhode Island Reds
C. and C. E. Gustafson, Tannymorel	Bellevue ..	Australorps, White Leghorns, and Rhode Island Reds
P. Haseman, Stanley terrace, Taringa	Black and White	Australorps and White Leghorns
C. Hodges, Kuraby	Kuraby ..	White Leghorns and Anconas
H. Hufschmid, Ellison road, Geebung	Meadowbank ..	White Leghorns, Brown Leghorns, Minorcas, Australorps, and Rhode Island Reds

Name and Address.	Name of Hatchery.	Breeds Kept.
J. McCulloch, White's road, Manly	Hindes Stud Poultry Farm	White Leghorns, Brown Leghorns, and Australorps
F. McNamara, Vogel road, Brassall, Ipswich	Frammara ..	White Leghorns and Australorps
A. Malvine, junr., The Gap, Ashgrove	Alva	Australorps and White Leghorns
H. L. Marshall, Kenmore ..	Stonehenge ..	Australorps and White Leghorns
W. J. Martin, Pullenvale ..	Pennington ..	Australorps, White Leghorns, and Langshans
J. A. Miller. Racecourse road, Charters Towers	Hillview ..	White Leghorns
F. S. Morrison, Kenmore ..	Dunglass ..	Australorps, White Leghorns, and Brown Leghorns
Mrs. H. I. Mottram, Ibis avenue, Deagon	Kenwood Electric	White Leghorns
J. W. Moule, Kureen	Kureen ..	Australorps and White Leghorns
D. J. Murphy, Marmor ..	Ferndale ..	White Leghorns, Brown Leghorns, Australorps, Light Sussex, and Silver Campines
S. V. Norup, Beaudesert rd., Cooper's Plains	Norups ..	White Leghorns and Australorps
H. W. and C. E. E. Olsen, Marmor	Squaredeal ..	White Leghorns, Black Leghorns, Australorps, Brown Leghorns, and Anconas
A. C. Pearce, Marlborough ..	Marlborough Stud Poultry Farm	Australorps, Langshans, Rhode Island Reds, Light Sussex, White Wyandottes, Khaki Campbell Ducks, Indian Runner Ducks, and Bronze Turkeys
E. K. Pennefather, Douglas street, Oxley Central ..	Pennefathers ..	White Leghorns and Australorps
G. Pitt, Box 132, Bundaberg ..	Pitt's Poultry Breeding Farm	White Leghorns, Brown Leghorns, Australorps, Langshans, White Wyandottes, Rhode Island Reds
G. R. Rawson, Mains road, Sunnybank	Rawson's ..	Australorps
J. Richards, Atherton	Mount View ..	White Leghorns and Australorps
H. K. Roach, Wyandra ..	Lum Burra ..	Australorps and White Leghorns
C. L. Schlencker, Handford road, Zillmere	Windyridge ..	White Leghorns
S. E. Searle, New Cleveland road, Tingalpa	Tingalpa ..	White Leghorns and Australorps
A. Smith, Beerwah	Endcliffe ..	White Leghorns and Australorps
A. T. Smith, Waterworks road, Ashgrove	Smith's ..	Australorps and White Leghorns
T. Smith, Isis Junction	Fairview ..	White Leghorns and Langshans
H. A. Springall, Progress street, Tingalpa	Springfield ..	White Leghorns
J. Steckelbruck, The Gap, Ashgrove	Cosy Nook ..	White Leghorns and Australorps
A. G. Teitzel, West street, Aitkenvale, Townsville	Crescent ..	White Leghorns
W. J. B. Tonkin, Parkhurst, North Rockhampton	Tonkins' ..	White Leghorns and Australorps
W. A. Watson, Box 365, P.O., Cairns	Hillview ..	White Leghorns
G. A. C. Weaver, Atherton ..	Weaver's ..	Australorps, White Leghorns, Buff Leghorns, Wyandottes, Anconas, Indian Game, Rhode Island Reds, Barred Rocks, Buff and Black Orpingtons
H. M. Witty, Kuraby ..	..	White Leghorns and Australorps
P. A. Wright, Laidley ..	Chillowdeane ..	White Leghorns, Brown Leghorns, and Australorps
R. H. Young, Box 18, Babinda	Reg. Young's ..	White Leghorns, Australorps, and Brown Leghorns

Following is a list of new applications received up to the 20th March, 1940:—

Name and Address.	Name of Hatchery.	Breeds Kept.
B. Cross, Apple Tree Creek, Childers	Spring Hill ..	White Leghorns, Australorps, and Langshans
O. M. Dart, Upper Brookfield ..	Woodville ..	Australorps, Rhode Island Reds, White Leghorns and Langshans
C. Mengel, New Lindum road, Wynnum West	Mengels ..	Australorps
V. White, Cleveland	Pinklands ..	White Leghorns

MARKING EARLY LAYING PULLETS.

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

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

(1) Early laying pullets are, as a rule, the highest producers;
(2) Birds that lay late into the autumn and are late in moulting are also high producers.

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

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

Pullets which are early layers show the following characteristics:—

(1) A large red comb;
(2) An active disposition and a ravenous appetite;
(3) Roominess between the keel and pelvic bones;
(4) An occasional disappearance of the yellow coloration round the vent in some yellow shanked varieties.

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

During the following season, all fowls that were marked as late maturing the previous autumn and moult in December, January, and

February can be culled. All the early laying birds and those that moult after 1st March may be kept for layers or placed in a special breeding pen and mated to a male known to have come from a high laying hen that has been trap nested. In this way the egg production of the offspring may be raised.

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

FEEDING FOWLS.

Poultry-raisers as a whole have a very fair idea of the principles and practice of feeding, and take into consideration factors which make for efficient and economic production.

The present-day values of cereals may induce some to depart from old and accepted practices in order to reduce costs. There are three points, however, that must not be lost sight of, if the best results are to be obtained, and the general health of the stock maintained—viz., the vitamin content of the ration, the protein content, and the quantity supplied.

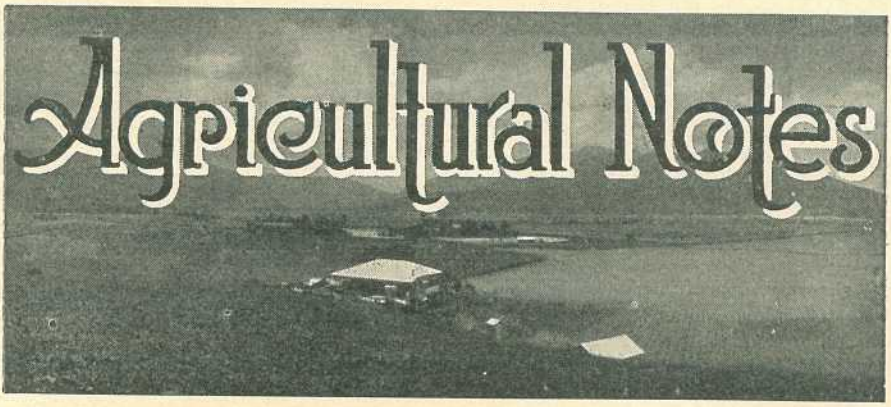
Vitamins.—Vitamin A is of outstanding importance at the present juncture, for a shortage in the ration may cause outbreaks of nutritional roup as well as lowered egg production. The feeding of yellow maize and green feed ensures a sufficient supply of this vitamin.

On most poultry farms during the winter months green feed is not plentiful; consequently under normal circumstances the loss due to a shortage of maize cannot be overcome. It is therefore of paramount importance that the poultry-raiser should make a special effort to supply the birds with good succulent green feed. Green feed is the cheapest form in which the birds' requirement of this vitamin can be supplied. In cases where home-grown feed cannot be obtained, poultry-raisers should use at least 10 per cent. of good green lucerne chaff or meal in the mash fed to their birds.

Protein.—To obtain the maximum economic production, laying birds should have in their ration (i.e., grain and mash) a total of approximately 15 per cent. of crude protein. Maize has about 10 per cent. and wheat about 13 per cent. of protein. Where maize has been used extensively and is replaced with wheat, it may be desirable to reduce slightly the protein content of the ration. This is most easily brought about by a slight reduction in the meat meal fed.

Generally speaking, however, the protein-rich meat meal is not overfed, and its greater use is advisable in certain circumstances. This is particularly so in the case of the poultry-raiser who feeds extensive quantities of skim milk to his birds. With the approach of winter the milk supply will probably diminish. In such cases the loss of protein of animal origin in the form of milk should be supplemented with meat meal.

Quantity.—Providing the right kind of food is being used, economic production is only possible by feeding the birds all they will consume. Do not be afraid of making your birds unduly fat. The good producer will convert the food supplied in excess of body requirements itno eggs. Birds which cannot do this should be culled and sold for table purposes.



Winter Pastures.

MANY farmers will soon be preparing land for sowing winter pastures to provide grazing during winter and spring. The sowing of winter pastures should be done during late March or in April. Later sowings will be successful only if exceptionally good seasonal conditions are experienced subsequent to sowing. Annual winter pastures, which are being sown for the sole purpose of providing feed during the present year, must go in early if a long grazing season is to be obtained.

If through dry weather or some other circumstances the preparation of land intended for winter pastures has not been done thoroughly, and a fine seed-bed is not available, the sowing of permanent winter pastures is not recommended. Instead, an annual pasture should be laid down, and after the land has been ploughed in the summer the area should be well worked for autumn sowing with a permanent pasture mixture in 1941.

