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LUCERNE ON THE FARM.

CULTURE AND MANAGEMENT UNDER NEW ZEALAND CONDITIONS.

Fields Division.

LUCERNE is a forage crop of such outstanding merits over a wide range of conditions that it should be used much more freely in New Zealand farming than is the case at present. The area under lucerne in the Dominion is relatively small, the statistical returns for 1929–30 giving the figure as 31,690 acres, the increase having been but slow.

In contrast with this the lucerne acreage and its rate of increase in other countries is significant. In Canada the area increased from 57,000 to 400,000 acres between 1909 and 1924. In Argentina in 1903 the area was 4,273,000 acres and in 1924 19,290,000 acres. In the United States the area in lucerne grew from 2,000,000 acres in 1900 to 11,040,000 acres in 1925.

NEW ZEALAND EXPERIENCE.

Experience with lucerne in New Zealand has extended over very many years. It has covered a wide range of conditions, and it has been sufficient to provide reliable evidence that more extensive use of lucerne is well warranted throughout the greater part of the Dominion. At times authorities seem to incline to the belief that lucerne is suited only for relatively dry climatic conditions, such as would occur, for example, in localities with less than 30 in. of annual rainfall. This belief that the usefulness of lucerne is restricted to relatively dry conditions probably is partly due to the fact that the merits of the crop are apt to be particularly emphasized under dry conditions. For instance, when droughty conditions prevail in Canterbury, Marlborough, or Hawke's Bay, then it is that the special value of an area of lucerne becomes particularly apparent, for under such conditions it is likely to be the only crop making fresh vigorous growth. But New Zealand experience has definitely shown it is unsound to hold that the use of lucerne should be restricted to the drier farming areas. In proof of this it need only be mentioned that for years thousands of acres of lucerne have given markedly profitable returns in Taranaki, one of our wettest provinces,

and that highly profitable areas are to be found in parts of the Auckland and Wellington Provinces in which the rainfall is well in excess of 30 in.

New Zealand experience has further shown conclusively that lucerne is not at all as exacting in its requirements as some seem to believe. Indeed, it has been grown successfully on practically all types of well-drained soils except peaty soils.

Our experience in this connection does not differ from that of other countries. As evidence of this we find Wm. Lawson in the *Journal of the Ministry of Agriculture* (England) saying, "Lucerne is suited to a wide range of soils; drainage is most important, and a well-drained soil and subsoil are absolutely necessary." Again, Bulletin 1283 of the United States Department of Agriculture, states, "The wide distribution of alfalfa [lucerne] in the world indicates a remarkable adaptability to climate and soil."

Valuable Features of Lucerne.

The excellence of lucerne as a forage crop arises from a combination of factors, including its high yield, high nutritive value, reliability during crucial seasons, low cost of production, and its capacity to improve soils.

High Yield.—Over a wide range of conditions in New Zealand lucerne suitably managed will provide three to five "cuts" annually for a series of years. Each cut will contain on the average from 5 to 7 tons of green forage per acre. Hence an acre of lucerne will yield annually in the vicinity of 25 tons of green forage. Frequently the annual yield is in excess of this. As 25 tons of green forage represents a yield of about 6½ to 7 tons of hay per acre the annual production of lucerne is high.

High Nutritive Value.—Investigational work in New Zealand agrees with similar work overseas in showing that the lucerne herbage is exceptionally nutritive, and that it is especially rich in those substances most apt to be lacking in the rations of stock, particularly of the highest-producing animals. It is rich in phosphates, lime, and protein, all of which are of practical moment in animal production and particularly in body-building. The nutritive components of lucerne are also highly digestible, especially when the crop is utilized before it has become woody. Hence, green lucerne is very valuable in dry seasons during late summer and autumn, when other succulent material is scarce, to provide the necessary fresh digestible material required by cows in milk. Lucerne hay, because of its high nutritive value, may also be suitably used to supplement feeds which are inferior or low in their content of substances in which lucerne is relatively rich. For example, lucerne hay and roots may be made to constitute a well-balanced ration, the lucerne supplying the deficiencies of the roots.

Reliability during Crucial Seasons.—One of the most valuable features of lucerne arises from the fact that established lucerne, because of its deeply penetrating root-system, is well fitted to withstand periods of drought. Hence, lucerne may safely be relied upon to make vigorous nutritive growth when practically all other crops fail. Lucerne is outstanding in respect to the quantity and quality of its yield, but if it were not so, and if it were only normal in these respects, its reliability during crucial seasons would be a weighty factor in its favour in comparison

with other forage crops that compete with it in popular usage. One is more likely to undervalue than to overvalue the reliability of lucerne during crucial seasons.

The relative values of a lucerne crop which may be relied upon for forage during unfavourable seasons and of other crops which may not be so relied upon cannot be ascertained merely by comparing the crops in respect to the annual yield of nutritive matter. Hence, even if it were true to say that an acre of, say, grass, would under certain circumstances produce annually as much nutritive matter as an acre of lucerne, it would not follow necessarily that the products of the grass and of the lucerne were of equal cash value. The reliability of the lucerne during critical seasons would almost always swing the balance in its favour.

FIG. 1. TYPICAL LUCERNE STAND IN SOUTH TARANAKI.

Low Cost of Production. — Forage from lucerne is ordinarily characterized by low cost of production. Low cost arises as the combined effect of three factors — the heavy yield of the crop, its reasonably low cost of establishment, and its relatively long life as a producing unit.

The matter of yield has already been discussed. For some obscure reason it is frequently assumed that it is a very costly matter to establish a crop of lucerne. In view of all the facts it is difficult to know why this idea is held. Under ordinary circumstances, apart from the cost of lime, it should be no more expensive to establish an acre of lucerne than to sow down the same land in permanent pasture. The preparatory cultivation and manuring needed for the one would serve equally well for the other. The only difference would be in respect to cost of seed, and 15 or 16 lb. of lucerne seed is not substantially different in cost from the pasture seeds for an acre.

Normally lucerne lasts as a profitable crop for many years—in fact, at times it becomes practically permanent. But should its life be limited to five or six years, as sometimes happens, it will even then usually have proved a handsomely profitable proposition. This is because

the initial cost of establishment, when spread over so many years of good production, represents but a slight overhead charge on the gross returns.

Capacity to improve Soils.—The fact that lucerne, being a legume, has the power of utilizing the nitrogen of the atmosphere is a feature which commends it. This fact means that usually lucerne, instead of calling for the use of expensive nitrogenous manures, actually builds up the content of nitrogen in the soil. This, together with its deeply penetrating root-system, means that lucerne tends to built up rather than to exhaust soil-fertility.

Selection of Soil and Situation.

Deep fertile, open, well-drained loams are undoubtedly best for lucerne. On account of the deep habit of its root-system lucerne does not thrive on a soil which because of bad drainage or impervious subsoil does not allow of deep root-penetration. Good surface drainage and under-drainage are both necessary. Land selected for lucerne should be either of high productivity naturally, or made so artificially by the application of suitable dressings. The marked success which characterizes lucerne in Central Otago may definitely be linked with the fertility of the soils.

In selecting land for lucerne it should be remembered, also, that lucerne is not well fitted to battle against weeds in its early life. Hence it is not advisable to select land which is known to be infested with seeds of annual weeds, or with parts of twitchy perennial weeds, unless these have been weakened by previous cultivation or cropping.

Because of the injury weeds may cause lucerne in its early delicate stages, it is at times good practice to select for a new area land which has been down in grass for many years, and to plough it deeply once only. A preliminary skim ploughing to secure disintegration of the turf may often with advantage precede the deep ploughing, but a second deep ploughing is inadvisable, because it would bring to the surface again the numerous weed-seed population which was buried by the first ploughing and which will remain dormant and harmless provided it is not brought back to the surface. Apart from weed considerations, the establishment of lucerne on a soil freshly broken up from old pasture is at times of advantage because such a soil possesses a certain amount of accumulated fertility likely to be of value to the lucerne. A pasture infested with twitchy weeds should as a rule be avoided when it is intended to sow lucerne immediately after grass.

It is almost courting disaster to sow lucerne on land which recently has been under the plough unless the crops preceding the lucerne were kept free from weeds, or unless some way of freeing the land of weeds, such as suitable cultivation, has been adopted.

Provided lucerne can become reasonably well established it will frequently battle successfully even against persistent vigorous weeds. For instance, at times lucerne successfully combats Californian thistle, but for this to happen the thistle must have been weakened sufficiently by previous cultivation to allow of the satisfactory establishment of the lucerne.

On very light soils deficient in humus it may be advisable to precede lucerne by a crop such as lupins, red clover, tares, or oats, which, used for green manuring, builds up the soil-fertility.

Because of its better surface drainage, land which is slightly undulating is at times preferable to that which is quite level. It is also of value to have a lucerne field sheltered from the prevailing wind.

Preparation of the Seed-bed.

Lucerne-seed being relatively small the preparation of the seed-bed becomes of prime importance. To enable the seed to be sown at a uniform depth and not too deeply, a fine, firm seed-bed is necessary.

FIG. 2. LUCERNE AREA IN CENTRAL OTAGO, SHOWING CROP MOWN FOR HAY.

To obtain this a liberal amount of preparatory cultivation, commenced well ahead of the time of seed-sowing, must be carried out. Fortunately the cultivation which will most readily produce a suitable soil-tilth will also tend to destroy weed seedlings that develop in the surface layer of the soil during the period of preparation.

If lucerne is to follow old pasture it is usually advisable to skim plough the land in the autumn or early winter, and whether or not skimming has been carried out it is desirable to plough the land in the late winter or early spring to a depth of 5 in. or 6 in. For this ploughing it is as a rule advantageous to use a skimming attachment designed to remove the surface slice and place it in the open furrow. This not only buries surface weed-seeds, but also assists in the production of the desirable firmness in the seed-bed. Subsequent preparatory cultivation should be fitted to produce a fine, firm seed-bed without disturbing the original surface layer.

When lucerne is to be sown in land not newly broken out of pasture the previous crops should be fitted to minimize the danger of weeds. Over wide areas mangels or potatoes followed by a green crop may be utilized to leave the ground in suitable condition for lucerne. To obtain this result the root crop must be kept thoroughly clean, and it is desirable that the following crop, such as rape, kale, oats, or barley, with or without tares, used as green feed, should be a heavy one, as a result of liberal seeding and manuring, in order that it may smother any weeds that appear. Such a crop would need to be consumed early enough to admit of ploughing of the land in October. As in the case of lea land, the purpose of cultivation subsequent to ploughing should be the production of a fine, firm seed-bed. As a rule, for several weeks prior to seeding, all land being prepared for lucerne should be frequently cultivated to a depth of about 3 in. Such cultivation brings batches of weed-seeds to the surface, where they germinate and are then easily destroyed by the following cultivation. Further, such cultivation keeps the land bare of vegetation, the presence of which might lead to the eggs of the grass-grub being deposited on the land to the eventual detriment of the lucerne seedlings.

Liming.

Probably no other crop responds so well as lucerne to a liberal supply of lime in the soil, and it is safe to assume, unless there is definite evidence to the contrary, that profitable returns will be obtained from liming land for lucerne. Central Otago is an exception to this rule, and there liming for lucerne generally is not justified.

Lime may as a rule be applied with advantage before the final cultivation preceding seed-sowing. It is customary to apply about 1 ton of ground limestone to the acre, but smaller amounts are also used. If price warrants it, or if cost of transport is substantial, burnt lime used at half the above-stated rate may suitably replace the ground limestone.

In many places periodical liming of established fields of lucerne is considered advisable, and there is a tendency to favour dressings of a few hundredweights per acre at relatively frequent intervals instead of dressings of a ton or more at longer intervals.

Sowing the Seed.

To secure the required firmness of seed-bed the land should as a rule be rolled prior to seeding.

Under cold conditions vigorous development of seedlings does not occur, so as a rule there is nothing to be gained by early sowing while the soil is still cold. Generally, best results are obtained by sowing during the latter part of November or December. At times in favourable seasons really good results are obtained by earlier sowing, but there is as a rule no justification for taking the risk, unless it is expected that dry conditions will be experienced in the late summer before a crop sown late in November or in December has become securely established. At times autumn sowing is practised. One reason for autumn sowing is the avoidance of the competition of annual weeds which germinate in the spring. Another is the avoidance of the risk

of damage due to a dry summer spell while the crop is still in the seedling tender stage. While such special considerations may justify autumn sowing, generally the results from it are not as good as from November-December seeding. Whenever autumn sowing is adopted it should be carried out as early as possible, so as to admit of the development of strong plants before the dormant season of the plant commences.

Over wide areas good results are obtained by sowing the seed at the rate of 12 lb. to 18 lb. per acre through every coulter of a grain drill. By drilling half the seed in one direction and the other half across the other way any misses are avoided, and a very even stand usually results. The amount of seed used needs to be increased when the tilth of the seed-bed is poor. Drilling ensures the sowing of the seed to a more uniform depth than broadcasting ; the latter, however, usually gives good results, and calls for the use of a slightly larger amount of seed. The seed should not be sown at a greater depth than 1 in., and if broadcast it may be covered by lightly harrowing it, a brush harrow being suitable for this purpose.

The merit of the Marlborough strain of lucerne has been established, and it may be generally recommended. Success has also attended the use of the Hunter River strain, especially in warmer districts, but it is doubtful if it should at any time be used in preference to the Marlborough. Most striking claims are at times made in respect to other strains of lucerne, but conclusive evidence to substantiate such claims has not been submitted.

Inoculation.

Many of the past complete or partial failures with lucerne are now known to have been due to absence from the soil of a particular micro-organism with which lucerne collaborates in an important manner essential to its thrifty development. There is no way which could be used in farm practice of discovering, before growing the crop, whether the soil is inhabited by sufficient numbers of these micro-organisms. Hence, although the organism is present in some soils in ample supply for the needs of the most successful lucerne, yet the safest course is to supply the organism artificially, this being termed inoculation. By carrying out inoculation one may at times supply the organism when it is already present in sufficient numbers to meet all needs, but one at least ensures its presence, and this is well worth while, as any other available course involves the risk of a failure attended by considerable outlay in seed, manure, and cultivation. Supplies of the necessary organism are called " cultures," and are obtainable at a small cost from the Department of Agriculture, which also provides explicit instructions regarding the use of the culture.

Treatment of seed with suitable cultures may subsequently be nullified if the seed is brought into contact with soluble fertilizers such as superphosphate, sulphate of ammonia, nitrate of soda, kainit, and other potash salts. When treated seeds are mixed with any of these fertilizers the inoculating organisms on the surface of the seeds are destroyed. However, excellent results have been obtained when inoculated seed has been sown with superphosphate and carbonate of lime

mixed in equal proportions for about a week before the seed was brought into contact with the mixture. Evidence that the required organisms are present in adequate numbers is provided by the development of curious growths known as nodules on the roots of the lucerne. Excellent nodule-formation also occurs when seed-sowing is effected by mixing inoculated seed with rock phosphate and basic slag. If desired, superphosphate can be used with safety, provided it is broadcast or drilled before seed-sowing, or that the manure and seed are distributed from different boxes of the drill, even though they pass through the same coulter. The cultures remain viable on seed for three weeks after treatment, but poor results have been obtained when they were on the seed for longer periods. The cultures as supplied by the Department of Agriculture may be kept for at least six weeks without any loss in their efficiency.

MANURING.

On the basis of experience in many districts it has become the practice of successful growers of lucerne to apply 2 to 4 cwt. of phosphate at or about the time of sowing the seed. Superphosphate, unless carefully used in the manner already described, may have a detrimental effect on the germination of the seed and on the inoculating organisms. Hence, for safety, some favour the use at this stage of basic slag or a mixture of equal parts of superphosphate and lime. In most districts it is very advisable to dress lucerne at least annually with 2 to 3 cwt. of superphosphate, which is at times successfully replaced by basic slag in the wetter climates. In some districts, such as in parts of Central Otago, there does not appear to be a profitable response to phosphatic manuring, but in other districts failure to apply phosphates has been a primary cause of past failures with lucerne. A number of successful growers of lucerne advocate two phosphatic dressings annually, and the amount of mineral matter absorbed from the soil by a really productive crop supports such a practice, except in case of unusually fertile soils. Under conditions in which grass is prone to invade lucerne as a serious weed, phosphatic dressings should not be applied in the winter or early spring while the lucerne is still dormant. If applied at this stage the fertilizer would stimulate the grass and make it a stronger competitor of the lucerne—an effect the reverse of what is desirable. The manurial dressing may be applied with good results as soon as the lucerne has definitely made appreciable new season's growth, or after the first cut of the season has been removed, if this occurs early, as is usually the case when the first cut is utilized for ensilage. When a second dressing in a season is practised it is usually applied in late February or early March.

Available evidence does not indicate any general need for the application of potassic or nitrogenous fertilizers to lucerne.

TREATMENT DURING FIRST YEAR.

The practice that should be adopted during the first year will vary greatly with circumstances. If annual weeds such as fat-hen and thistles have developed rapidly, and threaten by their competition to weaken or even destroy the young seedlings, then it will probably

be necessary to mow the crop when it is only a few inches high in order to give the invading weeds a set-back. But if weeds are not threatening to give trouble it is harmful to mow the young plants until they are blooming or fresh young shoots have appeared at the bases of the plants. The delaying of the first mowing until this stage favours the growth of an extensive root-system, whereas a relatively early first mowing diverts the energy of the plant to a renewal of the aerial portion, with a resultant check to root-development. In the warmer districts lucerne sown in November will usually be at a suitable stage for a first mowing in early February, and often a second cut will be available in April. In the cooler districts the first cut may not be obtainable until late February or March, and unless the season is a favourable one a second cutting may not be advisable, although generally a second light cutting will be possible about the middle of April. The final cutting for the season should be carried out before the commencement of the dormant period of the crop; some growth on the plants during the winter is desirable for it fosters the stronger development of the root-system, and to some degree competes with and checks the invading weeds.

Management of Established Lucerne.

At the end of its first winter a lucerne stand may contain a heavy population of weeds; indeed, on this account the lucerne crop may seem to possess every promise of a failure. The next few months probably constitute the most critical period in the life of the crop. However, provided the lucerne plants are present in satisfactory numbers and have been able during the previous months to develop strong root-systems, there is no essential reason why with suitable management a weedy crop should not become a success. When the new growth coming from the crowns is approximately 2 in. high, which frequently will be the case about September, the vegetation that has been standing during the winter may be removed by mowing, which should be adjusted so as to leave 3 to 4 in. of stubble. Mowing in this manner may with benefit be made an annual practice, and if mowing is not carried out at this stage then at times light grazing is advantageous, but a field should not be grazed in its first year. Further, the heavier the soil the less likelihood is there of benefit from such grazing. At this stage top-dressing could suitably be carried out.

Generally the new growth, which should be allowed to grow unchecked, provides a cut towards the latter part of November. It is likely that year after year this first cut will contain a substantial proportion of weeds, inclusive of plants which ordinarily are useful, but which when invading lucerne are weeds. Partly because of its weed content and partly because the weather usually prevailing at this period is unfavourable to haymaking, the first cut of lucerne is as a rule most advantageously used for ensilage. Further, because of the weeds in the first cut it should be made early enough to avoid ripening of the weed-seeds.

If lucerne is mown in November, as suggested, it ordinarily should again be at a stage suitable for mowing early in January. The time and number of subsequent cuts will be determined principally by the rate of growth of the crop, but at least two other matters should be

taken into consideration: In the first place, the crop should not be mown so late in the season that some fresh growth will not develop from the stubble, since it is against the welfare of the crop for it to pass the winter in the bare stubble state. In the second place, mowing should be done only at a particular stage of development of the herbage. This stage is reached when new shoots are just starting from the crowns or bases of a considerable number of the plants. Usually when fresh shoots have so developed about a quarter of the plants will be in the early flowering condition, but as this does not always occur reliable guidance as to the time to cut is not provided by observation of the flower development.

If the herbage is cut too late feed of unnecessarily low nutritive value is obtained—it is unduly fibrous, and the proportion of leafage as distinct from stems is small. This is of importance, as the leaves are the most nourishing portion of the crop. Further, if it becomes the rule to mow the crop at a later stage than that advocated above, then the number of cuts obtainable each year will very likely be reduced with consequent loss in total annual production. Unduly delayed mowing of the first cut of the season is a fairly common fault when it is not utilized for ensilage. It is a fault which is very likely to lead to serious injury to a crop which is fairly heavily infested with weeds which started growth earlier in the season than did the lucerne, and which by this earlier development have an advantage over the lucerne in the vitally important competition for direct sunlight. The longer the first cut is delayed, the longer are such weeds depriving the lucerne of direct sunlight and thereby weakening it.

Mowing before the crop is mature enough is not such a common fault as mowing when it is too mature, but is prone to occur when a farmer is specially seeking succulent leafy forage in the summer, or when an endeavour is made to secure at the end of the growing-season an additional cut, even though it is only a light one and possibly should not be harvested. Cutting lucerne at an immature stage provides highly nutritious herbage, but, if persisted in, rapidly leads to a weakened stand of decreased production. This results from the fact that the root-system is drawn upon for the production of leaves and stems immediately after each cutting, and the more frequently this occurs the more heavily is root-development reduced. To cut an immature growth at the close of the growing-season is likely to be particularly injurious, because it results in a weakened stand to carry through the winter and compete with weeds in the spring.

Cultivation.

Principally as a means of reducing the competition of weeds, cultivation of lucerne is at times well worth while. For such cultivation to be of value it is essential firstly that the lucerne be not greatly damaged, and secondly that the cultivation be done under the conditions which will most greatly reduce the competition of weeds. In view of these requirements it follows that the implement employed should be fitted with tines designed for lucerne cultivation, that the use of disk harrows is generally too severe, and that dry summer or autumn conditions should be chosen for the work. As a rule a suitable time for such cultivation is after the second or third cuts; the dry weather

which then is commonly experienced assists in the destruction of the weeds. Cultivation of lucerne has proved of value most commonly on open porous soils on which weeds may be disturbed effectively without at the same time materially injuring the deep-rooting lucerne. It is certain, particularly on the heavier types of soils, that cultivation has at times resulted in more harm than good, because it has led to a gradual thinning-out of the lucerne plants until eventually they become so sparse as to make the area unprofitable.

A method that is proving a useful modification of simple cultivation of lucerne which is being invaded by weeds is practised widely in parts of the North Island. This consists in sowing in late April or early May from 1 to 1½ bushels of Algerian oats on stands which have been well cultivated shortly after having been mown or grazed. The cultivation injures the weeds and provides a seed-bed for the oats, with which about 2 cwt. of superphosphate to the acre is usually applied.

FIG. 3. STACKING A CUT OF OATS AND LUCERNE FOR ENSILAGE.

The oats furnish good feed in the spring, if required, and subsequently there will be available a heavy cutting of a mixture of oats and lucerne. It is as a rule highly advisable to use for silage the material thus provided. If it is not mown at an early stage the oats by shading the lucerne will unduly weaken it and thereby more than counterbalance the good they have done by checking persistent weeds. The success of the practice of growing oats with lucerne in this manner will depend to some extent on the texture of the soil; the practice is followed almost wholly on friable soils.

Cultivation under relatively wet or cold conditions is an unsound practice; it merely injures some of the lucerne plants without leading to a useful reduction of the weed competition. Suitable cultivation can be carried out by use of the tine harrows or of a light spring-tooth cultivator possessing specially narrow teeth.

If stem-rot (*Sclerotinia trifoliorum*) has appeared in a stand of lucerne cultivation is most inadvisable, as it assists in the spread of this disease by tending to scatter infected soil. In order to enable crops infected with stem-rot to survive in a useful condition as long as possible the aid to weed suppression provided by cultivation must be replaced by specially good management in respect to such matters as time of mowing and adequate manuring.

Cultivation of Irrigated Lucerne.

The following statement relative to lucerne under irrigation is an extract from Department of Agriculture Bulletin No. 120, "Irrigation: Practice for Central Otago Conditions," by R. B. Tennent and J. R. Marks:—

Under irrigation frequent cultivation of lucerne is of great necessity. One of the commonest causes of a lucerne stand rapidly going out is the intrusion of weed plants. Of these probably the grasses are most aggressive, and it is only by repeated cultivation that their invasion can be arrested. By cultivating during the winter months at least twice with a strong spring-tooth cultivator the bulk of the weeds can be kept under control. Where it is possible a cultivation after each cutting is desirable. Not only will cultivation of this description check the growth of weeds, but its secondary effect of breaking up the consolidated soil, thus separating it and lessening the rate of evaporation, will be of great advantage in maintaining the vitality of the crop. Any damage likely to accrue from this practice may be considered as negligible in contrast with the benefits conferred on the crop.

