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THE CATTLE-TICK (HAEMAPHYSALIS BISPINOSA).

INVESTIGATION OF ITS LIFE-HISTORY.

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IN February last the writer was sent to the North Auckland tick-infested area for the purpose of studying in as detailed a manner as possible the life-history of the cattle-tick (*Haemaphysalis bispinosa* Neumann), which is attracting increasing notice as a pest of cattle, and to a less extent of other stock. The present article is a preliminary note on the progress of the investigation, with a view to placing before those concerned a few of the more salient and hitherto unknown facts which will be of assistance in the control of the pest. It will be perfectly obvious that a complete and definite account of the life-cycle of the tick cannot be obtained until there have been accumulated observations made through every month in the year. Almost all the life-history observations in this case have been made in the field, under conditions as natural as was consistent with the isolation frequently essential for accurate observation. It is now actually demonstrated for the first time that the New Zealand cattle-tick is a "three-host" species, in which it resembles such other members of the genus *Haemaphysalis* as have so far been studied.

LENGTH OF TIME CATTLE-TICK PRESENT IN NEW ZEALAND.

One of the most difficult portions of the investigation was the sifting of evidence from various sources on such aspects of the tick problem as could not be solved by an appeal to the verifiable facts of observation. There is scarcely a person in the tick-infested area who has not some opinion, more or less hazy, but not necessarily any the less strongly held, as to the length of time that has elapsed since the cattle-tick was introduced into New Zealand. This tick is a tropical species with its centre of greatest abundance in India and neighbouring regions, and it has therefore almost certainly been introduced accidentally into New Zealand by the agency of man. The probability is the more strong in view of the fact that this tick is essentially a parasite of mammals, and these latter were practically unrepresented in pre-European New Zealand.

A large part of the "evidence" for the existence of cattle-tick in the Dominion for thirty years or more could be rejected at once as utterly unreliable. The only spark of truth in it is based on records of the kiwi-tick (*Ixodes anatis* Chilton), a totally distinct species which the Maoris rightly assert to have been in the country from time immemorial. Mr. H. Munro, principal Inspector of Stock for the Auckland District, states that when he was inspecting the whole North Auckland Peninsula up to fifteen years ago the tick did not come under his notice in any way. The first occasion on which specimens actually came under the notice of an officer of the Department was in December, 1910. It may be concluded provisionally that there is yet no exact evidence as to the length of time the tick has been present in New Zealand.

There is a very prevalent belief, amounting in places to dogmatic certainty, that the cattle-tick was introduced from South Africa in saddles brought back from the Boer War by members of the New Zealand contingents. This is conclusively negatived by the fact that this tick does not occur in South Africa. Perhaps the favourite explanation is that it came from Australia when the grass *Paspalum dilatatum* was first introduced from there into the north of New Zealand. This on the face of it is a more likely theory, especially in view of the close association now observed between the cattle-tick and paspalum in the infested area. Unfortunately, however, for the theory, *Haemaphysalis bispinosa* is by no means widespread nor common in Australia, and has probably been only recently introduced there.

LIFE-HISTORY OF HAEMAPHYSALIS BISPINOSA.

The Eggs.

The very numerous dark-reddish eggs are laid on the ground in one batch. Their glossiness is due to a liquid secreted over them by a bilobed dorsal organ, the purpose of the secretion being to stick the eggs together. In this tick, as in foreign species, it has been shown that unless the eggs are thus kept together in one compact bunch they will not hatch, the failure being perhaps due to resulting desiccation. Egg clumps are deposited by the engorged female at the bases of grass and weeds, at no great distance from the spot where she fell from the cattle-beast or other host. In about two months the

eggs commence to hatch, but some three weeks before this occurs a conspicuous squarish white patch is visible on one side of the egg. This represents the accumulated excreted matter of embryonic development.

The Larvæ, or Seed-ticks.

From the eggs, now left as empty transparent horn-coloured shells, there swarm the very minute young ticks in the first stage of their active existence. In this stage they are known as "larvæ," or "seed-ticks." They are rather less than $\frac{1}{50}$ in. in length and nearly as broad, but very flat, and, in fact, before their first feed, almost transparent. The pale-yellowish almost whitish colour in which they first appear soon deepens to a darker brown, and the seed-ticks, which may be distinguished at once from all succeeding stages not only by their minute size but also by their possession of only *three* pairs of legs, proceed to swarm up the stems of grasses and herbage, by means of which they can clamber on to the hides of cattle or other stock. On such vantage-points as the tall seed-heads of paspalum they will remain day and night until a suitable host should happen to brush past.

Once on the host the seed-ticks soon thrust in their mouth-parts and commence to feed upon the blood and lymph. In the early stages these minute ticks may be present in incredible numbers on a beast and yet be entirely overlooked. Even when recognized as ticks it is quite a frequent occurrence for their connection with the cattle-tick to be stoutly denied. The writer has known the larval ticks and those of the succeeding or nymph stage to be distinguished as "horse-ticks." The bestowal of this name is worthy of a little digression. Larval ticks so soon as or a very few hours after they have pierced the skin of a horse raise a small lump, which shows at a considerable distance, by interrupting the sheen of the coat, though the minute seed-tick itself, each one seated on such a lump, is invisibly hidden beneath the hair. Even on parting the hair over a lump there are ten chances to one against the larva being seen, since the lymphatic exudate caused even by this minute irritation soon more or less hides the tick from view beneath a covering of scurf, to the scales of which the tick itself bears a considerable resemblance. On cattle, on the other hand, apparently no lumps are formed, and as a result an infestation of larvæ of as many as six to the square inch over a large part of the animal may be entirely overlooked. The farmer is not in the habit of focussing his attention on objects so small as an unfed larval tick, and he appears to have some difficulty in seeing them when they are actually pointed out to him. Whenever the horses of a district show a plentiful supply of lumps due to larvæ it may be safely assumed that the cattle of the same district have an even greater number of larvæ upon them. It must be emphasized that the larvæ have no preference whatever for horses, but rather for cattle, but they are seen, even in extremely limited numbers, on the former, while on the latter they are almost always totally overlooked.

In a few days the larvæ begin to show an increase in size and to assume a dark blue-black colour, causing them to resemble, when fully fed, small beads of writing-ink among the white hairs of light-coloured hosts. This process of engorgement, by which the thin larval skin

becomes distended to its utmost capacity, takes on an average about a week, but depends to a certain extent on the position on the host. It is obvious that some portions of the animal might be pierced to better advantage with regard to blood-supply than others. Engorgement proceeds very much more rapidly towards the end, and the replete or full-fed larva disengages its mouth-parts from the skin of the host and drops to the ground.

For about three weeks, on an average, the shining-black full-fed larvæ lie upon the ground, hidden among the bases of grass and weeds near where they fell from the host. Early in that period the shining-black appearance is displaced by a misty almost mouldy look, due to the shrinking of the nymphal or next stage tissues from the distended and still stiff larval cuticle or "skin." At the end of the period the larval cuticle splits, and a pale-coloured nymph tick emerges.

The Nymph or Second Stage.

The nymph, although not so small as the larva, is still minute, and much less conspicuous than the replete larva from which it emerged. It may, however, be distinguished from the larva by the possession of four pairs of legs, as in the adult tick. After a longer or shorter period —at most a day—the nymphs, like the young larvæ, ascend herbage and thus reach a host—the second host of the individual life-history. Most of the remarks concerning the behaviour of larvæ on horses and cattle respectively apply also to the nymphs. Their period of heaviest infestation is, however, as will be shown in the account of the seasonal cycle, at a different time of the year. Both larvæ and nymphs attack almost any portion of the host, except where the latter happens to be a bird, when the head, for reasons of safety, becomes almost the sole point of attachment.

For a week or perhaps a little longer the nymphs suck the blood of the host until they are engorged. Then, like the larvæ, they drop to the ground and lie hidden among rubbish and vegetation, while the internal changes resulting in the conversion of the nymphal tissues and the engorged blood into the structures of the adult tick are consummated beneath the passive exterior. In about three weeks from the time of dropping to the ground the nymphal cuticle splits, and the adult tick, at first pale and rather soft, clambers out.

The Adult.

The adult is eventually of a deep rich-brown colour, the female rather larger than the male, but both quite flat and out of all comparison less bulky than the engorged female which corresponds to the farmer's more familiar conception of a cattle-tick. In this unfed state it is a matter of some difficulty to distinguish the sexes with the naked eye, but the vast majority are females. The males so far have proved very rare indeed. The males feed but little, and never engorge as do the females, so that the former sex keeps approximately the aspect of the female before she has commenced to feed. For this reason unfed females have been repeatedly taken for males and recorded as such.

As soon as possible after leaving the old nymphal slough and hardening its own integument the adult tick climbs herbage just as did the

younger stages, and awaits there the chance passage of a host. This is the *third* host of the individual life-history. Once on the animal the female soon settles down in a favourable situation. If the host be a cow the escutcheon and neighbourhood of the udder will be perhaps the most favoured spots. The male is said to wander over the host and to stay there much longer than the female, but the writer is not prepared to say much concerning this sex until more numerous examples have been observed. The female takes, on an average, when the host is a cow, a week in which to engorge, the greater part of the swelling which makes her then so conspicuous taking place during the last few hours. She then drops to the ground and takes such shelter as may be convenient. Observations on this stage are of the utmost value in control work.

For about a fortnight the female lies as well concealed as possible while the blood engorged is digested and finally elaborated into the substance of the numerous eggs which she then commences to lay in an almost continuous stream. The process of egg-laying may take as long as three weeks. Upon its completion—her labours ended—the female dies. This completes the life-cycle.

It should be borne in mind that all the foregoing observations, which are mainly averages from large series, have been made under the conditions prevailing from February to July inclusive. There remains, however, to be considered a seasonal incidence in the life-cycle, which can be definitely worked out in detail only after a year's observations have been completed.

THE SEASONAL LIFE-CYCLE.

The relative abundance of the various stages during February, as gauged by sweeping them from seeding paspalum where they awaited hosts, was approximately 300 larvæ, 1 nymph, and 5 adults. This clearly indicates that, for the present year at any rate, February was distinctly a seed-tick period, where the seed-ticks were derived from adults which were extremely numerous in the preceding December. If February–March, then, could be considered a seed-tick period it became difficult to see how eggs, as popularly assumed, could be the wintering stage. Observations in the field showed that this heavy autumn infestation of larvæ had practically all left the hosts by the middle of April. On the ground moulting had taken place as usual, and the resulting nymphs were found in May wintering at the bases of the clumps of rushes or wiwi (*Juncus effusus*) which are such a conspicuous feature of the northern pastures—rendered all the more noticeable by the close winter grazing. The replete or full-fed larval stage is swollen, smooth, shining, and easily seen, and it must therefore be advantageous for the tick to spend the winter in the far less conspicuous nymph stage. Much of the paspalum which has served as such excellent harbourage for the seed-ticks in February–March is in winter eaten to a close turf. The rushes, however, remain as compact stiff clumps. In the larger paddocks a few clumps of seeding paspalum are found not yet eaten. The majority of the nymph ticks winter in the clumps of rushes an inch or two above the surface of the ground. The overwhelming number of other wintering arthropods (insects, spiders, woodlice, and their allies) in the bases of these rush clumps, as compared with those in the shorter grass and in

the paspalum tufts, indicates the general suitability of these clumps as winter quarters. It is difficult to see how ticks could survive the winter in any numbers in short, well-grazed turf. The relation of this to the question of control is obvious.

The first ticks to appear in spring are these nymphs, which come forth from their winter quarters and seek hosts about the middle of July. From then until the following winter development apparently proceeds as indicated in the general life-history just described; but the verification of this will depend upon and guide future field-work.

HOST RELATIONSHIPS.

Although cattle are indubitably the chief hosts of every stage of this tick, it has already been pointed out that horses may be extensively infested, especially by the earlier stages. The list of hosts is, however, very much larger than this, and includes most of the larger animals of the North Auckland Peninsula and a few small birds. A few seed-ticks have been taken on the introduced skylark, thrush, and house-sparrow. Probably the most important of the wild hosts, from a control point of view, is the hare, which carries all stages. Man himself is a not infrequent host, the seed-ticks being often quite a serious nuisance to children, who become infested when playing in the grass. The effects of the bite are in most cases little more than a temporary irritation; but the writer would not dogmatize from his own limited experience, since the effects would doubtless vary both with individual ticks and with individual men.

One point needs further stressing than it has yet received. It is repeatedly asserted that the kiwi (*Apteryx australis* var.) and the sea-gulls (*Larus dominicanus* Licht. and *Bruchigavia novaehollandiae* Steph.) are infested with the cattle-tick and act as carriers. In the case of the kiwi this is totally incorrect, being based on the discovery of kiwis infested with *Ixodes anatis* Chilton, a different species of tick which does not attack stock. To the untrained observer all ticks look somewhat alike. Probably the case of the gulls is open to a similar explanation, since sea-birds of several New Zealand species are infested with *Ixodes eudyptidis* Mask., another of the bird-ticks. Up to the present, however, none of the gulls examined has shown any examples of ticks either of this species or of the true cattle-tick.

NATURAL ENEMIES.

In the existing literature on ticks much has been written about the length of time ticks can exist without food. Ticks have been kept in closed vessels for over two years without apparent harm. So far as the present species is concerned, the writer has a large number of seed-ticks collected from grass-heads six months ago and still quite happy and healthy. The relation of this amazing longevity to the question of control is not so important as is usually imagined,* and the reason can only be that those stragglers which do not find a host before a certain period has elapsed are carred off by natural enemies, thus rendering possible the quite exact delimitation of seed-tick

* Possibly the longevity is more important in the matter of the distribution of ticks in agricultural produce.

periods, nymph periods, and so on, without very serious overlapping. Undoubtedly the most important of these natural means of control are climatic conditions and birds. Among the latter the introduced starling (*Sturnus vulgaris* L.) stands pre-eminent. During a period when adult ticks are prevalent the starlings make a speciality of these, picking them from the cattle in the fields. No examination of starlings' stomachs at such a period has yet been made; but in Jamaica, where the value of insectivorous birds as tick-destroyers is widely recognized, the stomach of one bird was found to contain no fewer than seventy fully engorged female ticks. Starlings have not yet been shown to carry seed-ticks, but even if they did bear the usually slight small-bird infestation the harm done in this direction would be overwhelmingly more than counterbalanced by the destruction of adult female ticks.

SUMMARY.

Haemaphysalis bispinosa is shown to be a "three-host" tick—a fact which makes its control a more complicated matter than that of the North American or Australian "fever" ticks, both of which are "one-host" ticks. Cattle are the chief hosts, but other animals, including some of the introduced small birds, are infested. Kiwis certainly, and seagulls almost certainly, do *not* carry cattle-ticks as is generally supposed. The winter is passed as a nymph hidden at the bases of rushes and clumps of rough grass.

This article is to be considered only a preliminary statement. All acknowledgments to the large number of those who assisted in various ways and all references to literature are deferred until the complete report is ready.

NOTE.—Illustrations of *Haemaphysalis bispinosa* and other ticks will be found accompanying an article by D. Miller in the *Journal* for January, 1922.—EDITOR.

PASPALUM DIGITARIA AS A SAND-DRIFT BINDER.

MR. W. H. FIELD, M.P., contributes the following note: "Some time ago, acting on the advice of Mr. B. C. Aston, I tried growing one of the paspalum grasses (*P. digitaria*) in my grass-garden on the sandhills at Waikanae. This grass grows so rapidly and produces such strong shoots that I was induced to try it on a bad "blow-out" on the top of one of the grassed dunes near the homestead. It seemed to me a comparatively short time after this had been planted that I visited the spot again, when, to my astonishment, I found that the grass had become thoroughly established, was rapidly covering the loose sand, and had effectually stopped the drift. I am so impressed with the possibility of this grass that I am trying it on a much larger scale. Stock seem to be very fond of the grass, and possibly it may have to be protected from them in the early stages of its growth, but it is difficult to see how, with its strong rooting-system, they could exterminate it when once it had become established."

REDWATER IN COWS IN NEW ZEALAND.

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As the term "redwater" is commonly used by our settlers to denote a certain condition in cows, and is the one most frequently employed, it will be retained in these notes. It must be pointed out, however, that in veterinary literature technical terms are used which more clearly indicate the nature and cause of the different forms of redwater, and it follows that different causes must have different treatment. This explanation will serve to prevent confusion in the minds of readers of articles dealing with this trouble in other countries, where the cause is totally different from that in New Zealand, and for which the treatment recommended is unsuitable for conditions existing here.

In New Zealand redwater is not confined to any one locality, neither is it dependent upon soil conditions, as it has been found not only upon sour, damp country, but in variations from the heaviest to the lightest of dry soil. No live agent, such as ticks, is required to introduce the trouble into the animal. Redwater may appear upon any farm in the Dominion where cows are kept, but local conditions may be favourable or unfavourable for its development; it may assume a serious aspect, or the attack be so mild as to escape observation.

PREDISPOSING CAUSES.

Local conditions have a certain determining influence upon redwater. So far as we are aware, the disease has not been observed in male animals; but even if it has been noticed, the fact stands out clearly that it is only in cows that it gives considerable trouble and sometimes loss. As already mentioned, no locality is exempt from liability to an attack, the trouble is not caused by the agency of ticks, and male animals are seldom or never attacked. The field of investigation is therefore narrowed down practically to the cow. Here the first thing which will strike the practical stockman is that the trouble is closely associated with breeding-stock, and is more frequently observed just before calving or in a few weeks thereafter. There also would appear good reason for suspecting that some cows are more susceptible than others, as evidenced by the fact that with a number of animals upon the same feed and under the same conditions some become affected and others do not. It is further observed that the trouble cannot be put down to any one kind of feed, but that it can be definitely traced to excess of one kind of feed—be that turnips or young green feed. Even then, generally, all the cows are not affected, and their bodily condition does not appear to play a very important part in the matter.

We have therefore to fall back upon the idea that some animals are more susceptible to the trouble than others. This is an important point, and should be noted by all good stockmen who are building up a herd. Animals which suffer this year should be carefully identified for observation next year, for in building up a good milking-herd it is not sufficient only to note the external general appearance for

health and constitution and neglect the working of the internal organs. Therefore if an animal is found to be more susceptible than others to this disease she should be discarded, as susceptibility is undoubtedly hereditary.

It will have been noted from the foregoing remarks that the actual determining factor in redwater here is of dietetic origin. This is borne out by the well-established fact that immediate change of food alone acts as a prompt remedy, and that when the trouble is not too far advanced such change is all that is required.

SYMPTOMS.

As the term "redwater" implies, this discoloration is generally the first sign observed that anything is wrong with the animal. If, however, the trouble had been suspected earlier it would have been found that the animal was showing a touch of fever with a rising temperature, palpitation of the heart, and indications of diarrhœa. Later on, and often within a few hours, the urine discharged is of a dark-red colour with a peculiar offensive odour, and which on falling upon the ground produces an unusual amount of froth. The same odour may be detected in the breath, and even sometimes from the skin. Constipation now usually sets in, and all the symptoms already noted become exaggerated. The visible mucous membrane is pale, and the general appearance of the animal is that of great depression. If the vulva be examined its appearance is found to be peculiar, being of a dull leaden hue.

Very rarely discoloration of the urine may be observed due to other causes, such as internal injury after calving or injury over the back, but in such cases the colour of the urine is of a brighter red with all the appearance of diluted normal blood.

TREATMENT.

It has been demonstrated by practical stockmen that a change of feed is the first measure towards bringing about a cure. The next in importance is the administration of a laxative; this must be efficient, because in my opinion the accumulation of deleterious gases in the stomach and intestines has much to do with the redwater condition as it exists in New Zealand. A good drench for this purpose consists of ½ lb. each of Epsom and common salt, and 1 oz. of powdered ginger (if at hand, a tablespoonful of essence of ginger is preferable to the powder).

The animal should be housed and made as comfortable as possible, being kept warm and free from excitement. A drink of water with the chill taken off, to which has been added two or three handfuls of oatmeal and a tablespoonful of salt, should be offered about an hour after drenching. If collapse or general debility takes place the urine should be drawn off, as at this stage the bladder may refuse to function. Stimulants should also be given, and of these the most efficient is beer to the extent of a few bottles. In the convalescent stage great care should be exercised in bringing about a return to normal conditions. Hay, crushed oats, and a little linseed or other such dry feed should be given, and a salt lick provided.