Winter pastures should be sown only on land of at least fairly good fertility. If success is to be achieved with valuable grasses—such as *Phalaris tuberosa,* perennial ryegrass, Italian ryegrass, and prairie grass —it is essential that the soil should be of good quality. Land not quite up to first-class standard may support Wimmera ryegrass and cocksfoot pastures, but infertile and roughly prepared land cannot be expected to maintain a good winter pasture. Cultivation areas which have been "cropped out" should not be put straight down to winter pasture, as is often done, but should have their lost fertility restored to some extent by green manuring.

The winter-growing pasture plants available for use include perennial species—such as *Phalaris tuberosa,* perennial ryegrass, cocksfoot, red clover, white clover, and lucerne, and annual species, including Italian ryegrass, Wimmera ryegrass, prairie ryegrass, and Berseem clover. Not all of these plants are, of course, suited to all districts, but recommendations regarding suitable mixtures for most localities in the southern dairying and agricultural districts are available on application to the Department of Agriculture and Stock.

WINDBREAKS AND SHELTER TREES.

For the comfort of stock in cold weather windbreaks are a necessity, especially on open plain or high tableland country. In timbered country, provision should be made for windbreaks when the land is being cleared, by leaving suitable stands of the original forest covering. Otherwise, the expense of establishing shelter belts will have to be incurred later on. Meanwhile, stock will have to suffer all the discomfort caused by winter's frigid westerlies, which blow usually for days on end.

In country which has already been cleared the planting of suitable trees on the prevailing windward boundaries of farms on tablelands, plains, and undulating country is, therefore, worth serious consideration. If edible trees are planted they might be used in times of drought. A farmer would naturally hesitate before destroying shelter trees for feeding purposes, but, if the necessity arises, edible tres may be lopped without destroying them.

The undermentioned trees are mainly suitable for planting on the Darling Downs. Edible types are the kurrajong, bottle tree, Portuguese elm, honey locust, and carob bean. Less palatable trees are the cypress (*Cupressus torulosa*), *Pinus radiata*—commonly known as *Pinus insignis*—white cedar, and *Bauhinia hookeri*. The well-known and admirable western tree, the wilga, should be added to this list if it is available in the local forests. Although there is a considerable amount of variation in the palatability of individual trees, the wilga is both a useful and extremely ornamental species.

In most cases the trees mentioned can be purchased from nurserymen. In the event of expense proving an obstacle to adequate planting, the trees can be raised from seed in an improvised nursery on the farm. The seeds could be germinated in shallow boxes or tins about twelve months before the young trees are required for planting. In frost-free areas June, July, and August are suitable months for planting out the young trees in their permanent locations. Some protection must, however, be given to the plants in frost-susceptible districts if midwinter planting is attempted.

Protecting the young trees from stock is most important. If the trees are planted near a boundary fence, it might be found most convenient to erect a second inner fence to keep stock away from the trees until they are high enough to be out of reach. Smaller farm stock, such as sheep, can be let into the enclosure once the trees have attained sufficient height for their foliage to be above the reach of the animals.

LUXURY CROPS ELIMINATED.

In Britain, the growing of all luxury crops has been discontinued and the production of foodstuffs substituted. Derelict orchards are being grubbed and cleared and made available for potato growing. Strawberry growing is not considered essential, and the growing of asparagus, rhubarb, as well as flowers is being discouraged in order to make room for essential vegetables.

War-time necessity also has led to a curtailment of racing, and paddocks around the big racing centres like Epsom and Newmarket are full of valuable thoroughbred horses turned out to grass.

Bean Fly Control.

DURING recent seasons bean growers in the coastal areas, by following a tentative spraying schedule, have been fairly successful in controlling bean fly in the late summer and autumn crops. Results from recently completed departmental experiments enable definite recommendations to be made for the coming season.

The recommended spraying formulæ are:—

	(1)	(2)
Nicotine sulphate	1 fl. oz.	¼ pint
White oil	8 fl. oz.	2 pints
Water	5 gallons	25 gallons

The first application of the spray should be made three days after the first beans appear above ground and subsequent applications at four-day intervals. In the event of a particularly uneven strike, which occurs at times during a dry spell, the interval between the first and second sprays may be reduced to three days.

Four to six sprays are usually required for mid- and late-summer crops planted in February and March, and two to four for autumn and early winter crops planted in April and May. After May, spraying is rarely required. As the severity of fly attack varies considerably from year to year, growers should determine the exact number of sprays to be applied to any planting from observations of actual prevalence of flies in the crop, the extent of damage in the district, and the growing conditions of the plants.

Attention should be given to the following points:—

(*a*) Keep the plants growing well by correct cultural measures. Hill them up thoroughly to encourage the growth of secondary roots from the stem. Vigorous, rapid growth helps a great deal in the fight against this pest.

(*b*) Mix the spray in the correct proportions. Graduated measuring vessels, such as medicine glasses for small quantities or pint measures for larger volumes, are cheap and readily obtainable. Guesswork may result in waste of expensive spray materials, spray injury to plants, or inefficient fly control.

(*c*) Prepare fresh spray for each day's application. The mixture deteriorates rapidly if held in open containers.

(*d*) Spray thoroughly, though it is necessary to wet only one surface of the leaves. Use a double nozzle on the ordinary knapsack sprayer.

(*e*) If rain falls before the spray has properly dried on the leaves, apply another spray as soon as the weather clears.

THE QUALITY OF QUEENSLAND NUTS.

Subjoined is an extract from the December (1939) *issue of "The Peanut Journal and Nut World," the official organ of the Virgini-Carolina Peanut Association, Suffolk, Virginia, U.S.A., which is of especial interest to Queensland nutgrowers*—

NUTS FROM HAWAII NEW APPETIZER.

Gourmets and housewives have discovered that Hawaiian macadamia nuts give a tantalizing and tasty flavour to their meals when used as appetizers, relishes, cocktail crunches, or blended with almost any dish to impart an exotic deliciousness. The delectable taste of this caviar of the nut industry is matched by its nutritious elements, since it contains up to 70 per cent. of health-giving oil and an abundance of protein.

The macadamia nut is a tempting round kernel about the size of a hickory nut. In its natural ripe state, you would have a great problem in eating it. After clawing away a fibrous husk about a quarter of an inch thick, you would find the kernel still enclosed in a hard shell strong enough to crack a nut cracker. If hammered away, and the kernel taken out intact, your work is still only half done, for the kernel contains more than one-fifth moisture which must be dehydrated before roasting, especially if you don't want the macadamia to taste like just any other nut.

It wasn't until four years ago that the islands began building up a macadamia nut industry to rival the pineapple industry. There has always been an undersupply of nuts in the United States and there has never been an oversupply in Hawaii. However, the 182 acres of macadamias grown in Hawaii in 1932 has increased to nearly 1,000 acres to-day. Of the 81,000,000 lb. of nuts which the United States imports a year, macadamia nuts are considered the aristocrat of the nut family, its fame arising from the delicacy of their flavour.

Now macadamias can be obtained, it is said, in four sized vacuum packed jars to add that "Here's How" tang to any meal, whether it be a formal dinner or a midnight snack. They are especially good when included in warm weather menus since they give an energizing lift to salads and desserts.

The Fruit Market.

J. H. GREGORY, Instructor in Fruit Packing.

MARCH is usually a wet month with depressing marketing conditions for fruit and vegetables. Last month these conditions were, however, offset by an exceptionally dry period in other States of the Commonwealth.

Apple values were high because of a shortage of new season fruit. Pineapples were often severely "burnt" by both sun and wind, which reduced factory supplies and the volume of quality lines for the fresh fruit trade. Water blister was reported as affecting the quality of some southern consignments. Bananas were in demand at high price levels. If growers refrain from sending green fruit during the approaching colder months, prices should remain firm. First lines of new season custard apples have met with a ready demand. As with bananas, growers also are cautioned against consigning green custard apples and so spoiling the market. New season citrus fruit is now coming forward to a very favourable market; in fact, prices have been higher than for many seasons past—that is, at corresponding marketing periods. Vegetables, generally, have been in short supply with values strong.

The following were the ruling market prices during the last week of March:—

TROPICAL FRUITS.

Bananas.

Brisbane.—Cavendish: Small, 11s. to 15s.; Sixes, 14s. to 18s.; Sevens, 14s. to 19s.; Eights and Nines, 17s. to 20s.

Sydney.—Cavendish: Sixes, 14s. to 18s.; Sevens, 18s. to 21s.; Eights and Nines, 21s. to 24s.

Melbourne.—Cavendish: Sixes, 16s. to 18s.; Sevens, 17s. to 20s.; Eights and Nines, 20s. to 22s.

Adelaide.—Cavendish: 26s. to 28s. per case.

Bunches 1½d. to 10d. per dozen.

Lady's Fingers, 4d. to 9d. per dozen.

Sugars, 1½d. to 4d. per dozen.

Pineapples.

Brisbane.—Smoothleaf, 6d. to 3s. 6d. per dozen, 2s. 6d. to 7s. per case; Ripley, 2s. to 4s. per dozen, 5s. to 7s. per case.

Sydney.—Smoothleaf, 7s. to 13s. per case.

