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PASTURE ESTABLISHMENT ON PUMICE LANDS.

EXPERIENCE AND DATA FROM RECENT DEVELOPMENT WORK.

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DURING recent years the development of farms on the inland pumice areas of the central plateau of the North Island has received considerable attention. In the past some people have more or less boomed the pumice land as a farming proposition, while others have derided it as an area of extremely poor and unprofitable land with no farming future and suitable only for tree planting. Pumice land enthusiasts have stressed the land's ability to produce excellent red clover and turnip crops; its critics have pointed out the difficulties of establishing really good permanent pastures.

The inland pumice areas have lately been adopted by the Government for land settlement. The extensive grassing work carried out in the development of blocks of Crown land has thrown new light on the farming possibilities of pumice soil. The grassing work done shows that red clover and turnips are not as important as was once supposed in developing the land; the important things are the sowing of truly perennial strains of rye-grass and white clover, and top-dressing with superphosphate. Good permanent pastures can be fairly quickly established provided the land is carefully cultivated, permanent strains of grass and clover are sown, and the pastures adequately manured with superphosphate. This does not make the pumice land a farming El Dorado, but it does show that the land offers scope for permanent settlement with comparatively small holdings.

(1) The Pumice Area described.

The central volcanic plateau forms the main water-shed of the North Island. Commencing south of Lake Taupo, it stretches across the North Island from the main mountain range on the east to the high elevated marine plain on the west, and extends northwards as far as the Bay of Plenty. Relatively flat over wide areas, the plateau rises here and there into high volcanic cones, flat-topped hills, and serrated ridges. Rhyolite lava flows and large masses of

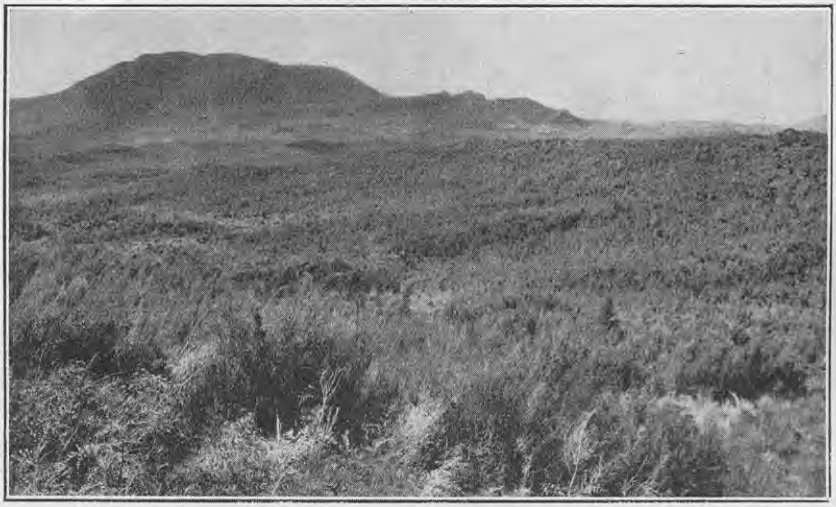

FIG. 1. MOUNT HAPARANGI—A TYPICAL VIEW IN THE UNDEVELOPED INLAND PUMICE AREAS.

[*Photo by H. Drake.*

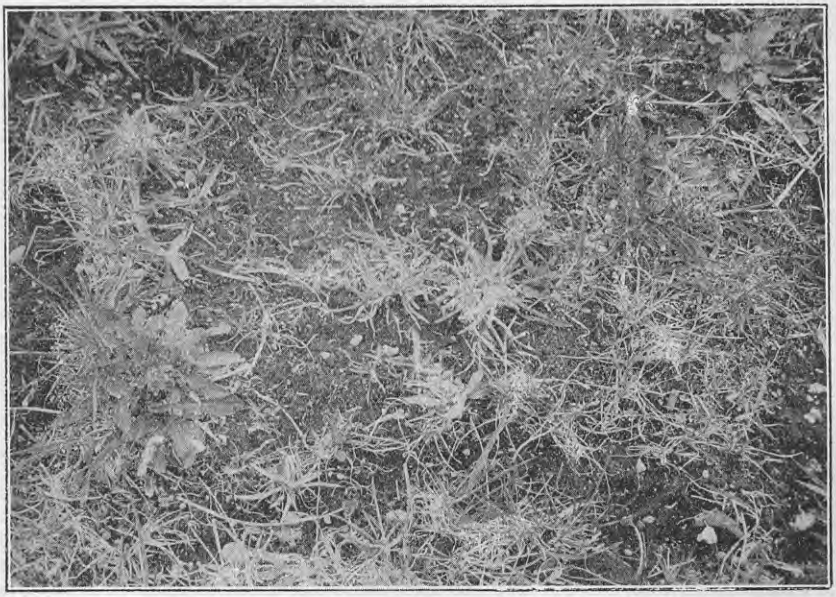

FIG. 2. "TO HALF DO THE JOB IS NO BETTER THAN TO LEAVE IT UNTOUCHED."