Unfortunately, even with a maximum amount of cultivation, couch-grass (*Poa pratensis*) gradually asserts itself, until in the course of from five to eight years the lucerne stand becomes a mixture of probably 50 per cent. grass and 50 per cent. lucerne. Experience has shown that it is practically impossible to renovate a stand of this mixture without ploughing and resowing, and probably the most practical method of dealing with a field in this condition is simply to treat it as a grazing paddock and establish fresh lucerne elsewhere.

Grazing.

To secure for lucerne a long life of maximum production grazing of the crop should as a rule be avoided. The consolidation caused by grazing favours grass, and thereby increases the competition with the lucerne. But at times despite this it is not practicable or desirable that the farmer should abstain totally from grazing of the stand. Provided the conditions are favourable to lucerne, grazing, if carried out carefully, may not do much harm to established stands, but grazing of lucerne in its first year is not advisable. Close and continuous grazing of a lucerne crop may be expected to lead to a permanent reduction in the yield from it. On the other hand, successful lucerne fields have been grazed firstly in the spring to remove coarse growth present from the winter, and secondly in the autumn when an intermediate amount of growth not worth mowing is available. Particularly is close grazing of lucerne during its dormant winter period productive of harm, as also is grazing when the land is so wet that it is subject to poaching by stock. Grazing at times has the effect of introducing viable weed-seeds in the dung of animals fed on herbage which has been allowed to ripen seed, and because of this, and apart

altogether from its direct harmful influence on the lucerne plants and on the soil, it may shorten the profitable life of a stand.

Grazing of green lucerne by dairy cows calls for care in order to avoid hoven or bloat in the animals. The lucerne should be fed sparingly at the beginning, and not when it is wet. To avoid the danger of the stock eating it greedily they should not be grazed on lucerne until they have had an opportunity of partly satisfying their appetities on other feed. Hence, as a rule they should not be given access to the lucerne until late in the day, and then only for half an hour or even less in the early stages; and when the stock are in the lucerne they should be watched carefully for signs of hoven. Gradually as the stock become accustomed to such feeding the period may be

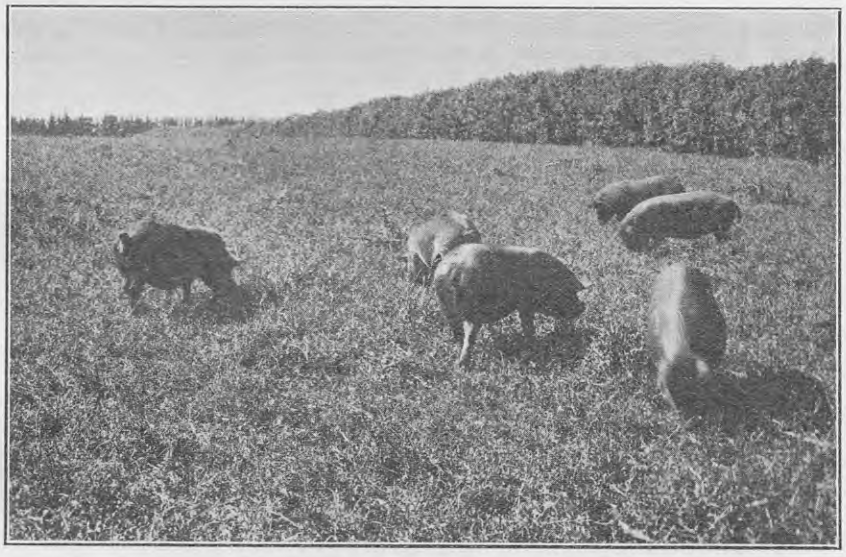

FIG. 4. PIGS GRAZING ON LUCERNE.

extended from half an hour to an hour and a half, and at the same time the danger from bloat will lessen, although there is always danger if hungry animals are given access to green lucerne. Field experience shows that the danger of bloat is greatest when succulent, immature lucerne is consumed.

As a rule the care necessary with dry stock in grazing lucerne is not as great as that called for with dairy cows, but particularly during the first few days the danger should not be overlooked, and precautions should then be taken to avoid such causative conditions as empty stomachs and wet lucerne. Grazing of lucerne has been carried out satisfactorily not only with cattle but also with sheep and pigs; these call for greater care than cattle in order to avoid injury of the plants.

When a weed is viewed as a plant in a place where it is not desired many highly productive plants, such as rye-grass, cocksfoot, and clovers, may be weeds when considered in relation to lucerne. If a lucerne field has become badly invaded by plants which provide useful feed, or if much cultivation is needed to prevent the invasion of lucerne by large numbers of such plants, then it may be sound practice to utilize the lucerne area chiefly as a grazing field from which probably it would be possible to obtain not more than three cuts in the year, in the first of which lucerne would be a minor constituent. The relatively small amount of mown material obtained from such a practice would be balanced by the increased grazing secured and the absence of any need for cultivation.

If thinning-out of a lucerne stand due to such a cause as repeated or excessively severe cultivation has occurred to such an extent as to make the stand of doubtful value, it is at times well worth while to cultivate it in April sufficiently to provide a seed-bed, and on this bed to sow Italian rye-grass or prairie-grass. By this practice the field may be made highly productive for another year or two.

Mowing Lucerne.

Lucerne is of outstanding value when utilized by mowing. Indeed, the highest production may be expected from lucerne when it is treated essentially as a hay, silage, or green crop to be mown and carted out to stock. Used as a mown crop it is fitted to serve as an exceedingly valuable companion crop to pastures, in that it may readily be made to supplement their feed in those seasons in which pasture-growth is scant.

The first cut of lucerne, which usually should be made in November, is as a rule most conveniently and effectively utilized in ensilage. This is partly because it is generally so mixed with other herbage as to provide material well suited for silage-production, and partly because the weather usually prevailing when the first cut is made is very unfavourable to the production of good hay. The amount of green material available from the lucerne area may not be sufficient for economical ensilage. Then, to provide the required bulk, material from the pastures may usually be saved with that from the lucerne area, or the lucerne may be saved with such a crop as green oats.

Apart from the first cut of the season lucerne may be used either in a green condition as a summer supplementary crop to grass or as a hay crop. When it is being fed as a green crop care must be taken to use it before it has reached a woody or stemmy condition. This is particularly advisable in the feeding of dairy cows. As a means of supplementing the feed from pastures green lucerne has given excellent results when fed together with soft turnips. Calves, pigs, horses, and sheep have all fared well on green lucerne.

The making of good lucerne hay calls for care designed to avoid the loss of leaves which readily occurs if handling is faulty. The mown crop should not be left in the swathe to dry sufficiently to allow of carting in. If this were done the leaves, which are much more nutritious than the stalks, would become dry and brittle, and would fall off readily before enough sap had been removed from the stems to allow the herbage to be stacked. Because of this, cocking should be practised

in saving lucerne hay. Lucerne hay is at times stacked before it is dry enough. This probably arises because the stems do not become dry enough as quickly as the leaves. Hence in the making of lucerne hay the condition of the stems should receive special attention.

Well-made lucerne hay is particularly nutritious, its content of protein and mineral matter as a rule being notably high. On this account lucerne hay is of special value for feeding to cows in milk in the winter or spring, if fresh leafy grass is then scarce. Lucerne hay is also fed to horses with excellent results.

Diseases of Lucerne.

Although several fungoid diseases have been found attacking lucerne in New Zealand, none of them, with the exception of stem-rot, is of great practical moment. The following are the most common ones :—

(1) *Stem Rot.*—The fungus *Sclerotinia trifoliorum* (which, according to Dr. G. H. Cunningham, is synonymous with *Rhizoctonia*) is a serious disease of lucerne in this country and can easily be seen if plants which have been attacked recently are examined during a spell of wet, warm weather. Then a whitish, soft, cobwebby growth will be found attached to the infected plants. The following statement prepared by the Mycological Laboratory relates to stem-rot :—

"The disease becomes readily noticeable on account of the rapid manner in which it induces wilt, followed by death, of attacked plants. Examination of such plants shows that the stems near the crown are infected, these carrying discoloured lesions, which are commonly concealed by a weft of coloured mycelium. Embedded in this mycelium may often be found sclerotia of the fungus, for the species differs from *Sclerotinia sclerotiorum* in producing these bodies externally, whereas in the latter they are invariably produced within the cavity of the stem. Field experience has tended to show that this disease is carried with the seed, and this evidence has been strengthened by recent laboratory investigations. Consequently it is advisable to have seed tested for the presence of the disease, and to recommend that only lines found to be free should be sown in new stands. Where the disease has become established in an old stand, it may be held in check by the following treatment :—

"(*a*) Remove infected plants and those showing signs of wilt, as it is by means of sclerotia produced on these that the disease is able to persist.

"(*b*) Lime the soil at the rate of 1½ lb. per square yard with freshly prepared hydrated lime. Soil fungi of this type are intolerant of alkaline conditions, and can be held in check by lime-dressings, provided the lime is of the type specified, since experience has demonstrated that carbonate is practically worthless."

If possible, a lucerne area infected with stem-rot should receive no cultivation which tends to spread the infection. Moist conditions favour the disease. Hence drainage of wet patches in a field should receive attention, and diseased areas of the crop should be mown to enable the stems of the plants to be as dry as possible. Grazing of fields infected by the disease tends to spread the disease to healthy portions of the crop.

(2) *Leaf-spot*, due to *Pseudopeziza medicaginis*, is characterized by small dark-brown or black spots on the surfaces of the leaves. The disease is common on lucerne especially in stands which are suffering from drought, from poor drainage, or from competition of weeds. In fact, any unfavourable condition will induce attack. The spots are accompanied by yellowing of the leaves, and in severe cases yellowing is followed by the fall of the leaves. Improvement of crop conditions where these are inferior will tend to reduce the disease. Generally a troublesome attack of the disease may be checked by mowing the crop.

(3) *False Mildew*, due to *Peronospora trifolii*, results in the development of a downy yellowish-grey or purplish mould on the under-sides of leaves. Infected plants are usually stunted, and they are generally found on wet low-lying portions of a field. To control the disease it is necessary to bring about dry conditions of both ground and crop. Hence wet areas should be drained and infected patches should be mown close to the surface.

Summary.

(1) The area of lucerne in New Zealand is relatively small and is increasing but slowly.

(2) Experience in New Zealand and overseas has indicated definitely that lucerne is not specially exacting in its requirements, and indeed that it may be grown with success over a wide range of soil and climate. Drainage and fertility are important factors in success with lucerne.

(3) A successful lucerne field is of remarkable value because lucerne is characterized by high yield, high nutritive value, reliability during crucial dry periods, low cost of production, and a capacity to increase rather than to exhaust the soil content of nitrogen.

(4) During the period of its establishment lucerne is unable to compete successfully with many common weeds; hence for the sowing of lucerne clean ground should be selected.

(5) A fine, firm seed-bed, which is highly desirable, calls for early and ample preparatory cultivation.

(6) Usually liming of lucerne areas is highly profitable. A dressing of 1 ton per acre of ground limestone at the time of the establishment of the crop is the general practice of successful growers of lucerne, and the initial dressing is supplemented by subsequent and usually smaller dressing at regular intervals.

(7) Sowing of the seed usually is not advisable until late in November or early in December, when warmer conditions obtain. Under special circumstances autumn sowing is at times justified. From 12 to 18 lb. of seed per acre, drilled in rows 7 in. apart or broadcast, gives good results. Marlborough or Hunter River strains may be recommended for general use.

(8) Inoculation of the lucerne stand is often essential, and as a safety measure should be carried out generally. The Department of Agriculture supplies cultures for inoculation.

(9) Top-dressing of lucerne with phosphatic fertilizers is as a rule very advisable, and at times governs the failure or success of a crop.

(10) In its first year lucerne should not be grazed, and unless weeds are shading it excessively it should not be mown until young shoots have appeared at the crowns or bases of the plants.

(11) Care should be taken to mow established lucerne at the correct time. The first cut of the season should be removed early, usually in November, and subsequent cuts when fresh shoots at the crowns of the old plants have developed a length of 1 in. to 2 in.

(12) Particularly when a lucerne stand is being invaded by other plants, surface cultivation of the lucerne may be of considerable value, provided it is done at a suitable time and in a suitable manner. It at times proves advantageous to grow autumn-sown oats in lucerne as a means of suppressing more persistent foreign growth. When this is done the first cut of the season should be removed at an early stage. Excessive or drastic cultivation may thin out a lucerne stand to an undesirable extent. Cultivation may also spread stem-rot.

(13) Grazing of lucerne is not to be generally recommended, and when practised special precautions are necessary.

(14) As a mown crop lucerne is of very great value. The first cut of the season should generally be saved as silage. Usually other cuts should be saved as hay or fed in summer in a green condition.

(15) Lucerne is attacked by several fungoid diseases, but only stem-rot is of considerable moment. The ravages of stem-rot may be reduced by suitable management.

Conclusion.

Lucerne has outstanding merits, and deserves a much more important place than it holds in our live-stock farming. It has had a place in New Zealand farming for many years, but the area devoted to it is small and is expanding but slowly. This will probably continue to be the case until the true facts regarding lucerne are more generally known. Lucerne is not an expensive crop; it is not a difficult crop; it is not an exacting crop; it is not an exceptional crop to be grown with success only under very particular circumstances on a limited range of soils.

Control of Californian Thistle with Sodium Chlorate.—This is referred to in the annual report of the Live-stock Division for 1930–31 as follows: During the year a number of settlers in Canterbury used sodium chlorate on Californian thistle with satisfactory results. Field observations have shown the roots killed to a depth of 8 in. to 10 in. in the ground, and where a second application has been carried out there has been no appearance of fresh growths to date. The Division itself treated with excellent results considerable areas of unoccupied river-bed lands that were heavily infested with Californian thistle, and the Inspectors concerned are of opinion that the work can be done more economically than by cutting. A later inspection of the Crown lands sprayed shows that in practically all cases the roots are quite dead for a considerable depth in the ground, and any fresh growths appear to be from seedlings. Experiments on Californian thistle carried out by officers of the Fields Division and at Lincoln College have shown that the best results were obtained when sodium chlorate was applied during the month of March or early in April. Lincoln College reports striking results. Patches that have resisted every known method of treatment for thirty years and more are apparently completely exterminated in one season, the few remaining sickly plants being easily finished off in the second year.

IMPROVEMENT OF NEW ZEALAND WOOLS.

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IN the previous articles of this series* the chief faults of New Zealand wools were explained, and an outline was given of the research work which is being carried out in England and Scotland for the purpose of bringing about improvement in raw wool and in methods of manufacture. If wool research on the production side is to be effective it must be carried out chiefly in the country concerned, owing to the variety of problems and conditions met with and to the different types of sheep bred. This side of the work may be said to be in its infancy the world over, and New Zealand is no exception, with the consequence that so far there are very few results which can be turned to practical use. Therefore, while research is able to point to methods whereby it is possible to correct a few of the faults of wool, there are a great many faults for which at present no definite remedy can be suggested, although certain lines of attack may be indicated. The reason for this is that the factor or factors involved in the production of some faults are not known, or, if they are known, it is not possible to suggest any practical method of overcoming them. However, it is hoped that the research work now in progress in this and other countries will yield valuable results in the course of a few years.

Wool-improvement in any country to a certain extent is complicated by the fact that wool as an article for manufacturing purposes is really a by-product, its primary use being to act as a protective covering for the animal. Before any recommendations can be made or any steps taken to bring about improvement, due regard must be given to the fact that any contemplated change must not affect detrimentally the protective qualities of the fleece. In this country there is also the additional factor of the fat-lamb trade, which is more important to many sheep-farmers than is the return from wool. Therefore, in any endeavour to produce better wool, the type of sheep must not be affected in any way which will affect adversely their value as producers of fat lambs. Other factors which enter into the question of what direction wool-improvement should take are the law of supply and demand, the probable future demands of fashion, and whether the new type of wool will be as profitable, under the existing conditions of soil and climate, as the type which is condemned or is to be discarded. All these points and probably several others must be considered carefully, especially when the manufacturers recommend, as they have done in the case of New Zealand, that a different breed or breeds of sheep should be kept in order that wool more suitable for certain manufacturing uses might be produced.

ELIMINATION OF MEDULLATED OR HAIRY FIBRES.

The outstanding fault of New Zealand wools, especially those of the predominating Romney-cross type, is the presence of medullated or hairy fibres mixed in with the good wool. As yet it has not

* See *Journal* for July and August, 1931.

been possible to demonstrate what is the particular factor or factors involved in the production of these fibres, but it is evident that in some cases at least it may be a combination of several circumstances. The question arises immediately whether or not it will be wise to eliminate completely this type of fibre from the fleeces of our crossbred sheep, especially those which have to live under the severe conditions that exist on some of the less-developed country. Under these circumstances the wool is subjected to rather rough usage by coming into contact with logs, scrub, and second growth, while at the same time the nutritional conditions are frequently not up to the standard required for the production of good wool. The greater proportion of the rams used in New Zealand are bred on the better class of country, but, in the case of flock rams in particular, many of them are used on the poorer country. While the breeder of such rams may have good country and no such difficulties to contend with, he must remember when considering wool-improvement where his flock rams have to be used. It would be a decidedly false step if the improvement of the wools on the stud sheep might lead to unsatisfactory wool on the greater number of flock sheep.

It is not meant by this that no endeavour should be made to improve so valuable a product as wool, but a note of caution is struck that the seemingly obvious step of eliminating completely these undesirable fibres might not be the wisest in the end. Attempts at wool-improvement in England and Scotland have demonstrated clearly that it is not always wise to try and bring about the improvement that appears on the surface to be most desirable. However, medullated fibre certainly should be reduced to that minimum which is compatible with a useful and payable fleece. It has to be remembered that the return for wool is a composite of its quantity and quality, and thus any improvement in quality must not be carried out at the expense of quantity, otherwise the returns will not justify the change.

Factors of Breed.

Some manufacturers have blamed the Romney breed for the production of most of the undesirable wool grown in New Zealand, but, while this breed must take a portion of the blame, it is obviously unfair, as will be seen later, to charge any one circumstance with all the responsibility. The primitive breeds which were the ancestors of our present domesticated sheep had two coats of wool—a hairy outer coat for protective purposes and a fine undercoat for the retention of heat. The popular theory is that man's selection, aided by environmental changes, has resulted in the outer coat being suppressed and the under coat greatly developed. Whether the hairy fibres found in New Zealand wools have any connection with this primitive outer coat is not known, but it is maintained by some that, in the case of our long-woolled breeds, the suppression of the hairy outer coat has not been so complete as in the case of some of the shorter and finer woolled breeds such as the Merino. The genetical factors concerned with the production of hairy fibres in the fleece are possibly recessive in character, and therefore will be brought out more prominently when back-crossing is reverted to in breeding practices.

The history of the breeding of flock sheep (as distinct from stud sheep) in this country is largely one of cross-breeding. The first sheep introduced in quantity were Merinos; then the Lincoln and Leicester breeds, besides being bred pure, were used as sires for a few generations on the Merino ewes and the progeny of their crosses. Latterly the Romney breed has come to the front, and has been used largely for crossing with the Lincoln and Leicester breeds, and the progeny of their crosses with the Merino, with the result that to-day the blood in some flocks is very mixed. If it had been possible to breed first crosses only it might not have been so bad, but the commonest practice has been to back-cross to either the Lincoln or the Romney sire as the demand has changed for different types of wool. Another practice is to use the Lincoln ram on the finer-woolled sheep with a predominence of Romney blood, while the Romney ram has been used on the coarse-woolled ewes with a preponderance of Lincoln blood. Such indiscriminate cross-breeding cannot do otherwise than bring out recessive characters, which would be intensified by future breeding unless very careful selection were practised.

When considering the question of medullated fibres in the previous article, dealing with the faults of New Zealand wools, it was pointed out that the amount of sulphur present in an organic form in the food of the sheep probably plays some part in the production of these fibres. The system of indiscriminate cross-breeding which has been so much in vogue in the past, combined with poor selection of the breeding-stock and unfavourable nutritional conditions, is more likely to be the chief cause of the production of hairy fibres than is the influence of any one breed.

When there is excessive variation in the size and shape of the fibres within a staple of wool, as occurs in some New Zealand wools, particularly those of the crossbred type, it becomes a serious fault from the manufacturing point of view. Wools which result from the crossing of two or more breeds of sheep frequently appear to have a greater variability of the size of their fibres than do wools from strictly pure-bred sheep. Therefore this is another reason why cross-breeding, except for butchers' purposes, should be limited to a minimum. A special feature of this irregularity is that, as a general rule, the coarest fibres are also the longest and quickest growing, and if nutrition plays some part in the production of medullated fibres then this feature would tend to increase the likelihood of medulla formation.

While the crossing of different breeds is undesirable from the wool viewpoint, the crossing of widely differing types within the same breed is very little better. Of recent years many well-known writers on animal improvement have stressed the necessity for line-breeding and careful inbreeding if uniformity of production is required. Many breeders are afraid of close breeding because in the past some faults, such as sterility, have been attributed, often erroneously, to this practice. It is quite possible to breed sterile animals by the most violent out-cross, provided care is taken in the selection of the parent stock. It should be remembered that inbreeding creates no new characters, but intensifies both the good and the bad characters that are already in existence, so that they may be mutliplied or discarded

as the case may demand. While the breeder with a small flock may not be in the position to inbreed to any marked extent, he at least should practice line-breeding, and if he is not able to use home-bred rams he should purchase rams from closely related stock. The larger breeder should be in a position not only to line-breed and to inbreed, but he should also try out-crossing to a limited extent to infuse new blood into his stock. Probably the best method of introducing such an out-cross is to purchase some good cast-for-age ewes and mate them with home-bred rams in the hope of breeding a good ram. With such out-crossing there is as much if not more need for careful selection and culling as there is in the case of inbreeding.

Selection and Mating.

From the foregoing remarks it can be seen that the first essential when considering wool-improvement in this country is that there should be an all-round improvement in the breeding practices and in the feeding and management of the sheep. The first step should be the selection of a class of sheep with that type of wool which is most suitable for the conditions ruling in any particular district. The rams selected for use in the flock should be similar to the ewes in type and should carry an even fleece of good-quality wool, even in fibre diameter from tip to base, and with as few visible medullated or hairy fibres as possible. When fresh rams are required an endeavour should be made to purchase them from the same flock each year, provided it is found that the type is suitable. It is only by such methods that an even line of sheep can be bred with wool as free from fault as is reasonable and also requiring a minimum of classing.

While continually changing the sheep and wool in an endeavour to meet the market demands may appear to give good results, it almost invariably results in several types of sheep none of which conform to any standard. This entails considerably more wool-classing than should be necessary, and the returns when considered over a number of years are not as sastisfactory as they would have been if the original type had been maintained. Although there may be fluctuations in the demand and price of any one particular class of wool, it should be remembered that good wools of any class are always required. It may be pointed out here that at the present time there is a decided swing away from certain fine-woolled sheep because of the ruling conditions. There may be a justification for this in certain cases, but it should not be carried to extremes, else it will lead to the introduction of a type of sheep unsuitable for the country.

Some breeders when endeavouring to breed sheep with a medium class of wool try to do so by mating the fine-woolled ewes to strong-woolled rams and *vice versa*. While such a practice may appear to give satisfactory results for the progeny of the first mating, subsequent matings will prove to be very disappointing. The more correct method is to mate continually the ewes with rams carrying a fleece of wool approximating very closely to the standard that is finally aimed at. Such a practice may not bring about the desired improvement very quickly, but it will certainly do it more thoroughly and permanently, and will result in an even type of wool throughout the flock.

Feeding and Management.

Although better breeding practices are essential, attention must also be given to the feeding and management of the animals, since any improvement in production requires a corresponding improvement in the nutrition of the animals if the best results are to be obtained. One of the first steps in any scheme of wool-improvement must be to improve, as far as is reasonably possible, the standard of the conditions under which the animals have to live. This can be carried out by better pasture-management, the rational use of manures, the saving of the excess growth of one season as hay or silage for feeding during periods of scarcity, the provision of an even supply of food throughout the year, and by more careful attention to the general welfare of the sheep. Until recent years there has been a general tendency in this country to question whether the returns obtained from the feeding of hay, silage, and other supplementary fodders justified the expenditure involved. This has been due to the fact that it is hard to judge the value of such returns, and that in most cases only the immediate returns are considered. Had more notice been taken of the indirect returns, and also the indirect losses which result from bad feeding, there can be little doubt that more supplementary fodder would have been used in sheep-feeding. At the present time there is a more general realization that supplementary feeding is essential if disease is to be checked and maximum returns obtained. However, only when the majority of the sheepowners realize the necessity of better feeding will the wool clip from this country be as even as it is desirable it should be.