Melbourne.—Smoothleaf, 6s. to 10s. per case, many lines showing water blister.

Adelaide.—Smoothleaf, 16s. to 18s. per case.

Papaws.

Brisbane.—Local, 4s. to 6s. bushel case; Yarwun, 10s. to 12s. bushel case. Growers are advised to carefully select fruit which will not ripen quickly.

Sydney.—11s. to 15s. tropical case.

Custard Apples.

Brisbane.—5s. to 7s. per half bushel. Care in sending only matured fruit to market should be taken at this stage of the season to avoid causing decreased consumption which would lower prices.

Monstera Deliciosa.

3s. to 4s. per dozen.

Avocados.

Brisbane.—8s. to 10s. per half bushel.

OTHER TROPICAL FRUITS.

Rosellas.

3s. to 3s. 6d. per sugar bag.

CITRUS FRUITS.

Oranges.

Brisbane.—Navel Oranges: Locals, 8s. to 13s.; Gayndah, 14s. to 16s.; Commons, 8s. to 10s.; Second Crop Valencias, 5s. to 7s.

Grapefruit.

Brisbane.—Gayndah, 8s. to 10s.; Palestine Grape Fruit, 35s. per case, 4s. 6d. per dozen.

Sydney.—Queensland, 10s. to 14s. Immature hard of sale.

Melbourne.—Queensland Grape Fruit arriving too green and immature, making sales hard to achieve.

Lemons.

Brisbane.—Locals, 8s. to 12s.; Gayndah, 10s. to 17s.

Sydney.—Queensland, 15s. to 24s.

DECIDUOUS FRUITS.

Apples.

Brisbane.—Jonathan, 8s. to 11s.; Granny Smith, 8s. to 10s.; Delicious, 9s. to 12s.; Others, 8s. to 10s.

Pears.

Brisbane.—Howell, 10s. to 13s. B de Cap, 10s. to 12s.; B. Bosc, 10s. to 12s.

Plums.

Brisbane.—N.S.W., 9s. to 10s.

Quinces.

Brisbane.—5s. to 7s. per bushel.

OTHER FRUITS.

Grapes.

Brisbane.—Waltham Cross, 8s. to 10s.; Muscatels, 10s. to 12s.

Tomatoes.

Brisbane.—Coloured, 3s. to 4s.; Green, 2s. 6d. to 3s.; Ripe, 3s. to 3s. 6d.

Sydney.—Stanthorpe, 2s. to 6s.

Passion Fruit.

Brisbane.—First Grade, 14s. to 17s.; Seconds, 8s. to 10s.

Figs.

2s. 6d. to 3s. 6d. per tray.
8d. to 9d. per box.

MISCELLANEOUS VEGETABLES.

Rockmelons.—4s. 6d. to 7s. bushel.

Cucumbers.—4s. to 5s. bushel.

Pumpkins.—4s. to 6s. bag.

Marrows.—1s. to 3s. dozen.

Lettuce.—1s. to 3s. dozen.

Cabbages.—6d. to 5s. dozen; Stanthorpe, 4s. to 9s. dozen.

Beans.—Stanthorpe, 5s. to 7s. bag.

Peas.—10s. to 12s. bag; New South Wales, 16s. to 24s. ½-cwt.

Beetroot.—6d. to 1s. 6d. bundle.

Chokos.—6d. to 1s. 6d. dozen.

Parsnips.—6d. to 1s. bundle.

Carrots.—4d. to 6d. bundle.

South Australian Celery.—14s. to 21s. crate.

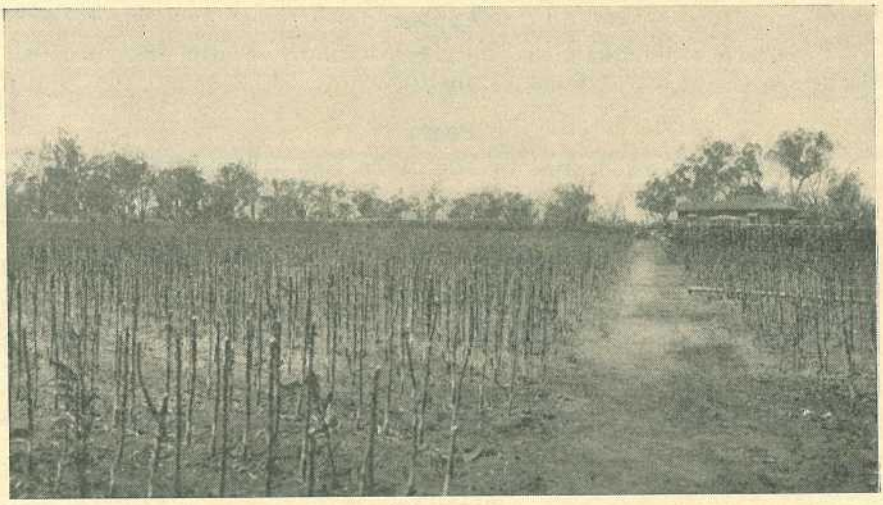


Plate 122.

BENYENDA NURSERY, NEAR GAYNDAH.—In this nursery there are 60,000 citrus trees.

In Memoriam.

IWAN WASSIL HELMSING.

THE death on 23rd March of Mr. I. W. Helmsing, Illustrator, Division of Plant Industry (Research), Department of Agriculture and Stock, is recorded with deep regret. Born in England fifty-five years ago, he had a most varied and interesting life. Throughout his whole career, however, he maintained a definite interest and ability in art work and microscopy, and these interests culminated in the excellent output of scientific illustration work in the Department during the past fifteen years.

Plate 123.

As an adventurous young man he forsook clerical work, first in England and later in Germany, to explore possibilities in Patagonia, South America. After some years in the pastoral industry there, he went to New Zealand, where for a time he engaged in fruit-growing. His biological interests later gained for him an appointment in New Zealand as an instructor in fruit culture. The desire for personal independence led him to Australia and for a period he was a successful banana-grower in the Tweed River district of New South Wales—a venture that was terminated by a disastrous outbreak of bunchy top disease of bananas.

During all those years he had carried with him a microscope which he possessed as a youth, and had also developed a remarkable talent for water colour work, mainly of botanical and plant pathological studies.

By his work in the Department he soon won recognition as a scientific illustrator of high standing. His work ranged through many classes of subject-matter—such as entomological, plant pathological, botanical, and veterinary specimens—and his output had for years added to the value and attractiveness of Departmental publications by making structures and forms intelligible to readers, which verbal descriptions would never adequately convey. Published illustrations included pen and ink, wash and colour, the pen and ink drawings being of a particularly fine, painstaking, and characteristic technique that is outstanding. Much of his work, in the form of insect life history studies in water colour, line the walls of the Departmental museum and remain as a fitting and lasting monument to his memory.

In addition, Mr. Helmsing studied taxidermy while in the Department with a view to adding to the collection of preserved insectivorous birds in the museum. In recent years he took up photography as a hobby and made official use of this interest

along the lines of photomicrography, producing some excellent photomicrographic illustrations where the strict authenticity of a photograph of minute structures was desirable. This photographic interest was linked with a love for the open air, his holidays being spent wandering amidst mountain scenery, mainly of the National Parks, recording striking views and studying native plant and bird life.

The death of the late Mr. Helmsing has left a distinct gap in the organisation of the Department of Agriculture and Stock, regrettable not only officially but also to his friends and colleagues, who recognised and admired his many sterling qualities. Sincere sympathy is felt for those whom he has left bereaved.

BRICE HENRY.

BY the untimely death of Mr. Brice Henry on 21st February last, North Queensland lost one of its most esteemed pioneers, and the State a citizen who in the course of a notable career had given great service to his country.

Brice Henry was probably best known to *Journal* readers for his enterprise in starting a scheme for fattening cattle on tropical coastal lands on his Tully property, to which reference has been made frequently in these pages and which, it is believed, will have a far-reaching influence on the development of the beef-raising industry in the Far North. In furtherance of this scheme, he made considerable areas of land available for field trials of introduced grasses. His remarkable success with this project, already beyond the experimental stage, has been recorded in official publications of both State and Commonwealth.

Plate 124.

Brice Henry will, however, be remembered for many other achievements. His was an essentially national outlook and with his great natural ability he became a driving force behind every progressive movement in the North. Practical, energetic, courageous, tenacious and far-sighted, he gave of his best to his generation. Quick to appreciate the possibilities of a richly endowed and yet unpeopled province, he made of land settlement and expansion a hobby. The moving spirit in enterprises which later brought abundant prosperity to his district, he had the happiness of seeing many a daring venture of his own initiation develop from phantasy to accomplished and enduring fact.

Born at Mittagong, New South Wales, in 1877, Brice Henry came while still a child with his parents to North Queensland, where they were among the pioneer settlers. In such a character-building environment he grew up to be an expert bushman with all the qualities of an intrepid explorer. North Queensland, which he knew throughout its development from untrodden jungle and trackless forest to the land of rich fulfilment it is to-day, was to him as an open book. The Tully sugar mill, to which he became one of the largest suppliers of cane, was, to a big extent, the result of his foresight, bold initiative, and business acumen. In every respect he was a big man who contributed generously, cheerfully, and ably to the welfare of the whole community. In local government, as councillor and chairman of the Cardwell Shire Council for many years, he did great work, and in every other district activity and institution Brice Henry was a leader of strength, wisdom, and kindly public spirit. Among other public offices held by him were patron of the Tully District Show Society, president of the Tully Chamber of Commerce, and member of the Tully Mill Suppliers' Executive, Tully Hospital Board and Ambulance Committee. In addition, he was a generous supporter of patriotic bodies, and for the Diggers of the A.I.F. and ex-service men generally he had a special regard.