A two-year-old pasture with weak and open sward of stunted perennial ryegrass, cocksfoot, dogstail, white clover, timothy, moss, rib-grass, catsear, self-heal, and fog. Compare with Fig. 7.

[*Photo by E. Bruce Levy.*

pumice-stone form the tableland, and the numerous volcanic cones that occur throughout its extent are built up of rhyolite, andesite, and partly also of basalt. Lake Taupo is a real inland sea, covering as it does an area of 238 square miles; it is twenty-five miles long from south-west to north-east, and its greatest breadth is about twenty miles; it lies 1,211 ft. above sea level. The lake is everywhere surrounded with volcanic rocks which form a high tableland 2,000 ft. to 2,200 ft. above the level of the sea, and upon which numerous volcanic cones arise.

The Waikato River leaves Lake Taupo at the north-east end and shapes its course north-east for a distance of twenty miles, flowing through a broad terraced valley on the boundary of the Kaingaroa Plain. After its junction with the Waiotapu River the Waikato makes a sharp turn to the west, flows through a mountainous region in a deep gorge, and emerges near Maungatautari, in the broad plain of the Middle Waikato Basin. This is a large area of flat land extending from the coastal range on the west of the Waipa River to the high volcanic country in the south and east, and extending northwards to the Firth of Thames. The plain is crossed by a low range of hills which separate the plains of the Waikato and Waipa from the plains of the Piako and Waihou Rivers, which empty into the Hauraki Gulf. The land of the plain consists of low rolling hills, flat areas of recent water-borne pumice brought down by the Waikato River from the neighbourhood of Lake Taupo, and large peat swamps.

Pumice Soils.

Soils derived from pumice-stone are of a sandy nature, and in an unimproved state appear particularly barren and unattractive. Probably no better description of pumice land can be given than the following extract from the evidence of Mr. J. B. Campbell, before the Rotorua–Taupo Railway Parliamentary Committee, 1929:—

> The land will do nothing itself. It differs from other land in that it is only the medium by which the human factor and capital can produce revenue, whereas in the case of most other classes of land the land is the main factor and the man and capital the medium. Whatever it turns out to be is in exact proportion to what is put into it. The land itself is not as asset; it is in fact a liability. Owing to the varying nature of pumice land its development up to a revenue-producing pitch is not a clear-cut job. It is a process in which time plays the largest part; the poorer the land the longer it takes. The more it costs the less revenue it produces, and the quicker it depreciates if neglected. When once started the work must be finished if a man is to get his money or a portion of his money back. To half do the job is no better than to leave it untouched.

Virgin pumice land may be likened to a pot filled with sand. Plants can be grown in a pot of sand provided correct moisture, food, and temperature conditions are supplied. If any of these factors necessary for growth are lacking, plant growth suffers. The sand itself supplies nothing. Raw pumice land lacks sufficient phosphoric acid and nitrogen for the successful growth of cultivated grasses. Phosphoric acid can be supplied in superphosphate, nitrogen is best supplied indirectly by white clover, which in turn is encouraged by top-dressing with superphosphate. Although deficient in humus, pumice land is usually moist, and lack of moisture is only a limiting factor in dry seasons when seeds are germinating.

FIG. 3. AN UNDEVELOPED TUSSOCK AND MANOAO FLAT. NGAKURU BLOCK, ROTORUA DISTRICT.