In America, recent work by Hardy and Tennyson on "Wool Fineness as influenced by the Rate of Growth" shows that there is every necessity for improved feeding. These workers, after an intense study of wool-growth, came to the conclusion that the sheep-raiser can control largely the quantity and the quality of the wool produced by controlling the thriftiness of his sheep. This means that if the maximum weight of fleece with fibres that are even in diameter from tip to root (this is very desirable) is to be obtained it is essential that the sheep should receive a regular supply of complete food. Such improved feeding will not only be reflected in the fleece, but should be shown also in improved health of the animals, more vigorous and better-quality fat lambs, and a lowered death-rate, especially that which is due to parasitic diseases in young stock.

Improvement of the "Handle" of Wool.

The "handle" of the wool is influenced by a large number of factors, some of which can be controlled, but others, such as the weather conditions, are beyond practical control, except in the case of a few special stud-sheep. The elimination of the coarse hairy fibres from the wool and the improved feeding mentioned above will improve to a certain extent the handle of some wools, and if combined with greater care in the selection of breeding-stock with soft-handling wool there should soon be a marked improvement in this most important feature of good wools. Wools with a remarkably soft handle usually are desirable spinning wools, owing to the

evenness and roundness of their fibres. Consequently, selection for soft handle will bring about at the same time an improvement in the evenness and shape of the wool fibres.

Research also has shown that if two wools of similar spinning quality are taken, one heavy in the grease and the other lighter, the one carrying the most condition is as a general rule the better spinning-wool because of the greater regularity in both size and shape of its fibres. From this there can be but little doubt that the lack of grease in the fleece is a contributing factor in the production of some harsh-handling wools. It was pointed out in the previous article that there probably should be a tendency to select towards *slightly* more yolk in the fleece than most breeders have been in the habit of doing in the past. Like all other improvements, however, it should not be carried to extremes, and care will need to be taken in the selection for soft handle that a wool is not produced which is unsuitable for withstanding weather conditions. In the case of stud sheep, especially rams, the handle of the wool should be judged after a sample has been freed from yolk by washing in either a warm soap solution or in petrol. This is necessary because in some cases there is a tendency for the yolk to mask the true handle of the wool. Admittedly buyers have been in the habit of penalizing wools heavy in the grease, but if they are going to make use of the results of the work of their own research associations and have a genuine desire for an improvement in the raw wool they must readjust slightly their valuing standards.

Kemps and Brown Fibres.

At the present time little complaint is heard about the presence of kemps in New Zealand fleece wools, but kemps are present in all wools to a greater or lesser extent. With all breeds of sheep every endeavour therefore should be made to limit the harmful fibres to the lowest possible minimum. This can be done by careful selection of all breeding-stock, especially stud sheep, with wool free from kemp. In this connection any stud lamb born with a covering of hairy fibres (called by some breeders "mother hairs") standing out from the usual close fleece of the lamb should be viewed with suspicion, and so marked that the fleece can be carefully examined for kemps before the sheep is added to the breeding-flock. The work of improvement in this respect can be aided considerably by show-yard judges and by stud-sheep inspectors disqualifying any sheep with kemps in the fleece wool.

The question of brown fibres in Southdown and slipe wools is connected with this problem, since in the majority of cases the brown fibres are usually true kemps. Some Southdown and Down-cross lambs are born with either a partly or wholly coloured birth-coat, but the colour usually disappears completely in a short time after birth. Dr. J. E. Nicholls, working with the Suffolk breed in England, has been able to show that the sooner a lamb loses this coloured birth-coat the less likelihood there is of the adult fleece containing coloured fibres. Research workers in America have also shown that Down lambs with a partly or wholly coloured birth-coat are more likely to have coloured fibres in the adult fleece than

are lambs born with only the lower extremities of their legs and the lower portion of their face coloured. While this work may need to be confirmed on the Southdown in New Zealand, there can be but little doubt that some notice should be taken of it by Southdown breeders. Although the wool of the Southdown itself is not very important, it must be remembered that the breed is now partly responsible for a large proportion of the slipe wools from the freezing-works.

In order to overcome this defect the manufacturers have recommended the use of Corriedale, Ryeland, and Dorset Horn rams in place of the Southdown. If it were a question only of wool-improvement such a step might be justified, but in this case it is more a question of mutton-improvement, and thus the fat-lamb breeder is not justified in trying to improve his wool by such a means. The return for wool from a fat lamb is only a small part of the total return, so it would not be wise to endeavour to improve the wool return by a few pence when the breeder would probably lose either directly or indirectly a few shillings on the return for his carcass. However, this should not be a barrier to an attempt at the elimination of brown fibres from the wool of the Southdown.

Length of Staple.

For a few seasons certain wool-buyers and writers on wool matters have complained that there is a tendency on the part of some New Zealand wool-growers to produce a fine wool that is too long for the spinning quality. This has applied particularly to fine Romney and Corriedale wools of a 50's count or finer. More recently some Bradford writers have stated that there is a demand for this class of wool and that, provided it is classed by itself, it will bring about a penny per pound more than a shorter but otherwise similar wool. This is typical of many of the statements and criticisms made by the wool-manufacturers, and is due in part to the fluctuations in the requirements for different types of wools owing to variations in the demand for different classes of cloths. What may be required one season or what may suit one manufacturer may be neglected the next season, or may not suit a manufacturer engaged in some other branch of the industry. Since this is so, the correct procedure should be to endeavour to breed a class of wool that gives the best return over a number of years combined with suitability for the conditions under which it is grown. At the same time it is a mistake to strive after abnormal wool-growth either in the form of extra length or extra density, for if this is done other objectionable features are sure to creep in. It should be remembered that there is an optimum length, fineness, and density for the wool of any breed, and that best results are obtained when the wool most closely approximates to these standards.

Manufacturers claim that there is at the present time a world shortage of long, strong, lustrous wools of the Lincoln and Leicester types, and they have maintained that it would be to the advantage of the New Zealand producer if he were to produce more of this class of wool. It is generally recognized by most sheep-owners in this

country that the Romney is the most suitable breed for the greater portion of the sheep-grazing country when the climatic conditions and the final returns are considered. However, some Romney breeders are wondering if it would be wise for them to attempt to grow a modified type of long lustrous wool of about a 40's to 44's count by selecting and fixing a type within the Romney breed. It should be quite possible to do this by a few years of careful selection and breeding from sheep that are already present in some flocks, but whether it would be economical is another question. It has been emphasized already that the best wool to grow is that type which suits the country and climate and gives the best returns over a number of years. Although it might be possible to grow the long lustrous wool on some of the heavier country the returns would be largely a matter of speculation owing to price fluctuations. The returns obtained last season for English Leicester and Romney wools from the stud flock at Canterbury Agricultural College certainly indicated that, even in the "buyers'" market which ruled at that time, the buyers were not prepared to pay a price for long lustre wool that would warrant a breeder changing from the true Romney type.

Discoloured Wools.

The amount of discoloured wool found in any clip varies from season to season, and while the proportion may never be very high every endeavour should be made to limit it to the lowest possible minimum. The discolorations may be of two types: Firstly, are those which affect the wool-grease and do not stain the fibre, so that on scouring the wool is still bright and white. As examples of this type we have ordinary dead yolk discoloration and tick or ked stain, both of which detract from the appearance of the wool when it is displayed for sale. However, if tick-stained wool is stored for a considerable time the trouble appears to become intensified and to affect the scouring qualities of the wool. The second type of discoloration is that in which the fibre itself is stained or coloured so that it does not scour clean and bright, with the result that the wool cannot be used for either white or high-class dyed goods. Examples of this class are canary yellow, and red, blue, green, and black wools, which in some cases appear as secondary complications of dead yolk and which apparently are due to bacterial action. In addition there is dip-stained wool, and a browning of the wool brought about through pressing when damp. At the present time it is possible only to control these last two discolorations, as no practical control measures can be suggested which would inhibit the growth of the bacteria which produce the other coloured wools.

There can be little doubt that there is a need for more careful dipping of sheep, and in some cases for better dipping materials, because occasionally it appears that the dips have not been prepared correctly. When preparing the dip the directions given by the makers should be followed carefully, the water measured accurately, and where rain water or other soft water is not available washing-soda should be added to the bath to soften it. From 2 lb. to 3 lb. of soda per 100 gallons of water is sufficient for the average hard water, but where exceptionally hard water from limestone country has to be used a slightly greater quantity may be necessary. The contents of the dip

should be stirred thoroughly before starting operations, and after any stop or when more dip is added. Should any scum form on the surface it should be removed with an old sheep-skin kept for the purpose or a piece of sacking. Trouble has been experienced lately by some dipping materials of the "bloom" type containing a dye-stuff which colours the wool fibres, and will not scour out.

While it may not be desirable, it is sometimes necessary to shear sheep which are not quite dry, and on such occasions every endeavour should be made to allow the wool to dry before pressing. Damp wool should be rolled loosely and spread out, so that it may lose by evaporation as much moisture as possible. Care should be taken also to see that such wool and also wool heavy in the grease is not pressed too tightly into the bales.

Branding-fluids.

Considerable trouble is experienced by the manufacturers owing to the sheep-brands on the wool not scouring out in the usual scouring-baths used in the mills. Some manufacturers even go so far as to say that even after exposure for twelve months none of the usual commercial fluids used for branding will scour out, despite assurances that they will do so. The British Wool Industries Research Association has done considerable work in endeavouring to produce a branding-fluid that will remain visible on the fleece for twelve months and will still scour out in the mill. It is certainly asking a lot of any fluid to conform to these conditions, especially with the heavy rainfall and other climatic variations which are met with in certain parts of New Zealand. Since the branding-fluids made according to the formula of the Research Association are as yet in the experimental stage, it may not be wise to recommend them for general use until it can be shown that they first of all fulfil the condition of remaining visible—on close-woolled sheep at least—for twelve months. The sheep-farmer can help the manufacturer, however, by (1) endeavouring to keep the brand as small as is consistent with ease of reading, and (2) by seeing that the fluid does not drip from the iron all over the sheep, and that the brand is not smudged by the sheep rubbing together. If a branding fluid is too thick and requires thinning, petrol or some other volatile liquid should be used. If vegetable turpentine or boiled linseed-oil are used they dry so hard that they will not scour out even when subjected to a severe scour.

Some stud breeders are in the habit of using a variety of coloured paints to distinguish mobs of ewes that have been run with different rams. Since these paints do not scour off the wool, even with a drastic scour, they should be discarded and a system evolved by which the existing branding fluids (which can be removed in a special scour) and marks on different parts of the sheep are used.

Testing for Quantity.

The points discussed so far have concerned the quality of the wool, but the quantity produced per sheep is equally important, and the time has arrived when more attention should be paid to this side of wool-production. In recent years the testing of animals for production and the valuing of sires for breeding purposes has come very much to the fore. To-day most farmers are aware of the benefits

that have accrued through dairy-herd testing, trap-nesting and egg-laying trials in poultry-keeping, and progeny tests with pigs. In view of the great importance of sheep to New Zealand, it is suggested that the time is ripe for starting some scheme of testing both the wool and mutton production of our flocks. This would show which were the uneconomic producers, so that they might be culled and eventually only the best producers used for breeding purposes.

A few of the American agricultural colleges have attempted work on the lines of wool-testing, and the results show quite clearly that, if properly organized, there is a great future in front of the work. The last paragraph of Publication No. 1048 of the United States Department of Agriculture summarizes the position very clearly as follows: "It is evident, therefore, that while season must be considered and every possible means used to offset adverse climatic conditions by proper feeding and management, if good wool yields are to be obtained it is most important to select and maintain in the flock those ewes with heavier clean weight of fleece and greater length of staple, and to use rams which transmit these qualities."

While stud-sheep breeders have wrought considerable improvement in our sheep it is questionable if they have won more than half the battle. What is required now is a system whereby the breeder will be able to select his animals on a knowledge of their value as economic converters of food combined with the quantity and quality of their produce. The work of testing sheep will not be carried out so easily as that of cattle or poultry testing, since a number of variables enter into the work. Simply breeding from sheep with the heaviest fleece may lead in time to a strain of sheep with one or more of the following objectionable features: (1) Wool very heavy in the grease; (2) very big-carcassed sheep, (3) sheep with exceptionally long wool, (4) wool too coarse in the fibre for the standards of the breed.

The first objection can be overcome by determining the approximate cleaned scoured weight of each fleece, and to do this it will be necessary to take a representative sample from each fleece. This would then be scoured, dried, and weighed, so that the amount of clean wool in the fleece could be determined. The second objection can be overcome by careful observations of the carcass qualities of each sheep immediately after shearing. Where scales are available weights would be a useful check on the eye observations, especially if they could be accompanied by some system of measurement. The third and fourth objections might be overcome by having the staple length and spinning quality of the wool checked on the samples taken for scouring purposes.

Preparing the Clip for Market.

While the preparation of the wool-clip for market may not come strictly under the heading of wool-improvement, care in this respect is equally important in any endeavour that is to improve the returns from wool. This is becoming more and more an age of specialization and standardization, and the care and treatment which may have been good enough for wool some years ago are really not sufficient at the present time if the best returns are to be obtained. The subject cannot be dealt with fully in an article of this nature, but the essential points

may be stated as follows: (1) The shed should be cleaned thoroughly before the start of shearing; (2) the sheep should be allowed to empty and be dagged before shearing; (3) every care must be taken to keep the wool clean during every stage through which it passes; (4) only wool which does not match the bulk of the fleece should be removed in the skirting operation; (5) when the wool is classed, what is necessary is a few distinct lines with no fancy lots; (6) with moderate to large-sized flocks the piece wool should be divided so that all wool light in the grease is in one lot and all wool heavy in the grease in another; (7) all stained wool should be kept by itself; (8) when the wool is pressed it is a mistake to endeavour to get too much into the bales, especially if the wool is at all inclined to be heavy in the grease or not properly dry.

Conclusion.

It may be said quite safely that if the sheep-farmer is to do his share in meeting the present economic crisis and at the same time prepare for the greater future competition in the world's markets he must be prepared to improve his methods of breeding, feeding, and management. The real foundation for such improvement can only be laid when a scheme of testing is evolved and put into more or less general practice. It is freely admitted that in dairy-cow testing a great deal of the benefit derived from the system comes from the better care and management of the stock and the spirit of emulation that is engendered. Although the system of testing the pulling-power of draught horses has been started only recently in America, it is claimed that already it has created a greater consideration for care, management, training, and the breeding of better farm horses. There can be but little doubt that sheep-testing would also encourage an improved standard in the general management of our sheep, and if such a system accomplished nothing else it would justify itself.

Some of the improvements suggested in this article may appear trivial or of little importance, but it must be remembered that any fault in the wool which prevents it being used for the highest class of goods for which it may be suitable lowers the value, even though slightly, and so affects the total return. Therefore, in the selection of breeding-stock care should be taken to see that the type of wool is that which is most likely to suit the climatic conditions and at the same time be as free as possible from defects, combined with a maximum yield of fleece. In order that such selection may be worth while a sound scheme of breeding should be laid down, and the sheep so fed and managed that they are able to produce the maximum quantity of good-quality wool. Then when the wool is shorn it should be so treated and handled that it will be displayed for sale to the best advantage.

Maori-bug Flavour in Cream.—In a recent note Mr. G. F. V. Morgan, Bacteriologist to the Dairy Division, states: "A streptococcus resembling in cultural characteristics a type isolated in the past from pasteurized milk for cheese-making was isolated from the cream sample supplied. This organism, which seems to be a definite type of lactic streptococcus, produces a burnt flavour in both milk and cream, resulting finally in a butter which, on keeping, has what has been described as "Maori-bug flavour." I have recently recultured a strain of this organism, and the same flavour is produced. I would advise special attention to cooling in order to keep the streptococcus family down as a whole."

COMMERCIAL FERTILIZERS AND THEIR BASIS OF SALE.

J. A. BRUCE, Inspector of Fertilizers, Department of Agriculture, Wellington.

II. PHOSPHATES SOLUBLE IN WATER—*continued.*

Concentrated Fertilizers.

THE present article deals with those fertilizers of the concentrated class now on the market which have a relatively high percentage of quickly soluble phosphoric acid in their composition. Later on in this series the whole group of fundamentally new synthetic fertilizers, made economically possible by the invention and elaboration of remarkable technological devices for taking nitrogen out of the atmosphere, will be discussed from the standpoint of their nitrogenous fertilizing constituents.

Although concentrated fertilizers may furnish valuable amounts of water-soluble phosphoric acid, in the broader sense they must be classed apart from the ordinary or standard-strength superphosphate group dealt with in the July issue of this *Journal*. What may be regarded as the leading feature of a concentrated fertilizer is that it should possess a high content of either one, two, or three of the fertilizing substances—phosphoric acid, nitrogen, and potash—in active or chemically pure form, with the minimum amount of what can be arbitrarily termed unessential material or diluent in its make-up. Diammonium phosphate, for example, a typical concentrated salt of German manufacture, contains, roughly speaking, 74 per cent. (1,660 lb. to the ton) of total plant-food (*i.e.*, nitrogen plus phosphoric acid) practically all in water-soluble form; whereas a mixture made from standard-strength fertilizers such as are in common use, containing nitrogen and phosphoric acid respectively, may only have a total plant-food content of somewhere about 20 per cent. (450 lb. to the ton). The majority of normal-strength fertilizers carry a single fertilizing ingredient, but may have other mineral elements not officially recognized as saleable plant-foods, such as calcium, sulphur, sodium, iron, and manganese, in their composition; for the present, however, these are tentatively considered not to be required for plant-nutrition in larger quantities than most soils can provide.

The principal sources* of phosphoric acid in the concentrated phosphate class of fertilizer comprise double superphosphate, which consists chiefly of monocalcium phosphate, and the two phosphates of ammonia—monoammonium and diammonium phosphates. These latter, as their names imply, combine the fertilizing compounds of ammonia† (or nitrogen) and phosphoric acid. Both these ammonium phosphates also occur in various commercial grades of new-type fertilizer offered for sale under such trade names as Nitrophoska, EnPeKay, Ammophoska, &c., each combining atmospheric nitrogen with potash and phosphoric

* Sodium and potassium phosphates apparently have not yet been offered on the fertilizer markets, except perhaps in experimental amounts, and are therefore not included.

† Ammonia contains 82·25 per cent. nitrogen and 17·75 per cent. hydrogen chemically combined.

acid in certain fixed proportions. Synthetically produced preparations bearing the three chief fertilizing ingredients in an intimately compounded or combined form for promoting vegetative growth are designated commercially as "complete" concentrated fertilizers.

Double Superphosphate.

Double superphosphate, now more commonly known as triple or treble superphosphate, is a form of phosphate hitherto usually manufactured by digesting phosphate rock with sulphuric acid to liberate phosphoric acid, and then using this form of phosphoric acid to decompose further batches of rock. The final product resembles normal-strength superphosphate—in fact, it may be more or less regarded as ordinary superphosphate with the gypsum (hydrated sulphate of lime)* removed. The word "double" has evidently been applied because of the double treatment of the phosphate rock with sulphuric and phosphoric acids. The new term "triple" or "treble" is employed in the fertilizer trade of Canada and the United States, possibly because some concentrated supers have approximately three times as much plant-food as superphosphate produced by only a single treatment of phosphate rock with sulphuric acid. In comparison with the high-grade superphosphate handled here, the general run of double superphosphates yield a little more than twice as much phosphoric acid.

From the viewpoint of W. Waggaman, a noted technologist, there would appear to be at least one notable economic advantage attached to this method of producing high-strength superphosphate—namely, that relatively low-grade phosphate deposits may be utilized to produce a grade high enough for economic application to the land. Apart from this, however, a number of technical and other objections seem to have hindered the expansion of the process, such as (1) installation and maintenance of expensive plant, (2) somewhat high price of the product, and (3) presence of free phosphoric acid in the fertilizer at times, causing bag-rotting and scorching of vegetation. Nevertheless, it is only fair to add that any such disadvantages connected with the manufacture of double superphosphate may be entirely eliminated in the future. It is now understood, for instance, that new technical processes for making this fertilizer are operating very successfully in certain countries overseas.

Double superphosphate has been prepared by small plants in Europe for many years, but the output has been limited. In America and Canada, more noticeably in the past two years, double super have gained a firmer footing in the fertilizer trade—perhaps as a result of new improved methods of manufacture. Nowadays the chief use of the product is for raising the phosphatic strength of proprietary mixtures. Only recently a large works, erected at a cost of £2,000,000, commenced the manufacture of concentrated superphosphate, together with ammonium sulphate and monoammonium phosphate, at Trail, British Columbia. This company apparently has in view the creation of a market for the three products in the Pacific regions as well as in Canada.

* A ton of ordinary superphosphate contains about 10 cwt. of gypsum.

Double superphosphate has not as yet found a regular place on the New Zealand market, but has been advertised for sale at £14 per ton. The unit* or commercial value of this article compared with that of the standard grade is as follows :—

	Superphosphate.	Double Superphosphate.
Chemical plant-food as phosphoric acid (P_2O_5)	20·2 per cent.	40 per cent.
Price per ton (quoted Auckland, autumn, 1931)	£4 17s. 6d. (cash)	£14 (cash).
Price per unit of plant-food (unit value) ..	4s. 10d.	7s.

To the purchaser the higher plant-food content of the double superphosphate would appear to permit of some economy in transportation, handling, and distribution costs ; nevertheless, on the face of it, the standard superphosphate, being 2s. 2d. per unit cheaper, is the better proposition, unless exceptionally high carriage costs are involved.

The plant-food content of double superphosphate ranges between 30 and 52 per cent. (672 lb. to 1,165 lb. per ton), but the grades most commonly sold have between 40 and 50 per cent. phosphoric acid. If the trade custom of expressing the fertilizing strength of normal-strength superphosphate in terms of tricalcium phosphate (*e.g.*, 44–46 per cent.) is adopted for double superphosphate, some rather awkward figures will arise. A double grade with 52 per cent. phosphoric acid in tricalcium phosphate equivalency gives a figure somewhere about 113 per cent., which admittedly would be a questionable method of describing quality.

Monoammonium Phosphate.

Monoammonium phosphate is a readily soluble salt made by combining a form of pure, free liquid phosphoric acid† (H_3PO_4) with pure ammonia in correct proportions, and evaporating the solution to dryness. The pure salt is white, dry, and crystalline, and provides 12·2 per cent. of nitrogen and 61·7 per cent. of plant-food phosphoric acid (P_2O_5). The crude salt more adapted for fertilizing purposes is prepared in the same way, except that the free liquid phosphoric acid employed in the process is utilized in an unpurified state.

Two commercial grades, analysing respectively 10·7 or 16·5 per cent. nitrogen and 48 or 20 per cent. phosphoric acid, have been prepared in granular form under the trade name of Ammo-Phos at large works in New Jersey, U.S.A., for several years. Both grades were at one time produced largely for the convenience of manufacturers wishing to raise the plant-food value of proprietary mixtures. However, more recently the makers have developed an export trade with various tropical countries.

The new line offered from the works at Trail, British Columbia, carries a guarantee of 10·7 per cent. nitrogen and 52 per cent. phosphoric acid. The warranted analyses of various qualities of

* Unit value is the value of 1 per cent. (22·4 lb.) of nitrogen, phosphoric acid, or potash in their respective forms in 1 ton of fertilizer.

† Now produced by the electric-furnace method.

ammonium phosphates and "complete" fertilizers, including a new series placed on the market recently by the British chemical combination operating an immense modern plant at Billingham, England, are presented in the following table:—

Table showing Plant-food Contents of Typical Concentrated Fertilizers bearing Water-soluble Compounds of Phosphoric Acid.

Name of Fertilizer.	Nitrogen soluble in Water.	Phosphoric Acid.		Potash soluble in Water.
		Soluble in Water.	Insoluble in Water.	
	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Double superphosphate ..	..	40 to 50	..	..
Monoammonium phosphate (*a*) (Ammo-Phos)	10·7	48·0	..	..
Ditto .. .. (*b*)	16·5	20·0	..	..
Diammonium phosphate ..	20·6	52·5	..	..
Leunaphos	20·0	20·0	..	..
Nitrophoska .. .. (*a*)	16·5	15·2	1·3	20·0 (as chloride)
,, ... (*b*)	15·5	14·2	1·3	19·0 (as sulphate)
Potassium ammonium phosphate	5·4	56·0	..	17·0
N.P. ammonium phosphate Series—				
Type A	14·3	43·0	..	..
Type B	18·0	18·0	..	..
Type C	16·0	32·0	..	..
Type D	12·3	56·5	..	..
Complete series*—				
No. 1 (EnPeKay)	12·5	12·5	..	15·0
No. 2	10·4	10·4	..	20·8
No. 3	10·4	20·8	..	10·4
No. 5	8·0	16·0	5·5	16·0
No. 6	7·5	26·0	6·0	7·5
No. 7	6·5	22·5	3·0	13·0

* Form in which potash (K_2O) occurs not given.