To his bereaved family deep sympathy is extended.

PRODUCTION RECORDING.

List of cows and heifers officially tested by officers of the Department of Agriculture and Stock which have qualified for entry into the Advanced Register of the Herd Books of the Australian Illawarra Shorthorn Society, the Jersey Cattle Society, the Ayrshire Cattle Society, and the Guernsey Cattle Society, production charts for which were compiled during the month of February, 1940 (273 days unless otherwise stated).

Name of Cow.	Owner.	Milk Production.	Butter Fat.	Sire.
		Lb.	Lb.	
AUSTRALIAN ILLAWARRA SHORTHORNS.				
MATURE COW (STANDARD, 350 LB.)				
Nellie 4th of Alfa Vale	W. H. Thompson, Alfa Vale, Nanango	20,789·65	760·431	Reward of Fairfield
Blacklands Princess 6th	P. Doherty, Box 31, Gympie	10,275·8	411·605	Premier of Hillview
SENIOR, 4 YEARS (STANDARD, 330 LB.)				
Kyabram Marie 3rd	A. H. E. Black, Kyabram, Kumbia	9,126·9	469·206	Springlands Brigadier
Rosehill Dahlia 3rd	W. Flesser, Boyland	9,488·5	346·981	Dnalwon Count
Palmetto Janie	R. Tweed, Kandanga	7,834·1	344·384	Glengallan Major
JUNIOR, 4 YEARS (STANDARD, 310 LB.)				
Navillus Violet 5th	C. O'Sullivan, Navillus, Ascot, Greenmount	10,312·5	413·108	Parkview Mars
SENIOR, 3 YEARS (STANDARD, 290 LB.)				
Barwin Royal 3rd	G. A. Meyers, Imbil	7,346·35	327·001	Blacklands Jewel
JUNIOR, 3 YEARS (STANDARD, 270 LB.)				
Alva Glen Plum	G. H. Knowles, Alva Glen, Nanango	10,018·4	406·508	Darcy of Iroquois
Highfields Rosemary 2nd	J. A. Heading, Highfields, Murgon	8,489·65	326·952	Greyleigh Legend
SENIOR, 2 YEARS (STANDARD, 250 LB.)				
Kalinga Roseleaf 4th	J. A. Heading, Highfields, Murgon	8,771·25	339·242	Headlands Hero
Barwin Sally 2nd	G. A. Meyers, Imbil	7,590·4	329·743	Blacklands Jewel
JUNIOR, 2 YEARS (STANDARD, 230 LB.)				
Tevor Hill Snowflake	Geo. Gwynne, Umbiram	7,413·71	329·057	Corunna Supreme
Trevor Hill Maple	Geo. Gwynne, Umbiram	7,213·11	296·932	Corunna Supreme
Faversham Minnie (214 days)	N. Bidstrup, Warra	7,623·01	295·341	Faversham Rex
Ventnor Mab	C. W. Black, Kumbia	6,450·97	291·042	Kyabram Twinny Boy
Kyabram Marie 4th (258 days)	A. H. E Black, Kyabram, Kumbia	5,553·98	264·157	Ledger of Greyleigh
Trevor Hill Una	Sullivan Bros., Valera, Pittsworth	6,918·77	261·918	Corunna Supreme
Trevor Hill Star 2nd	Sullivan Bros., Valera, Pittsworth	5,683·29	232·276	Corunna Supreme

JERSEY.

Mature Cow (Standard, 350 lb.).

Woodside Xenia	S. H. Caldwell, Walker's Creek, Bell	8,416·32	481·138	Rochette's Volunteer

Senior, 4 Years (Standard, 330 lb.).

Oxford Remus Amy	State Farm H.M. Palen Creek	5,505·22	330·089	Overlook Nancy's Remus

Junior, 4 Years (Standard, 310 lb.).

Hawthorn Brae Lady Colleen	P. Kerlin, Glenrandle, Killarney	7,067·5	373·039	Hawthorn Brae Navigator
Hurette's Hope of Inverlaw	R. J. Crawford, Inverlaw	5,778·37	321·468	Carnation Gentle Prince

Senior, 3 Years (Standard, 290 lb.).

Oxford Dahlia 5th	S. H. Caldwell, Walker's Creek, Bell	8,189·58	433·257	Oxford Belle's Ambassador
Glenview Sultane's Jubilee	F. P. Fowler and Son, Glenview, Coalstoun Lakes	8,951·75	419·035	Trinity Governor's Hope
Oxford Ambassador's Dolly	S. H. Caldwell, Walker's Creek, Bell	5,581·17	326·67	Oxford Belle's Ambassador
Trecarne Rosella 8th	T. A. Petherick, Trecarne, Lockyer	5,909·75	320·082	Trinity Some Officer
Glenview Trinket	F. P. Fowler and Son, Glenview, Coalstoun Lakes	6,454·0	291·998	Trinity Governor's Hope

Junior, 3 Years (Standard, 270 lb.).

College Starbright 6th	Queensland Agricultural High School and College, Lawes	5,185·52	284·833	Belgonia Peggy 9th Duke

Senior, 2 Years (Standard, 250 lb.).

Palen Fleur	H.M. State Farm, Palen Creek	5,650·19	299·583	Oxford Golden Dreamer
Lermont Rosaleen	J. Schull, Lermont, Oakey	5,275·65	282 607	Woodside Golden Volunteer
Bellgarth Bonfairnette	P. Kerlin, Glenrandle, Killarney	5,158·2	271·455	Trecarne Renown 2nd
Bellgarth Goldenette	P. Kerlin, Glenrandle, Killarney	4,695·3	270·161	Bellgarth Golden King
Glenview Skylark	F. P. Fowler and Son, Glenview, Coalstoun Lakes	4,754·6	257·632	Trinity Governor's Hope

Junior, 2 Years (Standard 230 lb.).

Tecoma Birdie	W. J. Semgreen, Kingaroy	7,114·6	380·254	Bruce of Inverlaw
Landside Dreamer's Dainty	S. H. Caldwell, Walker's Creek, Bell	5,936·62	322·707	Golden Dreamer
Lermont Treasure	J. Schull, Lermont, Oakey	5,640·15	276·988	Woodside Golden Volunteer
Brooklands Sultan's Ladylove	T. W. McMicken, Beauraba, Southbrook	5,063·18	271·726	Brooklands Royal Sultan
Broadview Petal	W. S. Kirby, Broadview, Byrnestown	5,167·6	265·923	Glenview Mason

AYRSHIRE.

Senior, 3 Years (Standard, 290 lb.).

Myola Opal 2nd (245 days)	R. M. Anderson, Southbrook	9,916·84	375·994	Benbecula Bonnie Willie

Junior, 3 Years (Standard, 270 lb.).

Myola Poppy	R. M. Anderson, Southbrook	9,403·1	356·917	Benbecula Bonnie Willie

GUERNSEY.

Senior, 2 Years (Standard, 250 lb.).

Laureldale Poppy	W. A. Cooke, Laureldale, Witta	6,637·85	254·958	Laureldale Peer

Junior, 2 Years (Standard, 230 lb.).

Laureldale Veronica	W. A. Cooke, Laureldale, Witta	6,126·45	290·649	Laureldale President

General Notes

Staff Changes and Appointments.

Mr. R. P. M. Short, Under Secretary of the Department of Agriculture and Stock, has been appointed Government nominee on the Veterinary Surgeons' Board of Queensland in the room of the late Lieut.-Colonel A. H. Cory, V.D., M.R.C.V.S.

The resignation of Mr. E. S. Smith as Millowners' Representative on the Central Sugar Cane Prices Board has been accepted as from 31st January, 1940, as tendered.

Mr. J. W. Carseldine (Miriam Vale) and Mr. F. A. E. Fisher (Southport) have been appointed Honorary Fauna Protectors.

Mr. R. A. Chapman, of Bishop Island, has been appointed an Honorary Protector under the Fauna Protection Act and an Honorary Ranger under the Native Plants Protection Act.

Mr. W. A. G. Haylett, inspector under the Stock, Slaughtering, and Dairy Produce Acts, Department of Agriculture and Stock, will be transferred to Biloela. Mr. C. R. Tummon, inspector, will be attached to the Willowburn Bacon Factory, Toowoomba.

Mr. W. G. Hancock, inspector under the Diseases in Plants Acts and agent under the Banana Industry Protection Act, has been transferred to Townsville.

Mr. R. Kerwin, puntman at the Norman River Crossing, Normanton, has been appointed also an acting inspector of stock.

Mr. H. G. Knust, instructor in cane culture, Innisfail, has been appointed also an inspector under the Fertilisers Act.

Mr. T. W. Wall, curator of Queen's Park, Ipswich, has been appointed an honorary protector under the Fauna Protection Act.

Mr. N. G. Monroe, The Crescent, Coorparoo, has been appointed an inspector under the Diseases in Stock Acts, the Slaughtering Act, and the Dairy Produce Acts, Department of Agriculture and Stock, Brisbane.