[*Photo by E. Bruce Levy.*

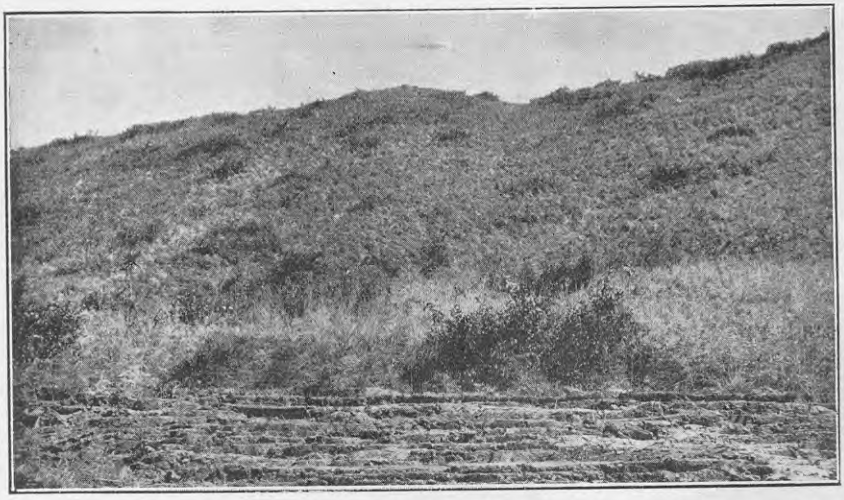

FIG. 4. HILLSIDE COVERED IN BRACKEN-FERN AND TUTU. NGAKURU BLOCK.

[*Photo by H. Drake.*

Climate.

The inland pumice areas receive a rainfall of about 50 in. per annum; the mean annual rainfall for forty years at Rotorua is 55·72 in., with 143·8 wet days. Frosts are common on the elevated inland districts and may occur at any time of the year. Rotorua, 925 ft. above sea level, has 85 days in the year with ground frosts; the months of most frequent frosts being May (11 days), June (14 days), July (16 days), and August (16 days). On the open pumice plains cold winter winds from the snow-clad mountains in the centre of the Island add to the severity of the climate. Shelter plantations are essential in dairy-farm development. Unseasonable frosts sometimes hinder pasture establishment, killing the germinating clovers. October is usually the best month for spring sowing of grass, and late February for autumn sowing.

Surface Covering.

The elevated plateaux of rhyolite are often densely wooded, and the rimu-tawa and totara forests predominate. On the open plains of recent air-borne and water-borne pumice-stone the porous sandy soil gives rise to semi-arid conditions, and the vegetation consists of a tangled mass of tea-tree (manuka) and manoao, with open spaces covered with tussock. The extent of tea-tree and manoao scrub on the open pumice country depends a good deal on its situation. Manoao scrub is usually dominant on the colder flats and tea-tree on the warmer hills and sidlings. Bracken fern and tutu cover most of the larger hills rising out of the pumice plains. The height of the tea-tree varies from 2 ft. to 10 ft., depending on whether fires have recently swept the country. Near the main roads, where fires are common, tea-tree and manoao scrub are short, but away from the roads much of the country is clad in fairly dense 5 ft. to 8 ft. tea-tree and 3 ft. to 4 ft. manoao.

Farm Crops.

Pumice land is a light sandy soil and easy to cultivate. When first turned over it will grow fair turnip and luxuriant red clover crops. The ability of pumice land to produce these crops at a low cost has been a great incentive to pumice-land development. Before the advent of certified perennial rye-grass seed the establishment of good permanent pastures was a difficult and costly business. The sowing of permanent or semi-permanent grass was usually preceded by temporary pastures of red clover designed to raise the fertility of the soil. Turnips were usually the first crop sown, and frequently red clover was drilled with the turnips. The rough red clover pasture was left down two or three years, during which time it considerably improved the soil fertility. Where turnips were sown alone the crop was usually followed by a temporary or long-rotation pasture, of which again red clover was the chief feature. After a second crop of turnips the land was sown down to permanent or semi-permanent grass consisting of perennial rye, cocksfoot, timothy, red clover, and white clover. The permanence of the pasture depended on the usefulness of the perennial rye sown and the attention given to top-dressing. Where good perennial rye was sown and the pasture regularly top-dressed, quite good

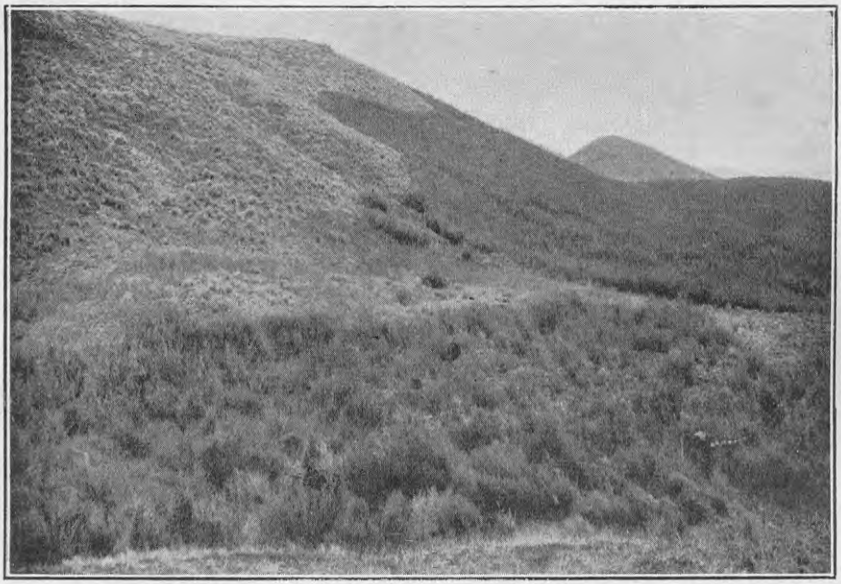

FIG. 5. HILLSIDE IN NATURAL STATE, SHOWING AREA BURNT SOME YEARS AGO WHICH HAS REVERTED TO TUSSOCK. NGAKURU BLOCK.