In the great majority of cases this simple treatment will be found effective, but, of course, where the life of a valuable animal is at stake the services of a fully qualified veterinarian should, if possible, be procured.

THE RELATION OF BIRDS TO AGRICULTURE IN NEW ZEALAND.

IV. THE INSECTIVOROUS SMALL BIRDS.

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AMONG the bird inhabitants of any country there is a certain number of kinds of small birds which live entirely on insects and other small forms of life, without exhibiting any failings which might detract from the benefits they confer on agriculture. The present article deals with some dozen species of indigenous birds which in this manner represent a summation of all that is beneficial in bird-life so far as the war against insect pests is concerned.

In Canada there has recently been secured exact numerical evidence of the value of insectivorous birds (Dunstan, 1922). The white-marked tussock-moth (*Hemerocampa leucostigma* S. and A.) is perhaps the worst pest of shade trees of all kinds throughout eastern Canada. In an investigation into methods of control it was found that "the type of infestation in the cities differed greatly from that found in the woods"—that is, under natural conditions. In the cities periodic outbreaks, in which the caterpillars appeared as a veritable plague, seemed almost inevitable, but in the forest "the insect was always present in small numbers, evenly distributed, but never in a state of outbreak." To ascertain the cause of this surprising difference a year was spent in the woods, and the insect studied under natural conditions from egg to adult. The insect passes the winter in the egg stage, in masses deposited on the branches of trees and in crevices of the bark, and it was found that a very large percentage of these egg masses was searched out and destroyed by birds. In the cities, on the other hand, in the absence of insectivorous birds, the egg masses went almost entirely free. To obtain an accurate estimate of the part played by birds in thus helping to keep this pest in check, caterpillars and pupæ (resting stage) were exposed and watched. On the basis of these experiments it was demonstrated that over 80 per cent. of the eggs laid under natural conditions were devoured by birds. Nor did their work cease here, for over 11 per cent. of the caterpillars which hatched from the surviving eggs were discovered and eaten by the same assiduous searchers. Finally, of those caterpillars which escaped to spin their cocoons, 30 per cent. were destroyed by predaceous enemies, among which the birds were of no mean importance.

Such a case as this is typical of the activities of the insectivorous birds. They are to be ranked among the greatest of those forces which tend to restore the balance of nature when a favourable set of circumstances has allowed the abnormal increase of any particular insect pest. Since the whole of man's relation to his environment may be summed up as an upsetting of the balance of nature and an attempt to escape the consequences, it follows that the insectivorous birds must be ranked among his most efficient allies, without which, in the long-run, it is difficult to imagine how vegetation could survive.

There is now scarcely a country in the world which has not come to realize the importance to agriculture of its insectivorous birds. A. Godard (1917), writing in a viticultural periodical on conditions of vine-growing in France, pleaded for the protection of birds as the natural means of controlling insect pests. "Outbreaks of pests in agriculture always coincide with the disappearance of birds, and this is more felt in agriculture and viticulture than in forestry, woodland birds being less liable to destruction." In New Zealand, of course, the last remark does not hold, since forest-birds are here the most liable to destruction. "In South Africa [to quote an abstract of FitzSimmons's article in the *South African Journal of Science*, 1917] if the native birds were exterminated the human population would in a few years be reduced to a condition of starvation, while the ticks would destroy the domestic animals throughout the country. All natural checks to insect-increase, including parasites, diseases, and fungi, acting together with man's fight against the pest, are considered entirely inadequate, without the aid of birds, to prevent insects from sweeping all vegetation from the face of the world." These are strong statements, but the coldest logic can lead to no other conclusion.

In view of the spread of the cattle-tick in the North Auckland district the relation between birds and ticks in Jamaica is of the highest interest. Buckland (1917) states: "The increase in number of *Margaropus annulatus* (Texas-fever tick) in Jamaica during recent years is synchronous with the decrease of insectivorous birds. Examination of the stomach-contents of one bird showed the presence of seventy-four adult female ticks in an engorged condition. The Island of Jamaica is remarkably suitable for the breeding of cattle-tick; experience has shown that all imported animals succumb to tick-fever. It is therefore essential that, in some way, the insectivorous birds should be encouraged to increase." The subject will be resumed when the writers come to deal with certain introduced birds which destroy ticks in the north of New Zealand.

THE WHITEHEAD, THE YELLOWHEAD, AND THE BROWN CREEPER.

To come now to the insectivorous small birds of New Zealand, there is first a group of three species, the chief characteristics of whose beneficial activities have already been briefly indicated in the article on the birds of the forest (Part II of this series). These are the whitehead (*Certhiparus albicilla* Less.), the yellowhead (*Mohoua ochrocephala* Gm.), and the brown creeper (*Finschia novaeseelandiae* Gm.)—three birds fairly closely related and performing much the same functions in the zone and object of their insect-hunting. Both the whitehead and the yellowhead are small brownish birds somewhere about the size of a sparrow, but with pale-coloured heads, that of the whitehead—which is confined to the North Island forestry—being white, while the corresponding colour in the yellowhead—a South Island species—is yellow. Both are frequently called "bush-canaries." In those bush districts where the one or the other is still to be found the whitehead or the yellowhead—according to the Island in which the district is situated—shows a habit of consorting in flocks or small travelling-parties, keeping usually to the higher branches, flitting from twig to twig, and uttering incessantly a great variety of notes. When their curiosity is awakened

by the approach of a stranger the happy notes of industry and sociability give place, especially in the whitehead, to a harsh chattering cry, while the birds themselves descend to the lower branches to interrogate the intruder.

The brown creeper is smaller, with longer tail, and all the upper parts, nape, and back a deep and beautiful brown colour, contrasting somewhat sharply with the uniform whiteness of the breast and underparts. This little bird is confined to the South Island, in a few areas of which its busy flocks may still be seen in almost any patch of bush. The three birds just mentioned are all essentially forest-birds, and their economic value is to be translated in terms of forestry alone. Their nests are placed almost invariably in the deeper bush, and it will scarcely be necessary to describe them here. It is surely obvious that *any* nest found in the depths of the forest should, by virtue of its position, be sacred from the attacks of those who, for reward, collect birds' eggs. The only legitimate prey of such collectors is the eggs of the house-sparrow, which never nests far from settlement.

THE FERN-BIRD.

The fern-bird (*Bowdleria punctata* Q. and G.), the next bird on our list, is one of those peculiar recluse species confined to a particular habitat—namely, the densest swamp and the thickest bracken of the hillsides. In the latter locality it is less frequent than its name would imply. Unfortunately, the writers possess little exact information concerning the food habits of this bird, beyond the indisputable fact that it is practically entirely insectivorous. The almost total absence of many of the indigenous swamp-birds, including the fern-bird, or "swamp-robin" as it is called in the North Auckland district, from most of our phormium areas, coupled with the increased damage to the phormium-fibre industry by insect pests, renders it not improbable that a little investigation into the case of the fern-bird would be of some economic interest.

THE PIED AND THE BLACK FANTAILS.

In Europe a summer scene would be manifestly incomplete without one or two birds of the swallow family with their familiar flight, hawking for insects almost from ground-level to the upper atmosphere. The swallows and martins are among the most aerial of birds, taking their prey almost entirely on the wing, and taking it, moreover, among such insects as mosquitoes, which inflict supreme annoyance on man. L. Pasqualis (1915) pointed out that "so long as swallows are to be found in Venice there is no annoyance from mosquitoes, but when the birds migrate late in July these insects appear in swarms." But the use of swallows in Italy was recognized long before this date. We are told (Balfour, 1914) that somewhere between 1790 and 1812 the Commune of Marsciano, Umbria, "asked for a papal decree prohibiting the killing of nesting swallows for food because their destruction brought about insalubrity in the region, one reason being that the swallows feed on the small flying-insects so troublesome and hurtful to man and beast." And this was before the relation between mosquitoes and malaria had been discovered.

We in parts of New Zealand are troubled with numerous flying-insects—mosquitoes and sandflies—and in the absence of all birds of

the swallow family from New Zealand it might be asked what agency we have here to prevent the increase of such pests to intolerable proportions. Such an agency is undoubtedly to be found in the two species of fantail, the black (*Rhipidura fuliginosa* Sparr.) and the pied (*R. flabellifera* Gm.), which subsist almost entirely on flying-insects captured in their native element by a succession of the most amazing evolutions, rendered possible largely by the large fanlike tail which has guided the choice of the vernacular name. Few birds are better known to New-Zealanders. It will suffice for a description to indicate that the black species has deep sooty plumage and is far commoner in the South Island, while the beautiful pied kind is widely distributed over both Islands.

The fantails are among the tamest and most confiding of birds, and it is probably largely on this account that indications are visible of a growing sentimental regard for these birds, comparable to the affection displayed in England for the famous "robin redbreast." In the case of the fantails, for once sentiment is guided well, by the soundest if unconscious logic, and it must be obvious that such a sentiment is of incomparably more protective value to the birds concerned than all the legislation in the world. There can be few more efficient or better-equipped fly-catchers than the fantails. The bill is capable of opening to a considerable extent, and when so opened the sides of the gape thus displayed are fringed by an impenetrable hedge of stiff bristles, forming a fly-trap from which escape must be hopeless.

During the summer months fantails show a decided predilection for the vicinity of water, where flying-insects and particularly mosquitoes are well known to abound. In such situations, frequently on a slender bough directly overhanging the water, the fantails love to build their quite unmistakable wine-glass-shaped nest — a structure of the very neatest workmanship, with shallow cavity often lined with the shining down of young tree-fern fronds, and a tapering bottom, bound with spider-webs and resembling an inverted gnome's cap. The small, whitish, somewhat shortly oval eggs are blotched with pale brown, chiefly towards the larger end.

When feeding their nestlings both parents work extremely hard, returning time after time with beak crammed full of minute flies. One of the writers observed last season a nest of young pied fantails to which the parents brought no fewer than fourteen beakfuls in forty minutes, and this in spite of the presence of the observer, only a yard away, quite unhidden.

In winter, even more than in summer, the fantails show themselves in a considerable degree adapted to the alien conditions of settlement. It is no uncommon occurrence during the winter months for them to enter houses and other buildings, hawk systematically for house-flies through the rooms, and finally depart with the grandest nonchalance. We have even an authentic record of a fantail which was regularly let in at the front door of a dwellinghouse and suffered to depart when it had cleared from the premises its daily catch of flies. In Australia a fantail very closely related to our own is of the greatest use in that it destroys the sheep-maggot blowflies which constitute there such a serious pest to the farmer. Doubtless the same good service is rendered by our New Zealand species.

THE GREY WARBLER.

We have now to discuss the grey warbler (*Maorigerygone igata* Q. and G.), sometimes misleadingly known as "native wren," but more appropriately called riroriro in imitation of its beautifully trilled note. Quite as much as the fantails, though in itself not so conspicuous, the little riroriro has adapted itself to the conditions of settled areas—in some places to such an extent as to have become independent of the native bush. This adaptation has had two consequences: its services to agriculture other than forestry have been tremendously augmented, and its eggs have become liable to find a place in the collections of small birds' eggs bought indiscriminately by local bodies, &c. All may recognize without difficulty the grey warbler, with its sober grey plumage relieved by spots of white visible in the tail when it is expanded to aid the fluttering of this little insect-hunter at the tips of twigs too slender to support even its fairy weight. The nest is even

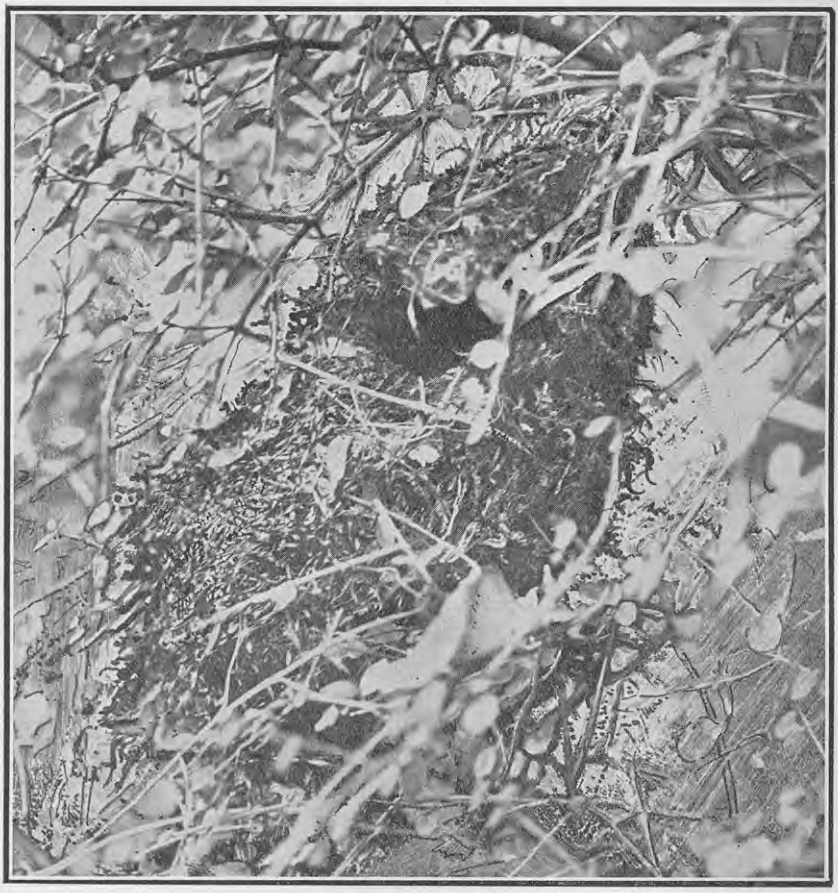

FIG. 1. NEST OF THE GREY WARBLER. ABOUT TWO-THIRDS NATURAL SIZE.

[*Photo by E. B. Levy.*

less mistakable, and should be confused with the work of no other bird in New Zealand. It is a covered structure hung from often a slender twig, though rarely pendulous. The opening in the sides, rather nearer the top than the bottom, is so small as barely to admit more than the tip of a finger, and is frequently shadowed by a small porch. The otherwise capacious interior is almost filled with the softest feathers, in which lie the tiny pink-speckled eggs.

Few birds are so exclusively insectivorous as the grey warbler. At a period with even less apprehension of the true position than at present, when the colonists of Canterbury considered as pests all birds except the truly destructive ones they themselves had imported from England, Potts brought forward as proof of the innocence of the grey warbler a nest which a pair had built embowered in a heavily fruiting red-currant bush. The parent birds had actually to brush aside the ripe fruit when entering the portal of their nest, yet not a currant was taken.

Strictly speaking, our rironiro is not a true warbler, but its differences from the warbler family are in no sense related to its insectivorous qualities. Hence the following figures published in *American Forestry*, 1917, will be of interest as showing the rate at which insects are destroyed by these birds and their allies: "One palm-warbler was observed to catch insects at the rate of from forty to sixty a minute during a space of four hours, making a total of nearly 9,500, while another species feeding on aphids (plant-lice) on a grey-birch destroyed eighty-nine in a minute and 3,500 in forty minutes. The destruction of caterpillars is on the same scale, one warbler destroying twenty-two gypsy-moth (*Lymantria dispar*) caterpillars in fourteen minutes, another twenty-eight browntail (*Euproctis chrysorrhoea*) caterpillars in twelve minutes, and a third forty-two in thirty minutes."

THE WHITE-BREASTED AND THE YELLOW-BREASTED TITS.

The two New Zealand tits which are really fly-catchers (*Muscicapidae*)—the white-breasted tit or miro (*Myiomoira toitoi* Less.) of the North Island, and the yellow-breasted tit or ngiru (*M. macrocephala* Gm.) of the South—are tame and familiar little birds which, nevertheless, are not very frequent in cultivated areas, though both show a considerable liking for clearings on the edge of the forest. The males of both have the same colour scheme of plumage, with black upper parts, head and breast, and pale abdomen, but the latter is white in the miro and yellow of varying shades in the ngiru. The females are greyish-brown with white under-parts, but may be recognized by their movements and build, which are similar to those of the males. Both species live practically entirely on insects, but they exploit a quite different locus from the preceding species and a correspondingly dissimilar set of insects. A large portion of their food, as indicated in the article dealing with forest-birds, is obtained from the ground, whither frequent darts are made from a position of vantage, in which the black beady eye is constantly alert.

In winter both the miro and the ngiru occasionally frequent orchards and gardens; but the writers know of no recent cases where nests have been built in such situations. The same remarks apply therefore to the nests of these birds as were made on those of the yellowhead and its relatives.

THE NORTH ISLAND AND THE SOUTH ISLAND ROBINS.

With regard to the North Island and South Island robins (*Miro australis* Sparr.), so far as economic considerations are concerned, we are almost compelled, on account of their great scarcity, to speak in the past tense. It is one of the great mysteries of the disappearance of New Zealand indigenous birds that the miro and the ngiru should have survived in such considerable abundance, while the two robins, so like in haunts, habits, food, and nesting-sites, should have become extremely rare. The moral is clearly this: that the decrease of the indigenous birds is not a topic on which any person is competent to express an opinion, but a scientific problem to be studied with all the methods of modern research.

FIG. 2. NEST OF GROUND-LARK, OR PIPIT.

This nest was found on the Tararua Range at an elevation of 4,500 ft., and was built in the heart of a bush of astelia, the leaves of which show round the centre of the picture.

[*Photo by E. B. Levy.*

THE PIPIT, OR GROUND-LARK (*Austranthus novaseeelandiae* Gm.).

In an indefinite manner every one knows "larks," but whether every one appreciates the difference between the little pipit and the introduced skylark is another question. It is, moreover, of the first importance that people should discriminate between the two, since the former is a wholly beneficial bird, while the latter is perhaps the most injurious bird in New Zealand—one which should never have

been introduced and for which very little good can be said. The pipit, or pihoihoi, which, by the way, is not a true lark at all, may be distinguished by the very conspicuous white outer tail-feathers, especially noticeable in flight, by its much slenderer build and longer tail, the longer and slenderer bill, and, above all, by its familiar habit of rising from the ground just in front of one, flying a short distance and then alighting just ahead, where it walks briskly about uttering its cheerful note until the observer again approaches.

The nest, which is a much more substantial structure than that of the introduced skylark, is placed on the ground among the roughage of a pasture, in the drier portion of a swamp, or sheltered among the alpine herbage far above the bush-line on the mountain-side, as shown in Fig. 2. The eggs, as will be noticed, need never be confused with those of the skylark. They are often more rounded, but the chief distinguishing character is the heaviness and distinctness of the blotches of darker colour. In the skylark's egg these are smudged and less contrasted.

The food of the ground-lark consists almost entirely of insects and their larvæ, some of the former of which it often snaps up on the wing. Small earthworms and occasional minute seeds contribute to its bill of fare.

THE RIFLEMAN AND THE WRENS.

The last of the purely insectivorous birds to be dealt with are those small active short-tailed birds popularly known as "wrens." It should perhaps be mentioned that they are none of them true wrens, but members of a family or two families found nowhere else in the world. Of the three species still existing at the present day the rock-wren (*Xenicus gilviventris* Pelz.) bears no relation to agriculture, since it is confined to the wilderness of rock above the bush-line on the mountains of the South Island; the green wren (*X. longipes* Gm.), a very rare bird, renders some service to forestry in that it is an ever-active insect-hunter in the subalpine beech forests, where the ordinary forest-birds are quite rare. The rifleman (*Acanthisitta chloris* Sparr.), however, the smallest bird in New Zealand, occurs plentifully in beech forests in the North Island and throughout all forest in the South. It is easily recognized by its extremely small size, greenish colour, and slightly upturned awl-shaped bill, and by its habit of running in a very mouse-like manner up the trunks and large branches. The nest is placed in a crevice of bark or bank, or in a natural hole in tree or log. Frequently, when in living timber, the nest-entrance is so small that the tip of the forefinger can be inserted only by turning it sideways. Such was the case in the nest sketched and shown in Fig. 3. The nest itself is of the most irregular shape, and is suited to the exigencies of the selected cavity. The eggs are small and pure-white.

CONCLUSION (OF PART IV).