Sales of ammonium phosphates, up to comparatively recently at any rate, have not yet attained any extended volume. A. N. Gray, secretary of the International Superphosphate Manufacturers' Association, London, estimates the world's total consumption (1928) of calcined rock phosphate (basis, 28·5 per cent. phosphoric acid) for manufacture of ammonium phosphates, Nitrophoska, and similar products at 200,000 tons, which is, roughly, only 1·5 per cent. of the total phosphate rock used for all other purposes of fertilizer-manufacture. According to present information, Japan seems to be about the heaviest consumer of ammonium phosphates—81,500 tons having been brought from Germany and the United States for use in the rice-fields of that country during the year 1929.

Diammonium Phosphate.

Diammonium phosphate, although similar to the monoammonium form, contains a higher proportion of nitrogen. The pure salt is produced as a white, finely crystalline compound when a solution of monoammonium phosphate, or of phosphoric acid, is saturated with ammonia. A marketable grade (Diammonphos I.G.), designed as a

special fertilizer for garden plants and vegetables, is prepared at huge synthetic ammonia works at Leuna and Oppau, Germany. This substance has been registered in the Dominion for the past four years, but seems hardly to have emerged locally from the experimental stages.* A sample analysed in the Department of Agriculture's Chemical Laboratory yielded 53 per cent. of phosphoric acid and 21 per cent. of nitrogen.

Without going into the question of landed costs compared with other fertilizers produced or imported here, it may be mentioned that the use of diammonium phosphate as a general-purpose fertilizer is limited on account of its extraordinarily high concentration. Moreover, it tends to cake very hard if stored in a moist atmosphere for any length of time. The material in small airtight packets retailed under the name of Floraphos has a good mechanical condition, and from all accounts is very successfully employed in local home gardens.

OTHER CONCENTRATED FERTILIZERS CARRYING AMMONIUM PHOSPHATE.

Nitrophoska I.G.—This is the proprietary name given to a group of so-called complete fertilizers sold in several commercial grades. The manufacture of this novel type of concentrated compound was first accomplished by the producers of Diammonphos I.G.; briefly, it is the product of the direct combination of diammonium phosphate with ammonium nitrate and potassium chloride or sulphate.

The following represents the quality of the article imported for local consumption: Nitrogen soluble in water, 16·5 per cent.; phosphoric acid soluble in water, 15·2 per cent.; phosphoric acid insoluble in water, 1·3 per cent.; potash (K_2O) as chloride soluble in water, 20 per cent. Particulars of another grade formerly registered for sale may be seen in the table (opposite page). The analysis of EnPeKay, manufactured in similar fashion to Nitrophoska and registered for sale in the Dominion, is also shown in the table.

Almost all the Nitrophoska brought into the Dominion has been delivered for use in orchards, tobacco-plots, and market gardens; small quantities have also been used for top-dressing pastures and for field experiments. Considerable success has attended the latest efforts of the makers to surmount the caking difficulty by packing this and other crystalline concentrated fertilizers in granular form in special waterproof bags. If the mechanical condition is good, a cyclone seed-sower is reported capable of distributing light dressings uniformly on areas of land that are not available to horse-driven distributing machines.

Leunaphos I.G., another compounded chemical plant-food of German origin, is prepared by mixing 40 parts of diammonium phosphate with 60 parts of sulphate of ammonia, and contains 20 per cent. of nitrogen and 20 per cent. of phosphoric acid. Leunaphos has been sold here in experimental amounts only, and is registered for sale under our Fertilizers Act.

Potassium Ammonium Phosphate.—The recent development on a semi-commercial basis of this product, bearing nearly 80 per cent.

* References: (1) Bell, J. E., "Manuring of Early Potatoes: Experiments at Pukekohe in 1930." *N.Z. Journ. Agric.*, Vol. 42, 1931. (2) Cawthron Institute Pasture Research Publications Nos. 3 and 5.

of plant-food (1,790 lb. to the ton), is credited to the Fixed Nitrogen and Research Laboratory of the United States Bureau of Soils, and from all accounts success has attended its employment in field trials with potatoes in Maine. The guaranteed constituents are: Nitrogen, 5·4 per cent.; available phosphoric acid, 56·0 per cent.; potash, 17·0 per cent.

Some further Recent Developments.

Present indications seem to point to the adoption of dicalcium phosphate as a component of certain high-analysis "complete" fertilizers in place of ammonium phosphate, which heretofore has been the most popular. The introduction of the former, which has the important nutritional element calcium as an ingredient, is considered more advantageous for special soil-types.

A recent issue of the *American Fertilizer Journal* states that a new product of somewhat lower concentration, Kalkammon Phosphat, consisting, as the name suggests, of lime, phosphate, and ammonia, is now on the market. Two grades are sold: (1) 7 per cent. nitrogen and 17 per cent. phosphoric acid. (2) 12 per cent. nitrogen and 12 per cent. phosphoric acid. Yet another addition to the concentrated group on the market is an ammonium magnesium phosphate, produced by a French company, with a guarantee of 22 per cent. phosphoric acid, 5 per cent. of nitrogen, and 13 per cent. of magnesia.

Ammoniation of superphosphate: A process showing considerable promise of expansion is one in which nitrogen in the form of ammonia is sprayed into superphosphate or a mixture of superphosphate with other fertilizing agents, whereupon the ammonia is fixed by chemical reaction with the superphosphate. Numerous reports confirm the idea that such a method is neither expensive nor complicated in operation, the finished product, which can be manufactured to almost any desired formula, being prepared from the cheapest plant-food materials.

An Overseas Opinion based on Field Tests.

In discussing results obtained from large-scale field tests, controlled by the United States Department of Agriculture, with various concentrated and ordinary strength fertilizers, Maine Experiment Station Bulletin No. 350 puts forward clearly some of the advantages and possible disadvantages of the new concentrated class of fertilizer chemicals as a whole. From the following extract it would almost seem that there is no class of fertilizer being produced to-day which offers as interesting a future as do the concentrated fertilizers.

Economic Advantages.—The economic advantages of concentrated fertilizers deserve serious consideration. Less handling, hauling, and storage are required at the factory or mixing-plant for concentrated fertilizers. Fewer bags are required. A marked reduction in freight is made possible. After the fertilizer reaches the farm, less handling, hauling, and storage are involved. At planting-time fewer trips are required to haul the fertilizer to the field, and the bags can be set from two to three times farther apart.

Taking the entire range of costs involved in manufacturing, shipping, and application of the tonnage of concentrated fertilizer referred to as

compared to the greater tonnage of the ordinary-strength fertilizer, concentrated fertilizers offer a good chance to effect certain economies. Future developments will depend on the cost of materials common to those of ordinary strength.

Possible Disadvantages.—One of the main difficulties likely to be encountered with certain combinations of concentrated fertilizer salts is that of poor physical condition. Salts which possess that property of absorbing moisture from the atmosphere are the chief offenders. A moist fertilizer cannot be distributed evenly. A badly caked one calls for extra labour to get it in the proper shape for drilling with fertilizer-drilling machines.

Other reputed objections to the concentrated fertilizers have been that they would be too hard to distribute uniformly with existing fertilizer-distributing machines; that they would leach from the soil too readily; that they would tend to leave the soil in a poor condition if used continuously; that the salts used in their production would be so pure that the absence of certain other elements might prove detrimental to crops; and that, above all else, they would lower the yield in comparison with ordinary-strength fertilizers.

These objections are not to be taken so seriously now as they once were, and it is reasonable to expect that any awkward physical condition will be taken care of satisfactorily, as will the matter of developing suitable fertilizer-distributing machines for applying concentrated fertilizers uniformly and getting them well mixed with the soil. It is true that some of these objections may be legitimate, but studies under field conditions, involving different types of soils and crops, will be required before definite decisions can be reached. It is quite evident that the use of concentrated fertilizers has opened up new problems alike for the fertilizer-manufacturer, the manufacturer of fertilizer-distributing machines, the fertilizer consumer, and the investigator of soil and fertilizer problems.

Commercial Application of Concentrated Fertilizers.

The drift in the fertilizer industry to-day is showing a definite turn toward the higher-grade types of fertilizer that can be economically produced. Continued progress is being made in raising the plant-food value of fertilizers and at the same time lowering their cost. In Europe, where the fertilizer industry had its inception, the production of concentrated fertilizers was showing signs of great expansion until the prevailing general trade depression set in, necessitating a very drastic curtailment of production. Germany, with her enormous industrial plants, may be cited as the home of the synthetic (air) nitrogen industry; in 1928 she was the chief fertilizer-consuming country of the world as regards potassic and nitrogenous fertilizers, and was second only to the United States in phosphate consumption. The chemical industries of Britain have also made notable advances in the fertilizer field of late years.

The New Zealand fertilizer user has now become accustomed to buying standard high-grade fertilizers; but it is quite within the range of probability that in the course of time well-balanced, readily available, concentrated fertilizer combinations may enter a little more into our systems of fertilizer practice—more particularly perhaps for increasing plant-food contents of proprietary mixtures and for use in remote inland districts where transport charges are heavy. Concentrated fertilizers are constantly being hailed as the

fertilizers of the future, but before finding increasing acceptance on the Dominion market accurate information will need to be available as to their economic employment and their effects on plant growth and composition under our manifold variations of soil and climate.

Knowledge of the reactions of plants and seeds to concentrated fertilizer salts is indeed very limited, and despite great advances in the technology of manufacture, making it practicable for almost any desired concentration of the three main fertilizing elements—phosphorus, nitrogen, and potassium—to be made up, other elements are needed to ensure the nutrition of plants on certain soil-types. Here, again, chemical ingenuity will be called upon to play a part in deciding what mineral elements should be included in the fertilizer-bag or used in conjunction with concentrated fertilizing-agents bearing the three so-called essentials.

Dr. Crowther, of Rothamsted Experimental Station, England, writing on "Soils and Fertilizers in Reports of the Progress of Applied Chemistry" (Vol. 15, 1930), draws attention to the fact that in connection with the American tobacco crop there is evidence that the application of the newer highly concentrated fertilizers is leading to symptoms of magnesium and calcium deficiency. Dolomitic limestone, which combines these two important elements, is one of the agents applied as a corrective.

With the advent of numerous and in some cases costly high-analysis chemical fertilizers on the market, an understanding of their fertilizing strengths becomes an imperative necessity. Unless the consumer knows what a fertilizer contains it is difficult for him to attribute results to the real fertilizing cause or to know how to supplement the main fertilizer constituents with other materials that may be essential for maintaining the quality and production of his crops.

In all countries chemical fertilizers are sold on the basis of their content of phosphoric acid, nitrogen, and potash, as the case may be. Practical experience has shown that commercial and agricultural values assigned to them must be judged with scientific accuracy. The rate of application per acre, for example, must also be governed by the analysis of the product employed. Therefore it is only by the interpretation of the true analysis that the relative merit of a fertilizer can be determined before being applied to the land. Now, unfortunately, the "unitary system" for evaluating fertilizers* is becoming increasingly difficult and more complicated, as a result of the multiplicity of grades and forms of fertilizers manufactured.

Unless one is assured of the analysis, the buying of fertilizers involves a certain degree of risk. On those occasions, then, when fertilizer is bought, the purchaser should take particular notice of the brand and analysis supplied on the vendor's invoice certificate.† Should any difficulty be experienced in understanding the nature of the information furnished, the nearest agricultural instructor or adviser should be consulted.

* It is intended to devote some attention to the unitary system of valuation of fertilizers in a later contribution to the *Journal*.

†Reference: "The Purchase of Fertilizers," by F. T. Leighton, in this *Journal* for June, 1930.

(Series to be continued.)

POTATO VARIETY TRIALS CONDUCTED BY THE FIELDS DIVISION, SEASON 1930-31.

IT is well known that potato varieties are selective in their requirements regarding soil and climate. One set of conditions may favour a certain variety but not others, and the need for potato variety trials has long been recognized. There has been, however, a very real difficulty in the past, and one which rendered such trials of little practical value. This difficulty is due to the presence of virus disease, a factor which limits more than any other the cropping-power of any particular line of seed. All crops are not equally infected, so that it is possible for a line of a particular variety to be very productive and another of the same variety to be incapable of producing proportionately more than one-tenth the yield. In fact, the cropping-power between one line and another of the same variety may be far greater than the difference between one variety and another. Thus a variety trial might be upset completely because differences would be largely a measure of virus infection rather than a measure of performance as between one variety and another.

This difficulty has not been removed altogether, but, as a result of work undertaken by the Department of Agriculture at Ashburton Experimental Farm*, relatively virus-free lines have been raised of most of the commercial varieties. This seed has been used in the trials now under review, and so offers a measure of accuracy not possible in the past.

Since it was desirable to try the varieties over as wide a range as possible, thirty varieties were selected and trials laid down in twenty localities representative of the potato-growing districts of New Zealand. Owing to supplies being very limited, only ten tubers of each variety were planted in any one trial, and this fact must be taken into account when reading this report. There must have been considerable error owing to the small number of tubers and absence of replication of plots, and the results, especially those of yield, cannot possibly be conclusive for any one trial.

The trials were organized by Mr. A. W. Hudson, Crop Experimentalist, and undertaken by the four Fields Superintendents and their local Instructors. It has not been possible, nor would it be profitable, to present in detail results of these trials. An attempt has therefore been made to give a general summarized interpretation of the year's work. The tables and related comments have been prepared by Mr. J. H. Claridge, Assistant in Agronomy, and are based on reports sent in by growers and Instructors through the several Superintendents. It is hoped to continue the trials from year to year, and from the accumulated results of several seasons it will be possible to draw more definite conclusions than have been possible in the present review.

Two trials were conducted in the Pukekohe district, where it is customary to grow two crops in one season on the same ground. It

* This work is now being undertaken at the recently established Government Pure Seed Station, Lincoln.

was decided to submit the most promising varieties to this "double cropping" system, but these results are not yet available, although indications are that Northern Star is likely to remain the variety most suitable for this system of management.

Sixteen trials form the basis of figures given in the accompanying tables. The trials were located at Ruakura, Maxwell (Wanganui), Karere (Palmerston North), Hastings, Grovetown (Marlborough), Mina (North Canterbury), Clarkeville (Kaiapoi), Papanui (Christchurch), Prebbleton, Timaru, Alma (Oamaru), Mosgiel, Stirling, Gore, Lorneville (Invercargill), Tuatapere. These localities cover a wide range of soil-types and climatic conditions, and include the main potato-growing districts of New Zealand.

For purposes of comparison the varieties have been classified into four groups according to the time taken for each variety to mature. In the main this classification confirms opinions previously held regarding maturity.

JUDGING-FACTORS EXPLAINED.

The following explanations are necessary for understanding the columns in the tables which follow.

Cropping-power: This is an estimate of the yield computed by adding to the yield of table-size tubers half that of the seed-size tubers. The figure given is in tons per acre, and is the average over the whole of the trials. Since the size of each ten-tuber plot was taken as 60 square feet, the cropping-power thus calculated is probably lower than what might be expected in actual practice.

Range of adaptability: In this column an attempt has been made to convey some idea of the general performance of the variety in the above-stated districts. In general the figure conforms to the cropping-power, but a variety which has yielded particularly well in ten centres and poorly in the other six would have a greater range of adaptability than one which has yielded particularly well in six and poorly in the rest. This is true even though the cropping-power over all the trials averages out at the same figure for both varieties.

Commercial possibilities: This figure is the average of marks in the trials for the relative value of each variety from a commercial point of view. In some cases merchants have acted as judges; in others potato-growers and Instructors have allotted marks.

Maturity: The number of days from planting to time of ripening is a relative period, which will vary under different sets of conditions. Furthermore, the date of maturity in most of the trials was not recorded with sufficient accuracy to allow them to be included in these computations. The figures may be taken as being reliable between one group and another, but a difference of a few days in maturity between two varieties must not be taken as significant.

Blight resistance: This figure gives an approximate relative indication of the resistance shown by the variety to late blight. Here, again, no great accuracy has been possible, since only a few of the trials developed late blight sufficiently for comparisons in resistance to be made.

Cooking-qualities: An attempt has been made in this section to determine the relative cooking-qualities of the varieties under trial. Thus flesh colour (white or lemon), texture (floury, firm, or soapy),

and flavour, &c., have been recorded from both steamed and boiled tubers. It should be remembered that soil-type influences cooking-qualities, and that a flavour and texture which appeal to one person do not necessarily appeal to another.

Grouping of Varieties.

The four classes into which the varieties have been grouped are: (1) Main crop, (2) early main crop, (3) second early, (4) first early. It should be understood clearly that while comparisons in cropping-power and maturity may be made between varieties of one class and those of another, such factors as range of adaptability, commercial possibilities, blight resistance, and cooking-qualities are so influenced by the date of maturity that comparisons should be made between varieties in one class only.

Table 1.—Main-crop Varieties.

Variety.	Cropping-power per Acre.	Range of Adaptability. 0–10.	Commercial Possibilities. 0–10.	Maturity.	Blight Resistance. 0–10.	Cooking-qualities.		
						Colour of Flesh.	Texture.	Comments.
	Tons.			Days.				
Kerr's Pink ..	9·8	10	7	164	9	White ..	Floury ..	Good flavour.
Field Marshal ..	9·7	10	10	157	8	,, ..	,, ..	,,
Up-to-Date ..	9·7	10	9	162	6	,, ..	Firm to floury	,,
Dakota	9·3	10	8	171	4	,, ..	Floury ..	Good; occasional pink coloration in flesh.
Brownell's Beauty (N.Z.)	8·8	9	5	174	7	Lemon to white	Firm to soapy	Not good eating.
Endurance ..	8·6	9	6	158	1	White ..	Floury ..	Good flavour.
Beauty of Hebron	8·1	7	5	172	4	,, ..	Firm to floury	Fairly good.
Aucklander Tall-top	8·0	8	8	170	9	,, ..	,,	Good.
Iron Duke ..	7·6	6	8	173	9	,, ..	Floury ..	,,
Arran Consul ..	7·5	7	8	163	8	,, ..	Firm to floury	,,
Northern Star ..	6·9	5	5	171	7	,, ..	Varies from soapy to floury	Poor flavour in most reports.
Arran Chief ..	6·3	4	8	167	6	,, ..	Floury ..	Good flavour.
Golden Wonder ..	5·1	1	5	169	8	,, ..	,, ..	,,
Average yield	8·1	..	..	..	..	..	..	..

Comments on Varieties Listed in Table 1.

Kerr's Pink.—An excellent variety with a wide range of adaptability. It was placed first in these trials, and was not below eighth place in any trial of the series. Its performance in New Zealand has confirmed reports on this variety from Britain, where it is considered the heaviest-yielding main-crop variety grown for market. It has lost marks for commercial possibilities because of the pink colour of the skin, and will become popular in New Zealand only when the unfounded prejudice against coloured potatoes has been removed.

Up-to-Date and Field Marshal.—Field Marshal is a rough-skinned variant of Up-to-Date. Both have yielded exceptionally well, demonstrating that good crops of these varieties can still be grown provided virus-free stocks are used. There seems no reason, then, why Up-to-Date should not regain all its one-time popularity. Field Marshal

gained one first and four seconds, and was never lower than eighth on the list. Up-to-Date gained four firsts and two seconds, but dropped below ninth place on three occasions.

Dakota.—A high-class variety which has unfortunately lost popularity during the last year or two. It keeps very well and is an excellent table variety, yielding particularly well in the Canterbury District. Occasional pink discoloration in the flesh of immature tubers is characteristic of the variety. Dakota was first or second in all but one trial in Canterbury, and altogether gained four firsts and two seconds, which is offset by it being placed below ninth on two occasions.

Brownell's Beauty.—The variety used in these trials is sometimes called Yankee Doodle, and is quite distinct from the Tasmanian Brownell's. It has yielded well, but is not very suitable as a commercial variety, and its cooking-qualities are poor. Altogether, it is a variety which might well be discarded. The true Tasmanian Brownell's is a far superior variety, being very shallow in the eye and of high cooking-quality. It was not included in the trials this past season.

Endurance gained two firsts and three seconds and yielded satisfactorily in practically every trial. It seems most suited for light soils, and, provided the locality is one in which late blight is not a controlling factor, the variety is quite worth a trial. It is doubtful, however, if the variety will be found suitable for shipping on account of its brittle nature.

Late Beauty of Hebron.—A variety which yields heavily under suitable conditions, but the tubers are irregular in shape, and this, combined with a pink colour of the skin and a tendency to decay rapidly when injured, all indicate that it is a variety of doubtful commercial possibilities. It should be noted that there are also early types of Beauty of Hebron, but these are not included in the past year's trials, except Early Puritan, which is synonymous with the true White Beauty of Hebron.

Aucklander Tall-top was placed first in two trials, third in two, and in five trials dropped below ninth place, being last in one. It would appear that certain conditions are necessary for this variety, and when these are present it yields heavily, but as yet there is not sufficient evidence to define its limitations. When grown on rich land it is prone to develop misshapen tubers, and, being an extremely late variety, it is liable to be dug while immature, and the tubers are then easily bruised.

Iron Duke did not come up to expectations. It is probable that virus disease was to some extent responsible, and were this factor removed it would be a very useful and popular variety. It keeps well, is a good table variety, and shows a distinct resistance to late blight.

Arran Consul.—A new importation which did moderately well, being second in one trial, but below ninth in four. It is well worthy of further trial, as it was considered a promising commercial variety.

Northern Star was not placed higher than third in any trial and was last on three occasions. The variety seems very irregular in regard to its cooking-qualities, but as a rule its flavour when mature is regarded as unsatisfactory. It has a sphere of usefulness in those

districts where double cropping is practised and early crops raised, but apart from this it could be replaced very well by other varieties.

Arran Chief.—This variety has not in these trials justified its reputation. It is probable that virus disease has been in some measure the cause of this, since the line of seed used, although the best available, was more heavily infected than other varieties in the trial. Arran Chief should certainly not be condemned on this past season's results.

Golden Wonder was placed last in no fewer than eight trials, and only twice did it rise above tenth place. This confirms the reports from Britain, where it is considered the poorest-yielding main-crop variety. Its appearance is not attractive. It is, however, an exceptionally high-quality potato, and its usefulness is probably limited to private gardens.

TABLE 2.—EARLY MAIN CROP VARIETIES.

Variety.	Cropping-power per Acre.	Range of Adaptability. 0–10.	Commercial Possibilities. 0–10.	Maturity.	Blight Resistance. 0–10.	Cooking-qualities.		
						Colour of Flesh.	Texture.	Comments.
	Tons.			Days.				
Arran Banner ..	9·8	10	9	144	6	White ..	Firm to floury	Good flavour.
Abundance ..	8·4	6	8	155	3	„ ..	Floury ..	„
Aucklander Short-top	8·2	7	10	148	8	„ ..	Firm to floury	„
Great Scot ..	7·8	6	9	140	9	„ ..	Firm ..	Good flavour; tendency to discolour.
Bresee's Prolific ..	7·0	3	6	150	3	„ ..	Firm to floury	Medium flavour; flesh discolours on cooking.
Majestic ..	6·9	3	7	139	8	„ ..	„	Good flavour.
King Edward ..	5·5	1	8	153	5	Very pale lemon	„	„
Average yield	7·7	..	..	..	..	..	..	..

COMMENTS ON VARIETIES INCLUDED IN TABLE 2.

Arran Banner.—This new importation was the outstanding variety in the trials, and fully confirms reports of trials carried out in England. It gained first place in five trials and second in six, and only once did it drop as low as fifth in the early main-crop group. The variety has yielded exceptionally well, producing tubers of high commercial possibilities and very good cooking-quality. It can be confidently recommended for trial almost anywhere in New Zealand on this one year's results.

Abundance gained two firsts and three seconds, and was never placed below fifth. This year's trials would indicate that the variety is not outstanding in any particular instance but has a wide range of adaptability, and its reintroduction into New Zealand has been justified.

Aucklander Short-top.—(Sold extensively under the name of Sutton's Supreme.) This variety, which is probably the most popular in New Zealand at the present time, produces a high percentage of

good marketable tubers, and may be grown either as second early or main crop. It gained first place in five trials, second in one, and dropped to sixth on two occasions. Its resistance to blight makes it a particularly valuable variety and one which can be recommended with confidence almost anywhere in New Zealand. Trouble is often experienced if tubers of this variety are cut for seed, and since it tends to produce only a very small proportion of seed-size tubers, growers are often tempted to plant very small seed. Such practice would soon result in deterioration.

Great Scot. — Another variety which has performed quite well throughout the trials. It does not seem to have cropped so heavily in relation to other varieties in Otago and Southland as it has in other districts. Very large tubers tend to develop hollow heart, but it is a variety that can be strongly recommended and should be grown more extensively.