Clearing costs can be considerably reduced if the manuka and manoao scrub are burnt standing two or three years ahead of cultivation.

FIG. 6. PLOUGHED LAND BEING ROLLED ON THE FURROW, NGAKURU BLOCKS.

[*Photos by E. Bruce Levy.*

rye-cocksfoot-white clover pastures were obtained; where poor short-lived strains of rye-grass were sown (and these unfortunately comprised the majority of sowings) the pastures rapidly deteriorated and soon reached a stage of poor open swards of cocksfoot, fog, and white clover.

(2) Development of Farming on Pumice Land.

The settlement of the Waikato district marks the first stage in the development of pumice lands. The plains of the Middle Waikato Basin consist of low rolling hills of unconsolidated pumiceous sands and silts, flat areas of recent water-borne sandy pumice, and large peat swamps.

FIG. 7. PERMANENT PASTURE, NGAKURU DEMONSTRATION FARM, THREE YEARS OLD.

Sown October, 1930, on first furrow, after clearing scrub. Dominantly perennial rye-grass, white clover, red clover, and cocksfoot.

[*Photo by E. Bruce Levy.*

The soils of the low rolling hills are loams of fair fertility; the soils of the plains are sandy in texture, and in an unimproved state are of low fertility.

After the Waikato War in 1864, the Natives were driven from the plains of the Waikato, their land was confiscated, and the country settled with Europeans. Successful early European settlement took place mainly on the low rolling hill country where the soil was moderately fertile, but progress was very slow until the phosphatic top-dressing of grassland became an established practice. The development of the plains of pumice sand spread out gradually from the farming centres on the low hill country, and it is very doubtful whether the pumice plains of the Waikato would have been successfully settled as early as they were had not areas of moderately good land occurred through

them. From the farming centres of Hamilton, Cambridge, and Te Awamutu settlement gradually spread south and east to Matamata, Tirau, and Maungatautari, until settlement reached the edge of the central volcanic plateau, where the occurrence of "bush sickness" checked settlement.

Bush sickness is a deficiency disease occurring in cattle and sheep, and is caused by an insufficiency of iron in the herbage. The condition occurs chiefly on areas covered by wind-borne pumice; areas of water-borne pumice are generally free from the complaint. Bush sickness for many years hindered the settlement of pumice land on the central plateau, but it is now satisfactorily treated with limonite licks for cattle and sheep.* Checked on the edge of the plateau by bush sickness, the more recent settlement of the inland pumice country took place on the alluvial pumice areas surrounding Lake Rotorua and in the valley of the Upper Waikato.

Settlement of Waiotapu Valley.

Pioneer settlers were attracted to settle in the Waiotapu River Valley, near its junction with the Waikato River, by the existence of considerable areas of good swamp land. From the swamps land development spread to the open pumice plains. Mr. W. G. Butcher and Mr. E. Earle Vaile were the pioneer settlers, and their valuable experience in developing inland pumice land is described in an article ("Breaking-in of Light Pumice Lands") in the September, 1920, issue of this *Journal*. The course of development described is to clear and burn, plough and sow turnips, and follow with grass. The need for soil consolidation is stressed. Perennial rye-grass was not considered permanent, the reason being that false perennial rye was at that time being sold as perennial. With this exception their notes on grassing may well be repeated here as follows:—