As was indicated in the opening article of this series, there are some birds which are beneficial, provided their numbers be not too great; with others a careful balance must be struck between the services they render and the damage they do. In the case of the insectivorous small birds dealt with in the preceding pages the only verdict must be one

of unqualified appreciation. The writers would stress that the annual loss to this country through the damage wrought by insect pests is estimated at several million pounds, and that unquestionably the

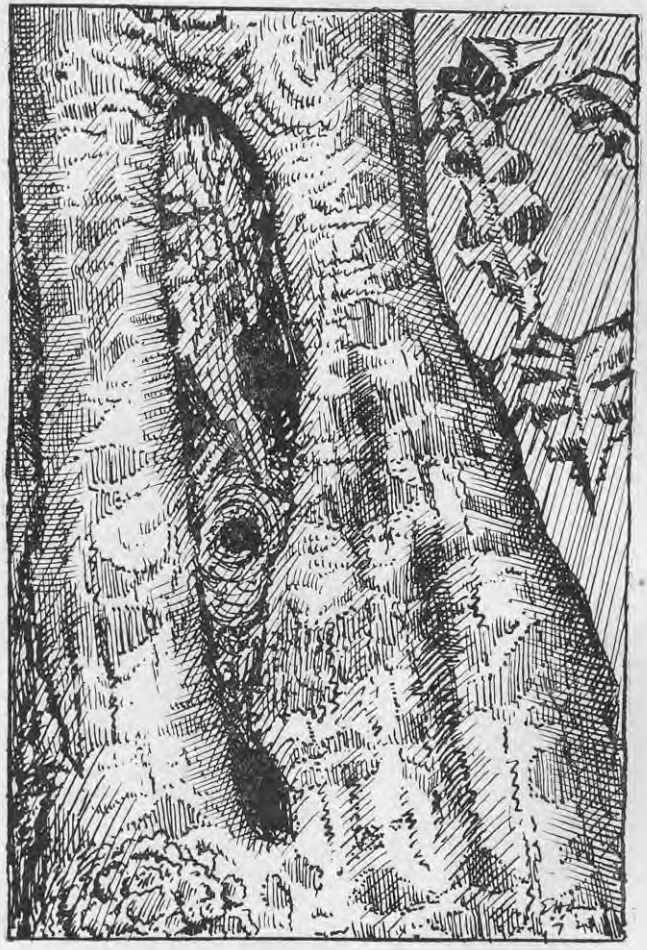

FIG. 3. NEST OF RIFLEMAN IN KAMAHI (WEINMANNIA RACEMOSA) TRUNK.
[*Drawing by E. H. Atkinson.*

greatest factor in the prevention of the increase of that damage to an extreme extent is the activity of bird-life, and particularly of such specialized insect-hunters as those just described.

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THE ORGANIC MATTER OF THE SOIL.

B. C. ASTON, F.I.C., F.N.Z.Inst., Chemist to the Department.

THE various classes of material which go to make up a fertile soil may be broadly classified into five groups, according to the origin of each.

First there is the rock-derived mineral matter, wholly lifeless, but capable of change in composition, character, and appearance — compound reacting with compound, or with the soil-water, or with the substances dissolved in it. Second are the important salts of calcium, mostly derived from pre-existing life—the carbonates and phosphates of lime, as they are commonly called. Third is the soil-water or soil-solution, containing, in addition to a certain amount of carbonic-acid gas, small amounts of other soil-constituents. Fourth is the soil-air, about which so much remains to be learnt. Fifth, and most important, is that portion of the soil which will burn away when ignited, known as "organic matter," derived from the remains of plants and animals dying in or on the soil, forming ultimately a black spongy mass, the culture medium for nourishing that portion of the soil-life which lives wholly below the surface.

This organic matter, or, as it is often broadly termed, humus, is the portion which gives character to the soil, and when present in sufficient quantity obliterates all other distinctions. For instance, both sandy and clay soils when altered by the growth of organic matter lose their characteristic features, both loose porous and very dense impermeable soils, when mixed with organic matter, becoming altogether changed in texture. Thus on the Manawatu dune-sands, where the topography will not permit the escape of the copious surface water, aquatic and semi-aquatic vegetable growth develops, organic matter accumulates, and finally, in an area surrounded by sandhills and resting upon sand, occurs an area which when drained and "brought in" presents none of the difficulties of treatment which the sand (with which it may be still largely admixed) originally exhibited.

A good supply of organic matter darkens the colour of the soil, thereby causing the absorption of more sun's rays than is possible in a lighter-coloured soil. This effect in rise of temperature is appreciable, and may be measured by means of a thermometer. Organic matter can withdraw from the soil-solution various plant-foods. It causes the soil to swell up, thereby increasing its pore-space and

mitigating the evil effects of wet seasons on the growth of crops. By increasing the water-holding capacity of the soil in seasons of temporary drought it again benefits the growing plant. Organic matter is a source of energy. With it beneath the soil-surface life is possible to many kinds of visible and invisible plants and animals, some having a beneficent and some a maleficent effect on crop-growth, but the net result on crops must be for good. Organic matter assists the decay of rocks, and in soils of coarse texture fills up the large excess of air-space with colloidal (or gelatinous) vegetable matter, which has a decomposing effect on the mineral particles and renders the whole into a mellow loamy mass highly responsive to cultivation, liming, and artificial manuring, resisting abnormalities of climate—a fit home for the nurture of the seedling crop at its tenderest stage.

The importance of conserving the organic matter in a soil will be seen when the difficulty of replacement and the result, if this is not done, are considered. Usually everything that a soil requires may be purchased in commerce except organic matter. This must be either supplied on the farm or accumulated indirectly by an artificial system of fertilizing and liming, green-manuring, or by laying down in pasture. The history of many of the derelict farms of the United States of America is that of neglect in conserving and replacing organic matter. The rehabilitation of these farms is dependent on giving back those soil-constituents which have been squandered by wasteful and continuous methods of cropping. The replacement of the mineral nutrients removed by crops or washed away in the drainage-water may be accomplished at any time artificially, but the recovery of the nitrogenized organic matter is a much slower process, involving the abandonment of all tillage operations and leaving the soil to be covered by vegetation for a number of years. So by the aid of life the gases of the atmosphere—carbon dioxide, nitrogen, and oxygen—and water are slowly built up into life-giving humus.

Chinese market-gardeners—oldest of husbandmen—know the advantages of organic matter, and not only endeavour by manuring with decomposable materials to maintain a state of high fertility, but in the first place take care to select the site of old swamps black with decayed vegetation as the situation of their gardens.

The organic matter of the soil consists of material in all stages of decomposition, from material which shows organized structure (even the kind of plant which yielded it can be made out in some swamps) to the spongy black material in which all visible traces of organic structure have been lost. The change goes further still, for the oxidation of the humified mass continues towards the stage at which it is resolved into those gases and water whence the organic matter was originally derived.

Among the factors in nature which bring about an accumulation of organic matter are low temperature, excessive water, and limestone. In the subantarctic islands southward of New Zealand a humus soil accumulates as it does in the northern islands of Britain, even in situations where there should be good drainage. One would think that the low temperature would be the main factor in our southern islands, though the absence of bacteria may contribute to the result. In the warmer North Island of the mainland, where peaty soils develop, one

would think that it is the stagnant water and lack of oxygen which determines the accumulation; while in situations where limestone comes near the surface in dry, warm districts one finds a deposit of mellow black soil accumulating which can be due neither to cold nor excessive moisture, nor to lack of oxygen.

In certain areas where swampy soils containing much organic matter have developed and are deficient in mineral matter it may be practicable to transport inorganic or mineral matter, such as sand and pumice or clay, on to the surface, and so improve the soil in its deficiency. Nature has done this for the extensive Te Puke and Rangitaiki Swamps. Layers of air-borne pumice and volcanic ash are to be found at various levels in the former, and calcareous mud, pumice, and ash layers in the latter swamp. These layers greatly facilitate drainage, and ameliorate the conditions physically and chemically to a degree which owners of other swamp lands can only envy. When one reflects on the good which a pumice deposit will effect on a swamp soil it at once suggests what should be supplied to a pumice soil to improve it.

It must not be thought, however, that humus soils are everything that could be desired, for even they have their weaknesses. Frequently they are deficient in mineral plant-food, but respond at once to dressings of phosphates or potash when these are lacking. Sir John Russell, F.R.S., quotes a pathetic instance of an American farmer who endeavoured to farm on a black soil. "The land looked rich," he said, "as rich as any land I ever saw. I bought it, drained it, and built my home on a sandy knoll." His first crops were fair, but grew rapidly worse. He and his wife and children wasted twenty years of their lives on this land. It was poverty, poverty always. After he had given up his holding, and a chemist had been at work on the problem, the farmer one day brought his wife and children to see the heavy crops on plots treated with potassic fertilizers alongside the miserable ones on untreated land. In tears he asked, "How was I to know that this single substance which you call potassium was all we needed to make this land productive and valuable?" In the case of humus soils mechanical analysis is inapplicable, so that any knowledge, apart from field and pot experiments, must be gained by chemical analysis.

The importance of increasing the store of organic matter or humus in New Zealand soils has not in the past received that attention merited by the importance of this aspect of manuring. There are three ways in which the organic matter in the soil may be increased in farming practice: (1) By applying dung, stable, farmyard, or other crude refuse of an approved organic nature to the soil; (2) by growing and turning in a green crop, known as "green-manuring"; (3) by putting the land down in pasture, which allows organic matter to accumulate. The difficulties of supplementing the store of organic matter in the soil are sufficiently indicated by these methods of redress, but the problem must be faced if many of the coarser-grained soils of this country are to be profitably and continuously worked.

At Stanley Brook Valley, Nelson, there is a flat area of gravelly loam and sandy silt concerning which the writer advised the local branch of the Farmers' Union in March, 1919, that "the improvement of these soils will depend largely on increasing the organic matter in

the soil, which may be accomplished either by ploughing in green crops (green-manuring), or growing a larger share of clovers and other leguminous plants in the pasture, or, where possible, by applying organic manures, stable manures, or flax-waste refuse, and generally adopting methods of farming which will conserve the organic matter in the soil." The Cawthron Institute's chemist, Mr. T. Rigg, has recently pointed out as a result of his investigation of this land that "every effort should be made to maintain the humus content of the soil. This may be effected by periodical ploughing-in of catch-crops of blue lupins or tares with oats. The latter crop is particularly recommended."

The pumice gravels and coarse sands of the North Island thermal district show similar improvement, and largely lose their identity as coarse soils when they have been submerged by lake or river, mixed with the remains of aquatic plants, and have finally emerged as a terrace highly fertile in comparison with the material as it existed in its original state, and still exists in many parts where the beneficial influence of lake or river has not been felt.

Attempts to improve coarse pumice lands should be based upon the methods seen to be successful in nature, but hastened to accord with present needs. In forested areas which have been cleared top-dressing methods must suffice until the stumps can be profitably removed, but in areas growing scrub green-manuring and rolling could at least be tried experimentally. In areas suffering from exceptionally severe climatic conditions the planting of exotic forest will mitigate the severity of the cold and add organic matter to a soil greatly in need of it. (A discussion on pumice soils may be found in the *Journal*, vol. 4, 1912, page 374.)

CONCLUSION.

It is thus seen that organic matter improves the texture of all soils deficient in that constituent, whether they are, on the one hand, extremely loose and porous, or, on the other hand, stiff, impermeable, and tenacious. However rich a soil may be in mineral plant-food, if it lacks the texture conferred by an adequate supply of organic matter there will be trouble in abnormal seasons; while for a large number of soils of coarse texture and deficient water-holding power it is essential that prompt attention should be paid to the organic-matter content if fertility is to be maintained. Organic matter tends to accumulate in land under permanent pasture, and to diminish in land under crop.

List of Qualified Veterinary Surgeons.—The name of Mr. A. Taylor, F.R.C.V.S., was omitted from the list published in the June *Journal*. Mr. Taylor recently retired from the staff of the Canterbury Agricultural College, Lincoln, and is now located at Christchurch.

The Gold Medal of the Linnean Society (London) has this year been awarded to Mr. T. F. Cheeseman, of Auckland, author of the "Manual of the New Zealand Flora."

TESTING OF NEW-ZEALAND-GROWN WHEATS.

II. STRENGTH OR QUALITY OF FLOUR.

L. D. FOSTER, Analyst, Chemistry Section, Wellington.

THE best wheat is that one which will produce the greatest amount of flour of the best quality. In the previous article, printed in last month's *Journal*, the amounts of flour obtained from wheats grown in various localities in New Zealand were considered. Yield of wheat per acre and yield of flour are indeed important considerations; the miller, however, has to supply the market with a product of as good quality as possible. He judges a flour largely by colour, strength, and weight of flour per bushel of wheat. By blending the very best wheats with more average samples he endeavours to maintain a satisfactorily high standard, and one which satisfies the requirements of the baker and the consumer. Since it is the quality or strength of the flour which really determines the demand and the value of a wheat, this factor of strength is no less important than those other considerations. A strong wheat has been defined as one which yields flour capable of making well-piled loaves.

The strength of flour, then, is its apparent and potential ability to produce a large loaf of good texture: a hard wheat will generally produce a strong flour, a soft wheat a weak one. It is a well-known fact that if the starch is carefully washed away from flour a curious plastic elastic mass remains. This is the so-called gluten, which is a mixture of two nitrogenous chemical compounds, gliadin and glutenin. Gluten imprisons gas generated by the fermentative processes due to the addition of yeast, and in this way enables a loaf to retain, after baking, that texture so characteristic of well-baked bread. Many attempts have been made to correlate strength with any one constituent as determined by chemical analysis. For many years discussion of strength centred on whether the protein (or gluten) content of a flour was or was not a true indication of this quality. Proteins, it will be remembered, are a group of compounds present in plant (and animal) tissues, easily assimilated by the body and contributing to the formation of muscle, &c. It was at first thought that the amount of gluten (which is very closely related to the total amount of protein) was the controlling factor; then the idea became general that the quality of the gluten was all-important and the quantity rather negligible. Many other factors which at first sight have appeared rather contradictory have been considered at length, and in the light of fuller knowledge found often to be supplementary in character rather than otherwise. It is true that much remains to be done; at the same time it is likely that the truth lies between many divergent statements of fact and of theory. Stockham (1) thinks that the total quantity of gluten present is important, and that a consideration of quantity no less than quality is essential to an understanding of strength. In applying the statistical method Zinn (2) has compiled a large amount of published data on the

chemistry of wheat, and computed the coefficients of correlation for the important chemical characters; he has shown that there is a very close connection between quality, quantity, and amount of gluten present.

Another method of arriving at the strength of flour is to determine the amount of water retained by the gluten extracted from any sample (3). In New South Wales the proportion of water taken up by the flour itself has been regarded as a good indication of strength (4). Lastly, the percentage of ash serves, among other things, as an indication of the skill of the miller (5 and 6).

These methods may not apply equally to wheats grown under New Zealand conditions. But even if no single property is an unfailing measure of strength, it is probable that from a consideration of several a very good idea of the quality may be obtained. Only by further investigation of varieties grown under local conditions, and collection of data obtained from them, will more information be obtained.

It was pointed out in the previous article that the cause of strength, or lack of it, is due to three main factors—climate, soil-fertility, and variety. Fertility, of course, affects yield of wheat, but apparently not strength of flour (7 and 8). There remains the varietal factor, and there is no doubt that strength may often be improved by proper selection and breeding.

EXPERIMENTAL WORK.

Some sixty-six samples were milled in this Laboratory, and further examination was made as to the probable strengths of the resulting flours. A selection of the results obtained is tabulated in the accompanying Table II.

It is to be regretted that only a few samples of Pearl were received. It will be remembered that this variety gave as a rule a very good yield of flour. Referring to Table II, it will be seen that the sample with the lowest percentage of flour (P 305) contained the most valuable amount of protein; but the other three samples—which, on the other hand, all yielded very good amounts of flour—were all very close in protein content to the highest. The amount of water absorbed per cent. of flour reached a good average in these samples. It will be seen that the amount of dry gluten was approximately the amount of total protein present; the ratios of wet to dry gluten showed considerable divergence, but in view of the small number of samples received nothing further can be said on these figures.

A more satisfactory number of samples of Velvet was received. The sample giving the second highest yield of flour (P 294) also contained 15·75 per cent. of protein, which is a remarkably good figure. Its water-absorption figure was also high, and the ratio of wet to dry gluten was satisfactory. This wheat—from Dumbarton,* near Roxburgh—appears to be a wheat of all-round excellence. It is followed closely by three samples which also showed very good protein content. Of these three it appeared that the lowest in protein

*This and all other samples from Dumbarton were grown at the Moa Seed Farm.

TABLE II.—TESTS FOR STRENGTH OR QUALITY OF FLOUR OF NEW-ZEALAND-GROWN WHEATS (SELECTED RESULTS).

Laboratory No.	Variety.	Locality and County.	Flour.	Moisture.	Absorption of Water.	Gluten, Wet.	Gluten, Dry.	Ratio of Wet to Dry Gluten.	Nitrogen.	Protein.	Ash.
			Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
P 305	Pearl ..	Balcairn, Kowai.. ..	71·0	12·92	51·6	27·22	9·74	2·79 : 1	1·60	10·00	0·48
O 811	,, ..	Lincoln, Springs.. ..	73·8	12·98	54·4	26·94	9·51	2·83 : 1	1·58	9·88	0·48
P 382	,, ..	Frankton, Lake	74·3	13·53	56·0	24·05	8·89	2·71 : 1	1·54	9·63	0·58
P 307	,, ..	Weedon's, Paparua ..	75·2	12·83	53·0	31·35	10·12	3·10 : 1	1·54	9·63	0·60
P 294	Velvet ..	Dumbarton, Tuapeka ..	74·1	13·40	57·5	45·70	15·84	2·88 : 1	2·52	15·75	0·67
P 291	,, ..	Middlemarch, Upper Taieri	72·6	13·50	57·4	45·00	15·65	2·88 : 1	2·38	14·88	0·54
P 290	,, ..	,, ,,	71·8	13·67	57·0	39·73	13·82	2·87 : 1	2·11	13·19	0·56
P 262	,, ..	Windsor Downs, Waitaki..	73·1	12·87	58·6	42·78	14·06	3·04 : 1	2·04	12·78	0·65
P 292	,, ..	Nenthorn, Upper Taieri ..	72·9	13·62	57·8	34·13	11·41	2·99 : 1	1·81	11·31	0·54
O 814	,, ..	Lincoln, Springs ..	70·8	12·89	56·0	28·85	10·52	2·74 : 1	1·69	10·56	0·51
O 812	,, ..	,, ,, ..	75·2	12·80	57·0	30·65	10·74	2·85 : 1	1·61	10·06	0·59
P 308	College Hunters	Doyleston, Ellesmere ..	71·5	12·73	52·2	33·57	12·77	2·63 : 1	1·95	12·19	0·56
P 295	,,	Dumbarton, Tuapeka ..	73·6	13·79	54·0	32·31	11·15	2·90 : 1	1·75	10·94	0·69
P 313	,,	Lincoln, Springs ..	71·7	13·09	50·4	34·93	11·68	2·99 : 1	1·74	10·88	0·56
P 265	,,	Airedale, Waitaki ..	73·0	13·18	52·4	27·73	9·65	2·87 : 1	1·53	9·54	0·63
P 383	Tuscan ..	Malaghan's, Lake ..	72·6	13·80	53·4	32·13	11·09	2·90 : 1	1·78	11·13	0·60
P 201	White Tuscan..	Tuamarina, Marlborough	70·4	13·34	51·4	30·21	10·44	2·89 : 1	1·64	10·25	0·59
P 467	,, ..	Winton, Southland ..	71·5	13·78	52·4	25·02	9·02	2·77 : 1	1·58	9·88	0·72
P 317	Solid-straw Tuscan	Horrelville, Eyre ..	71·1	12·94	53·0	28·02	10·59	2·65 : 1	1·57	9·81	0·58
P 416	Ditto ..	Carterton, Wairarapa S. ..	70·5	14·69	51·8	29·37	10·30	2·85 : 1	1·53	9·54	0·60
P 256	Purple-straw Tuscan	Windsor, Avon	71·3	12·93	53·6	29·16	10·46	2·80 : 1	1·67	10·41	0·62
P 322	Victor ..	Domett, Cheviot ..	74·4	13·04	50·2	24·53	8·39	2·92 : 1	1·54	9·63	0·56
		Miscellaneous.									
O 815	Burbank's Super	Flaxton, Eyre	70·0	12·96	57·2	41·10	14·85	2·77 : 1	2·31	14·44	0·50
P 431	Huron ..	Dumbarton, Tuapeka ..	74·9	13·67	51·6	31·84	11·58	2·75 : 1	2·03	12·69	0·74
P 432	Thew ..	,, ,, ..	71·1	13·45	54·2	35·61	12·52	2·84 : 1	2·00	12·50	0·68
P 430	Rymer ..	,, ,, ..	70·4	13·51	53·2	29·88	10·63	2·81 : 1	1·96	12·25	0·61
P 429	Marquis ..	,, ,, ..	72·4	13·54	56·2	30·65	11·44	2·68 : 1	1·84	11·44	0·69
P 466	John Brown ..	Winton, Southland ..	70·0	13·86	53·2	31·76	11·53	2·76 : 1	1·81	11·31	0·66
P 260	Dreadnought ..	Kurow, Waitaki.. ..	75·0	12·77	51·0	33·82	11·38	2·97 : 1	1·67	10·41	0·57
P 259	,, ..	Kia Ora, Waitaki ..	73·1	13·10	49·8	35·60	12·00	2·97 : 1	1·75	10·94	0·64

was probably the best all-round wheat, a conclusion that was arrived at from a consideration not only of the protein present, but also of its very good milling-properties. Its capacity for water was also higher than that of the other two. All three, however, were very good wheats. The three remaining samples were fairly good wheats and better than the average; O 814, however, was rather low in its milling-properties. Velvet, then, in 1922, was an all-round good variety. The absorption-of-water figure was always high, a fact of much interest and importance to the baker. This variety also gave a good average yield of flour per bushel. Lastly—and this is always important—the average protein content was good, and, when grown in some localities, excellent. In this respect it is interesting to note the very good sample of wheat from Dumbarton, and the high average of the three samples from the Upper Taieri, districts near the borders of the area of lowest rainfall in New Zealand. As a variety, Velvet would be classified in Australia as a "medium strong" wheat. There is no doubt that at least four individual samples among those now under discussion might with justification be classified as "strong" wheats.