Bresee's Prolific has a range of adaptability which appears limited to the lighter lands of Canterbury. The tubers frequently have a dirty-white appearance when cooked, and the flavour is not up to the standard of such varieties as Arran Banner and Aucklander Short-top. The variety is not recommended unless it is known that the particular conditions are suited to its requirements.

Majestic yielded moderately well in half the trials, but has not come up to expectations. The cooking-qualities are excellent, and it is a variety well worthy of trial. The tubers are well shaped and have a good appearance. This is another variety which will not stand cutting for seed purposes.

King Edward.—It has been generally considered that this variety should be confined to Otago and Southland. This opinion was confirmed by the trials, the variety being very well placed in three of the five trials conducted in Otago and Southland, and in only one trial outside those districts did it rise above sixth place in the list. Moreever, the variety scored heavily in marks for commercial possibilities in Otago and Southland, but elsewhere reports indicate that it is not at all popular in commerce. The variety may therefore be recommended with confidence only in the southern portion of the South Island, where it is at the present time very popular.

TABLE 3.—SECOND EARLY VARIETIES.

Variety.	Cropping-power per Acre.	Range of Adaptability. 0–10.	Commercial Possibilities. 0–10.	Maturity.	Blight Resistance. 0–10.	Cooking-qualities.		
						Colour of Flesh.	Texture.	Comments.
	Tons.			Days.				
Ally	5·9	10	9	132	5	White to very pale lemon	Firm ..	Fairly good flavour.
British Queen ..	5·0	8	7	135	1	White ..	Floury ..	Good flavour.
North Downs ..	4·5	5	6	133	3	,, ..	Firm to floury	,,
Sharpe's Express..	4·1	4	6	122	1	White to very pale lemon	,,	,,
Witchhill ..	4·0	2	7	123	4	White ..	,,	,,
Average yield	4·7	..	..	..	..	..	..	..

COMMENTS ON VARIETIES LISTED IN TABLE 3.

Ally.—This variety is not well known in New Zealand, although it gained first at eight centres and second at three. It showed, in fact, a consistently good yield in all trials except one. As a second early the yield may be regarded as exceptionally good. Its cooking-qualities are perhaps not the best, but in other directions the variety is so good that it deserves extensive trial.

British Queen yielded consistently, dropping below third place in this group only twice in the sixteen trials. Cooking-qualities are highly satisfactory, and, taking all points into consideration, it is perhaps one of the best all-round second-early varieties. Its susceptibility to late blight is a distinct disadvantage in districts where this disease has to be considered.

North Downs was placed first in three trials, second in three, and last in five. It may be worth further trial, however, since it seems a desirable variety, except in the matter of yield.

Sharpe's Express.—The yield has not been satisfactory, and its pale lemon-coloured flesh is a disadvantage in view of popular prejudice. It may be of use, however, for early market and garden culture.

Witchhill can be classed in yield with Sharpe's Express, but the flesh of the tuber is white and the variety is probably more blight-resistant. Cooking-qualities are very good, and, while it may not be possible to recommend it as suitable for commercial crops, it should be a very popular high-quality garden variety.

TABLE 4.—FIRST EARLY VARIETIES.

Variety.	Cropping-power per Acre.	Range of Adaptability. 0–10.	Commercial Possibilities. 0–10.	Maturity.	Blight Resistance. 0–10.	Cooking-qualities.		
						Colour of Flesh.	Texture.	Comments.
	Tons.			Days.				
Early Regent ..	5·2	10	7	112	4	White ..	Firm to floury	Fairly good flavour; tendency to discoloration.
Epicure ..	4·0	6	7	105	2	„ ..	Firm ..	Good flavour.
Early Puritan ..	3·4	7	6	113	1	„ ..	Floury ..	Good flavour; tendency to discoloration.
Duke of York ..	3·2	2	6	120	1	Lemon ..	Firm ..	Fairly good flavour; tendency to discoloration.
Herald	3·0	1	5	112	2	White ..	„ ..	Fairly good flavour.
Average yield	3·7	..	..	..	..	..	..	..

COMMENTS ON VARIETIES INCLUDED IN TABLE 4.

Early Regent.—This variety is generally considered a second early, but in these trials it has been classified as a first early. It was first in nine trials and second in three, giving it a very wide range of adaptability. The flesh tends to discolour somewhat during cooking.

Epicure.—This is generally regarded as the standard early variety for New Zealand. It gained first or second place at seven trials and last in three. On the past year's results it is recorded as the earliest-maturing variety under trial.

Early Puritan.—A variety which has performed quite well, being first or second in nine trials and last in two. It is therefore worth further trial as a first early. The variety used in these trials is true Early Puritan. There appear to be no stocks of this variety in New Zealand, and in the past Early Regent and sometimes Bresee's Prolific have been sold as Early Puritan.

Duke of York has not yielded well, being last in six trials. The flesh is lemon-coloured and would not be popular. It is therefore not a variety that can be recommended for commercial purposes.

Herald has yielded very poorly, being last in eight of the trials. The cooking-qualities are satisfactory, but it is not possible to recommend the variety.

General Remarks.

In conclusion, attention might be drawn to the fact that in the early and second-early groups there is no variety which shows outstanding merit. Perhaps the most promising are Ally and British Queen as second earlies, and Early Regent and Epicure in the first earlies. It is remarkable that the variety grown in the earliest potato districts of New Zealand is a main crop variety—Northern Star. Elsewhere and in very limited areas such varieties as Epicure and Early Regent are grown, but the greater proportion of our commercial second-early potatoes come from such early main-crop varieties as Aucklander Short-top and King Edward. There are no popular second earlies, unless Early Regent is classified as such, and the introduction of Ally and virus-free lines of British Queen may possibly fill a real need for a variety a little earlier than Aucklander Short-top, King Edward, Majestic, and Bresee's Prolific.

Meanwhile the practice of growing early main-crop varieties, so that they may be marketed when the Pukekohe crops and few first earlies are about finished, remains very popular, and the introduction of Arran Banner is a notable addition to the list of suitable varieties for this purpose.

From one season's trials very few definite conclusions may be drawn, but, nevertheless, the trials have given some very satisfactory indications about which something more definite will be known as material accumulates. It is hoped that eventually the trials may determine, within limits, those varieties most suited to the more important potato-growing districts of New Zealand.

Acknowledgment is here made to those growers who have rendered these trials possible by giving land and labour.

—*J. W. Hadfield, Agronomist, Plant Research Station, Department of Agriculture.*

Top-dressing of Hill Country.—The Fields Instructor for the Wairarapa district reports very marked results from the use of lime and super at Gladstone—the carrying-capacity on certain country being increased from about one sheep to three sheep per acre in one season.

POTATO-MANURING IN THE SOUTH ISLAND.

SUMMARY OF EXPERIMENTS IN PAST SIX SEASONS.

A DETAILED report has been prepared on potato-manuring experiments in the South Island conducted by the Fields Division during the past six years, but cannot be published in full in the present issue of the *Journal*. In order, however, to make the more essential information available to growers in connection with the present season's work, the salient features and recommendations as summarized in the report are here presented.

SUMMARY.

(1) The results of fifty-six experiments in the South Island (mainly in Canterbury Province) conducted in the four seasons 1927–28 to 1930–31 inclusive are given.

(2) The effects on yield of various fertilizers used in sixty-three trials covering six seasons, 1925–26 to 1930–31 inclusive, are analysed.

(3) Nearly all trials were carried out on a co-operative basis on farms, using a system of six to twenty replications of plots in the various experiments.

(4) In most cases the crops were weighed in the various recognized grades—namely, table, seed, and small (or pig) potatoes.

(5) The results of all experiments were submitted to statistical examination, "Student's" method being used generally.

(6) The chief objects of the trials were:—

(*a*) Comparison of no manure with superphosphate at 3 cwt., 5 cwt., and 7 cwt. per acre.

(*b*) Determination of the effect of using sulphate of ammonia and sulphate of potash, each at 1 cwt. per acre, as single additions to super and together with super, the latter being used at 3 cwt. per acre.

(*c*) Comparison of the ammonium phosphates—Ammophos and Diammonphos—with equivalent amounts of phosphate plus nitrogen in the form of a mixture of super and sulphate of ammonia.

(*d*) Determination in three trials of the effect of adding sulphur, at 3 cwt. per acre, to a mixture of super plus sulphate of ammonia plus sulphate of potash.

(7) Super at 3 cwt. per acre is compared with no manure in forty-four trials. It is considered that forty-one of these show significant increases due to the use of super. The general average increases (forty-four trials) are 0·96 tons (19 cwt.) and 0·25 tons (5 cwt.) of table and seed potatoes respectively. On the basis of value of potatoes and costs of fertilizers adopted this results in a net profit of about £2 9s. 6d. per acre, or 330 per cent. return on the outlay of about 15s. per acre for 3 cwt. of super.

(8) Increasing the quantity of super to 5 cwt. per acre in nineteen experiments gave satisfactory and highly paying returns only on the better-class potato soils of a rich alluvial nature. In seven experiments on such soils the net return per acre from 5 cwt. of

super was £4 10s. On light to medium soils the use of more than 3 cwt. per acre is shown to be not justified.

(9) Increasing the quantity of super to 7 cwt. per acre in eighteen experiments gave inconsistent results. A few increases over super at 5 cwt. are recorded, and in two experiments yields were depressed by the use of 7 cwt. below that from 5 cwt. In the main there is no justification for using more than 5 cwt. of super per acre, even on the better-class potato land.

(10) The use of sulphate of ammonia at 1 cwt. per acre as an addition to super in thirty-six trials shows a general average increase over super alone of about 0·48 tons (9½ cwt.) and 0·27 tons (5½ cwt.) of table and seed potatoes respectively. This represents a net profit of about 25s. per acre, or approximately 200 per cent. on the outlay for sulphate of ammonia. When used with super plus potash the effect of sulphate of ammonia is very similar. The effect of sulphate of ammonia on yield appears to be influenced by climatic conditions. Dry midsummer weather generally results in poorer returns than when the rainfall is fairly well distributed.

(11) The effect of sulphate of potash to a paying extent appears to be limited to certain districts which are represented by experiments conducted at Kirwee (North Canterbury) Mitcham (Mid-Canterbury), Temuka and Willowbridge (South Canterbury), Taieri (South Otago), McNab and Gore (Southland). In the case of Willowbridge the economic value of potash is doubtful.

(12) Super plus sulphate of ammonia has proved superior to the ammonium phosphates—Ammophos or Diammonphos—in four experiments out of eight; but neither of these has proved superior to the mixture of super plus sulphate of ammonia. It is concluded, therefore, that in the main this mixture is more effective than the ammonium phosphates.

(13) Sulphur proved effective in increasing the yield in one experiment, but its use at the current price of sulphur was not profitable.

Recommendations to Growers.

(1) *Superphosphate.*—On the lighter to medium-class potato soil use up to 3 cwt. of super per acre. On the rich alluvial potato soils use up to 5 cwt. of super per acre.

(2) *Sulphate of Ammonia.*—Use 1 cwt. of sulphate of ammonia per acre, in addition to super recommended above, on all soils.

(3) *Sulphate of Potash.*—Use 1 cwt. of sulphate of potash, in addition to the super and sulphate of ammonia, in those districts named in section 10 of the foregoing summary with the possible exception of the Willowbridge district, where results are conflicting. Potash is at least worth trying in that district, and there may be others not covered by the experiments in which potash is worth using.

(4) *Application of Manures.*—Those farmers who have no potato-planting machine which sows manure, nor a manure-box attachment for the plough, are strongly advised to apply manures by hand or with a hill-country hand top-dresser of the "Hillman" type. Applied in this way the fertilizer should be spread in a strip about 3 in. to 4 in. wide along the bottom of the furrow in which the

potatoes are planted afterwards. Confining the manure to a narrow strip is likely to render it more efficient than broadcasting it over the whole width of the furrow. Contact with fertilizers used at the rates recommended is not likely to damage the sprouting of the potatoes so long as the manure is spread before the potatoes are planted. If cut seed is used it would be advisable not to allow the potatoes to come too freely in contact with the manure, however.

—A. W. Hudson, Crop Experimentalist, and J. W. Woodcock, Assistant Crop Experimentalist.

VOLCANIC SOILS OF THE CENTRAL NORTH ISLAND TERRITORY.

A LECTURE entitled "The Volcanic Soils of the Central North Island Territory and their Agricultural Utilization," was delivered by Mr. T. Rigg before the Wellington Philosophical Society on 26th August, 1931. The following summary of the lecture is supplied by the Department of Scientific and Industrial Research:—

Although it has been known for many years that large deposits of volcanic ejectamenta cover enormous tracts of country in the Rotorua–Taupo zone, it is only during the last year that a full realization has been arrived at of the very widespread nature of volcanic deposits throughout the whole of the central North Island territory. From the work that has been done in the course of the soil reconnaissance survey during the last twelve months it has been ascertained that volcanic deposits cover the whole country from Kawhia Harbour and Mount Egmont on the west coast, to Tauranga and Whakatane on the Bay of Plenty, and Napier on the east coast. In particular districts the ash coating has been removed by erosion or by slumping, and on the river-flats extensive resortment of ash from different sources has taken place.

It is now clear that three great centres of volcanic activity were concerned in this widespread distribution of ash. These centres were located in the Rotorua zone, the Taupo zone, and Mount Egmont. In the case of volcanic activity in the Rotorua and Taupo zones, it is evident that several vents were responsible for the distribution of volcanic material. In the Taupo zone the more important vents were situated in or near Lake Taupo, but Mounts Tongariro and Ngauruhoe also have contributed to the covering of ash over particular areas of country.

Volcanic activity has been taking place over a very long period, and it is thought that even in Miocene times eruptions on a vast scale took place. At such widely separated points as Napier and Te Awamutu deposits of volcanic material 15 ft. to 50 ft. in thickness can be seen. An examination of these deposits shows that a number of separate showers of ash were deposited. In all probability, great periods of time frequently elapsed between the deposition of the various showers that are visible in these sections. An examination of the deposits near any great centre of activity shows that a number of eruptions were of restricted distribution and are confined to the country in the vicinity of the vent.

Of the volcanic deposits which are responsible for the soils of the central territories, the most extensive deposit is one that has come from a vast eruption near Lake Taupo. Material from this eruption, which apparently took place in comparatively recent times, covers the whole country from Te Kuiti and Taumarunui in the west, and extends almost as far as Napier in

the east. Waiouru in the south, and Rotorua in the north, mark the limits of well-defined deposition in the north and south. Eruptions from Mount Egmont are responsible for the soil-types covering a great part of Taranaki, extending almost as far as Ohakune in the east, and probably as far as Ohura and the Mokau River in the north. Between the Mokau River and Te Awamutu the principal soil-covering is derived from ash from another source. This ash appears to be much older than that from the eruptions of Mount Egmont and from Taupo. The same ash in the district between Te Awamutu and Putaruru contributes largely to the soils of this district, but there appears to be a superficial coating of ash from an unknown source which materially influences the characteristic properties of these soils.

Ash from vents in the Rotorua centre covers large tracts of country between Rotorua and Tauranga and Whakatane. The eruption of Mount Tarawera in recent times covered, in its turn, earlier deposits from the Rotorua centre lying between Mount Tarawera and Opotiki. Ash from the Ngauruhoe eruption covers a somewhat restricted area in the vicinity of the mountain, and overlies the Taupo ash. Volcanic ash from Mount Tongariro is almost entirely covered by ash from the last Taupo eruption, but a considerable area of soil between Waiouru and Taihape has been identified as ash from the Tongariro eruption.

Examination of the different volcanic deposits has revealed striking differences in the chemical and textural properties of the soils derived from them. Chemical analyses show that ash from the Egmont, Tongariro, and Ngauruhoe eruptions is andesitic in origin, and is well supplied with lime and other bases. The phosphoric content of ash from these eruptions is notably high. The chemical analyses suggest that the soils derived from the weathering of these ash deposits are of high potential fertility. The rhyolitic deposits of Taupo and the Rotorua centre, compared with soils derived from the recent Egmont and Ngauruhoe deposits are low in lime and phosphoric acid. The ash coating in the Te Kuiti district probably is andesitic in origin, but great leaching of lime and other bases has taken place.

Although textural changes in the soil derived from any particular ash deposit occur in traversing the country from the eruptive vent to the limit of deposition, it is surprising how uniform the texture is in particular localities from any one volcanic deposit. The texture, however, of soils derived from different deposits, varies widely from loam to gravelly sands.

The great chemical and textural changes which are associated with the volcanic deposits very clearly point to the desirability of very detailed laboratory examinations in order to determine more accurately the distinctive properties of the volcanic soils. This is a matter of great importance to the development of agriculture in the volcanic territory, as farming experience already has shown that difficulties are frequently encountered in connection with the grazing of stock on established pastures.

A particular type of stock ailment affecting sheep in the country west of Te Kuiti in recent years has occasioned much concern to farmers in this district. Investigations carried out by Mr. B. C. Aston under the auspices of the Department of Scientific and Industrial Research have shown that the pastures contain low amounts of lime and phosphate. Treatment with mixtures of lime and superphosphate, accompanied by close grazing of the pastures, has resulted in great improvement in the health of stock on certain farms, and also has greatly improved the carrying-capacity of the land.

The incidence of stock-ailment in the country to the west of Te Kuiti must not be confused with bush sickness, which has presented such great difficulties to the extension of agriculture in certain areas covered by Taupo and Rotorua rhyolitic deposits. Bush sickness in its acute form has been noticeable in particular localities from the moment when the land was broken in. Generally, bush sickness has diminished in severity under ordinary

farm-management. The reverse appears to be the case in connection with the "dopiness" affecting sheep in the districts west of Te Kuiti.

The long and careful work of Mr. B. C. Aston for the Department of Agriculture has shown that typical bush sickness on volcanic soils is associated with soils of a somewhat coarse texture. As a result of pasture and soil analyses a deficiency of iron in the feed of stock has been suggested as the cause of bush sickness. It has been demonstrated that administration of iron drenches and the provision of iron licks effects a cure or greatly reduces the incidence of the ailment.

During the conduct of the present soil survey the observations that have been made show that bush sickness is very definitely associated with particular volcanic deposits, and is not common to all the soil-types derived from ash-deposits. The ryholitic ash from the Rotorua centre, covering the country north of this centre to the Bay of Plenty, and the Taupo deposit of widespread distribution, are very definitely associated with bush sickness. The ailment occurs at such widely separated points as Mamaku, Ngaroma, and Kopaki, which are all located on the Taupo deposit.

Investigations conducted by the Cawthron Institute, at Glenhope, in the Nelson territory, have shown that a similar form of stock ailment occurs on certain granite soils. The administration of ferric ammonium citrate has given great improvement in the condition of sheep, clearly pointing to a close similarity to bush sickness in the volcanic soils of the North Island.

An examination of healthy and unhealthy pastures in the Glenhope district does not support the theory of low iron content of pasture being the sole cause of the stock ailment. There is good reason to suspect that the iron in soil particles digested along with grass provides a portion of the iron requirements of stock. On healthy soils the percentage of iron and its availability is much higher than on bush-sick soils. In the case of weathered soils a relatively large proportion of the available iron is held by the clay and silt fractions. This explains why bush sickness is not found in any acute form on loamy soils. A chemical examination of bush-sick soils shows that they all have a low content of iron, and that relatively little of this iron can be extracted by weak acids. The evidence points to the incidence of bush sickness on those pastures where soil contamination of the grass is not extensive, or where the soil particles contain relatively little iron which can be extracted by weak acid solutions.

In connection with the development of volcanic soils, the whole area of country covered by the Taupo deposits must be regarded with some suspicion in view of the incidence of bush sickness at at least three points widely separated. The success that has been obtained by the use of iron licks in combating this ailment, however, gives great hope for the eventual development of intensive agriculture on large areas of the Taupo deposit. In selected localities in this sector the carrying-capacity of pastures sown to English grasses and clovers and top-dressed with superphosphate, has been notably high, and if the bogey of bush sickness could be definitely removed there is little question that very large areas of the Taupo deposit could be successfully farmed.

In concluding his address, Mr. Rigg stated that although the Soil Division established by the Department of Scientific and Industrial Research had been in existence for only a little more than a year, very valuable information had been secured. The different volcanic deposits had been identified, the approximate limits of deposition had been ascertained, and the combined work of geologists and chemists of the Department of Scientific and Industrial Research and of the Cawthron Institute already had resulted in new information of great value to farmers in the volcanic territory. Much further work, however, was required in order to enable the greatest use to be made of the great areas of unoccupied country which presented such great possibilities for agriculture.

CORTICIUM DISEASE OF POTATOES.

I. PROPAGATION AND SPREAD OF THE DISEASE.

E. E. CHAMBERLAIN, Mycological Laboratory, Plant Research Station, Palmerston North.

CORTICIUM disease, caused by the fungus *Corticium vagum* Berk. et Curt., is one of the commonest potato-diseases in New Zealand. The symptoms of this disease have been described by Cunningham (1925) as follows :—

" When the crop is being lifted the disease may be seen in the form of small black sclerotia scattered over the surface of the tuber. These sclerotia are resting bodies of the causal organism capable of remaining in a quiescent condition for an indefinite period. They are firmly attached to the tuber by means of hyphæ, and are not readily removed, consequently they accompany the tubers when the latter are planted. In the presence of moisture, such as is present in the soil, the sclerotia produce hyphæ which ramify through the soil in the vicinity of the tubers, and spread to the potato-shoots as they develop. These hyphæ would appear frequently to damage the growing points of the main shoots, with the result that secondary shoots are produced from below the injured portion. In this manner affected tubers may give rise to bunches of small and stunted plants ; these in turn produce few and small tubers. Thus infection, when severe, may tend greatly to reduce the yield."

A TUBER-BORNE DISEASE.

On most potatoes will be found the black sclerotia of corticium (Fig. 1). When the tuber is planted the sclerotia germinate and produce hyphæ which follow the shoots up through the soil and attack the growing tips (Fig. 2). While the plant is making its early growth the fungus forms cankers on the stems just below the ground-level and lives as a parasite on the growing plant. Later in the season when the new tubers are formed the fungus, generally but not always, spreads through the soil and produces sclerotia on some or all of them. That only partial infection may occur is shown by an experiment in which a line of one hundred infected tubers were planted in 1929, and in which the progeny of only seventy of the tubers became infected. In the 1930 experiments the progeny of seventy-three out of one hundred infected tubers showed the disease. Bisby, Higham, and Groh (1923), using one line of potatoes, tested out the effect of different times of harvesting on the percentage infection of the tubers. They found that the longer the crop was left in the ground the higher was the percentage of infection, as follows : Date of digging, 1st September, 39 per cent. ; 10th September, 43 per cent. ; 4th October, 71 per cent. ; 13th Obtober, 83 per cent. From this it may be seen that although the fungus must have been present in the soil, and had possibly been living as a parasite on the parent plant, it had not up to the time of the earlier diggings had time to reach the new season's tubers. This failure of the fungus to reach the progeny, or all the progeny, in every case, explains why it is rare for a line of potatoes to show 100 per cent. infection.

FIG. 1. POTATO TUBER BEARING SCLEROTIA OF CORTICIUM.

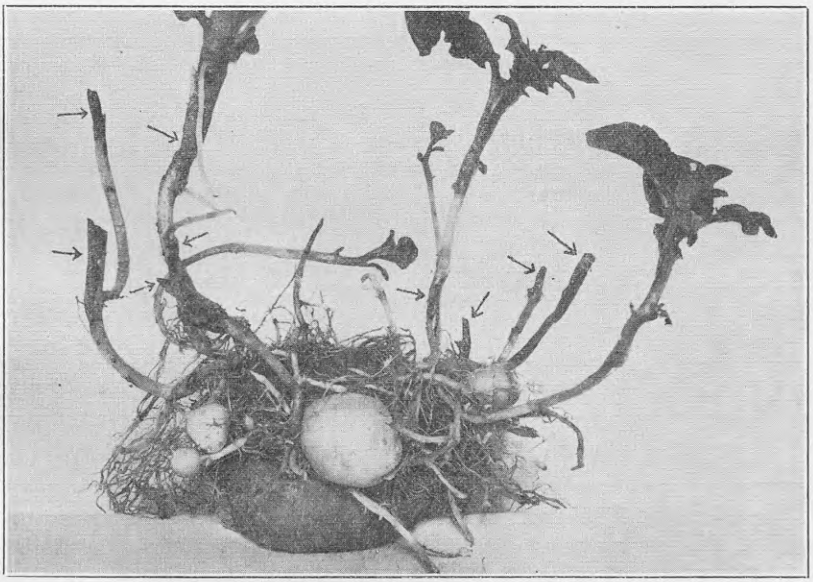

FIG. 2. CORTICIUM ATTACK ON GROWING POTATO PLANT.