Mr. F. J. Waring, Victoria Sugar Mill, Ingham, has been appointed millowners' representative on the Victoria and Macknade Local Sugar Cane Prices Boards, *vice* Mr. N. R. Dowling, resigned.

Mr. P. D. Parker, Courthouse, Mackay, has been appointed chairman of the North Eton, Cattle Creek, and Racecourse Local Sugar Cane Prices Boards during the absence of Mr. H. L. Kingston on recreation leave.

Mr. H. L. Hayles, Hassell street, Corinda, has been appointed an honorary protector of fauna.

Mr. H. H. R. Walker, inspector under the Stock, Slaughtering, and Dairy Produce Acts, has been transferred from the Doboy Bacon Factory to Toowoomba.

Mr. A. H. Strohfeldt, inspector under the Stock, Slaughtering, and Dairy Produce Acts, has been transferred from the Oxley Bacon Factory to the Doboy factory.

Honey Board.

The existing regulations under the Primary Producers' Organisation and Marketing Acts covering the Honey Board levy have been rescinded, and new regulations empowering the Honey Board to make a levy on growers of honey and beeswax, and to exempt certain growers from the operation of that part of the Acts which provides that all the commodity shall be delivered to the board for sale by the board, have been issued in lieu thereof. The levy is at the rate of 1½ per cent. on all honey and/or beeswax sold during the period from the date of the issue of the regulations until the 8th March, 1944, and will provide for the administrative expenses of the Honey Board.

Arrowroot Board.

An Order in Council approved under the Primary Producers' Organisation and Marketing Acts amends the constitution of the Arrowroot Board to provide that persons eligible to vote at any election held after the date of this Order in Council shall be those who, during the twenty-four months immediately preceding the date of such election, supplied arrowroot bulbs grown in Queensland to the Board.

Citrus Levy.

The Citrus Levy Regulation issued in April, 1939, under the Fruit Marketing Organisation Acts and made by the Committee of Direction of Fruit Marketing on citrus growers has been extended for a further period of twelve months from 1st March, 1940.

Fauna Sanctuary at Mount Morgan.

An Order in Council has been issued under "*The Fauna Protection Act of* 1937," declaring the area embraced within the external boundaries of Water Reserve R. 38, Mount Morgan, to be a sanctuary for the protection of fauna.

Canary Seed Board.

An Order in Council has been issued under the Primary Producers' Organisation and Marketing Acts amending the constitution of the Canary Seed Board to provide that the Board may authorise certain persons approved by the Minister to enter upon premises and inspect the books and accounts of any grower or person and to be supplied with such information as may be required.

An Order in Council has been issued under the Primary Producers' Organisation and Marketing Acts extending the operations of the Canary Seed Board for the period from 1st July, 1940, until the 30th June, 1943.

Regulations under the Pest Destroyers Act.

Regulations have been issued under "*The Pest Destroyers Act of* 1939" to give effect to the provisions of the Act. These cover the registration and analyses of pest destroyers.

Pest Destruction.

Appointments made under "*The Pest Destroyers Act of* 1939," which came into force from the 1st January, 1940, include those of Mr. F. B. Coleman, Officer in Charge of the Seeds, Fertilisers, Veterinary Medicines, Pest Destroyers, and Stock Foods Investigation Branch of the Department of Agriculture and Stock, to be the Registrar of Pest Destroyers; and Mr. R. A. Taylor, Inspector and Examiner in the abovementioned branch, to be the Deputy Registrar of Pest Destroyers.

Messrs. F. B. Coleman, R. A. Taylor, F. P. C. Bell, and R. J. Holdsworth have been appointed inspectors under the Act.

The following have been appointed members of the Pest Destroyers Board:—Messrs. E. H. Gurney, agricultural chemist; J. H. Smith, entomologist (plants); Dr. F. H. S. Roberts, entomologist (veterinary); Mr. J. H. Simmonds, pathologist (plants); Dr. J. Legg, pathologist (veterinary); and Mr. F. B. Coleman, officer in charge of the Seeds, &c., Branch.

Fruit Marketing.

An Order in Council has been issued under the Fruit Marketing Organisation Acts extending the operation of the provisions of the Acts for a period of five years from 1st January, 1940.

Brisbane Milk Board.

An Order in Council has been issued under "*The Milk Supply Act of* 1938," appointing the members of the second Brisbane Milk Board for the period from 1st February, 1940, to 31st January, 1943.

The members are—

E. H. Lindsey—Representative of the Government and chairman of the board.

M. Harland (Clayfield), E. E. Carson (Dayboro'), W. J. Smith (Branch Creek, via Strathpine)—Representatives of producers.

G. Andrew (Brisbane), R. H. Bentley (Margate), W. E. Bell (Milton)—Representatives of wholesale vendors.

Wild Life Preservation.

Mr. S. Head (Berry street, Toowoomba) has been appointed an honorary protector under the Fauna Protection Act.

An Order in Council has been issued under "*The Fauna Protection Act of* 1937," declaring the pasturage reserve, Cape Edgecumbe, Bowen, to be a sanctuary for the preservation of wild life.

Answers to Correspondents

BOTANY.

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

Bracken.

C.V.H. (Toowoomba)—

The common bracken spreads by means of an underground rhizome which extends for some considerable length in the soil, branching freely, and which is a source of food material for the plant. If the leaves are continually kept down by scything, the roots eventually become exhausted of organic food material, and die out; but the scything must be done very frequently. Most people have found that, when not using poisonous sprays, it is better to break the fronds off with a stick or other blunt instrument, since when they do this a rot sets in and destroys the rhizome. Steers will eat the fronds usually without any ill-effects. In "The Farmer and Stockbreeder" (19th December, 1939), "Blythe," a regular contributor, has this note on pigs and bracken:—"During the last war I happened to be farming in a district where considerable areas of 'marginal' land had gone to bracken. Then, as now, we were urged to keep pigs on 'natural' lines, and I determined that the sows and gilts, at any rate, should work for their living. A portion of the bracken ground was fenced off and the pigs were turned in unrung. Bracken shelters were provided for them, and the pigs soon got to work on the bracken roots, and throve on them."

A Nutritious Grass.

C.S.C. (Toowoomba)—

The specimen is *Urochloa panicoides*. This grass has previously come under attention as a species with possibilities for controlling mint weed. It seems a rapid grower, and is said to be a highly palatable and nutritious grass. It seeds heavily, and it seems worth experimenting with.

Wistaria. Trees for Open Downs Country.

Inquirer (Charleville)—

Most people find the pruning of wistaria best done at the beginning of the deciduous time—that is, some time in June, and favour a cutting of them fairly hard back. Mr. Bick, the Curator of the Brisbane Gardens, says, where the plants make very long growths during the growing period, it is best to cut this back also, say, about half-way, soon after they start leafy growth, say, in early summer.

Regarding trees for the open downs, the following are suggested:—Kurrajong, White Cedar, Jacaranda, Portuguese Elm, Camphor Laurel, Citron Gum, Sugar Gum.

Wild Poppy, a Plant Poisonous to Stock.

E.M.K. (Westwood)—

The specimen represents *Pimelea hæmatostachya*, commonly known as wild poppy or red poppy, and generally regarded as a plant poisonous to stock. No feeding tests have been made with the present specie, but the genera *Pimelea* is a large one, and several are known definitely to be poisonous. The present one has a fairly wide distribution in Queensland and has a bad reputation.

A Plant Harmful to Horses (*Leucaena glauca*).

Inquirer (Townsville)—

The specimen is *Leucæna glauca*, a shrub, a native of tropical America, but now widely spread, either naturalised or cultivated throughout the tropics. It is very common throughout the South Sea Islands, where the seeds are sometimes woven into bags and other small articles. We were very interested in the statement that the plant was causing horses to lose the hair from their manes, tails, and legs. A similar observation has been made in other countries, but not, so far as we know, previously in Queensland.

Rural Topics

A Tribute to Australian Butter Quality.

As evidence of the marked improvement in the quality of Australian butter exported to Great Britain during the past three years, here is the opinion of Sir John Russell, the famous English agricultural scientist, who was a visitor to Queensland last year. In asking for an account of the methods of dairy production in Australia for publication in the "Empire Journal of Experimental Agriculture," he referred to the development of the present high quality of Australian butter as one of the most striking achievements in modern agriculture. Coming from an eminent authority like Sir John Russell, who for so many years has been closely associated with the butter markets of Great Britain, such an opinion is praise indeed. It should certainly act as a stimulant to all connected with the dairy industry to continue their efforts for further improvement of Australian butter generally.

Sir John Russell, by the way, thought so highly of the Queensland Agricultural College that he sent his son from England to be enrolled as a student at the College.

Why the Price Goes Up.

Farming is a more scientific business than it used to be. "Farm products," complained a townsman to his farmer friend, "seem to cost more than they used to. How's that?" "Well," admitted the farmer, "when a man has to know the botanical name of every crop he grows, the scientific name of every pest that eats it, and the chemical name of what will kill the pest, somebody's got to pay!"

Fertilizing for Better Vegetable Crops.

Bean growers in the Gosford-Wyong district of New South Wales have adopted fertilizer methods which are giving excellent results. They apply the fertilizer either in a band near to and on the same level as the seed, or in a band on one side of and below seed level.