Three samples of College Hunters were good wheats, and might be called medium strong; the fourth was a medium wheat with 9·54 per cent. protein. The best of these was from Dumbarton, with a yield of 73·6 per cent. flour, and containing 10·94 per cent. protein; its capacity for water and the ratio of wet to dry gluten were both good.

The best of three samples labelled Tuscan came from Malaghan's, Lake County, part of which is the driest district in the Dominion; this wheat milled well, with 72·6 flour, possessed a fair capacity for water, and contained a good amount of protein—quite a good all-round wheat. Two samples of White Tuscan and two samples of Solid-straw Tuscan contained moderate amounts of protein. A Purple-straw Tuscan was rather better in this respect. It will be remembered that the samples of Victor gave generally very good yields of flour. In 1922, however, they appeared in most cases to be lacking in strength, but P 322, from Domett, Cheviot, was a sample above the average for this variety.

The "Miscellaneous" samples gave some interesting results. It is true that usually only one sample of each was received; nevertheless the information obtained is sufficient to warrant further investigation of these lesser-grown varieties. One of the outstanding samples milled in 1922 was the Burbank's Super, grown at Flaxton, Eyre. It is said that this variety compares favourably with other wheats in yield per acre, and that its chief characteristic is early maturity. This particular sample milled rather poorly, with 70 per cent. of flour; but it more than made up for this deficiency by its protein content, which was as high as 14·44 per cent. This is nearly 1 per cent. higher than the average of the strong red wheats exhibited during recent years at the New South Wales Royal Agricultural Society's show at Sydney (9). The absorption figure was very good, and, although the ratio of wet to dry gluten was unexpected, it was observed that the physical condition of the extracted gluten was better than is usually the case. One cannot, of course, judge a variety by one sample, but the figures undoubtedly show that the adaptability of the variety to local conditions is well worth looking into.

From a sample of Huron (apparently a Canadian wheat), grown near Dumbarton, results as interesting as those of Burbank's Super were obtained. Its milling-yield (74·9 per cent. flour) was very good, and, in addition, its protein content reached the high figure of 12·69 per cent. This is an excellent strong sample.

A sample of Thew, also from Dumbarton, milled moderately well, and contained a very good amount of protein (12·50 per cent.); it had a fair capacity for water, and the ratio of wet to dry gluten was satisfactory. It might be classified as a medium-strong wheat. In the same class might be placed the sample of Rymer (grown at the same place), which is a rather poor milling-wheat but one of good strength (12·25 per cent. protein); it is also classified in New South Wales as of medium strength.

Marquis, originally a Canadian variety, is now extensively grown in Australia, where it is classified as a strong red wheat; in certain American States it fetches highest prices (10). The one sample tested here hardly maintains that high level, but its milling-yield is good, and it still contains a good percentage of protein.

John Brown, from Winton, yielded only 70 per cent. of flour, but it possessed a good amount of protein, and appears to be a medium-strong wheat. It is interesting as being a Farrer cross, which in Canada has the reputation of being a strong wheat with a good average yield per acre, and giving better all-round results than many Canadian varieties.

Two good all-round samples are those of Dreadnought, grown in Waitaki County. Both gave very good milling-yields, and both contain good percentages of protein, being medium-strong wheats well above the average.

VARIETIES AND LOCALITIES.

In grouping the 1922 samples into districts it must be remembered that at present, because of lack of sufficient data, no general comparison between varieties is possible. In a few cases, however, the results do seem to point to one or two outstanding characteristics which should be noted.

Nine samples were received from the drier parts of the Tuapeka-Upper Taieri districts. Here the very well defined good quality of these wheats and the high average which they maintain are clearly apparent. Not only are they good milling samples, but five appear to be strong wheats, while four of them are medium-strong samples. Some of them are not widely known in New Zealand, and only further experiment will show if they can maintain this standard. It is probably no coincidence that three samples of Velvet occupy prominent positions among this collection of strong wheats.

The Waitaki wheats contained medium-strong samples of Dreadnought. Of the others, one was a Velvet with a very good milling figure of 73·1 per cent. flour, and containing a very good amount of protein, 12·78 per cent. This could be considered a hard wheat, giving a flour of very good strength. Among the others a fair average was maintained.

From Springs County six samples were received, of which two, a College Hunters and a Velvet sample, were good medium-strong

wheats; samples of Velvet (P 812) and Pearl (P 811) were average samples. A sample of College Hunters from Ellesmere was a good wheat, with 12·19 per cent. protein. Lastly, from Eyre came the excellent sample of Burbank's Super, referred to at length in a previous paragraph.

SUMMARY AND CONCLUSION.

Wheats may be classified into (*a*) strong, (*b*) medium-strong, and (*c*) weak samples.

On examining Table II it will be found that in 1922 one variety, Velvet, stands out as being generally the best wheat grown in its district. In particular, when grown in the drier parts of Tuapeka and Upper Taieri districts bordering on the area of lowest rainfall in New Zealand, three samples of Velvet are conspicuous even among strong wheats. Varieties which, although represented often by single samples, give promise of being wheats of good strength are Burbank's Super, Thew, and Huron. Others which appeared to be good medium-strong wheats are John Brown, Dreadnought, Marquis, and Rymer.

It is apparent that variety has a considerable influence on strength. Some varieties maintain a relatively high standard under different environments; such a variety is Velvet. Others show a fairly large range in protein content, some samples containing high percentages of protein; but the average for such a variety may often be low. In such a case, notwithstanding these better exceptions, the variety as a whole must be regarded as a soft wheat. Only in special cases, such as suitability of climate and soil favouring production of the better samples of the variety, should such a wheat be grown—from the milling and breadmaking points of view.

Another important factor is that of climate, samples from some districts showing to distinct advantage. It will be noticed that the drier districts in general produce stronger wheats. To a marked degree this is true of Central Otago, a notably arid district, as evidenced by the samples from Tuapeka and Upper Taieri. This is what one would expect from data published in other countries where it has been observed that comparatively high temperatures, long days, and absence of excessive moisture during ripening, hasten maturation of the grain and increase its content of gluten, and hence its protein (8 and 11). There are probably other districts in the Dominion with characteristic climates which the examination of further samples will prove also to be specially adapted to the growing of strong wheats.

It is probable that no one variety possesses combined the desired characteristics of yield per acre, protein content, flour-yield, weight per bushel, and the required milling-qualities. Evidence may be obtained, however, by experimental milling and chemical investigation, indicating which varieties combine most of these qualities and are therefore most profitable to grow or to use for selection.

Finally, although individual samples may often be regarded as possessing the elusive quality of strength to a marked degree, a variety may be classified as a strong or medium-strong wheat only from data obtained from many individual samples and extending over a period of years.

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BLACK-ROT (PHYSALOSPORA CYDONIAE ARNAUD).*

A FUNGOUS DISEASE OF APPLE, PEAR, AND QUINCE.

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THIS disease has been recorded from North America, Australia, and Europe. In certain parts of North America it is considered as a serious parasite of the apple, second in importance only to black-spot, but in Europe and New Zealand it is comparatively a minor disease. In New Zealand it is a common canker of apple and pear, and in North America it has been recorded on many additional hosts, among which may be enumerated elder, hawthorn, lilac, mulberry, oak, and rose. In our earlier reports cankers caused by it were attributed to European canker, *Nectria galligena* Bres., but fortunately this fungus is not known to occur in New Zealand.

APPEARANCE AND EFFECT ON THE HOSTS.

Black-rot infects shoots and branches, fruits, and leaves. On the laterals and branches, but more frequently on the latter, it forms definite cankers. These at first appear as small elliptical areas, noticeable on account of their colour differing from that of the healthy bark. Shortly after its formation the cankered area becomes separated from the normal bark by a crevice. Then the diseased bark shrinks so that the canker appears slightly sunken (Fig. 1). Usually the healthy bark at the margin of the canker becomes slightly raised, due to the development of corky tissue in this region. The diseased area then

* Synonyms: *Sphaeropsis malorum* Berk.; black-rot canker; black-rot leaf-spot; body-blight; body-canker; frog-eye; fruit-spot; New York apple-tree canker; ring-rot.

becomes lighter in colour, and consequently more conspicuous. Growth of the fungus proceeds in a radiate manner, so that invariably in old cankers there are present numerous crevices, arranged in zones, which have been formed as successive layers around the canker. These render the canker conspicuous and readily discernible; further, they serve as quite a good character to separate black-rot cankers from those formed by other diseases (Fig. 2). Cankers may continue

FIG. 1. BLACK-ROT CANKERS ON PEAR-BRANCH: POINT OF ENTRY THROUGH DEAD FRUIT-SPUR. NATURAL SIZE.

[*Photo by W. D. Reid.*

FIG. 2. BLACK-ROT CANKER ON ONE-YEAR LATERAL OF PEAR: POINT OF ENTRY THROUGH DEAD LEAF-BUDS. NATURAL SIZE.

Note the concentric cracks characteristic of black-rot canker.

[*Photo by G. H. Cunningham.*

3

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FIG. 3. DUNN'S FAVOURITE APPLE AFFECTED WITH BLACK-ROT. NATURAL SIZE.
FIG. 4. OLDER CONDITION OF FIG. 3: TYPICAL MUMMIFIED CONDITION. NATURAL SIZE.

[*Photos by G. H. Cunningham.*

to grow for several seasons, or until the branch is ring-barked, when the portions above die. Death is often preceded by a gradual yellowing of the leaves, which usually fall prematurely. The bark sometimes falls away from old cankers and exposes the wood.

Sections through a canker on a medium-sized limb show that the sap-wood is discoloured for some distance beyond the visible point of infection, and microscopic examination reveals the presence of hyphæ of the fungus in this discoloured area. On large limbs girdling may not occur, the fungus in such a case forming large irregular cankers,

which may attain a length of 1 ft. or more. Some time after a canker has been formed fructifications of the fungus appear on the surface of the killed area.

Spots become noticeable on the leaves shortly after they emerge from the bud, and infection may occur during the whole of the growing season should conditions become favourable. At first the spots are minute, circular, scattered, and dark purple in colour. They soon increase in size, growth proceeding in a radiate manner, so that the centre portion (the original spot) may appear surrounded by definite zones. Later this central portion changes to greyish-brown, and as the surrounding zones are darker, these spots present a characteristic appearance, which has led to the name "frog-eye" being applied to them. Finally, spots may lose their circular outline and become lobed and irregular in shape. In cases of severe infection the spots may become so numerous as to coalesce, forming irregular dead areas on the leaf. Severe infection may be followed by defoliation.

Fruit-infection is followed by the appearance on the surface of small circular brown areas; these rapidly increase in size until the whole fruit becomes rotted. As these areas enlarge, zoning may occur, as in the case of leaf-infection, but this is not a common manifestation of the disease. Infected fruits do not become soft, but remain firm and spongy. Finally, the colour changes to jet-black, and the fruit gradually shrivels and becomes mummified (Fig. 3).

ECONOMIC IMPORTANCE.

Although in certain parts of the United States black-rot is a serious disease, causing an annual loss of several hundred thousand dollars, in New Zealand it is of minor importance, its chief damage being due to the cankers it forms on the branches of apple and pear trees. On leaves its effects with us are so slight as to be negligible, and on fruits it has little effect, as it appears to be confined to those which have been injured by codlin-moth or damaged during picking or packing. During the recent fireblight campaign in the Auckland District many hundreds of cankers were forwarded to this Laboratory, and in nearly every instance these were found to be caused by fireblight, black-rot, or macrophoma-canker. In most cases it was found that the source of infection of black-rot was through some bark-injury, such as is caused by branches rubbing together, or abrasions caused by woolly aphis.

LIFE-HISTORY OF THE CAUSATIVE ORGANISM.

Black-rot is caused by the fungus *Physalospora Cydoniae* Arnaud,* an ascomycete having two spore stages in its life-cycle. The first or pycnidial stage, commonly known as *Sphaeropsis malorum*, is the parasite, the second or ascomycetous stage being saprophytic, as it appears in the dead bark of old cankers. In North America this stage

* Considerable doubt exists in mycological literature as to the proper name that should be applied to this species. For Shear (1914) claimed that ascospores of *Melanops Quercuum* Rehm. forma *Vitis* Sacc. produced in pure cultures pycnidia and spores morphologically identical with *Sphaeropsis malorum* Berk.,

appears to be rare, but in New Zealand it is quite common in cankers that are more than two years old. This fungus is a wound parasite, for it is apparently able to infect fruits and branches only through some injury of the epidermis or bark; but under certain conditions it is a true parasite, for in America it has frequently been demonstrated, by experiments in which spores (conidia) have been sprayed on to leaves, that the hyphæ of the fungus are able to penetrate directly through the epidermis into the underlying tissues.

Spores discharged in the early spring from fructifications embedded in the dead bark of cankers and the epidermis of mummified fruits are carried by wind or other agency to leaves and injured surfaces of branches, where if moisture conditions are suitable they germinate and produce a germ-tube (hypha). This penetrates into the tissues and there branches repeatedly, the hyphæ growing between the cells and absorbing from them the food substances necessary for their continued existence. As a result the host cells are killed, and turn brown. At this stage the hyphæ are colourless, but after a time they become dark-coloured, and it is these black masses of hyphæ that give the characteristic colour to infected fruits. After a time masses of hyphæ immediately beneath the dead epidermis become aggregated into little knots, which eventually develop into spore-bearing receptacles or pycnidia. These are flask-shaped or globose (Fig. 5), and contain numerous one-celled olive-coloured spores (Fig. 5, *d*, conidia†), which are borne on slender stalks (Fig. 5, *c*, conidiophores) produced from the inner surfaces of the lower portion of the pycnidia. The apices of the pycnidia at maturity pierce the epidermis; each is perforated by a small opening (ostiolum) through which the spores escape. The spores are embedded in mucilage, and as this readily absorbs moisture the spores are forced out through the opening by the swelling of the mucilage, when they appear on the surface in olive-coloured tendrils. The mucilage is dissolved away by rain, and the spores are released, when they may be washed by rain on to lower leaves and branches, or else carried by wind and insects to adjoining trees.

If a canker lives for more than one season, and the killed bark persists, the second or ascigerous form may appear. This consists of a flask-shaped perithecium containing numerous asci in which colourless one-celled spores are borne (Fig. 6).

These spores may be discharged on to the surface and carried to adjacent trees, where they are probably able to infect leaves and branches, and produce hyphæ, which in turn give rise to pycnidia.

whereas Hesler (1913), after carrying out similar experiments with ascospores of *Physalospora Cydoniae* Arnaud, also obtained *Sphaeropsis malorum*. Hesler was able to infect apple-branches with ascospore material and produce typical black-rot cankers. On account of this, and the fact that the New Zealand ascigerous material agrees closely with his descriptions and figures, the name he used has been adopted. Our species obviously belongs to the Pleosporaceae, and not to the Melogrammataceae, so that Shear's claim would appear to be untenable in so far as the New Zealand organism is concerned.

† These spores are more correctly termed "pycnidiospores" or "pycnospores," as they are borne in pycnidia; but to save unnecessary use of terms they will in this and subsequent articles be termed "conidia."

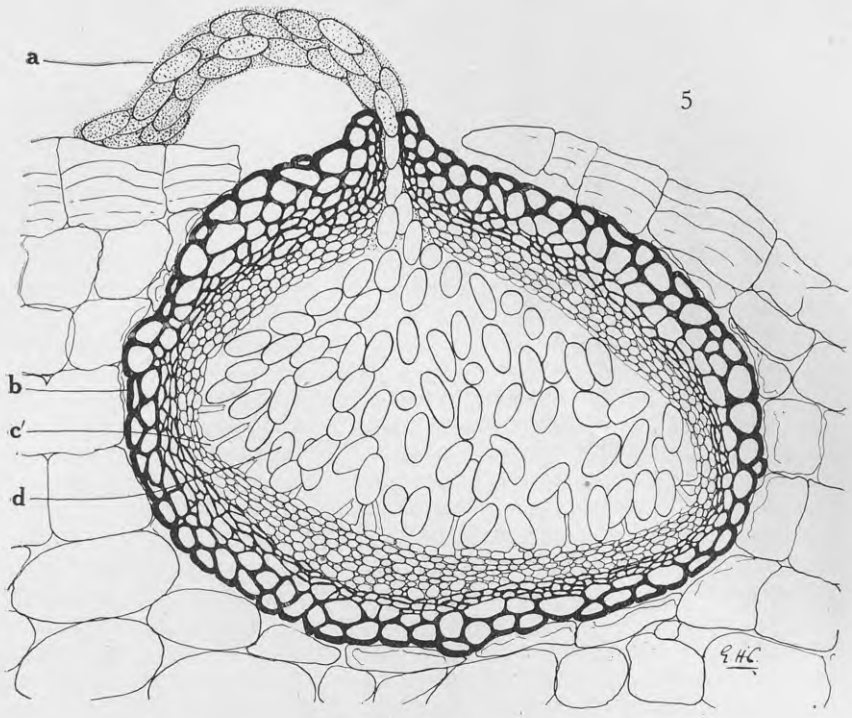

FIG. 5. SECTION THROUGH PYCNIDIUM (NOT QUITE MEDIAN).

(*a*) Spore tendril; (*b*) wall of pycnidium; (*c*) conidiophore; (*d*) conidia. × 150.

FIG. 6. ASCI, SPORES, AND PARAPHYSES OF BLACK-ROT ORGANISM. × 250.

FIG. 7. CONIDIA. × 250.

[*Original.*

Conidia are apparently able to remain viable for a considerable time, for in this Laboratory the writer has been able to infect apple-fruits with conidia taken from pear-cankers which have been kept in the herbarium for over twelve months.

REMEDIAL TREATMENT.