Cankers formed by the fungus are indicated by arrows. Note the way in which, on the left, two of the shoots have been killed, and the secondary shoots formed to take their place have also been cut back.

[*Photos by H. Drake.*

Soil-persistence.

Corticium is a fungus which, according to the work of McAlpine (1911), Mueller (1924), Wellensiek (1925), Hurst (1926), Rayllo (1927), and Braun (1930), has a wide host-range. Thus when introduced into the soil it is capable of attacking plants other than potatoes, and so remaining in the ground for a number of years. Mueller (1924) listed 160 different hosts on which the fungus is parasitic. These hosts include most of the common garden and crop plants. Braun (1930) has since compiled a more complete list of some 230 hosts belonging to sixty-six families. Corticium has not so far been recorded in New Zealand as being parasitic on any plant other than the potato.

Several workers—Bisby, Higham, and Groh (1923), Dana (1925), and Clayton (1929)—have found that soil-infection occurs to such an extent in certain districts that it is quite useless to treat seed potatoes for corticium. Melhus and Gilman (1921), realizing the significance of soil-infection when conducting seed-treatment trials for the control of corticium, demonstrated the presence of the fungus in the soil and carried out experiments to estimate the degree of infection.

An experiment was laid down in 1928 at the Plant Research Station to test the persistence of the disease under various crop rotations. Details of the experiment and the results are given in the following diagram, the figures representing the percentage of plants bearing corticium-infected tubers :—

1928–29.

Planted with a severely infected line of potatoes.

1929–30.

Grass.	Swedes.	Peas.	Cereals.	Potatoes.
..	..	..	..	81

1930–31.

Planted with corticium-free treated potatoes.				
73	93	91	91	90

1928–1929 : The area, which is 2½ chains by ½ chain, was sown with a line of corticium-infected potatoes. The crop was inspected during the harvest, and the potatoes were found to be heavily infected with the disease.

1929–1930 : The same area was divided up into five ½-chain-square plots, and each plot sown as indicated in the diagram. Potatoes from an infected line on which the sclerotia had been killed by treatment

with acidulated corrosive sublimate* were sown in one of the plots. The crop was examined during harvesting, and the counts taken showed an 81-per-cent. corticium infection. A control plot of 120 tubers of the same line of treated seed, planted in soil which had not grown potatoes before, showed an infection of 8 per cent. at digging-time.

1930–1931 : The whole area was again planted in potatoes, the seed tubers being hand-selected for freedom from sclerotia, and then treated by the standard acidulated corrosive sublimate method. Three hundred sets were sown in each of the small plots shown in the diagram, and the tubers of all the plants examined for sclerotia. The percentage of plants which yielded infected tubers at harvest-time are given in the diagram. A control plot of ninety plants grown from the selected seed showed 100 per cent. freedom from the disease when sown in soil where there had not been a previous crop of potatoes.

The results of this experiment show that in a one-year crop rotation grass is the only crop to bring about any apparent reduction in the amount of soil infection.

During the 1929–30 season a corticium control and yield trial was carried out at Belfast, North Canterbury, in co-operation with the Fields Division. A line of corticium-infected potatoes was secured, and one-half of them were treated with the standard acidulated corrosive sublimate method, while the other half was left untreated as a control.

An examination of the potatoes before planting showed 93 per cent. to be infected with sclerotia. The potatoes were sown in 1-chain rows, and at harvest one bucketful of table tubers was selected from each row. All tubers were examined, and the results were as follow :—

—	Number of Tubers inspected.	Number of Corticium-infected Tubers.	Percentage of Infection.
Untreated	509	407	80
Treated	584	490	85

From these figures it is evident that the soil must have been heavily infected, and that under market-gardening conditions corticium is capable of remaining in the soil for several years.

Spread of Corticium from one Plot to another.

Corticium is not dependent on previous soil-infection for its spread to healthy plants and tubers, but spreads readily from plant to plant during the season. To test the extent of this spread from plant to plant in the row clean treated tubers and corticium-infected tubers were planted alternately. The trial was carried out in two sections, (1) in which the tubers were planted 11 in. apart, and (2) in which the tubers were planted 16 in. apart. In all seventy-eight tubers, each of clean seed and infected-seed, were planted. A control of ninety sets of

* The treatment used in this instance and referred to throughout this article as the standard acidulated corrosive sublimate treatment is as follows: The potatoes are soaked for 1½ hours in a solution of 1 part corrosive sublimate, 6·6 parts concentrated hydrochloric acid, and 1,000 parts water. This treatment has been recommended by the Mycological Laboratory and used in New Zealand for several years, although the method has not been published.

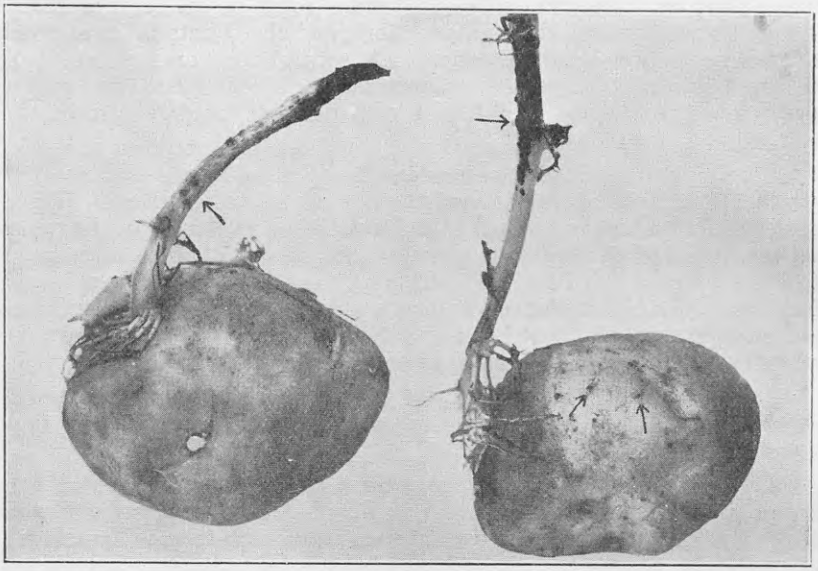

FIG. 3. SPREAD OF CORTICIUM DURING STORAGE.

These tubers have sprouted while stored in sacks, and the disease has spread from adjacent infected tubers on to the shoots. The arrows indicate the position of the sclerotia on the sprouts and also on the tubers, where they have started to form.

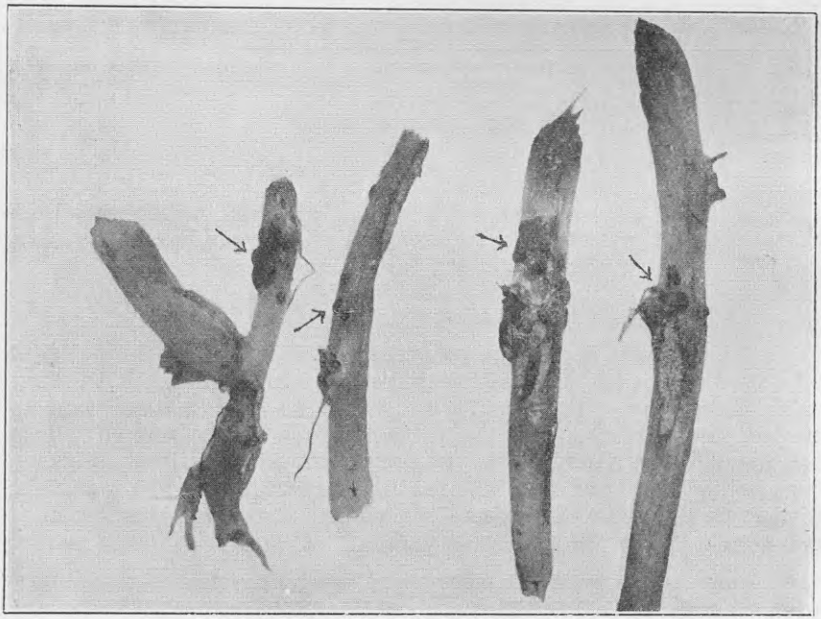

FIG. 4. CORTICIUM SCLEROTIA ON POTATO SPROUTS.

The sclerotia, indicated by arrows, were formed during storage, and demonstrate how readily the disease may spread by this means.

[*Photos by H. Drake.*

the clean seed was planted in soil on which potatoes had not been grown before, and the progeny of these showed 100-per-cent. freedom from disease. The results at digging were—

—	Distance apart of Plants.	Number of Clean Tubers planted.	Number of Plants clean at Harvest.	Percentage of Spread.
Section 1 ..	11 in.	48	18	62
Section 2 ..	16 in.	30	23	23

Under field conditions the normal distance between sets is about 14 in., so that the spread in the field may be expected to be between 23 per cent. and 62 per cent. This spread from plant to plant explains the natural increase of corticium infection within a line of potatoes.

Spread during Storage.

Observations have shown that under certain conditions corticium may spread from infected to healthy tubers in the sacks. When potatoes are piled up in sacks and allowed to remain undisturbed the potatoes in the lower sacks sweat and become damp. It has been found at the Plant Research Station that under these conditions the fungus spreads rapidly and sclerotia are formed on the tubers and the sprouts. (Figs. 3 and 4.)

An inspection after storage of one sack of potatoes in which the original infection was known to be 9 per cent. showed that of 428 tubers examined 275, or 64 per cent., were carrying sclerotia. Since it is not unusual for potatoes to become damp in the sacks, either through sweating or other agency, this manner of spread may on occasions be of definite importance.

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NOTES ON THE THYROID GLAND.

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A BRIEF description of the thyroid gland, and the function of iodine in the development and maintenance of the general health of farm animals, may be of interest to *Journal* readers.

The thyroid gland contains a higher percentage of iodine than any other tissue in the body. Iodine absorbed by the animal passes into the thyroid, where it forms one of the chief constituents of a specific compound which exercises a profound influence on the development of the young and the maintenance of general health. A deficiency of iodine may have serious consequences, and manifests itself in very definite symptoms, the commonest of which is an enlargement of the gland itself. It may be due either to insufficient iodine in the diet of the animal, or to too great a drain on the iodine-supply. Iodine helps destroy the toxins in the body, so that unhygienic conditions of life, such as living in sunless places, rainy seasons, unprotected water-supplies, &c., may cause a serious drain in the supply. The minimum amount of iodine required for the adequate functioning of the thyroid glands of large animals is 0·03 per cent. fresh weight. A gland with less than this is generally, but not always, enlarged. Following are examples :—

	Fresh Weight. Grammes.	Percentage of Iodine.
(1) Ten months ram lamb, Ohau, Manawatu	1·52	0·089
(2) Ram hogget, Westmere, Wanganui	3·95	0·013
(3) Lamb, Murchison	114·14	0·002

The first sample is a gland from the Manawatu district, and is typically normal. The second, from Wanganui, although actually deficient in iodine, is only very slightly enlarged. The third is a typically bad goitre.

In extreme cases of iodine deficiency the symptoms are very pronounced ; the wool of sheep becomes coarse and hair-like, the lambs are born very weak and hairless, in many cases dead or deformed, while the animals as a whole are listless and apathetic. (See this *Journal* for April, 1930, p. 226.) Fortunately, such cases are rare in New Zealand.

Since the iodine in pastures is subject to seasonal variations, and the soil iodine is not all available for use, an analysis of the thyroid gland forms the most satisfactory indication as to the amount of iodine the animal has at its disposal. It is important to know whether any particular type of soil is more liable to be goitre-producing ; hence an attempt is being made to obtain glands from sheep reared on every type of soil, particularly from similar soils in different localities. For this reason the Department of Agriculture is asking for the co-operation of farmers in the forwarding of glands taken from sheep and lambs which they have reared on their own properties. The difficulty in obtaining glands from abattoirs and freezing-works lies in the fact that it is often not feasible to trace the farms from which these animals have come.

The supplementary feeding of licks in districts where the mineral content of pastures is low is coming into general practice in New Zealand, and iodine may be included where warranted. A widespread

and indiscriminate use is not to be advised, however, for as yet it has not been proved that iodine has any actual feeding-value, and an overdose is not only wasteful, but in many cases actually harmful.

How to take the Thyroid Gland from Sheep or Lambs.

Following is a brief description of the gland and directions for its dissection. Samples should be obtained from normal lambs, such as those killed for human consumption, as well as from abnormals—for example, lambs born dead, or dying from sickness.

The thyroid is a red bilobed glandular structure growing firmly against the windpipe. To obtain a sample, when killing, cut the throat of the sheep through or above the "Adam's apple" and take out about six inches of windpipe immediately below. Remove adhering flesh and fat until the gland is exposed. The accompanying diagram shows a normal gland in its natural relative size and position. An enlarged gland may have lobes as large as a hen's egg. The "isthmus" is a very thin piece of gland joining the two lobes across the windpipe, and is somewhat difficult to remove. The gullet is on opposite side of windpipe to isthmus. A pair of fine nail-scissors is the best instrument to use for removing the gland.

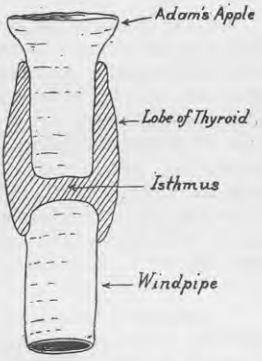

DIAGRAM OF THYROID GLAND AND ITS POSITION IN THROAT.

The gland should be kept whole, wrapped in grease-proof paper, shut tightly in an old tobacco tin, and posted with the least possible delay. Information as to age and sex of animal, also as to whether it has had access to iodized licks or not, should be enclosed. Samples should be addressed to the Chief Chemist, Department of Agriculture, Box 40, Wellington.

TREATMENT OF MILK FEVER IN DAIRY COWS.

Dealing with the subject of milk fever in the annual report of the Live-stock Division for 1930–31, Mr. J. Lyons, Director, states: "During the past season a considerable number of cases were treated with solutions of calcium injected intravenously and subcutaneously, with satisfactory results. The salts used were calcium chloride and calcium gluconate. The former is somewhat difficult to use, and must be injected intravenously if the destruction of the surrounding tissue is to be avoided. The gluconate can be injected intravenously or beneath the skin of the neck or shoulder without any danger to the surrounding tissues. As stated, both methods of treatment can be recommended with confidence. It is doubtful, however, if the calcium treatment will ever supersede the old method of inflation of the udder which has been in vogue for the past thirty-odd years. Nearly every dairy-farmer keeps a milk-fever pump in his shed which he is capable of applying, whereas calcium salts are somewhat difficult to obtain, and are beyond his means of application. It can be claimed for the new method of treatment that there is no danger of contaminating the udder, the secretion of milk is not interfered with, nor has the tedious process of freeing the udder from air to be undertaken. The use of lime in the drinking-water as a preventive for milk-fever is gaining ground among dairy-farmers and the results will be observed."

SEASONAL NOTES.

THE FARM.

Production and Utilization of Pasture.

FOR some months good farmers generally have been rightly giving attention to measures, such as top-dressing and grass-harrowing, designed to beget efficient production from pastures. During the next few months such measures will continue to warrant attention, but it is opportune at this season to recall that good grass-farming calls not merely for efficient production of grass, but also for its efficient utilization.

At the present time it can scarcely be overstressed that the proper objective in grass-farming is of a dual nature, embracing both production and utilization. Although frequently the standard of production of our pastures could be increased substantially with profit, yet it is probable that there is more general scope for improvement in respect to utilization. This is primarily because we have not given due thought to utilization. Something would certainly be achieved if each farmer would carefully seek an answer to the questions, How do my methods of using the grass I produce appear when examined in the light of the best proved practice? Am I sufficiently acquainted with the known best practice to judge my own efforts? Honest answers to such questions would often constitute a first step towards much-needed improvement.

Fortunately, greatly improved utilization may often be brought about without either the introduction of difficult practices or the expenditure of much money. Unsatisfactory utilization arises primarily from allowing pasture growth to become too rank and mature during the spring and summer months. Practical farmers know well that excessive length and maturity in grass herbage is most undesirable in the grazing of sheep, and, particularly during recent years, experience has shown that it is almost equally undesirable in the grazing of dairy cows. Yet many farmers seem by their actions to be prepared to accept as unavoidable an overmature condition of a considerable portion of their grassland during much of the period of heavy grass-growth.

The two main means of avoiding the objectionable overmaturity of pasture growth should both frequently receive attention during the current season. One of these is ensilage, which is referred to in a subsequent paragraph. The other is systematic control of pasture growth by means of well-planned grazing, supplemented at times by the topping of any portions which, without such treatment, would run to seed-heads.

By some who are interested, systematic control of pasture growth seems to be looked upon as necessarily linked up with and dependent upon farm-subdivision much closer than has usually been provided. In reality reasonably good pasture-growth may be secured on a farm divided into from nine to twelve fields of fairly even size, and in actual practice some remarkably good results in grazing-management are being obtained on such farms. From this it follows that on many farms to-day, since there are many farms subdivided to the extent mentioned, the only thing necessary to give improved control of pasture growth is the introduction of new methods calling for little or no outlay in capital.

The essential features of the method of grazing which should be adopted are (1) rapid grazing of fields by means of relatively heavy stocking, and (2) periods of subsequent spelling to allow of recovery. Frequently, even under really good management, intermittent spelling and rapid grazing will not suffice to prevent the development of patches of overmature

growth. In the control of such patches, which tend to become rank and to be neglected by stock, topping with the mower proves of great assistance. Further, it has been shown in practice that to bring about reasonably good control of pasture growth it is not necessary at any time to punish either the grazing animals by keeping them on markedly short growth, or the pastures themselves by subjecting them to periodical hard grazing, which is particularly apt to be injurious during or immediately preceding dry conditions. In brief, much improved grazing-management is often possible without any radical change from the grazing methods previously in vogue.

Usually the main measure to be taken lies, firstly, in discarding haphazard grazing in which stock pass from paddock to paddock without any particular attention being given to the condition of the herbage on the paddocks, and in which stock are often given access during late spring and summer to much more feed than they can consume; and, secondly, in replacing such haphazard grazing by regulated grazing in which pastures are eaten down rapidly, and then completely spelled until they are at a most advantageous stage to graze again, and in which stock are given entry only to as much pasture as they can properly eat down and maintain in a leafy condition—all other grassland being shut up for haymaking or ensilage.

Detailed guidance in regard to controlled grazing cannot be given in a form which with safety could be applied generally, for an efficient procedure under one set of conditions might be quite unsuitable under other conditions. Those desiring detailed advice should apply for it to the officers of the Fields Division in their respective districts. The significant feature of past experience is that improvement in grass-utilization has been associated with increases of 40 per cent. and even greater increases, in production, while the extra outlay involved has been relatively small.

Ensilage.

In New Zealand the making of silage has been practised to some extent for many years, but until relatively recently it was not adopted generally. It is significant that the support given ensilage was for a long time small and spasmodic rather than general and continuous as it has become.

Why, it may well be asked, has the change taken place? There are two principal reasons. One is that the grass-farming position has changed vitally, largely on account of top-dressing, so that now farmers are faced with a late spring and early summer surplus of grass—a surplus of a type that they were not previously called upon to handle. Ensilage in recent years has been introduced as the most effective and economical means of conserving this surplus, whereas in earlier years ensilage was largely employed in the conserving of special forage-crops, such as oats and maize, in the green state. To sum up, in general ensilage to-day is essentially a part of our pasture-work, whereas in the past it was part of our special forage-crop work; to-day it is linked up with top-dressing and grazing-management, in the past it was linked with cultivation and special seed-sowing; to-day ensilage minimizes the need for the plough, in the past it definitely called for the plough.

The second reason why ensilage, after years of relative neglect, has somewhat suddenly won and warranted popular favour is a labour one. The ensilage of the past generally was a back-breaking task. The handling of the weighty green material under old-fashioned methods was a laborious undertaking which quenched the enthusiasm of many. Ensilage to-day can be made laborious by clinging to the methods of the past, but there is no need for it to be so, and it is actually not so in those districts where it has become generally and permanently popular. This is the significant point: Where ensilage is most popular and permanently established—

where the odd farmer is not he who makes silage, but he who does not—there we find ensilage is not specially laborious. Indeed, many who practise silage-making in those districts contend it is less exacting than haymaking.

As labour considerations probably have done more than anything else to check the adoption of ensilage as a pasture-management measure, it is well to consider how labour may be saved. As soon as labour-saving in regard to ensilage is mentioned, some jump to the conclusion that this leads necessarily to a considerable outlay in equipment—an outlay running into from £50 to £100 or more. Fortunately, this is often not the case. Silage may be saved with the minimum of labour, and yet without any substantial outlay being necessary, where pits or trenches are used in conjunction with suitable sweeps which gather the green material as it has fallen from the mower. Large sweeps are sold by implement-merchants at from £20 to £25, but useful ones can be made by any farmer who is reasonably handy, and call for an outlay in material of about £4 to £5 at most. Guidance as to the making of such sweeps may be obtained by applying to the officers of the Fields Division in their respective districts.

Incidentally, such sweeps may be employed in haymaking as well as in silage-making, so that they are doubly useful. The use of sweeps, linked with the use of pits or trenches, eliminates almost all forking of green material, and enables silage-making to be carried out efficiently by a team of two or more men, according to the amount of silage to be saved. This means there is no need for the grouping of neighbouring farmers into fairly large teams, such as is frequently done in connection with haymaking. Neither is the ordinary farm-routine work interfered with, for the ensilage-work can usually be conveniently done between milkings.

The making of pits or trenches usually should not call for much, if any, direct outlay, being work which well can be undertaken by ordinary farm labour, if it is not overlooked until just about ensilage time so that it becomes a rush job. The provision of ensilage pits or trenches is better done well ahead of the time when silage-making operations are being carried out, in order to allow of the thorough settling-down of the earth disturbed in the construction work. Where the pit or trench system of ensilage can be adopted it usually should be employed, because it minimizes the amount of wastage, and is economical in its labour and equipment requirements.

In selecting a site it is necessary to ensure, firstly, that it is conveniently situated both for harvesting and feeding. This usually means that a pit should not be placed at one corner of a large field. Further, labour is saved if the pit is situated on a bank or terrace, so that the green material is pitched in from the top and the cured material loaded out from the lower side of the pit. This necessitates the possibility of a good roadway for carting out from the lower side. Pits calling for special drainage measures should, if possible, be avoided.

The assumption that a satisfactory pit or trench demands a terrace of considerable height is quite unfounded; really efficient results have been obtained in trenches approximately 4 ft. in depth. At times, because of overlooking the possibility of using trenches, pits are constructed in inconvenient places simply because these places provided the depth for a pit which was not offered by other sites more conveniently located. A conveniently placed trench is as a rule to be preferred to an inconveniently placed pit. A trench is essentially a shallow pit, and considering that silage has been conserved in such trenches with a wastage so slight as to be negligible, it is highly desirable that the merits of such trenches be more generally understood.

If a farmer cannot safely resort to either a pit or a trench, he may adopt the stack system of ensilage, but this does not mean that ensilage then becomes necessarily a back-breaking job. In the stack system it is open

for him to employ the sweeps already mentioned, and one of the several efficient stackers which do all the heavy work of lifting the green material and which are not particularly costly.

To sum up, the vital differences between the ensilage of to-day and that of years ago are two. Firstly, ensilage years ago generally called for the plough in the provision of the crop to be conserved, whereas to-day, as a rule, it lessens the need for using the plough. Secondly, ensilage in the past was a laborious and therefore a costly task, whereas to-day, by labour-saving practices which are not necessarily costly, it need not be avoided on the score either of outlay or labour.

A fairly common error is the making of silage at a later date than is desirable. One of the respects in which silage is often superior to hay lies in the fact that the herbage for silage may frequently be removed early enough to allow of the development of a fresh leafy aftermath before the advent of the dry summer period, during which such aftermath is apt to be particularly valuable. Further, silage from material mown when unduly mature is of inferior feeding-quality. There should be no avoidable delay in the closing of fields for ensilage. Before closing fields for haymaking or ensilage, any stones, fencing-wire, dead grass, &c., likely to cause stoppages in mowing should be carefully removed. It is frequently well worth while to top-dress fields with superphosphate just before closing them for hay or silage, and this is specially likely to be the case if these fields were not top-dressed during the preceding twelve months. Fuller information and a bulletin regarding ensilage are available from local officers of the Fields Division.

The Potato Crop.