This improved practice is based on the fact that the movement of fertilizers in the soil is mostly vertical rather than lateral. It would seem that fertilizers placed directly above the seed would be likely to cause injury to the seed when rain comes, while fertilizers placed immediately below the seed may have a worse effect during dry periods, when the moisture is evaporating at the surface. Because of the restricted lateral movement of the soluble salts in the fertilizer mixture, seed placed on one side of the fertilizer band is not affected by excessive concentration of the soluble salts, and by the time the roots reach the fertilizer much of its injurious effect will have vanished.

Dairying in Great Britain.

Here are some interesting facts which the national war effort in the Old Country has brought out: More than 150,000 farmers are engaged in dairying in the United Kingdom, and the yearly output of milk and milk products is valued at more than £60,000,000 sterling. And that huge sum is only a quarter of the annual value of the total production of British farms.

Another Way to Use Whey.

Here is the experience of a Maoriland farmer, as reported in "*The New Zealand Farmer Weekly*":—Additional feed may be put into pit silage by sprinkling whey over the fodder as it is stacked. The advantage of whey to the cheese factory supplier is that it costs nothing but the cartage. Where whey has been added to silage the product is better in every way and the silage turns out much greener. This is said to be probably due to lower fermentation with less loss of green colouring matter.

When Appetites are Tight.

At a demonstration on pig carcases recently a bacon factory supplier was heard to remark that "Some farmers seem to judge the appetite of their pigs by the amount of food they can conveniently carry." "Exactly," said another farmer, "just as many dairy farmers when feeding out in the paddock judge the appetite of their herd by the size of their cart."

Camera Records of Faked Brands.

The way of the transgressor is being made harder in America's "wild west." In Wyoming, stock inspectors have been equipped with cameras as an additional aid in detecting doctored cattle brands. It is claimed that photographs of the brands on animals will generally reveal whether they have been altered in any way.

It seems a bright idea, but, camera or not, it would take an unusually expert brand "doctor" to get his beast past any Queensland brands inspector who has been reared in cattle country.

A New Freezing Process.

An interesting experiment was recently carried out at Smithfield Meat Market in London. Some English livers were subjected to a process of quick freezing, and then packed in cold store at a controlled temperature. That was done over a year ago. At the end of the twelve-month experiment period, the livers were taken from the cold store and defrosted. The livers were quite firm and retained their natural colour without any sign of bleaching. The usefulness of the process was proved when the livers showed no evidence of freezer "burn," while, when cooked, they ate well and were very appetising.

The Value of Pastoral By-products.

Last year the value of skins, tallow, and other by-products of the pastoral industry in Australia was just on £8½ millions, or more than 8 per cent. of the gross value of all pastoral products for the year.

That is an indication of the importance of by-products to an industry, and the place they take in the economy of the Commonwealth.

The Dorset Horn Cross for Fat Lambs.

The advantages of the Dorset Horn cross for the early fat lamb trade has again and again been strikingly demonstrated. A line of New Zealand lambs drafted for sale recently, 85 per cent. of which were off their mothers, returned an average of 38.6 in weight. The oldest of the lambs was thirteen weeks, and the youngest twelve weeks.

That item of news will interest many farmers on the Darling Downs who are building up their fat lamb flocks largely on a Dorset Horn foundation.

Heavier Lambs Wanted.

With the demand by the British Government for a heavier lamb, some New Zealand lamb-raisers are becoming more interested in the Suffolk and Dorset Horn breeds.

Britain the World's Pedigree Stock Farm.

Being interested in the agricultural and stock position in war-time Britain and watching the trend of events on "the other side," one comes across some very interesting and unusual facts at times. Going through the list of different breeds of livestock, one is amazed at the number—some of which we in Queensland rarely hear about. The British Isles have been termed the pedigree stock farm of the world; and rightly so, when one realises that it is the home of ninety-five distinct breeds of stock—to say nothing of the various crosses of these breeds.

The figures are: Four distinct breeds of heavy draught horses; sixteen light horse breeds; fifteen beef and dual-purpose cattle breeds; nine dairy cattle breeds; nine long-woolled sheep breeds; eleven Downs and other sheep breeds; thirteen mountain sheep breeds; twelve breeds of pigs; and six breeds of goats.

The remarkable thing is that each breed is flourishing and has a large following of "fanciers."

Cows with Head and Tail Lights for War Time "Black-outs."

The nightly "black-out' in the Old Country is causing considerable anxiety to many stockowners. This is how one English farmer solved his difficulty:—

After several of his cows had wandered on to dark country roads at night and been killed by passing motor cars and trucks, he thought out a plan for placing head and tail lights on his cattle. Tiny lamps powered by small dry cells were fixed to the horns and tails of the animals, making them visible to motorists coming from either direction along the roads bordering his farm.

Farm Notes

MAY.

WHEN seasonal conditions permit, the May sowing of wheat is recommended in the Maranoa and Central districts, where early sown crops invariably outyield those established later in the season.

For the main Downs sowing, June is preferred unless sheep are available to check the early growth, as the principal varieties now grown, Flora, Florence, Pusa, Three Seas, Seafoam, and Gluyas, are all sufficiently quick maturing for early sowings to risk damage by frost. All seed wheat should be graded and treated with copper carbonate or a reliable mercury dust as a preventive of ball smut, utilising 1 to 2 oz. per bushel. Seed barley and oats are preferably treated with formalin, or with either of the mercury dusts agrosan and ceresan.

Succession sowings of oats, barley, or wheat required for grazing may be made during the month, with a mixture of field pea seed or tares, as described in previous issues of this Journal.

Winter grasses should now be well established. Land now in good condition may still be sown with suitable types, preferably *Phalaris tuberosa*, Wimmera rye, or prairie grass, all of which will withstand fairly dry conditions. Sowings later than May are not recommended.

Lucerne sowings may be continued, drilling the seed to a shallow depth only, on soil containing enough moisture for satisfactory germination. Rolling is beneficial if the surface is somewhat loose and rough, but should be followed by a light harrowing.

Potatoes will have received their final cultivation and hilling, so that cultivators may now be diverted to root crops, such as mangolds and swede turnips grown for pig feed.

The sowing of onion seed may be continued on suitable soils, drilling in their permanent position, in rows spaced from 12 to 15 inches apart, and lightly covering with not more than ½ inch of soil. Hand seeders are useful for this work if the areas are not large.

Mature sweet potatoes may be dug, allowed to dry in the sun for a few hours, and if desired for home use placed in dry sand until required. Sweet potatoes are mature when the cut surface dries white and does not turn greenish black round the edge.

Attention should be given to the important work of seed selection for future sowings before finalising the harvesting of maize, sorghum, sudan grass, cowpea, pumpkin, &c., as it is wise to be sure of varietal purity rather than depend on the seedsman from year to year.

Orchard Notes

MAY.

SUCCESS in fruitgrowing depends not only on the proper working and management of the orchard, but also on the way in which fruit is handled and marketed. With citrus fruits particularly, none pay better for extra care in packing and presentation.

Some growers do not realise how easily the skin of citrus fruits is injured, especially that of fruit grown under moist and humid conditions.

In order to prevent injuring skin when gathering, all fruit should be cut and not pulled. Any fruit that falls or is injured in any way should be rejected, as it is not fit to send to a distant market. If, however, the injury is only slight it may be sent to a local market for quick sale.

For oversea and interstate markets, only choice fruit should be selected. It should be graded for size, colour, and quality and properly packed, only one grade of fruit being packed in a case.

All orchards, vineyards, and plantations not completely clean should receive immediate attention.

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

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

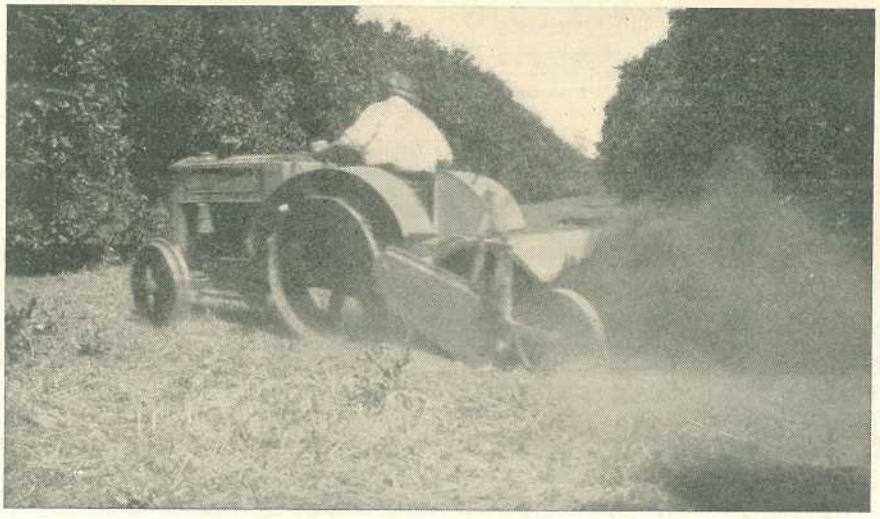


Plate 125.

ROTARY HOE AT WORK IN THE CITRUS GROVE.—On Benyenda Orchard, near Gayndah.

Maternal and Child Welfare.

Under this heading is issued each month an article, supplied by the Department of Health and Home Affairs Maternal and Child Welfare Service, dealing with the welfare and care of mother and child.

THE ONLY CHILD.