As the mycelium of this fungus may remain alive in a canker for several seasons, and during the growing-period is capable of producing fructifications (pycnidia) bearing spores, it would appear that these cankers are the means by which the fungus is able to carry over from season to season. This is borne out by American experience, for there it has been observed that early in the season, in the vicinity of viable cankers, leaf-infection commences shortly after the leaves emerge from the buds. Furthermore, American workers have recorded the fact that infection may commence from mummified black-rot fruits remaining on the trees, for they have frequently observed leaf-infection to commence in the vicinity of these fruits. On spots on living leaves spore-production is so uncommon that it is probable leaf-infection occurs throughout the season from spores produced from pycnidia in cankers and mummified fruits. Fructifications are commonly produced on leaves that have fallen to the ground, so fallen leaves that have escaped desiccation during the winter months are in all probability a source of infection the following spring.

Doubtless in New Zealand black-rot is held in check somewhat by spray treatment, but not entirely, for it appears to be about equally common in sprayed and unsprayed orchards. Such being the case, the eradication of the sources of infection would appear to be the only effective treatment that can be recommended. These sources are (*a*) cankers on the branches, (*b*) mummified fruits remaining on the trees and lying on the surface of the ground, and probably (*c*) infected leaves which have escaped desiccation during the winter months. The following treatment is therefore suggested :—

(1.) Cut out cankered branches, cutting some 3 in. below the visible point of infection.

(2.) Remove and destroy any black-rot mummies lying on the ground or hanging on the trees.

(3.) Plough in late autumn, after the leaves have fallen, and with a spade turn under portions beneath trees which have been left untouched by the plough.

The writer does not suggest that any treatment of cankers be practised, for at best this is difficult and involves a great amount of work ; furthermore, as the hyphæ of the fungus spread in the sap-wood some distance beyond the visible point of infection, control at best would be uncertain. As many wounds are caused by branches rubbing together, trees should be pruned in such a manner as to prevent this. Finally, all wounded surfaces should, as soon as made, be coated with coal-tar.

SUMMARY.

(1.) Black-rot forms cankers on the branches, spots on the leaves, and causes rotting of fruits.

(2.) In New Zealand it is confined to the apple, pear, and quince, but in North America has been recorded on numerous other hosts.

(3.) On branches and fruits it behaves as a wound parasite, as it is apparently able to infect these only through some abrasion in the bark or epidermis; on leaves it behaves as a true parasite, infecting them directly through the epidermis.

(4.) Black-rot is caused by the fungus *Physalospora Cydoniae* Arnaud.

(5.) It overwinters by means of resting mycelium in cankers and mummified fruits, and probably in fallen leaves.

(6.) Remedial treatment consists in the removal of the sources of infection.

(7.) In New Zealand its economic importance is comparatively slight, but in certain States in North America it ranks second in importance only to black-spot as a disease of the apple.

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MARKETING DANISH BUTTER IN BRITAIN.

IN reply to a question in the House, the Minister of Agriculture made the following brief statement regarding the marketing of Danish butter in Britain, with special reference to the Copenhagen quotation: "There are about fourteen hundred dairy factories in operation in Denmark. A few of these sell their produce weekly to firms in Great Britain. Another part is bought from the dairies by Danish exporting firms—often to standing orders week after week—mostly f.o.b. Danish ports. What butter remains unordered is generally consigned to wholesale houses in Great Britain to be sold for a commission. Other dairies have formed 'Butter Export Societies,' and these trade in just the same way as the private exporters. A number of these societies have formed an association for the purpose of securing the best possible prices, and also to improve the quality, and generally to further the interests of the societies. The fixing of weekly prices is carried out by the Copenhagen Butter Quotation Committee. This committee meets each Thursday. The basis of its deliberation is formed by reports from the various butter-markets, and very largely by the number or sizes of the orders received from customers at these markets. If the demand is above the average the quotation is increased; if less orders have come in, it is lowered. The quotation is an attempt to give, weekly, expression to the average price or value of Danish butter in the British markets. An error made one week is made good the next. If, for instance, the price be fixed too high, orders fall off, and the quotation is lowered next week, or *vice versa*."

BREEDING OF FARM ANIMALS.

THE LAWS OF HEREDITY.

Paper read by Mr. W. D. HUNT, Wellington, to the New Zealand Board of Agriculture.

I SHOULD like to state at the outset that I think it can be taken as an established fact that the first necessity in stock-breeding is ability to select the best animals; that knowledge of the laws of heredity is no use without this ability; that a breeder will never get anywhere either in breeding purebred stock or crossbred stock unless he has the ability to select good animals; that the person who wishes to succeed as a breeder of any class of animals must first learn how to select, and when he has learnt this, then—but not till then—will he be ready to make use of the knowledge of the laws of heredity.

I would like also to state before I go further that one of the first things a man must do if he wishes to succeed as a stock-breeder is to consider his country—what is the class of animal best suited to his country. The breed of stock must be selected that will suit the country they have to occupy. A breeder may be an excellent judge of his breed, and know the last word on the laws of heredity, but he will never get far if his stock does not suit his country. No breeder can succeed with his country working against him.

Another necessity, if a breeder is to be successful, is proper feeding. I do not mean overfeeding, but feeding that will give the stock a chance of full normal growth and development. Particularly is this necessary when the stock are young. An animal underfed when young may, if well fed afterwards, develop to normal size. Its growth, in fact, has been arrested for a time, and has afterwards moved on again until normal size has been reached. The period of starving, however, leaves its mark on constitution, and constitution is the most important attribute of all in stud stock.

The natural laws that govern heredity are not yet fully known; the study is as yet in its infancy. It is only about 168 years since Bakewell first started his work, and while he and other master breeders discovered the methods that were necessary to get the results they achieved, it is really only during quite recent years that we are beginning to learn some of the reasons why the methods adopted give the results obtained. In this connection it is found that the broad principles that govern inheritance are much the same in the vegetable world as in the animal world. Inquiry into the laws governing the inheritance of animals can be much helped by studying inheritance in plants. Experiments can be made with much larger numbers and in such shorter time with plants than is possible with animals, and definite results with plants are thus obtained much more quickly.

The work of the really successful breeders, both past and present, has been based upon the principle that "Like begets like, with a continual tendency to variation." In the working-out of the principle

it was found that while the offspring might come like the parents, it might also come like grandparents or more remote ancestors. This made it important that all the ancestors should be as nearly as possible alike in type, and all to be of the type that the breeder is aiming to get. This brought out the importance of purity of blood. All the ancestors must not only be of pure breed, but of similar strain and type. A crossbred may be as fine an animal as a purebred, but it was found it would not breed true. The same applies to the crossing of different strains within the same breed where the strains differ from each other in type.

While the first part of the principle "Like begets like" enabled breeders to fix their type, it was the second part of the principle, "with a continued tendency to variation," that enabled breeders to improve their stock. In nature no two things come alike. Every animal has individuality. Every animal is different from every other animal. There is perpetual variation. These variations are carried on to the next generation and lead to further variation. In nature the law of the survival of the fittest eliminates variations towards inferiority and perpetuates variations towards superiority. It is thus that the present animal and vegetable worlds have been established. The stud breeder temporarily suspends the law of the survival of the fittest and puts his own selection in its place. His job is to perpetuate all variations towards superiority, and cull out all variations towards inferiority. It is his success or otherwise in doing this that fixes his place as a breeder.

I said a breeder temporarily suspends the law of the survival of the fittest and puts his own selection in its place. Nature has for the time being merely transferred her law of the survival of the fittest from the breeder's stock to the breeder himself. If he selects his variations well he gets a market for his stock and he goes on breeding. If he selects unsuccessfully he loses his market and is forced out of the breeding business. Fortunately, nature's law always operates in the end. The stud breeder can only permanently take a hand if he is an improver. If he fails to improve he is forced out of the business.

I have tried to show the importance of pedigree, and at the same time the fallacy of thinking of pedigree only without seeing that the right animal is with it. Variations towards inferiority will perpetuate and intensify themselves just as surely—in fact, probably more surely —than variations towards superiority.

The Merino sheep which has been developed to its present state of perfection in a comparatively short time by the breeders of Australia and Tasmania is an example of what can be done by the skilful use of nature's variations. The Merino is grown almost entirely for wool, and the desire was to produce a sheep that would grow the greatest amount of the best quality of wool. The following is a note of results obtained by the noted Tasmanian breeder James Gibson, of Belle Vue Estate. These results were obtained entirely from Belle Vue blood; no outside blood was introduced.

In 1868 he bred the ram Sir Thomas, who was the most noted Merino of his time. He was sold when six years old for 680 guineas, which was the highest price up to that time ever paid for a Merino ram. The heaviest fleece Sir Thomas ever cut for twelve months'

growth was 12 lb. In 1872 Sir Thomas sired Sir Thomas 2nd, who cut 14 lb. of wool, an increase of 2 lb. on his sire. . As an indication of the value put on Sir Thomas 2nd, he was sold when six years old for 604 guineas. In 1878 Sir Thomas 2nd got Golden Tom, who cut a fleece of 17 lb. He was sold when four years old for 500 guineas. In 1880 Golden Tom got Treasurer, who cut 18 lb. wool, and was sold in 1883 for 300 guineas. Treasurer got Golden Horn, who cut 20 lb. wool, and Golden Horn got Golden Horn 2nd, who cut 26 lb. In 1890 Golden Horn 2nd sired President, one of the most famous Merino rams ever known in Australia. He cut only 23 lb. wool, but he had with it a quality and evenness which, together with his general symmetry and bearing, made his name a household word all over Australia. He was sold in 1896, when six years old, for 1,600 guineas, the highest price paid up to that time for a Merino ram. In 1895 President got President 2nd, who cut 27 lb. wool. In 1898 President 2nd sired President 3rd, who cut 30 lb. wool. In 1900 President 3rd sired Patron, who cut 36¾ lb. wool. Patron was sold in 1907, when seven years old, for 1,000 guineas.

Thus in a little over thirty years, by selecting those variations in the direction of increased weight of wool, the weight was increased from 12 lb. to 36¾ lb., and this was done entirely within the flock without bringing in any outside blood.

THE MENDELIAN LAW AND SOME EXAMPLES.

The discoveries of Mendel have opened up a new field of thought and experiment in breeding, and explain the reasons for many results. These discoveries were first published in 1865, but their importance was not realized at the time, and it was not until the beginning of the present century that they became generally known even to scientists. As time passes, it is becoming more and more evident that the Mendel laws of heredity are very far-reaching, and it is worth considering them closely in connection with any breeding plans. Most people connect Mendel's results merely with the crossing of long and dwarf peas; but this was only one of his experiments. He found the same results were obtained with round and wrinkled pea-seeds, with yellow and green seeds, with brown and white seeds, with inflated and constricted pods, with green and yellow pods, and with axial and terminal position of flowers. In all these experiments the first-named quality was found to be dominant and the second recessive.

I will give an example of the working of the Mendel law in the breeding of live-stock. It is well known that red calves sometimes appear in pure herds of Aberdeen Angus cattle, and that red-and-white calves appear in pure Friesian herds of black-and-white cattle. Black and red are Mendelian characters. Black is dominant, and red recessive. A purebred black animal produces germ-cells which contain what is known as the factor for black. A purebred red animal produces germ-cells containing the factor for red. The birth of a new animal arises from the union of two germ-cells. If at some period in the history of the herd a pure-black animal is mated with a pure-red the result will be a union of black and red germ-cells. In the resulting egg which is to give rise to the new animal the black factor is dominant to or conceals the red, which is recessive; the calf, although black in appearance,

will contain the red factor in 50 per cent. of its germ-cells and the black factor in the remaining 50 per cent. For example, cross a black animal with a red and we get this result :—

	Black Animal.	Red Animal.
Germ-cells	Black	Red.

The result of this cross is a black animal, because black is dominant to red; but half the germ-cells of the progeny are red. Cross two animals bred this way and we get the following results :—

	Bull.	Cow.
50 per cent. germ-cells..	Black	Black.
50 per cent. germ-cells..	Red	Red.

The progeny may be the result of the meeting of a black germ from the bull with a black germ from the cow, and the result will be a pure-black carrying only the factor for black in its germ-cells. The progeny may be the result of a black germ from the bull meeting with a red germ from the cow, and the progeny, while black in colour, will have the factor for red in half its germ-cells. A similar result will come from the meeting of a red germ from the bull with a black germ from the cow. A fourth alternative is the meeting of a red germ from the bull with a red germ from the cow; the progeny will then not only be red in colour, but all its germ-cells will carry the factor for red, and it will breed true as a pure-red. One-fourth of the calves from this cross are therefore pure-blacks, one-half are blacks carrying the factor for red in half their germ-cells and the factor for black in the other half, and one-fourth are pure-reds. To illustrate the result :—

	Offspring			
	No. 1.	No. 2.	No. 3.	No. 4.
50 per cent. germ-cells ..	Black	Black	Black	Red.
50 per cent. germ-cells ..	Black	Red	Red	Red.

No. 1 bred with another pure-black will breed true blacks. No. 2 and No. 3 bred together will give the same results over again as those first explained; and No. 4 is a pure-red, and if bred with other pure-reds will breed true.

Now let us examine the result of crossing offspring Nos. 1 and 2. We get the following :—

	No. 1.	No. 2.
50 per cent. germ-cells	Black	Black.
50 per cent. germ-cells	Black	Red.

If either of the black germs from No. 1 unite with the black germ in No. 2 we get pure-blacks, but if either of the black germs in No. 1 unite with the red germ in No. 2 we get a black animal carrying the factor for red in half its germ-cells. Out of every four calves from this cross we get :—

	No. 1.	No. 2.	No. 3.	No. 4.
50 per cent. germ-cells ..	Black	Black	Black	Black.
50 per cent. germ-cells ..	Black	Black	Red	Red.

If we now cross No. 1 and No. 2 we get pure-blacks, but if we cross No. 2 and No. 3 we get the results again just explained. If we cross Nos. 3 and 4, as already explained, we get one pure-black to two blacks carrying the factor for red in half their germ-cells, and one, the fourth, will be a pure-red.

From the foregoing it will be seen (*a*) that before a red calf can appear in a black herd both sire and dam must both carry the factor

for red; (*b*) that if one animal were introduced into a herd which, although itself black, carried the factor for red, it would be possible in time by selection for red to convert the whole herd into a red one.

The only way to make sure of keeping red out of a black herd is as follows: (*a*.) Before introducing a new bull into a herd try it out with some red or red-and-white cows. If it is a pure-black all the calves will come black. If it carries the factor for red about half the calves will come red. (*b*.) Watch the results obtained from bulls bred in the herd when used in crossbred herds. If any calves come red it is an indication that the bull carries the red factor. He must have got this either from his sire or dam. If the sire has been proved pure he must have inherited the red factor from the dam, and the dam should therefore be eliminated from the herd. (*c*.) If a red calf is born in a pure-black herd the sire and dam must both carry the red factor, and both should be eliminated from the herd.

I have dealt with the red and black factors in cattle at some length merely to give a practical illustration. This example will, I think, show the manner in which all Mendelian inheritance works. The same rules apply to other qualities or factors.

Pollies and horns in cattle are Mendelian factors, the polly quality being dominant and the horn quality recessive. The white face of the Hereford is a dominant factor also. An interesting cross in cattle is a pure Polled Angus with a pure Hereford. We have one parent with a black body and one with a red. Black is dominant, so the progeny will have a black body but carry the red factor in half its germ-cells. Polled quality of the Angus will dominate the horn quality of the Hereford, and the progeny will be polled but will carry the factor for horns in half its germ-cells. The white face of the Hereford will dominate the black face of the Angus, and the progeny will have a white face but will carry the factor for black in half its germ-cells. We can predict therefore with certainty that this cross, if the parents are pure, will produce animals with black bodies, white faces, and polled heads, but carrying in half their germ-cells the inheritance of a red body, in half the inheritance for horns, and in half the inheritance for black faces. These factors will, however, be mixed through each other, and the breeding together of these black-polled Herefords will produce most uneven results.

The foregoing deals with qualities that do not mix in the immediate offspring: the one quality dominates the other. A mixture of black and red cattle does not result in a composite colour: the first cross are all black, and the breeding of the progeny together produces either black or red. Mendel's crossing of long and dwarf peas did not produce any of intermediate length: the first crossing produced progeny all long, and these produced both long and short. There are other qualities, however, that do mix in the progeny, such as we see in the various kinds of crossbred animals that provide the great bulk of the farm-stock of this or any other country. Recent inquiries point in the direction of Mendelian rules governing this class of inheritance also when the crossbred animals are bred together.

An experiment was made of crossing a Gold-pencilled Hamburgh cock and a Silver Sebright bantam hen. These two differ greatly in size. The Hamburgh is, roughly, twice as heavy as the Silver Sebright.

The first-cross birds were of intermediate size — in fact, they showed the blended inheritance most breeders would expect. When, however, a further generation of over two hundred birds was raised from these crossbreds it was found that this consisted of all sorts of size, ranging from birds smaller than the Sebright to birds larger than the Hamburgh. Moreover, it was found that the small birds bred true to size at once, and there is evidence that strains of intermediate and of large size could also be established without difficulty.

BREEDING TRUE.

The last paragraph raises important questions to the stud breeder. It goes to show that although in the crossing of animals we often get progeny which to all outward appearance are of blended inheritance, this blended inheritance does not apply to the egg or germ-cells. The germ-cells in these crossbred animals contain a mixture of unit characters derived from their ancestry, but these unit characters are not blended—each is pure in itself. In breeding these crossbred animals together there can be no fixed type in the progeny, as it is just a matter of chance which unit characters come together to form the new animal. I think this explains the reason why stockmen who breed crossbreds find from experience that to get good results they must use a pure sire. The prepotency of a good purebred sire dominates the mixed inheritance of a crossbred dam, and at the same time the progeny gets the advantage of the increased vitality and vigour that seems to come from an outcross.

If we get the results stated in the last paragraph when different breeds are crossed, shall we not also get something of a similar nature, although less in degree, when different strains or types within the same breed are crossed? If this is true, then stud breeders must always bear this in mind when mating their animals. The object of stud breeding is not only to breed animals as near perfection as possible, but also to produce animals that will, when mated with similar animals, produce animals of similar type and quality; in other words, they must breed true. If the breeder produces fine animals, but they do not breed true, then he is a failure. Now, every stud breeder will have some ideal in his mind to aim at, and he will be constantly trying to bring his flock or his herd, or a large proportion of it, nearer his ideal. In doing this he can proceed in two ways: he can use sires of type and ancestry as near to his ideal as he can get them, or he can select sires specially with a view to correcting some weakness in his own animals — that is, if he thinks his own animals have gone to an extreme in one direction he can try and correct this by using sires that go to an extreme in the opposite direction.

Now, it seems to me that the first method is right and the second method wrong. The second method might get quicker results as far as the outward appearance of the animals is concerned, but it will not produce animals that will breed true. Let us take an example. Suppose a stud-sheep breeder thinks that his flock, or a portion of it, has become too coarse in the wool, and he wants to get it finer. Suppose he thinks he will attain his ideal quickest by selecting a sire finer in the wool than his ideal, but just so much finer that a blended inheritance will produce the wool he has in mind. Let us see the result.

The progeny may be just the sheep the breeder aimed at, but half their germ-cells will carry the fine-wool factor, and half will carry the coarse-wool factor; and when these are mated they will produce progeny one-fourth with fine wool which, if mated together, will breed true as a fine-woolled strain, one-fourth with coarse wool which mated together will breed true as coarse-woolled strain. The remaining half will be like their parents, having wool of the desired type, but which when bred together will not breed true, but will again break up into one-fourth fine, one-fourth coarse, and one-half correct wool but with mixed germ-cells.

Now, suppose that instead of selecting a fine-woolled sire with a view to bringing his wool to his ideal type a breeder selects a sire having wool of his ideal type and coming from stock that all had wool of this type. Call this ram "Perfection." The progeny will not in outward appearance be as near the breeder's ideal as the progeny from the fine-woolled ram; but let us think of the germ-cells. Each one of the progeny will have half its germ-cells carrying the factor of Perfection, and half carrying the factor for coarse wool. Breed the progeny together, and we have the following mating:—

	Ram.	Ewe.
50 per cent. germ-cells ..	Perfection	Perfection.
50 per cent. germ-cells ..	Coarse wool	Coarse wool.

The result of this cross will be that one-fourth of the progeny will have reached perfection and will breed true; one-half will be like their parents—that is, a cross between perfection and coarse wool; and the remaining one-fourth will have reverted to coarse wool, and if bred together will come true to this type.