In many districts the main crop of potatoes may very suitably be planted during the coming month. In view of the abnormally low price of table-potatoes at the present time particular interest attaches to the fact that field trials have given definite indication of superior yields when the tubers used for seed are of table size instead of the customary seed size. The explanation lies in the fact that tubers of table size are on the whole not so badly affected with virus troubles as the smaller tubers. The present low price of table-potatoes offers an excellent opportunity of reducing the influence of virus troubles by using table instead of seed potatoes in planting this season's crops. The Agronomist advises that if it is intended to cut tubers of the Aucklander and Majestic varieties for planting, then the cut tubers should not be allowed to become dry. Hence it is advisable with these varieties to do the cutting immediately prior to planting if possible, to keep the cut seed in moist sacks, and to plant into moist soil.

Successful crops of potatoes are most readily secured on rich open loams. Field trials have shown that in the main potato-growing districts, which as a rule consist of good soils, the use of 3 cwt. per acre of superphosphate is to be recommended strongly, while on less fertile soils it may be well worth while to use potash and nitrogenous material such as sulphate of ammonia or blood and bone in conjunction with superphosphate.

Further information relative to potatoes appeared in these notes in the *Journal* for September, 1930; much useful information is also contained in the recent departmental publication, "Questions and Answers on Potato Certification," which is obtainable free on application. A summary of recent trials and recommendations regarding the manuring of potatoes in the South Island appears elsewhere in this issue of the *Journal*.

Forage Crops.

Frequently, particularly in dairying, satisfactory provision is not made for supplementing the pastures when in summer they begin to fail to meet the requirements of the stock. The feed available from pastures often becomes inadequate at an earlier stage than many realize; at times the feed from the pastures is failing shortly after Christmas. While it is relatively easy to suitably supplement the feed from the pastures during the latter part of January and February, it is not quite so easy to remedy the weakness that occurs somewhat earlier, because the standard forage-crops used about this season are as a rule not ready early enough to remedy the feed-shortage in its initial stages. Fresh, leafy growth, such as the aftermath from an ensilage field and the second growth from a lucerne field, are likely to be of great value at this stage.

If one cannot depend upon a sufficient supply of feed from such sources it is often worth while to sow in October an area of quickly maturing soft turnips, such as Red Paragon or Purple-top Mammoth, for use early in the new year. The yield obtained from such a crop may not be heavy, but it is likely to be particularly useful. Shortly after the sowing of the early variety the remainder of the soft turnip area may be sown in later-maturing varieties, such as Imperial and Hardy Green Globe, so as to have a portion of these available for use when the more quickly maturing kind has been consumed.

Kales, including chou moellier or marrow-stemmed kale, have frequently been sown with good results in October, when as a rule they will provide feed from the middle of January or the beginning of February. Later sowings of the kales may be made to provide feed for use in the following autumn and winter. Of the kales, chou moellier is foremost in popularity, and, strictly on account of its merits demonstrated in our farming, it is being grown in increasing amounts. A suitable seeding is 1½ lb. to 2 lb. per acre, sown broadcast. Chou moellier demands and deserves high fertility, and usually responds very profitably to a dressing of 2 cwt. to 3 cwt. of superphosphate on good land, a dressing which on poorish land might well be supplemented by 2 cwt. to 3 cwt. per acre of blood and bone.

In general, at this season it is most advisable to take advantage of every opportunity of pushing forward with preparatory work for such crops as mangels, rape, kale, lucerne, and swedes. Year after year the extensive farm-crop competitions held in many districts demonstrate the great value of ample preparatory tillage. They show, further, that expense in other aspects of crop production is apt to be at least partly wasted if the tillage has been neglected.

—R. P. Connell, Fields Division, Palmerston North.

THE ORCHARD.

Spraying Points.

DURING October spraying for the control of diseases should take precedence over all other activities in the orchard. The germination of fungus spores will be taking place rapidly under the influences of rising temperatures and atmospheric humidity, and young fruit will become exposed and develop rapidly in size, thereby increasing the field of infection. It should be borne in mind that the end of this month, generally speaking, terminates the period during which the more concentrated spray-solutions can be applied with safety, and that the maintenance of the orchard free from infection by fungus diseases at the commencement of the season has a valuable influence up to the close of the growing-period. This statement also applies

to the control of those insect pests the broods of which come forward in the early part of the season. "Prevention of increase and limitation of distribution" should be the slogan of all commercial fruitgrowers, this referring particularly to red-mite and apple-leaf hopper, both of these insects appearing as nature provides the foliage for their sustenance.

Last month's notes dealt with suitable spray programmes for the control of the principal diseases and pests, but a special reference to apple-leaf hopper is timely. For the information of readers whose orchards are subject to infestations of this insect it may be mentioned that at the nymph stage the activity of the insect is much restricted, and in consequence control is more easily effected. An application of emulsified oil 1–150 plus Black Leaf 40 1–800 will give a 100-per-cent. kill of those insects which come into actual contact with the solution. Thorough application of the spray, so that the under-surface of all foliage is wetted and no detail is missed, makes this possible.

Fireblight.

Careful watch in both infested and non-infested areas for the occurrence of this bacterial disease is a duty on the part of all orchardists in the interests of themselves and the industry as a whole. Primary infection becomes obvious with the blackening and withering of the blossoms, and later results of infection may be observed by the oozing of sap from the cankers following the breaking-down of wood tissues in the limbs of the trees. The only means recognized as providing satisfactory control is that of cutting away (well outside the area infected) and destroying by burning all diseased parts. The diseased part of the tree is defined by discoloration of the cambium layers. In cases of tip or blossom infection removal should take place at least 6 in. below discoloured tissue, and in the case of large cankers on the main branches removal of the entire limb can be recommended. This somewhat drastic precaution is desirable in order to avoid the retention of infected surfaces over which ooze may have passed and which has become unnoticeable by drying off.

In addition to attention to the fruit-trees, it is of vital importance to fruitgrowers that all hawthorn growing in the vicinity should be kept under observation. Flowers should be closely examined during the blossoming period, bearing in mind that infection in the first instance may be comparatively localized, and that it is within the range of possibility to stamp out initial outbreaks of the disease.

Thinning of Fruit.

This work is of great value in the elimination of disease-infected fruit, together with regulation of the size of fruit and quantity of crop. The results of systematic thinning are far-reaching, not only improving the crop for the current season, but determining in most instances the growth of the tree and subsequent development of the fruit-buds for the succeeding year. It is not always an economic proposition to thin large stone-fruit trees, and such being the case severe cutting-out of fruiting wood during the dormant season should be resorted to, especially in the case of peaches, nectarines, and Japanese plums. Heavy cutting-out of fruiting wood may appear a sacrifice at the time, but it is in most cases a really good investment in fruiting wood for the following season.

In thinning apples and pears, growers must be guided by the general condition of the trees. Robust trees likely to maintain their growth and size of fruit may be left with three fruits to the cluster; others with less constitution should be thinned to two or even one fruit, according to vigour and variety. Generally short-stemmed spur-bearing varieties require more drastic thinning than long-stemmed lateral-bearing varieties, having in mind that opening-up of the clusters restricts the shelter and security afforded such insects as bronze-beetle and leaf-roller caterpillar.

Care of Grafts.

Results of reworking will become apparent towards the end of this month. Where failures have occurred it is not too late to retrieve the position by an addition of more scions, provided the wood has been kept dormant by complete burial in damp sand and stored in a cool place. Growth which arises from the cut-back branches should not be entirely removed until the following dormant pruning, pinching only being practised where the growth is likely to submerge the scions. Growths arising from the stocks have a definite value in the maintenance of excitement to the roots.

Cultivation.

The harrows should now be used to conserve all moisture obtained from the spring rains and to kill weed seedlings. In heavy soils this work is best carried out when the soil is damp but not wet.

—M. Davey, Orchard Instructor, Mapua.

Citrus-culture.

The principal work for the coming month will consist of pruning all trees. This should be specially directed towards the removal of all dead or worn-out wood. It is very necessary that particular attention be given to the centre of the tree. All growths should be well regulated, otherwise a large portion of the fruiting-area may be lost. Cutting back all exhausted wood to a sound bud will give replacements of fruiting laterals. In this manner the crop can be considerably increased. This applies only to lemons, which carry their fruit throughout the tree: it does not apply to oranges with the fruit on the fringe extensions.

Citrus trees have naturally a shallow-rooting habit, but cultivating to a fair depth will assist towards forcing these rootlets to a greater depth where more moisture can be obtained during seasons of limited rainfall. This is of some importance, otherwise wilting of the leaves or partial defoliation of the trees may occur, and thereby cause a loss in the succeeding season's crop. Ploughing should be completed before the surface dries out, otherwise the trees may be checked by disturbing or exposing the roots. Moreover, should a green crop have been grown it will be in a good condition to turn under, and should there be a growth of weeds they can also be buried. If the soil is in a clean condition ploughing at this period of the year is always beneficial, as it breaks up the compacted soil and thereby permits aeration. Ploughing should not be done too close up to the trees, as it may destroy a large quantity of useful roots.

The whole of the cultivation of citrus orchards should be carried out with a certain amount of method—each seasonal operation as it is required. The small portion of ground near the trees should receive attention with hand implements, but the area need not be large so long as the right implements are being used for the general cultural practices.

—L. Paynter, Orchard Instructor, Auckland.

POULTRY-KEEPING.

End of the Hatching Season.

A MATTER of special concern at the present time is that of getting the last hen eggs for the season under the incubation process, in order that the young birds may be given an opportunity of attaining a complete development while the days are long and the weather conditions favourable. In the case of the latest-hatched stock a special effort should be made to prevent any check in development. This involves good feeding and careful management.

It is always a waste of time to try to rear weakly chickens. Not only do they frequently acquire the habit of huddling, but they also induce the stronger birds to do so, and cause much mortality. In nature it is only the fittest which survive to maturity, hence only the strongest birds are permitted to perpetuate the species. A point to be remembered is that constitution is the basis of heavy-producing and disease-resisting stock. It is therefore obvious that to waste time over a weakling is not only inviting an outbreak of disease, but is decidedly unprofitable. The wise poultryman will not even waste time in putting weaklings into a brooder, for even if they come to maturity they will probably never pay for the cost of keeping, and will be a constant drain on the profits of the plant.

Feeding the Laying Birds.

Now that the season has arrived when fowls produce their maximum of eggs, many of the hens are apt to seriously decrease in weight, owing to the great demand on the body-fat for the formation of yolks, which largely consist of fat. Especially is this the case with pullets which commenced their period of production in the late autumn—say, in April. Thus, if the birds are to be maintained in a healthy thriving 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 the eggs that are laid will also rapidly become smaller, while the yolks will not be of the desired rich colour.

The good laying bird when in a heavy-laying condition 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, particularly at this period of the year. If they become too fat it indicates that the food supplied is of the wrong kind, or that they are of a poor laying-strain, or that as a result of old age they have passed their best period of production. An egg is one of the most concentrated and richest food-products known, and 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 set 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 use his powers of observation and his judgment in anticipating the birds' requirements. There is no danger of overfeeding the laying bird with food of the right quality, providing she is given ample opportunity to exercise.

In successful poultry-keeping the aim must be to provide a ration that will return the greatest profit over cost of production, and not necessarily one which will produce the highest number of eggs. Care must be taken, however, that this principle is not carried too far. For example, the present low price at which potatoes can be purchased has induced many poultry-keepers, as a means of cheapening the food-bill, to adopt the plan of including a large quantity of boiled potatoes in the mash and moistening the latter with the water in which the potatoes were boiled, and, as a result, the birds have not laid up to expectations. The feeding of potatoes to fowls of any age does not tend to promote heavy egg-production, especially during the winter months in the case of pullets, but to use the potato-water for mixing the mash is simply inviting trouble not only from an egg-producing point of view, but for the health of the birds as well. For growing stock, or for fattening purposes, a small quantity of boiled potatoes may be included in the mash as a means of reducing the cost of food, but even for this purpose they will do more harm than good if the water is not well drained off before using.

Brooder Troubles.

Asking for information in regard to several details in connection with brooder management, a correspondent raises some points of general interest to which it may prove instructive to refer. He states that during the early season his chickens generally thrive and do remarkably well, but as the season advances heavy losses are experienced, although the young birds receive uniform food and attention at all times. Mention is also made of the fact that the breeding-stock are maintained in a highly desirable breeding-condition throughout the season. As the correspondent has failed to mention the class of brooder used, or to give any advice regarding the local conditions surrounding the stock, a definite opinion as to the cause of the trouble cannot be well expressed. It is safe to assume, however, that the chief cause of the mortality is due to subjecting the chickens to extremes of temperature, and to failure to regulate the degree of warmth and the amount of ventilation to suit the particular season of the year.

It is common for poultry-keepers to work their brooders in exactly the same manner, say, in October and November as during the early season. This is a mistake, as during the early season the weather conditions are more uniform than is the case later, and because of this uniformity the desired degree of temperature and ventilation demanded by the chickens in the brooder can be easily controlled. With the approach of summer, however, extreme variations of climatic conditions are often experienced, and it is these that must be guarded against. It frequently happens that a warm night follows a cold one, and that is where the chief trouble lies. This is chiefly because the chicks become overheated at night, and when leaving the brooder next morning the extreme change of temperature proves too much for them, resulting in chill and its consequent troubles—white diarrhœa, droppy wings, &c. It will thus be seen that as the season advances the greatest care must be taken to ensure that the young birds are provided with a uniform degree of warmth and the necessary fresh air for their welfare.

Where the canopy style of brooder is being used, which is heated with coke or electricity, it is important that methods of management be amended to suit the climatic conditions at this period of the year. These brooders give off a high degree of heat, and with ordinary care they can be relied upon to give good results, particularly during the early season; but with the approach of summer special care must be taken to provide ample ventilation in the brooder-house, in order to prevent the chickens from getting into overheated sweated condition, which is always fatal to their welfare.

It has been found at the Wallaceville Poultry Station when chickens which were being reared under highly heated brooders failed to make desired development towards the end of the season were transferred to canopy lamp-heated brooders, enabling the brooder-house to be maintained at a much lower temperature, the young birds immediately commenced to thrive and do well. This strongly suggests that overheating and insufficient ventilation are the chief causes of the heavy losses that frequently take place among brooder chicks when warm weather conditions prevail.

—*F. C. Brown, Chief Poultry Instructor, Wellington.*

THE APIARY.

Attention to Feeding where necessary.

As advised last month, advantage should be taken of the milder weather conditions obtaining to complete the spring overhaul. This work should not be delayed, as broken weather may be experienced which will not only delay operations, but prevent the bees from gathering sufficient nectar

to meet the requirements of the colony with its increasing number of young bees and larvæ to feed. The first examination is of the utmost importance, as it may reveal cases where the stores are insufficient for the immediate requirements of the colony, or cases of queenlessness.

The spring months are most critical for the bees, and the beekeeper will find that if adequate stores are not provided his losses from starvation will be as great if not greater than those which result from inattention to disease. Few but experienced beekeepers, and those who suffer financially, realize how readily the supply of stores may become exhausted after breeding is in full swing in spring. Usually willows and other spring forage afford a good supply of nectar, but too often these sources of supply are cut off owing to the unsettled weather which invariably obtains in the spring. Normally where colonies contain good queens breeding will go ahead rapidly; containing as they do a larger number of bees and larvæ to feed, the drain on the stores is enormous, and if left without food during a week's bad weather the colony will perish.

Reference to feeding at this period would not be necessary if careful consideration had been given to the matter at the proper time when placing the hives in winter quarters. It is in the autumn that the foundation of the next season's crop is laid down, and this point is too often overlooked. Feeding to obviate starvation may be necessary, but it should be considered only as an emergency measure, and not one of general apiary practice. Too often beekeepers when taking the surplus have little or no regard for the future requirements of the colonies in the way of stores, and in the process ultimately lose many that would otherwise yield a surplus.

Should feeding be necessary a syrup comprised of one-third sugar and two-thirds water may be used. Use only the best white sugar. Once feeding is started it should be continued until such time as the bees can gather sufficient from natural sources.

Swarming.

In the warmer parts of the Dominion, and where colonies are up to normal strength, swarms may be expected any time in October. Many beekeepers attribute swarming to overcrowded brood-chambers, lack of ventilation, and poor queens; but it often happens that swarms issue when none of these conditions is present. On the other hand, bees will refuse to swarm when everything is apparently conducive to their doing so. It must be left to the beekeeper to decide whether he will increase his stock by natural swarming or artificially. If the former plan is adopted it will be wise to allow only strong colonies to swarm. If a weak hive is showing symptoms of swarming—that is, if the bees are building numbers of queen-cells, these should be removed and the colony prevented from swarming until such time as it can be requeened. A swarm from a weak hive is not worth encouraging, because it consists simply of a poor queen, probably failing, and a small cluster of bees.

If, however, a strong colony has made up its mind to swarm, the best thing to do is to allow it to throw a prime swarm, and then to most rigorously guard against after-swarming. This can best be done by cutting out all the queen-cells save one, after the prime swarm has issued. Even then it is wise to carefully watch the parent hive for about ten days after the departure of the prime swarm, because there will be eggs in the old hive, and the bees may continue to raise queen-cells.

Prevention of Swarming.

Frequent examinations of the colonies—every week or ten days during the swarming season—for the purpose of cutting out queen-cells is a help; but this requires considerable work, and, since it frequently fails in spite of every care, it is not usually relied on.

The occurrence of swarming is largely due to overcrowded brood-chambers; hence the queen should be given plenty of room to lay. A suitable plan is to give a new brood-chamber comprising two drawn combs and the rest frames of foundation. Secure the queen and confine her in this new chamber below a queen-excluder, placing the old brood-nests directly above, thus giving additional work for the young bees and plenty of room for the queen to lay in. If for some reason this plan is not desirable, the brood may be equalized by robbing the stronger colonies for the benefit of the weaker.

A young queen in the hive is an outstanding factor of success, as bees are rarely inclined to swarm with a young queen if they have reared her themselves under natural conditions. This feature, however, is not always satisfactory to the beekeeper, as he frequently buys young queens in large numbers from a queen-breeder. He still has to contend against the swarming impulse, although in a lesser degree. A beekeeper rearing his own stock should select not only prolific queens to produce from, but those that have previously shown the least tendency to swarm. There are also other reasons why young queens should be employed, and the practice of introducing them in the spring before the swarming season commences, at intervals of not longer than two years, is a very excellent one. Autumn introduction is also commendable, as the full tide of a queen's maturity is gained from the commencement of the following spring. In order to follow the lives of the mothers as closely as possible and to avoid mistakes some system of recording the various ages must be employed. In addition, notes should be taken of their general behaviour, such as tendency to swarm, prolificness, and gentleness. Such notes will prove of great value in selecting a mother of future queens.

Ventilation also plays an important part in controlling the natural inclination to swarm, and care should be taken to provide sufficient air at all times of the season. A well-known and effective method is to place blocks 1 in. high under the two front corners of the brood-chamber. In the very flush of the honey-flow additional ventilation may be given by drawing one of the supers forward over the rest. This forms two additional entrances and permits the workers to escape to the field without having to traverse the whole depth of the hive.

No single system will be found universally effective. Climatic conditions also frequently play an important part in the behaviour of bees. It will be found, however, that the methods here given, or variations of the same, employed either singly or in combination, will materially assist in the prevention of swarming.

Prevention of After-swarming.

In many cases a prime or first swarm is desirable, and in others the bees often issue in spite of all precautions. It is a simple matter to hive the swarm, but to combat the results in the parent colony arising from this condition entails special action. Persistent after-swarming is one of the discouraging features of natural increase, and is often hard to stop. A good plan is to place the swarm on the old location, removing the parent colony to a new stand some distance away. The immediate result is for all the flying bees to join the swarm, and thus the parent colony is still further weakened. This encourages them to tear down all queen-cells but one, or to destroy all embryo queens after the first young queen has emerged from her cell.

Treatment of Swarms: Providing Supers.

There is little doubt in the minds of many beekeepers who have been accustomed to box hives as to the surplus to be obtained from a swarm. It is not uncommon to find swarms put into frame hives and not provided

with room for surplus. Unless supers are given to strong early swarms from ten to fifteen days after they are established, these colonies will often swarm again and no surplus will be obtained. It must be understood that the season plays an important part in the returns netted, but large amounts are yearly lost through neglect to give ample room for the swarm to store honey. When a swarm has been established a few days a hurried examination should be made to note progress, and from this the beekeeper will be able to form some idea as to the time at which the super will be required.

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

HORTICULTURE.

Small Fruits.

OCCASIONAL light cultivation in fine weather to maintain fertility and destroy weeds is the chief requirement in this section at the present time.

For mulching strawberries, straw or other suitable material should be prepared for bedding-down so soon as the fruit commences to set. Just prior to this a dressing of organic or chemical nitrogenous manure is usually applied with advantage. Where young plants are required for setting out next autumn a sufficient number of rows should be selected for special treatment. This consists of removing most of the flowers in order to check fruiting and encourage the early formation of runners. The mulch also is dispensed with, so that the runners may become established quickly and make strong plants for early planting in the autumn. These will be all the better if the number of runners from each plant is restricted. It has been amply demonstrated that this extra trouble to obtain strong sturdy plants is well worth while, as very few will fail to establish and the cropping average will be improved. Big runners may be obtained by the liberal use of fertilizers, but this is a bad practice, as such plants are invariably soft and turn out unsatisfactory. The less fertilizers are used among the stock plants for growing runners the better.

Tomatoes under Glass.

In a number of instances damage from wireworm has been reported to be taking place in the tomato crops under glass. These larvæ of the click beetles are said to remain in that dangerous form for three or four years, which makes them a serious pest, and so should receive close attention. They are probably first brought into the house in the soil from the seedling-boxes, and they get into the boxes through the soil and other materials being improperly prepared. This is a mistake that is far too common. Soil and decaying vegetable matter is collected without preparation, and the boxes are filled and sown. The soil from rough grassland and decaying vegetable matter is usually heavily infected with plant pests and diseases. Naturally, when it is used without preparation the glasshouse becomes infected at planting-time.

It is for this reason that stacks of soil and manure are kept for two years or so to thoroughly decay and sweeten before they are used, and even then the precaution of steaming the soil is also sometimes taken. Most pests and plant-diseases in the soil may be destroyed by the use of steam, or the pests may be destroyed by means of a good soil-fumigant; but either of these treatments when necessary should be given before planting. After planting is done one is greatly restricted in the use of remedies, and for the pest above mentioned trapping is probably the best under those circumstances.

Some crops of tomatoes under glass fail badly at this period when the outside temperatures rise. This is chiefly due to insufficient ventilation

during the warmer periods. If to this is added a generous supply of water, the disaster is about complete. Soft flabby foliage, leaf-mould disease, and a very poor set of fruit is the usual effect. It is rather an easy mistake to give a crop too much of a good thing, specially heat and water. Tomatoes, however, demand a rather dry, buoyant atmosphere and a moderate temperature for maximum cropping. Recent experiments have affirmed the fact that 60° to 65° F. is the best range of temperature for this crop under glass. In bright sunlight it may rise higher, but if ample top ventilation is available and given no harm is done. Apart from such circumstances as that, high temperatures predispose the plants to disease and interfere with the setting of the fruit.

The Outside Tomato Crop.

The first planting of the outside crop usually takes place towards the end of October. Early maturity and the quality and quantity of the crop will depend very much on how the plants have been grown before planting out. Poor plants may be nursed with fairly good ultimate results, but it adds to the cost, and the returns are never so good. The hardening-off process now is very important, and should be carefully supervised. Reduce the water-supply just before putting the plants out in the cradles, and cover them at night for a while. A day or two before planting out an application of bordeaux mixture will usually be desirable, and land to be planted that is newly broken up should be baited with bran and paris green towards the end of an afternoon. If the land is in good heart apply the necessary fertilizers along the planting lines and mix them in. Carefully choose the weather for planting; plant in a furrow, cutting out each plant so as to disturb the roots as little as possible.

The Market-garden.

The hoeing of seedling crops should take precedence at this season. If the hoe is put through small seedling weeds on a bright dry day they are very quickly destroyed, but if the opportunity is missed wet weather may prevent the operation till the weeds have grown to such a size that the young crop cannot readily be seen.

Crops to be sown now on suitable land are marrows, pumpkins, cucumbers, and melons; also dwarf and runner beans. These are choice products in good demand which crop well on light rich soils that are well sheltered. The important crops harvested during winter and early spring are celery, leeks, cauliflower, broccoli, brussels sprouts, and savoy cabbage. These should be sown in beds outdoors now with a view to raising plants for planting out in December and January next.

Other crops sown now are main-crop carrots, beet, and potatoes, also lettuce, spinach, and salads. Summer cabbage and cauliflower should be planted out.

New Zealand Spinach or Kokihi.