IN giving advice about the management of the only child for application in the home, we need to consider whether that home is in the city, small town, or isolated in the "outback."

There are two main points that parents should remember first; that all educationists and psychologists, who differ on many points, agree on one, namely, that character is formed before six years of age. After that, training and environment still count, of course, but not to the same extent. The second point refers especially to the only child, or one leading the life of the only child, and is that man is a social being.

Companionship with children of his own age or, better still, of his own stage of development is a necessary part of a child's life. Without it he has little opportunity of learning to make adjustments and is apt to become "a spoilt child." By adjustment is meant the process of learning how to fit harmoniously into a group of children, how to give and take for the good of the group, the process of acquiring judgment, balance, and control. In the light of future citizenship it means that the young child is learning to co-operate, to work for the good of the whole social group or community. He is gradually learning to put into practice the universal law of interdependence: interdependence of one individual upon another, of one part of the community upon another, of one nation upon another. Every intelligent teacher and parent has this in mind when training the baby or older child.

The best solution of the problem of the care of the child leading the life of an only child in the city is to send him to a nursery school or kindergarten. The trained director in charge is qualified to handle intelligently and sympathetically the various types of children who come under her supervision—the so-called difficult or problem child, the child over-attached to his mother, the irritable and emotionally unstable child, and others. The mother with a selfish and mistaken type of affection who is afraid to trust her child to the care of anyone but herself will be gratified to observe the improvement in her child after he has attended such a school. The child becomes more content as the result of his new interest, his emotional life is able to develop along healthy channels in his new environment, and his intellectual growth can take pace normally. To the onlooker it may seem that all the activity that goes on at the nursery school and kindergarten is just play. Behind it all growth and development are proceeding. Characters are being formed. The process is slow but sure. Attention is paid to the physical as well as the mental development. A sound mind in a sound body is the motto of the kindergarten.

There may be no nursery school or kindergarten in the town in which you live. In this case, social development being most important for your child, it may be possible to invite some children in to play. You can exercise supervision unostentatiously. If you are able to play just a little with them or show an interest in their play, or tell them a story, or read some nursery rhymes to them, how they will love you! Perfect English is not maintained under normal circumstances anywhere while children are young and imitative. Mistakes in grammar, even "swearing," appear for short intervals in all well-conducted homes and schools; children love to imitate anything new.

For the parents of a solitary child in the "outback" there is often only one solution of the problem—the mother or guardian must give up much time, at the cost of some other duties, to give the child companionship. But the companionship must aim at strengthening, not weakening, the child. Let all games, all "jobs," all enjoyments, keep as near a fifty-fifty basis as possible. Train the child to be a "good loser." Develop responsibility by letting him keep pets and have entire control of their welfare. For mental culture, good books with clear pictures are essential. Handwork, be it connected with small house duties, carpentry, drawing, or other activities, is useful in helping to keep the only child practical. Aim always at turning his thoughts outwards, away from himself. Any creative work should be steadily encouraged; finishing things started is an important part of efficiency, so guide him to start only things simple enough to finish. Above all, if the parents co-operate and "pull together," then wherever the only child may be living he has the greatest help of all—the unified, harmonious home.

Bring your toddlers as well as your babies to the Baby Clinics for advice and for periodic examination and weighing.

Information on all matters concerning child welfare may be obtained by visiting the nearest Baby Clinic, by writing to the Sister in Charge, or by communicating direct with the Baby Clinic Training Centre, Alfred street, Valley, N. 1, Brisbane.

IN THE FARM KITCHEN.

"SMOKO" DAINTIES.

Cherry Drops.

Take 1 egg, 2 oz. butter, 2 oz. flour, 1½ oz. castor sugar, ½ teaspoonful baking powder, 1 dessertspoonful lemon juice, 1 oz. glace cherries.

Cream the butter, add the sugar, and beat till soft and white. Beat in the egg and lemon juice, add the flour, and last of all stir in the baking powder. Half-fill four to six paper baking cases and bake in a quick oven for about ten minutes.

Four O'clock Tea Biscuits.

Take ¼ lb. flour, 1 egg-yolk, 2½ oz. butter, 2½ dessertspoonfuls castor sugar, ½ flat teaspoonful ground cinnamon, 3 oz. currants and sultanas (mixed), ½ small lemon rind only.

Wash, dry, and pick over the fruit, and put it through the mincer. Work ½ oz. of the butter until soft and creamy, add the finely-grated lemon rind, one dessertspoonful sugar. the cinnamon, and prepared fruit, and mix all together. Rub the rest of the butter into the sifted flour, add the remainder of the sugar. Beat the egg-yolk and mix it with a teaspoonful of water and add it, and mix all to a stiff paste, adding a little more water as required. Roll it out and cut into rounds. Take half of them and put the prepared fruit mixture in the centre, damp the edge, and cover each with another round, pressing it down lightly. Make two cuts in the centre, brush the tops with water, sprinkle them thickly with castor sugar, then put them on a baking sheet and bake them in a quick oven from ten to fifteen minutes.

Shortbread Fingers.

Take ¼ lb. butter, ¼ lb. lard, 1 egg, 1½ cupfuls flour, ½ teaspoonful baking powder, 1 cupful castor sugar.

Sprinkle a little flour on the baking board. Place the butter and lard on the board. Work in the flour and sugar, sifted with baking powder. As the mixture becomes a lump, moisten with half of a well-beaten egg. Roll out smoothly about a quarter of an inch thick. Cut into strips 1 inch by 3 inches. Place on a greased baking sheet and bake in a moderate oven for fifteen minutes. When almost cold, brush over with the remainder of the egg and sprinkle thickly with sifted sugar.

Ginger Crisps.

Take 3½ cupfuls flour, 1 teaspoonful salt, ¾ tablespoonful ground ginger, ¼ teaspoonful ground mace, 1 cupful golden syrup, ½ cupful butter, ¼ tablespoonful ground cinnamon, ¼ teaspoonful baking soda.

Grease a baking sheet or tin. Measure the butter into a basin. Heat the syrup till tepid, then stir into the butter. Mix in the dry ingredients. Stand aside till quite cold. Knead well. Turn on to a lightly-floured pastryboard. Roll out very thinly. Cut into rounds with a cutter dipped in flour. Bake in a very hot oven for five minutes. Turn out and cool on a cake rack.

Cinnamon Slices.

Take ½ lb. flour, 4 level teaspoonfuls baking powder, pinch of salt, 1 oz. butter, 2 level tablespoonfuls castor sugar, 1 egg-yolk, ¾ gill milk, ground cinnamon, and castor sugar.

Sift the flour into a basin with the baking powder, salt, and sugar. Work in the butter with the tips of the fingers. Add the beaten egg-yolk, mixed with a little milk. Knead the dough for a few minutes on a well-floured board. Roll into an oblong shape a good fourth of an inch thick. Spread the rolled-out dough with a layer of soft butter (extra to that given in the ingredients). Sprinkle the butter with the cinnamon and castor sugar. Roll up the dough like a Swiss roll. Cut the roll into thick slices. Bake the slices in greased tins in a hot oven.

Bridge Biscuits.

Take 3 oz. castor sugar, 4 oz. butter, 5 oz. flour, ¼ level teaspoonful baking powder, 1 egg-yolk, large pinch cinnamon.

Beat the sugar and butter to a cream, stir in the egg-yolk, and beat well. Add the flour, sifted, with baking powder and cinnamon. Mix all together to a soft paste. Roll the paste out thinly and stamp it into shapes with bridge cutters. Put the biscuits on a lightly-buttered tin and bake them in a moderately hot oven for about ten minutes. Cool the biscuits on a sieve or cake cooler and dredge them with castor sugar.

Almond Balls.

Take 3 eggs, 8 oz. sugar, 4 oz. almonds.

Beat the eggs and sugar well together and add the chopped almonds and flour. Allow the mixture to stand for a few hours. Make the mixture into small balls and roll them in granulated sugar. Bake the almond balls in a good oven.

Cornish Rock Cakes.

Take ½ lb. self-raising flour, ¾ lb. castor sugar, 1 egg, milk, 1 lemon rind, ¼ lb. butter, 1 tablespoonful mixed peel, 6 oz. cleaned currants, salt.

Rub the butter into the sifted flour. Stir in the sugar, a pinch of salt, grated lemon rind, currants, mixed peel, and beaten egg, and a little milk if required. but the mixture must be stiff. Place the mixture on a butter baking sheet in little heaps an inch or two apart. Sift castor sugar on top and bake the cakes from fifteen to twenty minutes in a hot oven.

Soda Biscuit Rings.

Take 2 oz. butter, 2 oz. sugar, 3 oz. unsweetened tinned milk, 4 oz. flour, 4 oz. cornflour, ½ level teaspoonful bicarbonate of soda.

Beat the butter and sugar until creamy, and add the beaten tinned milk. Add gradually the cornflour and flour sifted with the soda. Roll out the mixture, prick it, and cut it into small round biscuits. Cut a small hole in the centre of each, using a thimble or small cutter. Bake the biscuits in a moderate oven for from eight to ten minutes.

Plate 126.

PALS.—In many parts of Western Queensland, particularly in mining centres, the goat is a domestic necessity as the supplier of rich, wholesome milk.

RAINFALL IN THE AGRICULTURAL DISTRICTS.