If instead of breeding the progeny of Perfection and coarse wool together the ewes are bred to another Perfection ram, we have the following combination of germ-cells:—

	Ram.	Ewe.
50 per cent. germ-cells ..	Perfection	Perfection.
50 per cent. germ-cells ..	Perfection	Coarse wool.

The results of this cross will be that half the progeny will be Perfection and will breed true, the other half will be like the dams—that is, a cross between Perfection and coarse wool.

It seems to me, therefore, that the only way to produce a first-class flock or herd that will breed true is to continually use sires as near the ideal as possible, both in appearance and in ancestry; and that using sires of one extreme to correct dams of an opposite extreme will lead to disaster, although it may temporarily produce some good-looking stock. Further, if the good-looking stock bred this way are purchased by other stud breeders the results will disappoint the buyers.

SEX-LINKED INHERITANCE.

There is evidence to show that certain qualities of inheritance are sex-linked—that is, they are only inherited through the male or through the female. Experience goes to show that high fecundity or egg-laying power is linked up with the factor of maleness, so that the highest grade of laying-hen producing eggs, some of which will hatch into cockerels and others into pullets, transmits the high egg-laying capacity only to her sons and not to her daughters. The high-grade

layers must therefore get this factor from their fathers. This is why such high prices are paid for cockerels from hens with a high egg-record.

When a "silver" cock is mated to a "gold" hen these colours follow the regular Mendelian rules, silver being dominant. All the progeny are "silver," but carry the "gold" inheritance-factor in half their germ-cells. When, however, a "silver" hen is mated with a "gold" cock the progeny are "silver" cocks and "gold" hens. This shows still another peculiar difference in male and female inheritance.

Evidence, too, goes to show that milk and butterfat production in dairy cows is inherited more through the male than the female—that is, a high-producing cow transmits her producing-qualities more through her sons than through her daughters. It is becoming more and more recognized by dairymen that to improve their herds or maintain them at a high standard they must use bulls from high-producing dams.

INBREEDING, LINE-BREEDING, AND OUTCROSSING.

The questions of inbreeding, line-breeding, and outcrossing have probably been more discussed and written about than any other aspect in connection with the breeding of purebred stock. It seems to be generally agreed that close inbreeding (*a*) fixes type, (*b*) increases prepotency, (*c*) brings out and intensifies good qualities, (*d*) brings out and intensifies bad qualities, (*e*) if long continued, reduces vitality and size and weakens constitution. Outcrossing increases size, vitality, and constitution, but decreases prepotency, and tends to produce unevenness in type. There is always the risk, too, when bringing in an outcross, of introducing a bad quality or weakness that is very difficult to afterwards get rid of. The illustration given of results in crossing black and red cattle shows how difficult it is to get rid of a hidden red taint. The same principles apply to other qualities.

Line-breeding is the mating of animals not so closely related as the relationships that are looked upon as inbreeding. The principle involved is the same; the difference is one of degree. The idea behind line-breeding is to get the advantages of inbreeding, and at the same time to avoid its disadvantages, and also avoid the risks attached to the introduction of an outcross.

Experience and experiments go to show that the loss of vitality, size, and constitution that generally follows continued in-and-in breeding is quickly put right by the introduction of an outcross, and that no animals respond so quickly to the advantages of an outcross as animals that have for some time been closely inbred. The outcross seems in one generation to bring back the size, constitution, and vitality that was lost by continued inbreeding.

The aim of the stud breeder is to produce the most perfect animals possible, and at the same time animals that will breed true. To breed true the animals must have uniform germ-cells all carrying the same inheritance-factors. This uniformity of germ-cells is gained by close inbreeding. With an outcross there is always the danger of introducing germ-cells carrying the factor for some fault that it may prove afterwards very difficult to eliminate. The problem to be solved is to overcome the loss of size, vigour, and constitution brought about by continued inbreeding, and at the same time avoid or reduce to a

minimum the introduction through an outcross of germ-cells carrying faults.

The foregoing brings up the question of whether the best plan in a stud of considerable size is not to divide the stud into several families, and closely inbreed each within itself until weakness appears; then introduce a sire from one of the other inbred families, and continue the inbreeding again from his progeny until another outcross is required, when another inbred family can be drawn upon.

What I have said in the last paragraph, of course, only relates to the operations of a stud breeder who aspires to be a leader in his own particular breed, and who has reached a stage when he considers his stock at least equal to that of any other breeder. The vast majority of breeders are not in this position, and they cannot do better than each select a leading breeder whose stock conforms most closely to the ideal he is aiming at, and in whose breeding methods he has faith, and then go to this breeder whenever he is in need of an outside sire. The breeder who adopts this method will improve his stud much more rapidly and get a more even type than the breeder who goes all over the place for his sires.

The breeders of racehorses and dairy stock have the advantage of seeing the actual performances of the animals they produce. These performances are guide-posts indicating to them whether or not they are keeping on the right lines. Breeders of other classes of stock are more liable to the influences of fads and fancies that often prove to have no sound foundation, and are therefore only of a passing nature. The real breeder with a mind of his own must resist these passing fancies, and must hold closely to the ideal he has in his mind. This ideal must be of a practical nature. The ideal should be to produce the class of animals that will give the greatest return to their users on the class of country and the class of feed they will have to make use of. Like the racehorse and the dairy cow, the test of the quality of all classes of farm-stock must in the last analysis be performance or production.

THE QUESTION OF LOCATION.

In establishing a stud the question of location is most important. Animals can be changed in a few generations by environment. They quickly adapt themselves to new conditions. It is important that any changes in the stock caused by their location should be in the direction of strengthening and not weakening the suitability of the sires bred in the stud for the class of country and the conditions generally that they will have to adapt themselves to when sold. This is one of the reasons why sires bred in colder climates, as a rule, do well. An example of this is the important position that Scotland has now attained in the production of the highest class of stud stock. Another example is the Friesian breed of cattle, now the world's leading dairy breed; it was produced and developed in the cold and bleak plains of north Holland. In the United States, where this breed of cattle has been so successfully transplanted, the leading studs are in the northern States. To put the matter shortly, the location chosen for the stud should be one where the conditions are such that natural selection will eliminate any individual unable to thrive under the conditions the sires bred in the stud are likely to be placed in when sold.

BOYS' AND GIRLS' AGRICULTURAL CLUBS.

NOTES ON THE TARANAKI AND WANGANUI EDUCATION DISTRICTS COMPETITIONS: SEASON 1922–23.

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THE work of the agricultural clubs in the Taranaki and Wanganui districts in the 1922–23 season was carried out on the same general lines as in the preceding year. In the root-growing competitions, however, the conditions were slightly altered by raising the points allowed for cultivation from 20 to 40, and reducing the points allowed for weight from 2 points per ton to 1 point per ton. By this means it was felt that more encouragement would be given to cultivation, and that competitors with poorer land would be put on a more equal footing with one on an exceptionally rich area, it being possible under the new method for a crop much inferior in weight to beat the heavier one, provided more attention had been given to cultivation and records, which are considered the two most important points.

The central division in Taranaki was cut out and the area divided between north and south Taranaki. Swedes were also eliminated, and the root competitions confined to mangolds and carrots. The mangolds grown were Prizewinner Yellow Globe, and the carrots Matchless White.

In addition to the root-growing and calf-feeding competitions a poultry club was started at New Plymouth. There were not a great many competitors—twenty entering and seventeen carrying on—but it is hoped that this class of competition will extend. The procuring of broody hens at the right time seems to be one of the greatest difficulties.

ROOT-GROWING COMPETITIONS.

The season generally was excessively wet and not conducive to the best results from field operations, especially where young people were concerned. While there were many failures from this cause, the percentages of competitors who carried their plots right through to the judging-day are very gratifying. In the Taranaki district fifty-four schools made 491 entries, of which number 335, or 68·2 per cent., had their plots judged. In the Wanganui district sixteen schools made 138 entries, of which 70, or 50·7 per cent., were judged. As in previous years, the judges reported a considerable number of failures owing to stock gaining access to the plots. It is regrettable that no improvement has been shown in this direction.

The Taranaki results show that the heaviest crops are not quite up to the best yields of the previous year. This is fairly general in all classes of crops, no doubt due to the excessively wet autumn. On the other hand, the average yields for each school are more even than in previous years. Further, the judges found that cultivation had been better carried out, and that the average plot was much tidier than in previous years. This indicates a closer study of the instructions given from time to time, and a better knowledge on the part of the pupil,

no doubt gained from previous experience. In many instances these plots afforded a splendid object-lesson in cultivation. Frequently the competitor's plot was in splendid condition and gave a big yield, whereas the parent's crop in the same field was very light and badly weed-infested. Lessons of this nature must be advantageous all round.

The heaviest mangold crop was one of 132 tons 5 cwt. per acre, grown by Harry Betts, Okaiawa. Although considerably below last year's best crop of 152 tons, it is a very high yield, and reflects great credit on the grower. Last year's champion, Dorothy Ward, also belonged to Okaiawa. When it is mentioned that the five competitors at this school secured the fine average of 104 tons 5 cwt. per acre

THE TARANAKI CHAMPION MANGOLD CROP FOR 1922–23, AND THE GROWER, HARRY BETTS, OKAIAWA.

it will be realized that the Okaiawa competitors are keen mangold-growers. This is the first occasion since the competitions started that the championship has been won by a boy, the two previous winners being girls. The average mangold crop for the whole of the competitions was 48 tons 1 cwt. per acre.

In carrots the heaviest crop weighed 66 tons 12 cwt., against last year's best of 72 tons. The champion this year was Jane Keighly, of Matapu. The average carrot-yield per acre was 36 tons 8 cwt., against 35 tons 5 cwt. for the previous year.

The placings for the championships are as follows :—

South Taranaki. — Mangolds : Harry Betts, Okaiawa, first, 229 points (Taranaki champion) ; Erna Ward, Okaiawa, second, 220 points ; Dorothy Ward, Okaiawa, third, 189 points.

Carrots: Jane Keighly, Matapu, first, 164½ points; Roy Green, Okaiawa, second, 157 points; Doreen Stanton, Rawhitiroa, third, 156 points.

North Taranaki.—Mangolds: Hazel Phillips, Mimi, first, 181½ points; Roy McKenzie, Tikorangi, second, 176 points; Elizabeth Free, Waiau, third, 167 points.

Carrots: Roy McKenzie, Tikorangi, first, 160 points; Bernard Brophy, Warea, second, 145½ points; Amy Phillips, Mimi, third, 135 points.

Wanganui-Feilding.—Mangolds: Elsie White, Glen Oroua, first, 170¾ points (divisional champion); Ivy McKay, Wangaehu, second, 163¼ points; Alison White, Glen Oroua, third, 160¼ points.

Following the practice of previous years, displays of roots were made at the New Plymouth, Hawera, and Palmerston North winter shows. At the two former the exhibition of roots was exceptionally good, the carrots being the finest I have ever seen staged, nearly every entry being worthy of a first prize in open competition. As in the past, these displays were a feature of the New Plymouth and Hawera shows; at Palmerston North the exhibit was rather poor.

CALF CLUBS.

These were confined to Taranaki. Altogether 259 calves were entered, of which 200, or 77·2 per cent., were brought forward to be judged. All the calves were graders, and represented the breeds as follows: Jersey, 161; Friesian, 25; Shorthorn, 12; Ayrshire, 2.

This year 100 points were allowed for cost of rearing, one point being deducted for every shilling of the cost of rearing. Thus, if the cost was £5, no points would be allowed; 100 points were allowed for condition, and 40 for record-charts. These points are not quite satisfactory, however, and may be altered for next year's competition. The average cost of food per calf in north Taranaki worked out at 17s. 7¾d., and in south Taranaki at 16s. 10d. The highest cost in the former division was £2 9s. 8d., and in the latter £2 2s. 6d.; the lowest costs were 3s. 6d. and 5s. 7½d. respectively.

GENERAL.

The general control of the clubs was on the same lines as previous years, the Farmers' Union, a number of individual farmers, and officers of the Education and Agriculture Departments co-operating. While it is generally admitted that these clubs serve a valuable purpose, the Farmers' Union is experiencing great difficulty in collecting sufficient funds to pay the prize-money. It would appear that unless the finances can be placed on a more satisfactory footing there is a danger of the movement falling through.

The Pukeokahu-Taoroa Rabbit District (Wellington) has been constituted for the purposes of Part III of the Rabbit Nuisance Act.

The West Coast Agricultural, Pastoral, and Industrial Association has been incorporated under the Agricultural and Pastoral Societies Act.

SEASONAL NOTES.

THE FARM.

SEPTEMBER is always a busy month in all classes of farming, and owing to the exceptionally wet, broken weather experienced during the past winter this year there will be an even greater rush of work than usual.

EARLY SPRING SOWINGS.

The sowing of cereal crops—wheat, oats, and barley—should be pushed along, except where the land is very wet. In such situations it is better to wait until it is reasonably dry before sowing, for where grain is sown on very wet land a great deal of it rots, and what does germinate makes poor growth.

For many districts Algerian oats give the best results, Gartons and similar varieties being very liable to rust. They should be sown at the rate of 3 bushels per acre, and on small areas where birds are likely to be troublesome it will pay to put in an extra half-bushel. Care should also be taken to see that the oats are well covered, in order to prevent birds getting them before they germinate; if the land has been firmed by rolling after sowing the birds will not pull out anything like so many seedlings after they come through the ground.

The Major variety of wheat is to be strongly recommended for the south Otago and Southland districts (as well as the North Island) on account of its early-maturing and quick-ripening characteristics. It yields well, and has proved a most suitable variety to grow.

Barley may be sown towards the end of September, or even in October, as it matures quicker than other cereals.

Grain crops sown at this time of the year will generally benefit from 1 cwt. to 2 cwt. of superphosphate per acre, according to the quality of the land. This fertilizer, besides bringing the crop away rapidly, stiffens the straw and helps the crop to ripen more evenly.

Many farmers will be sowing out grass-seed with the spring oats. This practice, although not of the best, has much to recommend it from an economy point of view, but the oat-sowing should be light, 1 bushel per acre being sufficient to give cover to the young grass. Heavy sowings of oats have a very depressing effect on pasture-establishment. The seeding with grass can often be delayed until the cereal is advanced well enough to stand harrowing.

A mixture of 20 lb. of Western Wolths rye-grass, 1 bushel of oats, and 4 lb. to 5 lb. of red clover per acre makes a good spring-sown hay crop, and may be put in early in September. Other special crops for hay or ensilage were dealt with last month.

FEEDING DOWN CEREAL CROPS.

The final feeding of autumn-sown crops should take place towards the end of September, the exception being rich areas where there is danger of the crop lodging. In such localities feeding may be continued into October. After the last feeding give the land a good harrowing with the tine harrows to open up the soil. If this harrowing leaves the land unduly rough, follow in a week with the roller. Owing to the subsoil being well soaked a very rapid growth can be expected in spring-sown cereals, and it may be necessary to feed off with sheep to prevent lodging and encourage tillering.

PREPARATIONS FOR LATER CROPS.

Lea land intended for late spring-sown forage crops should now be ploughed. It is most essential to allow plenty of time for the turf to rot before sowing the crop. Spring-sown forage crops require a large amount of water in the soil, and the only way to ensure an adequate supply of moisture is by means of early ploughing.

Land intended for rape, turnips, peas, potatoes, late sowings of vetches, and linseed should be cultivated as time permits. Owing to the delayed sowings of cereals there will be a tendency for late spring and summer crops to be neglected in this way. Land for mangolds and swedes should be deep-ploughed as soon as possible.

Old grassland intended for summer fallow should be cross-ploughed and thrown into rough lumps to allow the roots to be weathered and killed, especially if the land is infested with twitch of any description. The skimming should be deep enough to just get below the twitch and no more, probably 3 in. in old pasture.

IRRIGATION FARMING.

In Central Otago all irrigation ditches should by now be well cleaned and able to carry their full complement of water. Boxes must be repaired, and everything be in readiness for the irrigation season. Land intended for lucerne should be ploughed and kept cultivated to control fat-hen and sorrel prior to sowing in November. It is better to delay lucerne-sowing until November, thus allowing spring weeds to be overcome in the meantime.

LUCERNE.

Established stands of lucerne should be cut or quickly fed off about the end of September, and, if the land is dry, given a good cultivation. The object is to break the surface of the land which has become firm by too much grazing or constant rain, and allow the air to get in, also to shake up weeds and grass that have become established. If the field had a good autumn cultivation and was not heavily grazed during the winter the spring cultivation is simple, and can be done with a light cultivator or the tine harrows weighted with a few posts or a bag or two of soil. If, however, autumn cultivation was neglected, or the land has become badly infested with grass, the spring cultivation must be more drastic. In cases of this sort the best method is to give the paddock a good disking, in some cases several strokes being necessary. The disks should be run with as little set as possible, the object being to cut up the surface of land and grasses or weeds as small as possible. This having been accomplished, the loosened material can be shaken up by means of the cultivator or tine harrows. If the cultivator is used first in the spring on land badly infested with fog and similar grasses the ground is torn up in lumps, and subsequent working fails to properly break it up, with the result that it is almost impossible to get the mowing-machine over the paddock when cutting-time comes.

It should be remembered that spring cultivation is carried out more with the object of bringing about a rapid growth than destroying weeds, but if the cultivation is well done and carried out at the proper time—namely, when the weather conditions are suitable for the lucerne making rapid growth—the bulk of the weeds and grasses will be smothered. Lucerne should not be cultivated when the land is wet. If the stand cannot be worked reasonably dry it is better to leave it alone in the spring.

If the lucerne has not been doing very well and requires top-dressing this is the time for applying it, and provided the field has been liberally treated in the past with lime there is nothing better than superphosphate, which may be used at the rate of 2 cwt. or 3 cwt. per acre. Slower-acting phosphates like basic slag, Ephos, and Nauru rock are also useful, but they should be applied earlier in the season. Lucerne is expected to give heavy crops, and consequently must be well fertilized if the land is at all poor.

On old lucerne-fields that are becoming very thin the first cut of lucerne can be greatly improved by drilling 1½ bushels of oats in the ground after cultivation. The mixture of oats and lucerne is excellent for ensilage. Any weak patches in young lucerne-fields that were sown in the spring of last year can be greatly invigorated by top-dressing them with any well-rotted cowyard manure that is available. These weak patches usually show up along the "finishes" or on the hillsides, where the soil is thin, and quickly become a mass of weeds and grass if the lucerne is not helped along.

If green crops are being grown in preparation for lucerne they should be ploughed under during September. If this cannot be done it is better to feed them off and plough under the residue.

MISCELLANEOUS.

Ground in which it is intended to sow tares for seed should now be well prepared. In Marlborough this crop is best sown during September. The practice of sowing 2 bushels of tares with ½ bushel of oats, then feeding this off after it has made sufficient growth, has proved satisfactory. The tares smother the oats, and are easily harvested by use of the hay-rake. At the same time the oats during the growing-period serve the valuable purpose of keeping the tares more erect. September is also a good month in Marlborough for sowing peas for seed purposes.

Lucerne and cow-grass paddocks which are being set aside for seed-crop purposes should be thoroughly cultivated. If plants are too close together judicious grubbing-out will often be worth while—on smaller areas, at least. In order to yield good seed plants must have plenty of air and sunlight.

A peculiar position has arisen around Blenheim this year owing to the floods which took place in May. Until this month the ground has had little opportunity to dry. In many cases 6 in. or 8 in. of silt remains on the land. In the event of dry weather setting in this soil will cake, and working, if deferred too long, will become very difficult. A good plan is to run over the land with the cultivators to loosen and aerate the top soil, and follow by a surface-sowing of grass in the case of pasture. This has already been done on some of the flood areas. Similar advice may apply to some of the other localities which were flooded.

Fields that are intended for hay or ensilage should be shut up about the end of September. They should be thoroughly cleaned up and well harrowed to ensure a clean bottom for the mowing-machine. If not already top-dressed this may still be done, using superphosphate at the rate of 2 cwt. per acre, and where the land is light and poor 1 cwt. of blood-and-bone may be added.

—*Fields Division.*

CASTRATION AND DOCKING OF LAMBS.

One of the most important factors connected with these operations is to have the work carried out on clean ground, and under no consideration should the lambs be marked on the same ground two years in succession. The reason for this precaution is that the ground is soiled with blood, and consequently becomes a propagating-ground for bacteria, especially those which cause blood-poisoning or septicæmia. The organisms of tetanus, or lockjaw, must also be similarly guarded against.