> The main consideration in grassing is getting a soil covering. Bare spaces are fatal; therefore grasses that will grow should be sown. Cocksfoot gives most feed, except in winter, when frosts cut it rather badly. Perennial rye-grass is not perennial—if one may express it that way. Italian rye is useful for a quick bite while other grasses come on. Crested dogstail forms a good sward. Danthonia—the pilosa variety—forms a dense sole absolutely permanent, and keeps green throughout the winter. Brown-top gives a good pasture in the spring and autumn, but no feeding during frosts or drought. It, more than any other grass, tends to creep into and fill up all bare spaces, although inclined to get root-bound. Yorkshire fog is a grass too much neglected. It grows anywhere and gives a great bulk of feed, even if it be of rather poor quality. More than any other grass it adds humus to the soil and gives place to better grasses without much trouble. Among the clovers cow-grass is supreme, yielding an immense quantity of rich feed on all pumice soils. On its cost it pays far better than any other pasture plant. White clover also thrives astonishingly, and, once established, never leaves the soil. The native trefoil or suckling clover is very useful, and sheep's burnet is a welcome addition to the bulk of the pasture.
>
> The following is a good mixture for ordinary light pumice land: Cocksfoot, 10 lb.; Italian rye-grass, 4 lb.; crested dogstail, 4 lb.; Yorkshire fog, 2 lb.; brown-top, ½ lb.; Chewings fescue, ½ lb.; cow-grass, 4 lb.; white clover, 1 lb.; suckling clover, 1 lb.; sheep's burnet, 2 lb.; with 6 oz. soft turnips added for spring sowing, or 1 bushel of rye-corn for autumn sowing. . . .
>
> A mixture such as this, for a first furrow, will become quite permanent, but probably it will pay to plough it up after about seven or eight years. A crop of swedes should be put in this time, and the land afterwards relaid with better grasses for a permanent sward.

* "Control of Bush Sickness in Sheep," B. C. Aston, Chief Chemist, Department of Agriculture. June, 1932, issue of this *Journal*.

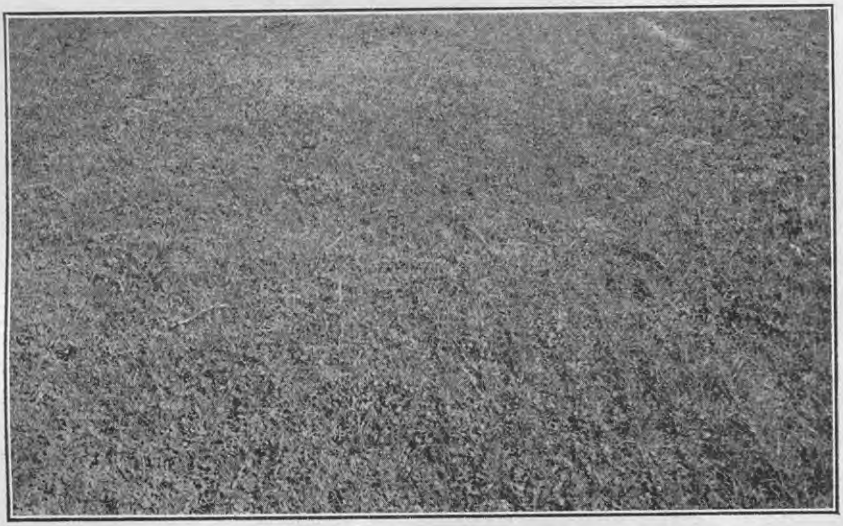

FIG. 8. PERMANENT PASTURE ON GALATEA ESTATE, EIGHT MONTHS OLD.

Sown March, 1933; sward well filled in with white clover; shows very good establishment. Compare with Fig. 9.

FIG. 9. OTHER PERMANENT PASTURE ON GALATEA ESTATE, EIGHT MONTHS OLD.

Sown March, 1933; shows poor clover establishment; note how grass and clover establishment is confined to Cambridge roller marks.

[*Photos by E. Bruce Levy.*

The writers have not tried top-dressing, but doubtless it would be beneficial. Nor have they had enough heart to plough in green crops. In their opinion it is preferable to feed off these green crops, and the resultant dung with a little artificial manure added will probably pay better than ploughing in the crop itself. . . .

Since this article was written in 1920 the position in regard to grassing inland pumice areas has been altered by the introduction of certified perennial rye-grass seed, and by improved road conditions enabling top-dressing to be carried out.

(3) Pasture Establishment.

Clearing.

The open pumice land is covered with a tangled mass of tea-tree and manoao, with tussock on the colder flats. Before ploughing, the surface covering should be cut and burnt. In developing pumice country a great saving can be effected in clearing costs if the tea-tree and manoao are burnt standing two or three years ahead of cultivation. Dense manoao scrub is difficult and costly to clear in its green state, but it carries a fire well and its burnt sticks soon rot. When immediate grassing is to be undertaken the whole of the natural covering of tea-tree and manoao is best cut and burnt before cultivation takes place in order that a really firm seed-bed may be obtained.

Cultivation.