Where the land is light, and especially in dry districts, it is difficult to grow a satisfactory supply of green vegetables and salads for harvesting about midsummer. It is under such circumstances that New Zealand spinach is valuable. In other parts of the world it is largely grown and highly prized for its generous clean crop under these difficult conditions. Kohiki (*Tetragonia expansa*) is a herb that is not uncommon on light lands about our sea-coasts. Sown now very thinly in rows 3 ft. apart it will thrive on a well-drained soil in a sunny situation. The plants should be thinned in the rows to 1 ft. apart. This crop is grown here and much appreciated, but it should be much more commonly planted, especially under the more difficult conditions above mentioned.

—*W. C. Hyde, Horticulturist, Wellington.*

GRADING OF EXPORT BUTTER AND CHEESE.

LEADING DAIRY FACTORY AVERAGES FOR YEAR 1930–31.

Dairy Division.

LISTS of butter and cheese factory companies or proprietaries which have obtained for their export produce an average grade of 93 points or over for the past dairy year—1st August, 1930, to 31st July, 1931—are printed below. Eighty-four butter-factories and twenty-one cheese-factories have gained a place in the lists this year, compared with ninety-three and nineteen respectively for 1929–30. Thirty butter-making companies have gained the very creditable average of 94 points or over, and the highest individual average is 95·198. It is to be regretted that no cheese-manufacturing company reached the 94-point level, the highest individual average in this class being 93·987. Of those included in the lists sixty-nine butter companies and one cheese company are operating in the North Island, and fifteen and twenty respectively in the South Island.

Company or Proprietor.	Registered No.	Brand.	Tonnage graded.	Average Grade Points.
Butter-factories.				
Taieri and Peninsula (Dunedin)	54	Peninsula	20	95·198
Rangitikei	1360	Rangitikei ..	576	95·160
Wangaehu	1326	Wangaehu ..	407	94·935
Rongotea	8	Rongotea	704	94·651
Rata	938	Rata	731	94·635
Awahuri	664	Red Rose	662	94·523
Golden Bay	146	Sovereign	559	94·467
Levin	910	Lake	1,202	94·447
Kokatahi	1144	Kokatahi	139	94·409
Mangorei	345	Mangorei	743	94·386
Lepperton	49	Lepperton	75	94·359
Moa Farmers'	341	Inglewood	918	94·336
Maketawa	342	M.D.C.	235	94·316
Apiti	414	Apiti	170	94·313
Midhirst	110	Rugby	1,242	94·270
United	1220	Whariti	75	94·267
Rangiwahia	750	Quail	180	94·247
Uruti	300	Uruti	199	94,198
Inter-Wanganui ..	6	Inter-Wanganui ..	66	94·104
Tikorangi	102	Shield	384	94·012
Waitaki	812	Waitaki	67	93·998
Taieri and Peninsula (Oamaru)	1234	Peninsula	158	93·943
Waitoitoi	20	Waitoitoi	64	93·931
Golden Coast	991	Golden Coast ..	76	93·926
Kairanga	1768	Longburn	244	93·909
Wairoa	1345	Wairoa	354	93·900
Whakaronga	1709	Whakaronga ..	232	93·891
Tarurutangi	728	Champion ..	109	93·866
Cheltenham	3	Pakeha	2,031	93·859
Okau	872	Okau	167	93·848
Farmers' Dairy Federation (Invercargill)	336	Murihiku	231	93·837
Taihape	1188	Tikapu	236	93·819
Shannon	1489	Shannon	859	93·816
Waitara	726	Waitara	496	93·812
Opotiki	337	Opotiki	1,120	93·802
Kaikoura	302	Kai	247	93·713
Arahura	1516	Arahura	74	93·640
Farmers' Dairy Federation (Gore)	165	Gore	74	93·628

LEADING FACTORY AVERAGES—*continued.*

Company or Proprietor.	Registered No.	Brand.	Tonnage graded.	Average Grade Points.
Butter-factories—*continued.*				
Tolaga Bay	1007	Tolaga Bay	154	93,610
Co-operative of Otago	266	Huia	352	93·606
West Coast Farmers'	675	Silver Pine	54	93·589
Okoia	413	Okoia	532	93·570
Matakana	1375	Matakana	218	93·564
Okato	85	Kaihihi	121	93·556
Palm	1838	Palmerston	169	93·551
Tariki	1818	Tariki	148	93·544
Golden Coast	387	Golden Dawn	22	93·537
Rotokare	248	Westown	28	93·534
Whenuakura	1237	Whenuakura	160	93·533
Te Aroha	344	Overseas, &c.	1,045	93·530
Kaitaia	1298	Kaitaia, &c.	1,073	93·524
Pembroke	234	Pembroke	30	93·523
Wellington Municipal Milk	202	Rahui	105	93·520
New Zealand (Ngatea)	291	Anchor, &c.	1,657	93·518
Norsewood	600	Norsewood	600	93·495
Raetihi	717	Raetihi	141	93·490
Kia Ora	926	Kia Ora	775	93·469
Ruawai	66	Ruawai	906	93·468
North Taranaki	723	Flax	583	93·458
Tamaki	1463	Bell	205	93·440
Kaponga	732	Kaponga	97	93·435
Bay of Islands	1312	Bay of Islands	653	93·368
Bell Block	488	Bell Block	120	93·352
East Tamaki	301	East Tamaki	1,126	93·316
New Zealand (Waiuku)	111	Anchor, &c.	2,097	93·316
Northern Wairoa	4	Northern Wairoa, &c.	1,940	93·308
Hinuera	329	Hinuera, &c.	685	93·294
Tarata	631	Tarata	109	93·281
Rangitaiki Plains	133	Rangitaiki Plains, &c.	2,448	93·271
Rodney	394	Rodney	215	93·258
New Zealand (Waharoa)	293	Anchor, &c.	3,678	93·243
Omata	82	Omata	364	93·242
Alpine	792	Pine	15	93·238
Okitu	1270	Okitu	51	93·207
Hokianga	1843	Hokianga	881	93·150
Eltham	31	Eltham	459	93·140
Katikati	1305	Katikati	519	93·132
Hikurangi	303	Hikurangi	1,139	93·106
Kaipara	794	Poplar, &c.	1,561	93·072
Maungaturoto	1407	Otamatea	527	93·065
Caroline	236	Caroline	161	93·047
New Zealand (Paeroa)	1238	Anchor, &c.	1,425	93·047
Patua	73	Patua	92	93·030
Raglan	1470	Raglan	389	93·018
Cheese-factories.				
Milton	1030	Milton	100	93·987
Barry's Bay	401	Onawe	213	93·910
Omimi	74	Omimi	88	93·823
Oware	662	Oware	141	93·438
Westmere	1621	Westmere	394	93·424
Menzies Ferry	623	Menzies Ferry	384	93·396
Stirling	292	Stirling	430	93·396
Orari	254	Orari	178	93·360
Takamatua	33	Takamatua	34	93·254
Morton Mains	1604	Morton Mains	250	93·217
Little Akaloa	32	Little Akaloa	59	93·196
Seaward Downs	702	Seaward Downs	443	93·164

LEADING FACTORY AVERAGES—*continued.*

Company or Proprietor.	Registered No.	Brand.	Tonnage graded.	Average Grade Points.
Cheese-factories—*continued.*				
Milford	267	Milford	281	93·151
Otahuti	331	Otahuti	138	93·127
Brydone	1821	Brydone	356	93·109
Waianiwa	1171	Waianiwa ..	160	93·098
Glenham	1484	Glenham	188	93·097
Tuturau	132	Tuturau	125	93·060
Edendale	36	Pioneer	629	93·058
Titiroa	361	Titiwiwi	106	93·046
Paretai	271	Paretai	320	93·028

CERTIFICATION OF SEED POTATOES.

CROPS PASSED TUBER INSPECTION FROM 1ST TO 31ST AUGUST, 1931.

Dakota.

Crozier, W. J., Mitcham, via Rakaia. (Line C.)
Eder, W., R.M.D., Sefton.
McGregor, M., Windermere.
Burrowes, J., Mitcham, via Rakaia.
Breakwell, A. J., Tinwald. (Line B.)
Stubbs, J. D., Rakaia.
Hardy, A., Winchmore.

Aucklander Short-top.

Marshall, D., R.M.D., Leeston.
Busch, W. S., R.M.D., West Eyreton.
Swanston, W., Selwyn.
Carroll, A. D., R.M.D., Southbridge.
Moore, H. S., Box 4, Kaiapoi.
Vaughan, H. S. F., Woodend.
Eder, W., R.M.D., Sefton.
Walker, C. E., West Melton.
Seifert, H. A., 33 North Street, Palmerston North. (Line B.)

Aucklander Tall-top.

Seyb, L., Washdyke, Timaru.
Bailey, J., R.M.D., Kaiapoi.
Cross, H. E., Sandy Knolls.

Bresee's Prolific.

Seyb, L., Washdyke, Timaru.

King Edward.

Anderson, A., Stirling. (Line B.)
Mosley, O. S., Stirling.

Majestic.

Clark, A. J., Rangiora.

Up-to-Date.

Walker, C. E., West Melton.

Early Regent.

Eder, W., R.M.D., Sefton.

Iron Duke.

Spillane, A., John Street, Temuka.

Early Rose.

Busch, W. S., R.M.D., West Eyreton.

NOTE.—Merchants and others purchasing seed from growers enumerated in the above and previous lists are advised to state definitely "certified seed" when ordering. This stipulation would ensure that the sacks would have certification labels attached, thus affording a guarantee that the tubers are from a certified crop. Seed so ordered, if delivered in sacks without an official certification label attached, should not be accepted as certified seed. (For previous lists see *Journal* for June, July, and August.)

—*Fields Division.*

Exportation of Stud Stock.—During the year ended 31st March, 1931, the following stud stock was exported from New Zealand: Sheep, 3,270; cattle, 69; swine, 10; horses, 4 (draught). There was the usual movement of racehorses to and from Australia.

WEATHER RECORDS: AUGUST, 1931.

Dominion Meteorological Office.

THERE were several brief periods of stormy weather during August, but on the whole there was a considerable improvement in conditions over those of the two preceding winter months. Temperatures were again below normal over the greater part of the Dominion. Cold, frosty nights were frequent, but, on the other hand, many mild, spring-like days were experienced, and, as a result, there was a moderate growth of pasture.

Rainfall.—The total rain for the month was below the average over the greater portion of the North Island, a slight excess only being recorded in parts of the Taranaki District. In the South Island, Marlborough and North Canterbury experienced less than the normal, while the remaining districts nearly all had above-normal aggregates, the excess in many cases being considerable.

The storms recorded during the month were in very few cases responsible for any particularly heavy rains, except at a few isolated places, chiefly in western districts, the falls generally being more of a showery nature.

Pressure Systems.—During the first four days of the month a very intense and extensive westerly depression was situated over and to the east of New Zealand, and stormy west to south-west winds prevailed, which, in some districts, developed almost hurricane force at times. They were accompanied by occasional heavy showers and, in places, hail. Snow also fell during this period on much of the high country, and on the 4th there was quite a heavy fall of snow in central Hawke's Bay.

From the 5th to the 11th, except for some scattered showers, the weather was mainly fine under the influence of an anticyclone which moved gradually across the Dominion. On the 11th, however, barometers commenced to fall with the approach of a steep westerly depression, and on the 12th a widespread north-west gale blew and heavy rain fell in the western districts. The nor'wester was an extremely fierce one in Canterbury.

The next important disturbance was again one of the westerly type, but it developed a centre in its southern portion, the latter crossing the southern districts during the night of the 16th. Beneficial rain set in with the southerly change on the night of the 16th in Canterbury and Otago, and continued throughout the 17th. Although the falls were not heavy, they relieved the situation in these districts where the land was showing the detrimental effect of the continued dry weather and strong westerly winds.

Another depression, but of moderate intensity, which crossed over the country between the 23rd and 26th, brought rain of a scattered nature. Some heavy falls, however, occurred in Westland about this time, but very little fell in Canterbury and practically none in Hawke's Bay.

During the last three days of the month the weather was affected by an extensive double-centred cyclone. The first centre passed in the south on the night of the 29th, while the following one moved up the west coast and eventually crossed the northern districts during the night of the 31st. Unsettled, dull, misty weather was associated with this depression, and rain fell at times in nearly all parts of the Dominion.

In addition to the depressions already mentioned, there were three occasions when cyclones moved down from the north-east and passed to the east of East Cape. Their nearest approach to the latter point occurred on the 15th, 22nd, and 28th respectively, and their effects were confined chiefly to the East Cape and Gisborne areas. About these dates strong southerly winds blew in those districts, but the accompanying rains

were only light and scattered along the east coast of the North Island, where relatively dry conditions persisted throughout the month.

RAINFALL FOR AUGUST, 1931, AT REPRESENTATIVE STATIONS.

No.	Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average August Rainfall.
	North Island.				
		Inches.		Inches.	Inches.
1	Kaitaia	2·22	17	0·58	5·33
2	Russell	2·87	12	0·64	5·00
3	Whangarei	3·71	16	0·68	6·66
4	Auckland	3·30	17	0·51	4·26
5	Hamilton	2·95	14	0·57	4·28
6	Rotorua	3·52	11	0·63	4·97
7	Kawhia	3·58	16	0·88	4·71
8	New Plymouth	4·84	18	0·84	5·37
9	Riversdale, Inglewood ..	9·12	18	1·35	8·75
10	Whangamomona	5·87	10	1·25	5·96
11	Eltham	4·83	17	0·80	4·98
12	Tairua	3·31	14	0·90	6·05
13	Tauranga	..	..	..	4·29
14	Maraehako Station, Opotiki	3·74	14	1·19	5·52
15	Gisborne	1·18	10	0·42	4·39
16	Taupo	3·04	13	0·82	4·10
17	Napier	0·49	8	0·15	3·54
18	Hastings	1·11	9	0·50	3·27
19	Taihape	2·36	15	0·36	2·80
20	Masterton	2·05	13	0·83	3·48
21	Patea	3·70	17	0·88	3·66
22	Wanganui	2·92	10	0·88	2·78
23	Foxton	2·65	13	0·54	2·90
24	Wellington	2·23	18	0·29	3·82
	South Island.				
25	Westport	11·86	21	2·19	7·70
26	Greymouth	9·74	17	1·74	7·38
27	Hokitika	10·91	19	2·18	9·29
28	Ross	11·87	14	3·10	10·66
29	Arthur's Pass	7·44	5	3·32	12·32
30	Okuru	16·39	14	3·20	11·14
31	Collingwood	8·91	15	1·81	7·01
32	Nelson	3·43	12	1·04	3·03
33	Spring Creek	1·63	9	0·38	2·76
34	Tophouse	6·32	15	1·35	4·58
35	Hanmer Springs	2·92	13	0·97	3·09
36	Highfield, Waiau ..	1·15	5	0·66	2·46
37	Gore Bay	0·50	6	0·21	2·71
38	Christchurch	1·50	13	0·44	1·83
39	Timaru	1·80	10	0·38	1·42
40	Lambrook Station, Fairlie ..	1·36	8	0·49	1·52
41	Benmore Station, Clearburn	1·71	8	0·46	1·57
42	Oamaru	2·67	13	0·78	1·71
43	Queenstown	2·43	11	1·03	1·96
44	Clyde	1·14	8	0·59	0·80
45	Dunedin	4·63	22	0·94	3·10
46	Wendon	3·24	15	0·64	2·06
47	Gore	..	..	..	2·25
48	Invercargill	3·52	19	0·55	3·28
49	Puysegur Point	4·79	22	0·73	7·33
50	Half-moon Bay	4·18	18	0·66	4·73

—*B. V. Pemberton, Acting Director, Meteorological Office, Wellington, 7th September, 1931.*

SEED CERTIFICATION.

SCALES OF CHARGES BEING ADOPTED.

IT has been decided that, commencing with the 1931-32 season, charges will be made in connection with the seed certification scheme conducted by the Department of Agriculture, as follows :—

(Note : The term "line" when used in connection with the machine-dressing charges refers to all that lot of seed covered by any one purity and germination certificate.)

A. Scale of Charges.

1. GRASS AND CLOVER SEED.

(a) Rye-grass and Cocksfoot :—

(i) Entrance fee : 10s., payable with application.

(ii) Excess-area fee : The entrance fee covers the first 10 acres. An excess-area fee of 1s. must be paid for each acre in excess of 10 acres ; payable before paddock-sealing is undertaken.

(iii) Machine-dressing fee : 1½d. per bushel or part bushel of machine-dressed seed. The charge thus made on any one line must not be less than the amount computed at the rate of 6d. per sack or part sack.

(b) White Clover :—

(i) Entrance fee : As in rye-grass and cocksfoot.

(ii) Excess-area fee : As in rye-grass and cocksfoot.

(iii) Machine-dressing fee : 1d. per 10 lb. or part thereof of machine-dressed seed. The charge thus made on any one line must not be less than the amount computed at the rate of 6d. per sack or part sack.

(c) Brown-top :—

(i) Entrance fee : As in rye-grass and cocksfoot.

(ii) Excess-area fee : The entrance fee covers the first 200 acres. An excess-area fee of 1s. must be paid for each 100 acres (or part thereof) in excess of 200 acres ; payable before paddock-sealing is undertaken.

(iii) Machine-dressing fee : As in white clover.

2. WHEAT.

(i) Entrance fee : As in rye-grass and cocksfoot.

(ii) Excess-area fee : As in rye-grass and cocksfoot ; payable before or when forwarding unofficial grain sample. Should the line be rejected on this sample, a refund of the excess-area fee will be made.

(iii) Machine-dressing fee : ½d. per bushel or part bushel.

3. BEANS.

(i) Entrance fee : As in rye-grass and cocksfoot.

(ii) Excess-area fee : The entrance fee covers the first 5 acres. An excess-area fee of 1s. must be paid for each acre in excess of 5 acres.

(iii) Machine-dressing fee : 2d. per bushel or part bushel.

4. POTATOES.

(i) Entrance fee : As in rye-grass and cocksfoot.

(ii) Inspection fee : 10s. payable before 15th December, otherwise no inspection of crop will be made.

(iii) Excess-area inspection fee : The inspection fee covers the first 5 acres. An excess-area fee of 2s. 6d. must be paid for each acre in excess of 5 acres. Payable with inspection fee.

In every case, whenever a fee is due, no further action will be taken by the Department until such fee is paid.

B. General Conditions.

1. The entrance fee for any crop covers all entries of that crop made by any one grower on the one farm. The acreage for the purposes of charging is taken as the total acreage entered by one grower on one farm, irrespective of whether this is in one or more paddocks.

COLLECTION OF FEES.

2. (*a*) The grower is responsible for the payment of all certification fees except the machine-dressing fees, which are payable by the merchant doing the machine-dressing.

(*b*) (i) Entrance fees are payable with application for certification.

(ii) Excess-area fees are payable before paddock-sealing (except in wheat, where it is payable when forwarding unofficial grain sample).

(iii) Inspection fee and excess-area inspection fee (for potatoes) are payable before the field inspection is undertaken.

(iv) The machine-dressing fees are payable by the merchant doing machine-dressing and monthly accounts will be sent out.

3. (*a*) If neither field-inspection nor paddock-sealing is necessary, only the entrance fee is payable, and no excess-area fee will be charged.

(*b*) If either field-inspection or paddock-sealing is necessary (or if both are necessary), then both entrance fee and excess-area fee are payable.

4. (*a*) If a grower enters more than one kind of seed for certification, then on each kind the charges will be computed separately, except as in (*b*) and (*c*) below.

(*b*) In the case of two kinds of seed being harvested together—*e.g.*, white clover (eligible for certification) separated from certified rye-grass at threshing-time—the field charges on the rye-grass also cover the white clover, and only machine-dressing fees will be payable.

(*c*) In the case of seeds dressed out at machine-dressing and being eligible for certification—*e.g.*, white clover dressed out of certified rye-grass—only machine-dressing charges for the white clover are payable.

(*d*) If an area is rejected at field inspection, no excess-area fee is payable except in the case of potatoes, where the excess-area fee covers part of the cost of making the inspection.

MACHINE-DRESSING CHARGES FOR BLENDING AND REDRESSING.

5. (*a*) Charges for sealing and tagging will be made at the time when a sample is drawn for the purity and germination certificate, except that no charge will be made for resampling sealed sacks for the purpose of a fresh purity and germination certificate.

(*b*) A charge will therefore be made at standard rates for resealing and retagging certified seed which is opened for the purpose of redressing or blending, and for which a fresh sample must necessarily be drawn for a purity and germination certificate.

(*c*) There will be no charge made for the sealing of machine-dressed seed which is being held temporarily with the object of blending (as may often occur in the case of brown-top) until such time as the blended seed is finally sealed and tagged and sampled for a purity and germination certificate.

—*Fields Division.*

FORTHCOMING AGRICULTURAL SHOWS.

THE following show dates have been advised :—

Hawke's Bay A. and P. Society : Tomoana, 21st and 22nd October, 1931.
Wairarapa A. and P. Society : Carterton, 28th and 29th October.
Marlborough A. and P. Association : Blenheim, 28th and 29th October.
Manawatu A. and P. Association : Palmerston North, 4th to 6th November.
Northern A. and P. Association : Rangiora, 6th November.
Canterbury A. and P. Association : Christchurch (**Royal Show**), 11th to 13th November.
Egmont A. and P. Association : Hawera, 18th and 19th November.
Otago A. and P. Society : Dunedin, 24th and 25th November.
Wyndham A. and P. Society : Wyndham, 4th December.
Dannevirke A. and P. Association : Dannevirke, 9th and 10th February, 1932.

Effect of Superphosphate on Kairanga Grassland.—Top-dressing with 2 cwt. of super per acre has brought the carrying-capacity of a 50-acre Kairanga farm (Manawatu) from twenty cows six years ago to a forty-cow capacity to-day.

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.

TREATMENT FOR SCOURING MARE.

"ANXIOUS," Lower Kaimai :—

I would like advice regarding a mare that has been scouring for about three months. I have treated her with linseed-oil and turpentine, and burnt flour gruel for about three weeks, also given her the liquid from boiled flax-root, but she is still the same.

The Live-stock Division :—

We would advise you to give the mare 1 oz. of baking-soda twice daily for a week or so in drinking-water or drench. You mention that you gave her the liquid from boiled flax-root; the effect of this would be to cause scouring, not to stop it. The karomiko is what the Maoris use for diarrhœa. Give the animal some crushed oats and bran with a tablespoonful of steamed bone-meal and a dessertspoonful of salt twice daily. Keep her warmly covered, and give a ration of good sweet hay.

THE CURRANT BORER.

"CURRANTS," Raetihi :—

What treatment can I adopt to rid black-currant bushes of borer, and what is the life-cycle of the grub?

The Horticulture Division :—

The currant borer is the larva of a moth known as the currant clear-wing (*Sesia tipuliformis*), of black and yellow colour. The wings are about ¾ in. across when expanded, a considerable area of which is transparent, which gives the insect its common name. Emerging at about midsummer, the moth lays its eggs singly, and they soon hatch out and burrow the stems, to pupate and emerge the following summer. The treatment usually adopted is to prune hard and burn the prunings, as they contain many grubs. If this is done in early autumn, and the bushes sprayed then with bordeaux plus arsenate of lead, the health of the plants would be better in this and other respects.

INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* from 16th July to 10th September, 1931, include the following of agricultural interest :—

No. 64158 : Carcass side holder; Swift and Co. No. 65315 : Teat-cup; E. Hight and H. Hight. No. 66472 : Cheese; A. Axelrod. No. 67040 : Forming fibre into bands; A. Ross. No. 63703 : Packing eggs; G. W. J. Sainsbury. No. 64344 : Teat-cup; A. A. Houghton. No. 64892 : Manure-distributor; A. C. Parker. No. 65075 : Ploughshare; T. Moir. No. 67126 : Pasteurizing-apparatus; Berry Engineering Works, Ltd. No. 64899 : Cover for cream-can; T. Lloyd. No. 65513 : Administering medicine to animals. No. 66550 : Milk and cream cans; P. G. Morse. No. 65008 : Grubber; W. Fleming. No. 65717 : Milk-strainer; A. T. Barclay. No. 67052 : Milking-machine connection; R. McIntyre. No. 67062 : Milking-machine; R. McIntyre. No. 67240 : Fertilizer; Kunst-dunger-Patent-Verwertungs-Aktiengesellschaft. No. 64547 : Drying casein-curd; Joseph Nathan and Co., Ltd. No. 65222 : Post and dropper; A. Watson. No. 65231 : Harrow; H. Stannard. No. 65360 : Harrow; W. E. Hunter. No. 65735 : Hay-sweep; J. Danes. No. 65803 : Tractor-plough control; M. P. Schmidt. No. 65818 : Plough; C. E. Kinnell. No. 65856 : Milking machinery; H. H. Johnson.

Copies of full specifications and drawings in respect of any of the above may be obtained from the Commissioner of Patents, Wellington, price 1s. prepaid.