The most suitable place is a clean grass-paddock, high-lying and well exposed to the sun. Low-lying and damp places should be avoided as far as possible. Bacteria must have moisture to keep them alive and multiplying, so that if the ground where the operation is carried out is wet or damp it may become a veritable incubator. On the other hand, ground in a high and dry position, well exposed to the sun, soon becomes clean, the sun's rays being the best disinfectant. On damp ground the moisture protects the disease organisms from the direct action of the sun.

Lambs should be castrated and docked when from three weeks to a month old. Marking lambs during the heat of the day or while heavy warm winds are blowing should be avoided as far as possible. The cool of the afternoon is the best time to carry out the work. For marking operations a few hurdles and coils of wire netting, together with a sufficient number of stakes, should be held in readiness. With these a pen and yard can be erected in a suitable part of the paddock where the ewes and lambs are to be folded.

The instruments required consist of two clean, sharp knives, together with a bucket of water to which has been added some disinfectant. The hands of the person operating should be well scrubbed in a solution of the disinfectant before commencing operations. The knife when not in use should be placed in the bucket containing the antiseptic solution.

The method of operating most often employed is as follows: The lamb is held by an assistant in such a position as to expose the pouch. The operator grasps the pouch at the tip and with one clean cut severs the end. The testicles are then pressed out and drawn. This is generally done with the teeth, but some operators prefer drawing the testicles with the fingers. If the cord should happen to be broken by rough handling before the testicle is properly drawn bleeding will be the result, and the blood collects in the pouch. This must be removed

and the pouch washed out with an antiseptic solution. The reason for this is that if a blood-clot collects in the pouch septicæmia supervenes, and death follows. The testicles and pouch-ends should be placed in a receptacle provided for this purpose. As soon as castration is completed the tail is grasped and severed with one clean cut. The cut is best made two or three joints from the stump; the joint can be felt by the finger and thumb. A weak disinfectant should be applied to the wounds before releasing the lamb.

The knife used for tailing should be a separate one from that used for opening the pouch. The knives and operator's hands should be dipped into the antiseptic after each operation. After the work is concluded the tails, testicles, and pouch-ends should be collected and destroyed by fire.

When marking is finished the ewes and lambs should be placed on good clean pasture with sufficient growth to keep the lambs' tails or pouch-ends from coming into contact with the soil. If these precautions are strictly observed any mortality from castration and docking should be reduced to a minimum.

—F. Mackenzie, Live-stock Division.

THE ORCHARD.

THE experience of the past season has proved conclusively that the Dominion markets are easily oversupplied with low-grade fruit; in fact, the demand for this grade at present is very limited, and fruitgrowing is not a profitable proposition unless the percentage of such fruit is kept down to 10 per cent. or thereabouts. Growers who have been unsuccessful in realizing this ideal should take courage from the fact that many are attaining it consistently year after year, and should again make an earnest effort. The reason for such success is not a secret, but merely lies in doing the right thing at the right time and doing it well.

SEASONAL SPRAYING.

Specially does the foregoing statement apply to orchard-spraying. Most of the pip-fruits are graded down for black-spot, and the stone-fruits for brown-rot, both diseases that can be controlled by proper spraying. Effective control requires the trees to be in good heart and the correct sprays to be applied at the right time. Again, the results of such a campaign largely depend on the initial effort. Black-spot and brown-rot fungi commence their new season's growth at the same time as the trees on which they live, and if they are allowed to establish themselves before preventive measures are taken the battle is lost, or, at best, the results will be unsatisfactory.

To prevent the loss of laterals, spurs, and fruit through brown-rot on apricot, peach, and stone-fruit trees generally, follow up the spray recommended last month with a further application of bordeaux, 8–6–40, as the blossoms commence to open—usually early in the month of September. Owing to the variable quality of quicklime it is always desirable to test bordeaux that is about to be applied to trees in growth; should there be any sign of acidity more milk of lime must be added until this is neutralized.

Towards the middle of this month pear and apple trees commence to resume their growth. Just before this takes place the first fungicide spray for the prevention of black-spot must be applied. In the districts and localities where this fungus gives comparatively little trouble, and probably powdery mildew and red mite are the worst offenders, the fungicide used may be lime-sulphur concentrate, 1 gallon to 10 gallons of water. In applying, close down the aperture of the spray-nozzle somewhat and give the job plenty of time, covering branches above and below. Where black-spot has been troublesome use bordeaux, 8–6–40, at the same period in place of the lime-sulphur, using the greatest care in mixing and applying. Should the trees also be affected with scale insects, aphides, or red or blister mites, follow this application almost immediately with red oil—1 gallon to 15 or 20 gallons of water—taking care that a good emulsion is obtained. These are the most important sprays of the year, and a clean crop cannot be harvested without them.

CULTIVATION AND PLANTING.

During the interval that follows these spraying operations the orchard should be ploughed and harrowed down, if this has not already been done. A special plough should be used for getting close in to the trees, thus avoiding the necessity of using the hand-grubber. Much damage is sometimes done at this season by ploughing too deep and cutting up the roots. Frequently it is done by ploughing the same way twice; if the ploughing was towards the line of trees last time, reverse it by ploughing away, and so leave the land level. Avoid working the land when it is wet. Complete all new planting this month.

GRAFTING.

Reworking trees by grafting may be carried out as soon as the trees commence to make new growth. Before cutting the trees down and preparing the stocks, carefully consider the best point for reworking, and retain the old forks if possible. Poorly cut scions of unripe wood, insufficiently tied and only partially waxed, are the commonest causes of failures. Scions must be held in firm contact with the stock for the whole length of the splice, and air excluded from the whole operation by a generous application of wax. Inspect them occasionally afterwards to see that the ties and wax remain in place and are effective.

—W. C. Hyde, Orchard Instructor, Nelson.

POULTRY-KEEPING.

EARLY HATCHING.

It should be unnecessary to reiterate that where winter eggs are the objective aimed at all chickens intended to be reared should be hatched out not later than September. Chickens hatched later than that make unsatisfactory stock, and the later the hatching the more disappointing are the results. Indeed, with the present cost of foodstuffs it is next to impossible for late-hatched birds to show even a fair profit over the cost of their keep. Not only do they lay only in the cheap-egg season, but they involve constant trouble with disease, and seldom or never make good breeding-stock, however good the strain.

Where possible, the aim of the poultry-keeper should be to secure all his chickens during two months — August and September — instead of extending hatching operations over a period of about five months, which is often the case. If the most money is to be made from the business it is not sufficient to have merely a small proportion of the pullets laying when eggs are worth most money; the great majority of the pullets must be in a productive condition if a payable winter-egg yield is to be secured. It should always be remembered that one egg in winter is usually worth more than two in summer, and it is the early hatched pullet that produces the dear egg. Thus on all plants an endeavour should be made to secure the required number of chicks at the earliest possible moment.

BROODING-POINTS.

Always at this season of the year I receive many complaints regarding mortality among young chickens that are being artificially reared. Usually my correspondents satisfy themselves that their loss is due to bad luck or to some mysterious epidemic form of disease over which they have no control. In most cases, however, there is nothing mysterious about it, the cause being mismanagement and nothing else. The man who is successful in rearing brooder chicks leaves nothing to chance. In the first place, he sees that his breeding-stock are in the best possible condition for the production of vigorous progeny. When the chicks are hatched out he keeps a close watch on them, and on the first sign of anything wrong he looks for the cause and removes it. He also takes climatic conditions into account, and sees that the right degree of heat is maintained both by day and night under the hover, as well as an ample supply of fresh air. This means long hours of work and giving the young birds almost constant attention.

In regard to success or otherwise in artificially rearing chicks, too many breeders fail to follow the set of instructions provided by the mother hen and

her brood. They attach the main importance to the food supplied. Good feeding is certainly an essential, but it is only one important link in the chain of management. For example, it is common to see chickens with the mother hen doing remarkably well on a class of food that would on its appearance alone be condemned for brooder chickens. The palpable lesson is that warmth—and this at a uniform temperature—is more essential than the providing of any special ration for the young birds. Herein is seen the prevailing weakness in artificial rearing. The chickens seldom enjoy that absolutely uniform degree of warmth and fresh air which they receive when being reared in a natural way. The hen studies weather conditions, and so must the poultry-keeper if he is to rear his chickens successfully.

The chief cause of brooder mortality lies in allowing the chickens to become chilled. Thousands of chickens die annually from no other cause. Chills are most commonly due to the temperature of the brooder not being maintained at a uniform degree, or to the chickens being allowed too much freedom for the first few days. Here the mother hen gives a striking lesson. For the first few days she keeps the chicks under her wings, where they are warm and comfortable, but at the same time are given an opportunity to breathe fresh air, that great essential for their welfare; during this period the time given them to feed and exercise is strictly limited. As they grow older, and providing the weather is favourable, the time given to exercise is extended by degrees, but on no account does she neglect to give them a warm-up when required.

The most pronounced sign that chickens have been chilled is the occurrence of bowel trouble, and once chicks become so affected there is practically no cure. Preventive measures at all times are really the only safeguards, and the chief of these is the maintenance of an even temperature and good ventilation in the brooder, together with strict attention to cleanliness.

There are also other details that must be observed if the young birds are to thrive and do well. For instance, the food supplied should contain all the elements necessary for healthy growth and development. Never feed inferior or musty grain because it is cheap. Do not on any account fail to provide an ample supply of succulent green material; chickens will never thrive in its absence. Keep always before the chickens a supply of fine grit, fine granulated charcoal, and clean water; dry wheat-bran should also be always within reach of the little ones. Another important matter is to see that the chicks get plenty of exercise, as they would in a state of nature. For this purpose the floor of the brooder-house should be littered with dry straw chaff (not oaten chaff) in which the dry broken grains should be scattered. To have to scratch for their food is instinctive to chickens, and if deprived of this exercise they will soon acquire such vices as toe and vent picking, &c., to say nothing of their ceasing to thrive.

FEEDING THE LAYING-BIRDS.

Now that the laying flock has settled down to heavy production the hens are apt to seriously decrease in weight, owing to the great demand on the bird's body-fat content for the formation of yolks, which largely consist of fat. Especially does this apply to pullets. Thus, if the birds are to be maintained in a healthy productive condition, sound and liberal feeding is imperative. If the birds are not well supplied with the elements necessary for the formation of eggs not only will the egg-yield decrease, but in addition the eggs that are laid will rapidly become smaller, while the yolks will not be of the desired rich colour.

The good layer is always a heavy feeder, and those who advocate keeping her on a scant ration have probably had little or no experience in profitable egg-production. The day has gone for saying that hens are too fat to lay. Where they become too fat it indicates that the food supplied is of the wrong kind, or that the birds are not concerned in heavy egg-production owing to their being of a poor laying-strain, or that they have passed their best period of production. An egg is one of the most concentrated and richest food products known. Obviously, a hen cannot be expected to lay day after day a 2 oz. product if kept in a state of semi-starvation.

There are no fixed rules that can be laid down as to the daily ration required by a laying flock. If the best results are to be obtained the poultry-keeper must have an observant eye, and must use his judgment by way of anticipating the birds' requirements.

—F. C. Brown, Chief Poultry Instructor.

THE APIARY.

SPRING WORK.

FULL advantage should be taken of the mild spring days to overhaul the hives. When the temperature will allow, the work should go on steadily, and notes should be made after inspection of the condition of the colonies. Do not delay the spring examination until brood-rearing has commenced in earnest. By the time of the first inspection small patches of brood should be formed, and under favourable conditions the quantity will rapidly increase, depending largely, of course, upon the amount of stores in the hives and the quality of the queens.

The spring months are the most critical to the beekeeper, as the bees are taking a steady toll of the stores, and if care has not been taken in the autumn to see that each colony contained at least 35 lb. to 40 lb. of honey, cases of starvation may occur. The practice of placing colonies in winter quarters with a short food-supply is not to be commended, for it must ever be borne in mind that the foundation of the next season's crop depends largely, if not almost entirely, upon the condition of the hives when they are placed in winter quarters. Spring feeding is a temporary expedient to evade starvation, and should not be looked upon as part of the regular spring work.

Removing Supers.

Where it was found necessary to leave supers on the hives these may now be removed and the bees confined to the brood-chambers. What constitutes the brood-chamber depends on the beekeeper and his methods of working. Of late years the tendency has been towards increasing the size of the brood-chamber proper, and in place of the usual ten combs a brood-nest of eighteen to twenty frames is now generally accepted to make for large colonies in addition to providing room for expansion as brood-rearing proceeds. In cases where the bees have entered the supers and deserted the brood-combs, place the supers containing the bees on the bottom-board and remove the combs to the storehouse. See that the hives are made snug, and provide each with one or two spare mats to conserve the heat of the cluster.

Queen-right Colonies.

Normally, at this season brood-rearing will be in progress, and an inspection of the hives will determine as to whether or not the colonies are queen-right. The extent of the brood-rearing depends largely upon the weather prevailing, locality, and altitude, and these factors must be taken into consideration. If no eggs or brood be found it may be safe to assume that the colony is queenless, and such a colony must not be tolerated, as there is a danger of its being robbed of its stores by other colonies and an epidemic of robbing started in the apiary.

To unite a queenless colony to a queen-right hive proceed as follows: Prepare the queen-right hive during the day by removing the cover and mat and placing a sheet of newspaper over it. In the evening lift the queenless hive off the bottom-board and place it over the queen-right hive. In the course of a few days the bees in the weaker hive will eat their way through the paper and unite peaceably with the bees in the stronger one. If not required, the surplus combs containing honey may subsequently be removed and stored away for feeding. This method is simple, and rarely causes any fighting between the united colonies.

Overhauling the Hives.

Each hive should be thoroughly overhauled during the mild spring days. There is usually an accumulation of pollen, cappings, and dead bees on the bottom-boards, which matter, if left, becomes mouldy and objectionable, besides acting as a harbour for insects. The operation of clearing the bottom-boards can be facilitated by providing a spare one. Lift the hive on to the spare bottom-board, scrape the dirty one thoroughly, and then replace the hive. Where necessary, each hive should be given a coat of paint, while in damp situations, in order to preserve the life of the bottom-boards, a thin coat of tar applied to the under-surface will be effective. Clear all weeds and grass from the hives: they act as a harbour for insects and keep the bottom-boards damp.

REMOVAL OF BEES FROM BUILDINGS.

When bees take up a position in a building they in course of time become troublesome to their owners. In the busy season, when they are flying freely, they usually find access to other quarters, to the annoyance and general discomfort of everybody concerned; and, as the bees in most cases select a location behind the weatherboards or under the eaves of the house, they are hard to remove. Fumigation is not as a rule successful, as it is well-nigh impossible to get the poisonous gases confined to the quarters the bees are occupying.

The quickest plan to adopt is to strip the weatherboards or otherwise remove parts of the building so as to expose the combs. If the services of a beekeeper are not available bees can be successfully removed by proceeding as follows: In case the person is unused to handling bees, or is nervous, a veil should be worn. Take a bee-smoker and charge with dry sacking, so that when lighted the smoke can be forced in at the entrances which the bees are using. Usually a few puffs of dense smoke will drive the bees to the honey, and they can then be handled without much risk of the operator getting stung. The weatherboards or other material can then be removed, the bees brushed into a box, and the combs removed. After the operation is complete, block up all entrances so as to prevent further swarms from taking possession; and if provision is made for smearing the inside woodwork with carbolic acid or a pungent chemical this will act as a deterrent to bees again entering the building.

If the position the swarm has taken up in the building will permit of a hive being placed so that the crevice through which the bees have been passing adjoins the entrance to the hive, the bees may be removed by means of a bee-escape. This will obviate the handling necessary in the other method described. It is first necessary to stop up all the openings except one. Over this should be placed a Porter bee-escape, through which the bees can come out but cannot re-enter. In the hive place several combs, including one containing brood with adhering bees, care being taken to see that eggs and hatching-brood are both present. As the bees pass out of the building they will be unable to find their way back, and will enter the hive

In a few days the field-bees will all have entered the hive, and in the course of time the emerging bees will shortly follow those outside, with the result that the entire colony, with the exception of a very few bees, will be in the hive. The bees in the hive, finding themselves without a queen, will raise one from the young larvæ in the comb provided. The nurse-bees will care for the brood in the old home, with the result that the colony will be transferred with little loss. In a few weeks' time, when the bees have settled down and the young queen has started to lay, the escape can be removed, and the bees allowed access to the honey in the old brood-nest. They will remove this and carry it into the hive. When the operation is complete the hive can be removed to a location in the garden, and the entrance to the building closed so as to prevent another swarm occupying the same position. When the hive is removed take the usual precautions to prevent the bees from returning to the old location.

—*E. A. Earp, Senior Apiary Instructor.*

THE GARDEN.

VEGETABLE-CULTURE.

EARLY crops of cabbages and cauliflowers will in forward districts now be well advanced in growth. If growth is not quite satisfactory apply nitrate of soda, ¾ oz. to 1 oz. per square yard, and repeat the dressing four or five weeks later. In later districts the surface soil should be loosened, where possible, after heavy rain. Nitrate of soda should not be applied till the normal frost period is past; after that it can be counted on to produce good results.

In some places cabbages and lettuces lose their bottom leaves, which turn yellow, and often show patches of grey mould. The grey mould is a fungus known as *Botrytis cinerea*, an early form of a damaging disease, *Sclerotinia fuekeliana*. The *Botrytis* form occurs only in wet conditions, and generally is the result of poorly drained soil or continued rainfall. If, however, it advances to the *Sclerotinia*

stage this will continue to advance regardless of weather, and in the end will destroy the plants, while the sclerotes falling to the ground will perpetuate the disease.

Affected leaves should be removed as soon as detected, and the stems of the plants dusted with air-slaked lime. The detached leaves should not be left on the ground; they may be composted with lime or buried very deeply in the soil. The disease, which is a very serious one, is far more prevalent than is supposed; it usually escapes notice until plants are killed. A good many plants are affected, including tomatoes and potatoes; but most frequently the first appearance is on lettuces and cabbages, because the way the bottom leaves rest on the soil creates conditions favourable to the disease.

Seeds to be sown at this period include peas, spinach, turnips, and turnip-rooted red beet, while broad beans may be sown if not already in. Celery for the main crop should be sown about the 15th September. Celeriac—known as turnip-rooted celery—is a valuable vegetable not so much grown as it should be; it is raised in the same way as celery. Tomatoes for late crops should be sown early in September. Plant potatoes, rhubarb, Jerusalem artichokes, cabbage, cauliflowers, lettuce, shallots, garlic, and various herbs—such as thyme, sage, mint, savoury, and marjoram—and sow or plant parsley.

Asparagus.

Asparagus-roots are active some time before the heads show through the ground, which in middle districts occurs early in September. The best time to plant is as soon as the roots are active, but if a head or two has broken it will do no harm. The activity of the roots prevents damaged roots dying back, and ensures a good start. If the plants have to be procured from a distance they must be packed in damp material. If raised on the place they should be placed between damp sacking and exposed as little as possible.

To plant, make a trench 6 in. deep with a shovel; then with a rake make a ridge in the centre of the trench by drawing up soil from each side of the floor of the trench. The plants should be placed on the top of the ridge with the roots spread on each slope, as on a saddle. The soil should then be returned, leaving the crowns from 2 in. to 3 in. below the surface. Modern practice is not to plant closely in beds, but at greater distances apart in lines on the flat. It would be better to plant one or two rows the whole length of a plot than a number of shorter rows side by side. In large plantations the rows should be from 30 in. to 36 in. apart, and the plants at least 15 in. apart, a greater distance being better. Two rows 18 in. apart, with the plants 18 in. asunder, is a good arrangement. This style of planting produces better heads than do crowded plants on the old-fashioned beds.

Established beds or plantations that have been previously covered with manure should now be put in order. In the case of beds, the soil previously taken off should now be returned to cover the manure. Where plants are in rows a light forking-over will be wanted. Where a good dressing of manure has been given, no fertilizer will be necessary except nitrate of soda, which should not be left out. Asparagus is benefited more by heavy manuring than is any other crop, except perhaps rhubarb. Nitrate of soda may be used with advantage in sufficient quantity to act as a weed-killer where necessary; it will also kill slugs. Amounts up to 6 oz. per square yard may be used.