For a long time there has been a division of opinion regarding the best method of cultivating pumice land for grass. Some people advocate disking the surface, others ploughing, but both sides are insistent on the need for a well-consolidated seed-bed. The disking advocates maintain that surface working retains the natural soil consolidation, while the ploughing advocates insist that ploughing is necessary to eradicate tussock, fern, and tea-tree, Good surface cultivation may be better than poor ploughing and sowing on an unconsolidated seed-bed; but good ploughing, sufficient fallow to aerate the surface soil, followed with surface cultivation aiming at seed-bed consolidation, invariably give better results than surface cultivation.

A good seed-bed is clean, sweet, moist, fine, firm, and deep at the time of sowing. These qualities favour plant growth because they offer conditions suitable for rapid root development. Aeration is one of the main objects of cultivation, although the fertilizing effects of aeration are not fully understood. It has an effect which the farmer expresses by the term "sweetening." Possibly one effect of exposure of the soil to the air is to decompose organic compounds which may in some way be injurious to plant growth.

Aeration and firmness are somewhat opposite characters. The soil cannot be well aerated unless its firmness be broken down, but a loose seed-bed is not satisfactory for the growth of plants. After the soil is aerated a suitable degree of firmness must be restored to the layers beneath the surface. Firmness is necessary to allow of the proper rooting of plants and the supply of moisture; the feeding organs of the young plants—the root hairs—must apply themselves closely against the soil particles in order to draw upon the film moisture surrounding them. Further, as the moisture is used or dried up from one part of the soil, it is desirable that the loss be replaced from another

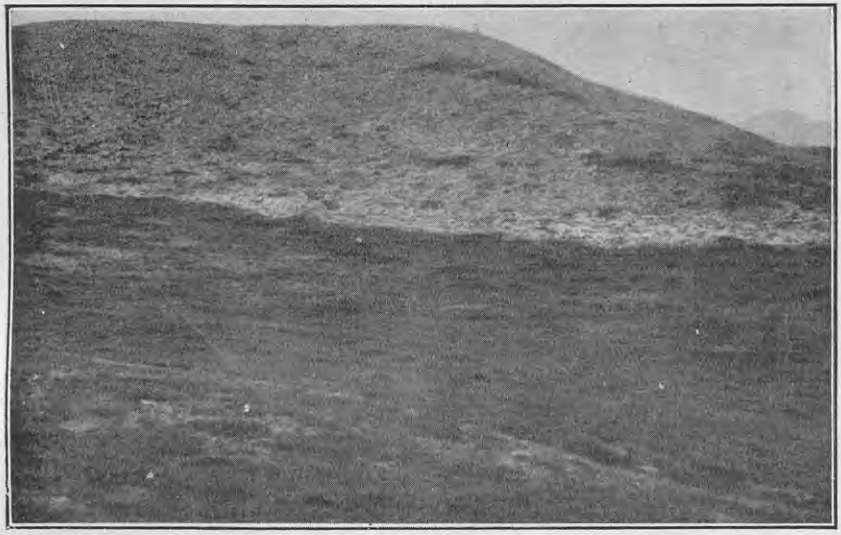

FIG. 10. "PERENNIAL RYE WILL NOT THRIVE WITHOUT WHITE CLOVER."

Showing hillside ploughed, lightly cultivated, and unrolled, contiguous to flat land, ploughed, well cultivated, and rolled. The hillside and flat country seed mixtures varied, but each included 2 lb. of white clover. The good sward on the flat land is due to amount of white clover present.

FIG. 11. "WHITE CLOVER IS SLOW TO ESTABLISH ON STEEP HILLSIDES WHERE THE CAMBRIDGE ROLLER CANNOT BE USED."

Hillside sowing, showing isolated white clover establishment and healthy grass, and stunted grass-sward where clover is absent. The main grasses shown are rye-grass, brown-top, and Yorkshire fog. Ngakuru Block.

[*Photos by E. Bruce Levy.*

part, usually the lower layers. Moisture will not move in a loose spongy mass of soil. The seed-bed must be consolidated from below up.

Experience has shown that the most suitable cultivation of pumice land preparatory to grass and crops is to plough with a lea mouldboard plough 5 in. deep (the better the ploughing the easier the subsequent work of seed-bed preparation); leave fallow for four or five months to allow of weathering and aeration, and for the furrow slices to close together; then roll on the furrow with the Cambridge roller; double disk; chain harrow to level the surface; roll before sowing seed and fertilizer; cover the seed with chain harrows, and finally roll.

Ploughing is essential for proper soil aeration; the plough brings up a layer of soil from below to be sweetened and weathered. The lea mouldboard is preferable to the digger mouldboard, as with the former subsequent consolidation is easier. Where roots or stumps are common tail-plates may be necessary on the mouldboards to allow of the furrow slices being completely turned and pressed together.