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

Divisions and Stations.	Average Rainfall.		Total Rainfall.		Divisions and Stations.	Average Rainfall.		Total Rainfall.	
	Feb.	No. of years' records.	Feb., 1940.	Feb., 1939.		Feb.	No. of years' records.	Feb., 1940.	Feb., 1939.
North Coast.	In.		In.	In.	*South Coast—contd.*	In.		In.	In.
Atherton	11·23	39	17·10	29·56	Gatton College ..	3·36	41	5·10	0·33
Cairns	16·13	58	17·11	38·63	Gayndah	4·12	69	7·40	1·25
Cardwell	17·01	68	22·39	21·87	Gympie	6·65	70	4·65	1·79
Cooktown ..	13·84	64	8·28	21·66	Kilkivan	4·80	61	5·80	2·15
Herberton ..	8·29	54	20·52	17·95	Maryborough ..	6·66	69	6·15	2·05
Ingham	16·72	48	29·22	28·15	Nambour	9·42	44	13·88	3·23
Innisfail	23·02	59	17·87	38·18	Nanango	3·93	58	5·05	0·79
Mossman Mill ..	19·18	27	..	35·13	Rockhampton ..	7·58	69	11.81	3·37
Townsville ..	10·39	23	23·73	9·48	Woodford ..	8·19	53	5·96	2·83
Central Coast.					*Central Highlands.*				
Ayr	9·37	53	20·87	18·20	Clermont ..	4·15	69	12·45	0·77
Bowen	8·77	69	25·16	10·01	Gindie	2·68	41	7·10	2·71
Charters Towers ..	4·50	58	12·28	5·65	Springsure ..	3·75	71	8·60	1·50
Mackay P.O. ..	11·80	69	37·20	11·78	*Darling Downs.*				
Mackay Sugar Experiment Station	11·28	43	38·62	14·45	Dalby	2·76	70	5·27	1·94
Proserpine ..	12·91	37	43·60	27·90	Emu Vale ..	2·45	44	5·99	..
St. Lawrence ..	7·59	69	11·38	1·36	Hermitage ..	2·31	33	4·96	..
South Coast.					Jimbour	2·52	52	5·88	1·18
					Miles	2·60	55	7·14	0·50
Biggenden ..	4·23	41	2·58	2·29	Stanthorpe ..	3·08	67	6·72	0·28
Bundaberg ..	6·36	57	9·02	2·36	Toowoomba ..	4·42	68	5·21	0·94
Brisbane	6·28	88	7·98	2·61	Warwick	2·98	75	5·46	1·05
Caboolture ..	7·58	53	7·87	1·62	*Maranoa.*				
Childers	6·50	45	5·54	2·74					
Crohamhurst ..	12·41	47	10·51	4·45	Bungeworgorai ..	2·10	26	..	..
Esk	5·25	53	6·87	0·38	Roma	2·83	66	8·62	0·13

A. S. RICHARDS, Divisional Meteorologist.

CLIMATOLOGICAL TABLE—FEBRUARY, 1940.

COMPILED FROM TELEGRAPHIC REPORTS.

Districts and Stations.	Mean Atmospheric Pressure, at 9 a.m.	Shade Temperature.						Rainfall.	
		Means.		Extremes.				Total.	Wet Days.
		Max.	Min.	Max.	Date.	Min.	Date.		
Coastal.	In.	Deg.	Deg.	Deg.		Deg.		Points.	
Cooktown	29·70	88	75	93	24	71	9	828	19
Herberton	..	80	67	86	24	63	14	2,052	25
Rockhampton	29·81	87	74	99	1, 23	69	8,10-13,	1,181	17
Brisbane	29·91	84	70	104·6	23	65·2	10	798	8
Darling Downs.									
Dalby	29·91	87	65	103	23	58	11	527	9
Stanthorpe	..	81	58	94	23	50	11	672	8
Toowoomba	..	81	63	98	23	55	12	521	10
Mid-Interior.									
Georgetown	29·70	88	73	95	15	70	9, 14, 19	1,524	22
Longreach	29·77	90	72	101	1	63	29	1,144	10
Mitchell	29·85	88	69	101	23, 24, 25, 26	60	29	552	8
Western.									
Burketown	29·70	89	76	99	18, 19	61	29	1,189	16
Boulia	29·76	90	72	100	5, 17, 18	60	29	996	8
Thargomindah ..	29·82	96	74	106	27	58	29	23	1

ASTRONOMICAL DATA FOR QUEENSLAND.

TIMES COMPUTED BY A. C. EGLINTON.

TIMES OF SUNRISE, SUNSET, AND MOONRISE.

AT WARWICK.

	April, 1940.		May, 1940.		MOONRISE. April, 1940.	MOONRISE. May, 1940.
	Rises.	Sets.	Rises.	Sets.	Rises.	Rises.
					a.m.	a.m.
1	6·2	5·50	6·18	5·20	12·9	12·40
2	6·3	5·49	6·18	5·19	1·3	1·31
3	6·3	5·48	6·19	5·19	1·54	2·21
4	6·4	5·47	6·19	5·18	2·42	3·11
5	6·4	5·46	6·20	5·17	3·34	4·3
6	6·5	5·45	6·21	5·17	4·27	4·53
7	6·5	5·43	6·21	5·16	5·14	5·48
8	6·6	5·42	6·22	5·15	6·9	6·41
9	6·7	5·41	6·22	5·15	7·2	7·34
10	6·7	5·40	6·23	5·14	7·53	8·28
11	6·8	5·39	6·23	5·13	8·46	9·22
12	6·8	5·38	6·24	5·13	9·40	10·13
13	6·9	5·37	6·25	5·12	10·33	11·1
14	6·9	5·36	6·25	5·11	11·24	11·48
					p.m.	p.m.
15	6·10	5·35	6·26	5·10	12·17	12·32
16	6·10	5·34	6·26	5·10	1·3	1·15
17	6·11	5·33	6·27	5·9	1·50	1·58
18	6.11	5·32	6·28	5·9	2·34	2·40
19	6·12	5·31	6·28	5·8	3·17	3·24
20	6·12	5·30	6·29	5·8	4·3	4·11
21	6·13	5·29	6·30	5·7	4·49	5·2
22	6·13	5·28	6·30	5·7	5·34	5·53
23	6·14	5·27	6·31	5·6	6·23	6·48
24	6·14	5·26	6·32	5·6	7·15	7·45
25	6·15	5·25	6·32	5·6	8·9	8·42
26	6·15	5·24	6·33	5·5	9·4	9·38
27	6·16	5·24	6·33	5·5	10·0	10·31
28	6·16	5·23	6·34	5·5	10·54	11·20
29	6·17	5·22	6·35	5·4	11·49	..
						a.m.
30	6·17	5·21	6·35	5·4	..	12·12
31	..	..	6·36	5·3	..	1·3

Phases of the Moon, Occultations, &c.

8th April	○ Full Moon	6	18 a.m.
15th ,,	● New Moon	11	46 p.m.
22nd ,,	☽ First Quarter	2	37 p.m.
29th ,,	☾ Last Quarter	5	49 p.m.

Apogee, 5th April, at 7.0 p.m.
Perigee, 21st April, at 5.0 a.m.

At moontime on the 9th Saturn and a very narrow crescent of the Moon will be very near the western horion shortly after sunset.

Jupiter, which in September last was in "Opposition"; rising as the Sun sets, will be in "Conjunction," on the opposite side of the Sun from the Earth, on 11th April, lost to the evening sky.

Other interesting phenomena will also occur on the 11th: Venus, having passed Saturn in March, will overtake Mars; the Moon, which will be in conjunction (at the same celestial longitude) with both planets at 5 a.m., will be seen very near them before they disappear in the west.

On the 12th, Mercury, a morning star, will attain its greatest altitude, 28 degrees, west of the Sun, and on the 17th Venus will be at its greatest distance, 46 degrees, above the western horizon at sunset, but while it loses altitude from this date on it will increase in brightness.

Saturn will be in conjunction with the Sun on the 24th and also disappear from view.

Mercury rises at 4.14 a.m., 1 hr. 48 min. before the Sun, and sets at 4.42 p.m., 1 hr. 8 min. befor it on the 1st; on the 15th it rises at 4.4 a.m., 2 hr. 6 min. before the Sun, and sets at 4.25 p.m., 1 hr. 10 min. before it.

Venus rises at 9.30 a.m., 3 hr. 28 min. after the Sun, and sets at 8.4 p.m., 2 hr. 14 min. after it, on the 1st; on the 15th it rises at 9.45 a.m., 3 hr. 35 min. after the Sun, and sets at 8.2 p.m., 2 hr. 27 min. after it.

Mars rises at 9.45 a.m., and sets at 8.21 p.m. on the 1st; on the 15th it rises at 9.33 a.m. and sets at 8.2 p.m.

Jupiter rises at 6.38 a.m. and sets at 6.18 p.m. on the 1st; on the 15th it rises at 6.0 a.m. and sets at 5.31 p.m.

Saturn rises at 7.32 a.m. and sets at 6.58 p.m. on the 1st; on the 15th it rises at 6.46 a.m. and sets at 6.9 p.m.

Venus and Mars will be in Taurus, northward of the bright star Aldebaran in the V-shaped cluster, on the 15th, both planets setting at the same time, 2 hr. 27 min. after the Sun.

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

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

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

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

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