SMALL-FRUITS.

Strawberries in most places are now coming into flower. If growth is not satisfactory a dressing of nitrate of soda should be given; 1 oz. per square yard, equal to 3 cwt. per acre, is sufficient. Nitrate of soda should not be applied till flowering begins, because if given earlier it is liable to cause luxuriant leaf-growth at the expense of the fruit. Weeds should be hoed out before the fertilizer is applied. Mulching-material should be prepared for application before the fruit-stalks extend too much. Materials suitable for the purpose include spent hops for small areas, or strawy stable manure, straw, rushes, pine-needles, and coarsely cut chaff. Where a good mulch can be afforded it serves to conserve moisture, as well as to keep the fruit clean.

Cape gooseberries may now be planted generally, and old plants cut down to the new shoots now appearing.

—*W. H. Taylor, Horticulturist.*

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

CHEESE-YIELD FROM FRIESIAN AND JERSEY MILK.

'ANONYMOUS," Hastings :—

Does the milk of a Friesian cow with a 3·6 butterfat test produce more or less cheese than that of a Jersey cow with a 5·0 test, the milk being in equal quantity ?

The Dairy Division :—

Under ordinary working-conditions there will be quite a variation in the yield of cheese from the two milks. The richer milk not only contains more fat, but also more casein. These are the two principal solids of milk which are found in cheese. The casein content varies in milks from different cows of the same breed, but if we assume that the Friesian milk contained 2·3 per cent. casein and the Jersey 3 per cent., the yield of cheese from 100 lb. of the Friesian milk would probably be about 9·6 lb., and from 100 lb. of the Jersey milk 13 lb.

ABORTION-CONTAMINATED PADDOCKS.

M. A. W., Tirau :—

I have been unfortunate in having some of my cows and heifers affected with abortion after carrying their calves about eight months. The animals have been confined to two small paddocks which are used as calf and bull paddocks during the early part of the milking season. Kindly inform me if any harm will result from the present use of the paddocks.

The Live-stock Division :—

It is not advisable to graze either bulls or calves on paddocks contaminated by the discharge from aborted cows. Such paddocks should be kept free of cattle for at least six months. Probably the best procedure would be either to graze sheep there or cultivate the paddocks.

HUBAM CLOVER.

"ONE IN DOUBT," Mangaohae :—

Will you kindly give any information you may have as to the usefulness of Hubam clover? Is it an annual or a perennial, and has it any advantages for particular purposes or positions, as compared with other clovers ?

The Fields Division :—

Sweet or Hubam clover (*Melilotus alba* var.) is a biennial, and should be sown in the spring at the rate of 10 lb. per acre on a well-consolidated seed-bed. Seed can be obtained from Messrs. Law-Somner Proprietary (Limited), Block Place and Swanson Street, Melbourne. Sweet clover, except in its young stages, is not relished by stock on account of its bitter taste. The stems become woody at flowering-time, and hence the crop is not very palatable either as hay or ensilage. It shows no advantage over our ordinary forage crops.

LUPINS FOR ORCHARD GREEN-MANURING.

R. S., Ripponvale :—

Would you kindly inform me the best kind of lupin to sow for green manure in an orchard ; also what quantity of seed and superphosphate to sow per acre, and where good reliable seed could be procured ?

The Horticulture Division :—

The blue lupin is recommended, being quicker in growth than the white variety. If sown in November the crop should be ready for turning under in May—a very good season, giving time for decay before the trees become active in spring. Sow 60 lb. of seed, in drills 12 in. to 15 in. apart, with 2 cwt. of superphosphate. If the seeds are broadcasted 80 lb. is required. Seeds should be procurable from any large seed firm.

DRYING-OFF OF COWS.

"RED CLOVER," Parkhill :—

How long do you consider a heifer should be milked before having her second calf ?

The Live-stock Division :—

It may be accepted as a common rule that a cow or heifer should be dried off at least two months before calving. This is necessary for the well-being of both cow and offspring. The fact of carrying a heifer on right up to the time of calving again will not improve her as a milker, and is detrimental to the calf she is carrying as well as to herself. About the end of the sixth and beginning of the seventh month of pregnancy the quantity of milk naturally diminishes, and the animal dries off of her own accord even although she is well fed and attended to. This, however, does not hold good in many of our highly developed deep-milking breeds, with which it is not unusual to have the milk-yield going on with no tendency to stop in the late months of pregnancy. In such cases it may be necessary to milk once a day or once in two days right up to calving, to avoid udder troubles. This is seldom followed by any harm to either cow or calf where the dam's tendency is to milk on, but to try to encourage the term of lactation beyond the seventh month of pregnancy, especially when the tendency of the animal is to dry off, is bad practice, and, as already stated, will not improve the cow as a milker.

HORSES AND WHEAT.

"SUBSCRIBER," Ashburton :—

Please advise treatment for horses that have had access to wheat by accident. I would like to be prepared.

The Live-stock Division :—

The treatment necessary depends largely on the amount of wheat consumed by the animal. If a horse is not engorged the first symptoms noticed are those of laminitis, or founder. If the amount consumed is large it causes dilation of the stomach. The main treatment in both cases is the evacuation of the stomach-contents by the aid of purgatives. For this purpose an aloetic ball containing from 5 to 7 drams may be given. For heavy draught horses 7 drams is sufficient. All dry or solid feed should be kept from the horse, but the animal should be given an ample supply of drinking-water. Luke-warm-water enemas should be given every three hours until the bowels respond and the contents of the stomach and bowels are evacuated. The horse should be starved for forty-eight hours, and only easily digestible food, such as bran or linseed mashes, should be given for a few days.

CONTROL OF SLUGS AND SNAILS.

H. S. STRATFORD, Crail Bay, Pelorus Sound :—

We are very much troubled with slugs in our locality. Many people from outside districts have recommended hedgehogs to combat the pest, and I would like to have your opinion regarding their use. There are no frogs in our locality. Do you think that if we brought them here it would be a step in the right direction ?

The Horticulture Division :—

Hedgehogs are now becoming fairly plentiful in a number of places in New Zealand, but are, of course, not often seen, as they lie hidden during the day. They certainly do devour slugs, snails, worms, and large insects, and naturalists regard them as friends to gardeners. Gardeners, however, usually regard them as friends only when they are outside the garden, for they also eat young plants and roots—not to mention milk, meat, hen's eggs, and young chicks. English horticultural journals frequently contain matter regarding slugs and snails, but they never advise the use of the hedgehog, which is a native of England. Frogs are useful for the control of woodlice, but so far as we are aware they do not eat slugs and snails. Readily effective means for the control of these pests are clean cultivation and the free use of air-slaked quicklime after dark.

Grading of Butter and Cheese for Export.—During the twelve months from August, 1922, to July, 1923, the following quantities were graded by the Dairy Division at the various ports, amounts for the corresponding previous yearly period being given in parentheses: Butter, 67,850 tons (50,548); cheese, 61,220 tons (63,790). These figures represent a net increase of 20·1 per cent. in butterfat production for butter- and cheese-making in the 1922–23 period.

Fees for Grading of Dairy-produce.—Amending regulations under the Dairy Industry Act fix the fee for butter at 1·05d. per box and for cheese at 1·40d. per crate. In the case of butter or cheese forwarded for export from a registered factory, creamery, or private dairy, the fee is payable by the manufacturer on demand; otherwise it is payable by the owner of the produce. Where it is found that the total amount paid in respect of grading-fees in any year ending the 31st March exceeds the cost, as determined by the Minister of Agriculture, of the dairy-grading service, including the salary and expenses of the Government Dairy-produce Officer in London, the Minister may credit to the payers of fees, towards the fees payable by them during the next succeeding year, the amount paid or payable in excess of such cost, in the proportion in which each payer contributed during the period in question.

Grading of New Zealand Hemp.—Amending regulations dealing with the grading and export of stripper-tow (carded stripper-slips) were published in the *Gazette* of 12th July. Three grades are established for this by-product, together with prescriptions for size of bales, tagging, &c.

Local Wool-sales.—During the season 1st July, 1922, to 30th June, 1923, there was offered at the wool-sales in New Zealand a total of 509,880 bales of wool, of which 457,547 bales were sold, the average price per pound being 10·40d. In the 1921–22 season 440,014 bales were offered locally and 405,125 sold, at an average of 6·06d. per pound.

British Market for Peas and Beans.—The following information was cabled by the High Commissioner, London, on 4th August: *Peas*—New Zealand Maple have arrived freely; stocks on hand and awaiting discharge at docks are more than sufficient for present requirements. July shipments sold for 80s. per quarter; September-October shipments, 82s. 6d.; very little forward business. Tasmanian are scarce; July-August shipments sold at 92s. Small sales of blue reported; New Zealand 90s. ex store, and 82s. 6d. asked for parcels to arrive. Japanese cheap; new crop hand-picked marrow-fats, delivery to be in two equal lots in November and December, quoted at £22 10s. per ton. *Beans*—Sale slow. English winter making 8s. 10d. to 9s. 6d. per cwt., according to quality; Pigeon, 12s. to 18s. per cwt. Chinese horse, August-October shipments, quoted at 10s. 3d. per cwt.

RUAKURA FARM SCHOOL FOR YOUTHS.

THE new permanent farm training-school for youths at the Ruakura Farm of Instruction, Hamilton, was opened on 15th August with some twenty students as a commencement.

The school is designed to provide a course of agricultural training for lads of not less than sixteen years of age and of reasonable educational attainments. The period of training will occupy two full years, divided into four terms of twenty-three weeks each, with vacation periods of three weeks between each term.

Approximately one half of each term is to be devoted to the actual carrying-out by the student himself, under direction, of all classes of farm-work incidental to the management of a farm where cropping, grazing, milk-production, meat-production, and stock-breeding are carried out. The other half of each term is to be devoted to direct instruction covering the main features of agricultural knowledge necessary to equip the student to become a successful farmer. The objective of the course is to turn out young men well versed in practical farming and live-stock management, with at the same time a good grounding in the sciences essential in the planning and management of the modern farm.

RESIDENTIAL QUARTERS, CLASS-ROOMS, ETC., OF THE RUAKURA FARM SCHOOL FOR YOUTHS.

[*Photo by I. Hopkins.*

In the course the principles of scientific agriculture will be given special prominence, but more from the viewpoint of the requirement of the farmer than that of the agricultural teacher or research worker. Qualified agricultural teachers will direct and superintend this side, which includes agriculture, agricultural botany and zoology, agricultural chemistry, farm veterinary science, farm mathematics and mechanics, mechanical drawing, and farm book-keeping. It is intended that the work in these subjects shall closely follow that laid down in the syllabus of the New Zealand University, but, with the exception of agriculture, be somewhat more elementary in character.

A further twenty lads will be taken at the school in February next, the plan being to maintain a total strength of between forty and fifty. The residential quarters, class-rooms, &c., occupy the buildings previously erected and used for the training of returned soldiers. A fee of £36 per annum is charged to students as a contribution towards the cost of board and maintenance.

WEATHER RECORDS: JULY, 1923.

Dominion Meteorological Office.

GENERAL SUMMARY.

JULY is, meteorologically speaking, the midwinter month of the Southern Hemisphere, and in New Zealand has been associated with some heavy falls of snow and hard frosts, especially in the South Island. A westerly depression between the 1st and 6th of the month accounted for the widest and heaviest falls of snow, which came down low in the South. Very cold and frosty conditions followed, and one observer states that "at this time the ground was for days as hard as iron, and the sun had no more effect on the frost than the moon." From the 16th to the 23rd the weather generally was dull, misty, and wet. Several ex-tropical disturbances passed in the North in this period. A remarkably heavy rainfall was experienced in Poverty Bay; Whakapunake (in the ranges) had a total rainfall of 16·27 in. for the month, which is believed to be the heaviest for that station for any month for the past seven years. The damp and dull weather was trying and unpleasant to animal-life. Cold and changeable conditions followed, and southerly gales on the 27th were succeeded by a remarkable high-pressure system. While the barometer was highest the weather was fine in the greater part of the Dominion, but on the east coast the weather continued cold and damp, with strong south-east winds, which were accounted for by a disturbance which hung on the edge of the anticyclone and in the neighbourhood of the Chatham Islands.

During the winter months we get the worst storms, but on the whole the wind is less than usual, and this July was no exception to the rule. Rainfall was also mostly below the average.

From America it is reported that observations of the sun show less heat has been radiated during the past seven months than usual, and icebergs in the Atlantic were earlier and more numerous than in former years. This opens up interesting questions concerning terrestrial conditions, and shows that the study of seasonal weather needs a very wide outlook.

—*D. C. Bates, Director.*

RAINFALL FOR JULY, 1923, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average July Rainfall.
North Island.				
	Inches.		Inches.	Inches.
Kaitaia	6·34	19	1·36	5·96
Russell	7·58	17	1·64	4·26
Whangarei	7·78	17	2·30	8·33
Auckland	2·80	19	0·60	5·10
Hamilton	3·45	14	1·00	5·24
Kawhia	3·70	16	1·01	6·86
New Plymouth	5·65	16	1·64	6·35
Inglewood	6·54	17	1·62	10·23
Whangamomona	4·36	18	1·10	7·68
Tairua, Thames	5·94	15	0·94	5·15
Tauranga	4·53	13	1·60	5·12
Maraehako Station, Opotiki ..	3·76	13	0·76	4·45
Gisborne	6·67	23	1·87	5·21
Taupo	2·42	13	0·82	4·21
Napier	3·65	18	0·84	3·95
Maraekakaho Station, Hastings ..	5·40	22	0·97	3·83
Taihape	2·62	19	0·42	3·33
Masterton	5·49	26	1·37	4·43
Patea	2·98	15	0·56	4·10
Wanganui	1·32	8	0·33	3·63
Foxton	1·94	7	0·72	3·47
Wellington	3·77	19	0·71	5·73

RAINFALL FOR JULY, 1923—*continued.*

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average July Rainfall.
South Island.				
	Inches.		Inches.	Inches.
Westport	2·83	14	0·90	6·99
Greymouth	3·15	8	1·22	8·43
Hokitika	2·50	8	1·06	9·20
Arthur's Pass	4·25	1	4·25	12·53
Okuru, Westland	2·54	7	1·54	12·03
Collingwood	8·35	10	2·21	9·65
Nelson	2·56	9	1·20	3·53
Spring Creek, Blenheim	1·52	10	0·80	3·93
Tophouse	3·56	9	1·50	5·65
Hanmer Springs	2·74	11	0·64	5·15
Highfield, Waiau	2·50	15	0·52	2·42
Gore Bay	2·53	19	0·70	3·31
Christchurch	3·90	22	0·85	2·77
Timaru	1·82	11	0·52	1·95
Lambrook Station, Fairlie ..	0·82	6	0·40	2·72
Benmore Station, Omarama ..	0·50	6	0·16	1·74
Oamaru	0·96	13	0·25	1·78
Queenstown	1·38	3	1·05	2·01
Clyde	0·28	4	0·08	0·94
Dunedin	2·14	13	0·62	3·02
Gore	1·08	10	0·25	2·05
Invercargill	1·62	12	0·42	3·45

IMPORTATION OF GRASS-SEED FROM AUSTRALIA.

THE regulations issued in September, 1921, relating to the importation of grass-seed from Queensland and New South Wales with a view to the prevention of the introduction into New Zealand of ticks of the Ixodidæ family have been revoked, and other regulations gazetted on 2nd August. Under the latter provisions the importation of grass-seed grown in Queensland, or in the tick-infestation-quarantine area of New South Wales, is prohibited. Grass-seed grown in New South Wales other than in the tick-infestation-quarantine area, or in any other State of the Commonwealth, may be imported subject to the condition that prior to shipment to the Dominion it has been subjected to cyanide fumigation for a period of not less than six hours, or to other fumigation, in a manner approved of by the Minister, and, further, in the case of paspalum-seed, prairie-grass seed, and millet-seed, that it is again similarly treated upon arrival in the Dominion. No grass-seed is to be imported from the Commonwealth unless it is accompanied by a certificate signed by the consignor, in the form prescribed by schedule, and also by a certificate signed by an officer of the Department of Agriculture of the State in which it was grown, in the form prescribed.

IMPORTATION OF PLANTS INTO AUSTRALIA.

THE Commonwealth regulations designed to prevent the entry of fireblight-infected material into Australia have been modified, and the prohibition now applies to the following: "(*a*) All deciduous fruit-trees or parts thereof (including the fruit and seeds), and (*b*) all plants or parts of plants of the family *Rosaceae* (including the fruit and seeds), which were grown in any country in which pear-blight or fireblight (*Bacillus amylovorus*) exists: Provided that the Minister may permit the importation of new or special varieties of deciduous trees or their fruit or seeds, subject to any conditions which he may think fit to impose."

PRINCIPLES OF LIVE-STOCK BREEDING.

THE annual report of the Board of Agriculture for the year ended 30th April last states under the heading of "Principles of Live-stock Breeding":—

"During the year the Board has been giving a good deal of attention to this most important subject as a result of a communication received from the Franklin Agricultural and Pastoral Association. Several members of the Board, and the Department of Agriculture at the request of the Board, have collected a great amount of useful information. The papers prepared by the members of the Board, and also a most valuable one read at a meeting of the Board by Mr. W. D. Hunt, giving the results of his experience, have already been forwarded to the Franklin Association, and are attached hereto. At a later date, when additional reports on the subject which the Board is securing from abroad come to hand, it is the intention to prepare and publish a digest of all the papers for circulation to breeders in the Dominion. This will enable those interested in breeding in the Dominion to compare their practice with what obtains elsewhere, and ensure that sound principles are followed. This subject is more particularly interesting to stud-stock breeders, but nevertheless all farmers who are raising stock should have some knowledge of the principles of breeding, and the publication of this data should be of considerable benefit to them. Members of the Council [of Agriculture] and breeders generally are cordially invited to assist the Board in its investigations by submitting papers giving the result of their experience."

The papers referred to are by Sir James Wilson (including letters from the late James Little of Corriedale fame), and Messrs. Edwin Hall, W. Perry, D. Marshall, John Ewan, and, as mentioned, W. D. Hunt. The latter contribution is reprinted elsewhere in this issue under the title of "Breeding of Farm Animals."

EXAMINATION OF FERTILIZERS.

THE Department's Chemist would value the assistance of farmers in examining the quality of the fertilizers on the market. For this purpose a portion of fertilizer should be taken from each of a number of bags and the portions thoroughly mixed together. Finally, a portion weighing about 1 lb. may be put into a clean dry tin, and posted with the invoice certificate or a copy of it, addressed to the "Agricultural Chemist, Dominion Laboratory, Wellington." It is essential that the invoice certificate should accompany any sample sent. Senders of samples will note that under this arrangement the results of the examination cannot be supplied to them unless confirmed by an official sample. If it is possible and the results warrant it an official sample will be obtained by the local Inspector from the vendor's store.

FORTHCOMING AGRICULTURAL SHOWS.

Hawke's Bay A. and P. Society: Hastings, 17th and 18th October.
Poverty Bay A. and P. Association: Gisborne, 23rd and 24th October.
Marlborough A. and P. Association: Blenheim, 24th and 25th October.
Timaru A. and P. Association: Timaru, 24th and 25th October.
Wairarapa P. and A. Society: Carterton, 24th and 25th October.
Manawatu A. and P. Assn.: Palmerston North, 30th and 31st Oct and 1st Nov.
Ashburton A. and P. Association: Ashburton, 31st October and 1st November.
Wanganui A. and P. Association: Wanganui, 7th and 8th November.
Canterbury A. and P. Association: Christchurch, 8th and 9th November.
Waikato A. and P. Association: Hamilton, 20th and 21st November.
North Otago A. and P. Association: Oamaru, 21st and 22nd November.
Stratford A. and P. Association: Stratford, 21st and 22nd November.
Otago A. and P. Society: Dunedin, 28th and 29th November.
Southland A. and P. Association: Invercargill, 11th and 12th December.
Feilding I., A., and P. Association: Feilding, 5th and 6th February.
Clevedon A. and P. Association: Clevedon, 9th February.
Dannevirke A. and P. Association: Dannevirke, 13th and 14th February.
Methven A. and P. Association: Methven, 27th March.