Rolling on the furrow with the Cambridge roller is important; rolling should be done in the direction of ploughing, and the heavier the roller the better. This rolling consolidates the bottom of the seed-bed, and brings the soil moved by the plough again in close contact with the unmoved subsoil, making a continuous firm layer of soil through which soil moisture may move from the deeper layers to the surface.

Permanent Pastures.

Recent grassing work on pumice country has shown that provided truly perennial strains of rye-grass are sown and the pastures regularly top-dressed with superphosphate quite good rye-grass-cocksfoot-white clover pastures can be established after the first ploughing. Establishment is somewhat slow, and it is usually twelve months before a rye-grass-white clover sward is obtained. Slow rye-grass establishment is due to lack of nitrogen, and a useful rye-grass growth is not obtained until the white clover growth, encouraged by top-dressing with superphosphate, has covered the bare ground between the grass plants. The use of ammoniated super to encourage quick rye-grass establishment has not proved economical; when sown with the seed it has proved detrimental to white clover establishment, and, although it promotes rye-grass growth on pastures after establishment, the effect of the sulphate of ammonia is short-lived. Permanent pastures following temporary pastures of red clover establish more quickly than those sown after the first ploughing. Whether the pastures should be sown after the first ploughing or after temporary pastures will depend on circumstances. When laying down large areas the sowing after the first ploughing appears to be most economical; while for a farmer gradually developing his farm the taking of initial crops of red clover and turnips, followed by permanent grass, is probably the best course to pursue. The time and cost of growing temporary pastures and value of fodder produced have to be balanced against the cost of 30s. to 40s. per acre for extra fertilizer for permanent pastures sown after the first ploughing.

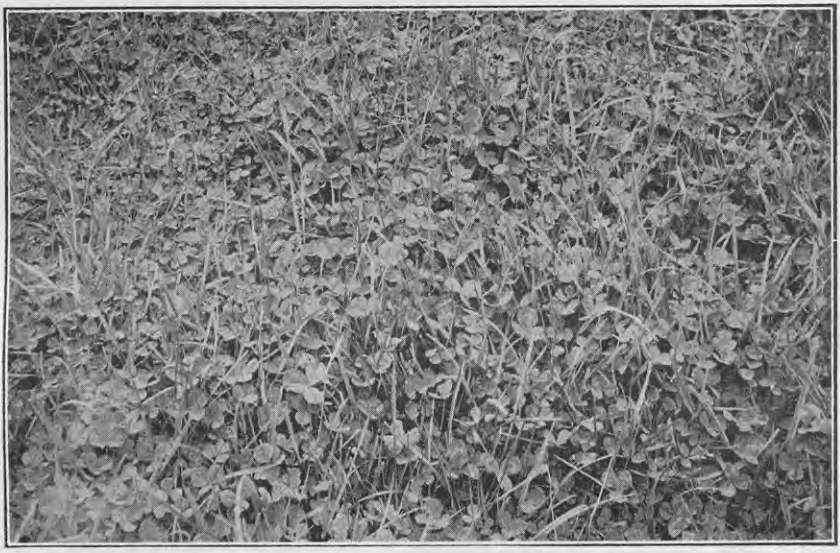

FIG. 12. "GOOD PERMANENT PASTURES CAN BE OBTAINED WITHOUT THE USE OF RED CLOVER."

Two-year permanent pasture sown October, 1931. Grass mixture: Italian rye 5 lb., perennial rye 22 lb., cocksfoot 10 lb., crested dogstail 3 lb., white clover 4 lb.—total 44 lb. Ngakuru Block.

FIG. 13. ONE-YEAR-OLD PERMANENT PASTURE, GALATEA ESTATE, SOWN OCTOBER, 1932, SHOWING STRONG RED AND WHITE CLOVER GROWTH.

[*Photos by E. Bruce Levy*

Grasses and Clovers.

Italian rye-grass is used in both temporary and permanent pastures. The production from Italian rye varies a good deal, depending on the fertility of the soil and the time of sowing. The grass is short-lived, and if spring sown (particularly if sown late) it throws very little feed. It is doubtful whether it is worth while sowing any Italian rye in permanent sowings. In places it may be worth while to include 5 lb. per acre in autumn-sown permanent mixtures. For temporary pastures, autumn sown, up to 25 lb. of Italian rye-grass should be sown.

Perennial rye is the main grass for permanent pastures, but it is essential that only truly perennial strains be sown; false perennial rye rarely lasts more than twelve months. Perennial rye will not thrive without white clover, and an essential feature of permanent pasture sowings with perennial is that the pastures must be regularly top-dressed with superphosphate. About 25 lb. of perennial rye-grass seed should be included in grass mixtures for permanent sowings.

Cocksfoot combines well with rye-grass and white clover in permanent pastures; it produces good summer feed but is cut by frosts in the winter. Cocksfoot does best under light conditions of stocking; it will persist on pumice soils under a soil-fertility condition too low for rye-grass, but then the quantity of feed it produces is small and herbage unpalatable. About 10 lb. of cocksfoot seed should be included in permanent pasture sowings.

The usefulness of timothy in permanent pasture sowings is difficult to gauge. Under rotational grazing conditions it does not appear to provide much feed, although it grows well when fields are closed for ensilage or hay. The seed is cheap, and up to 2 lb. of seed may be worth sowing in permanent mixtures.

It is usual to sow two or three pounds of crested dogstail seed in permanent sowings, but this grass does not provide anything like the feed rye-grass does. It may be usefully used in mixtures sown on steep faces where it is able to persist by reseeding.

Yorkshire fog grows well on pumice land, provided it is associated with either red or white clover; without clovers it produces little feed. It is a useful pioneer; sown with Italian rye-grass and red clover in a temporary pasture mixture, fog persists after the Italian rye has disappeared and gives a lot of feed, as well as providing humus when the temporary pasture land is ploughed up. It is also usefully employed in sowings on steep faces, where soil consolidation is difficult and where rye-grass and white clover will take a long time to establish. Sown in permanent mixtures it gives place to rye-grass and white clover as soil-fertility conditions improve with top-dressing.

Brown-top is only useful in grassing steep hillsides where soil consolidation is difficult, and where rye-grass and white clover take a long time to establish. Up to 2 lb. of brown-top seed per acre may be included in hillside sowings.

Red clover grows luxuriantly on pumice land. The great danger from heavy sowings of red clover in permanent pasture mixtures is that its luxuriant growth may smother out the rye-grass and white clover plants. The red clover growth must be controlled either by cutting for ensilage or heavy stocking. Farmers frequently sow up

FIG. 14. TEMPORARY PASTURE OF ITALIAN RYE-GRASS AND RED CLOVER ON NGAKURU BLOCK.

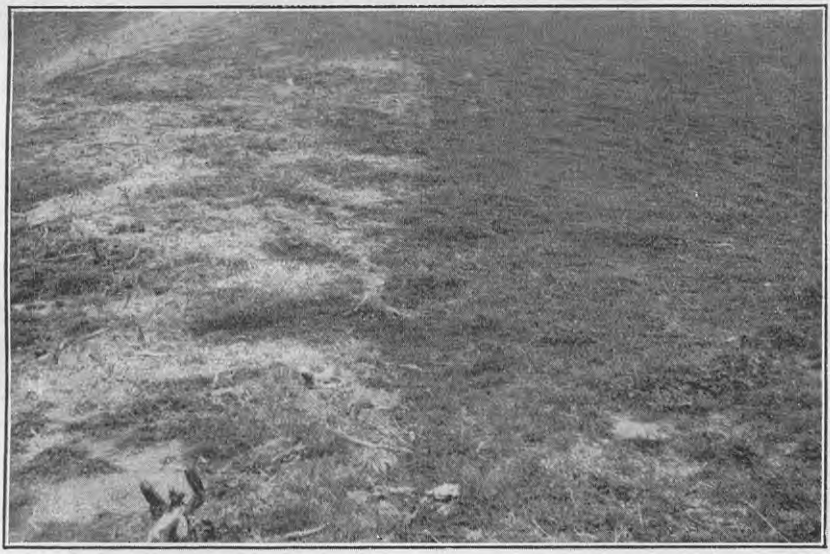

FIG. 15. RESULT OF BURNING AND SURFACE-SOWING COMPARED WITH SOWING AFTER PLOUGHING, NGAKURU BLOCK.

On left, surface-sown, February, 1931, after cutting and burning scrub; on right, sown after ploughing, October, 1931.

[*Photos by E. Bruce Levy.*

to 5 lb. or 6 lb. of red clover in permanent pasture seed mixtures; this sowing is too heavy, and 2 lb. should be looked on as the maximum amount advisable in permanent pasture mixtures; even this amount may be too much if subsequent management is not thorough. The rapid growth of red clover in late spring and early summer is not palatable to milking cows, and grazing is facilitated if pastures are trimmed with the mower and the clover wilted before the cows eat it. Experience has shown that good permanent pastures can be obtained without the use of red clover, and for ease of pasture management it is a decided advantage to have some fields on the farm without it. However, as a means of building up fertility in a permanent pasture,

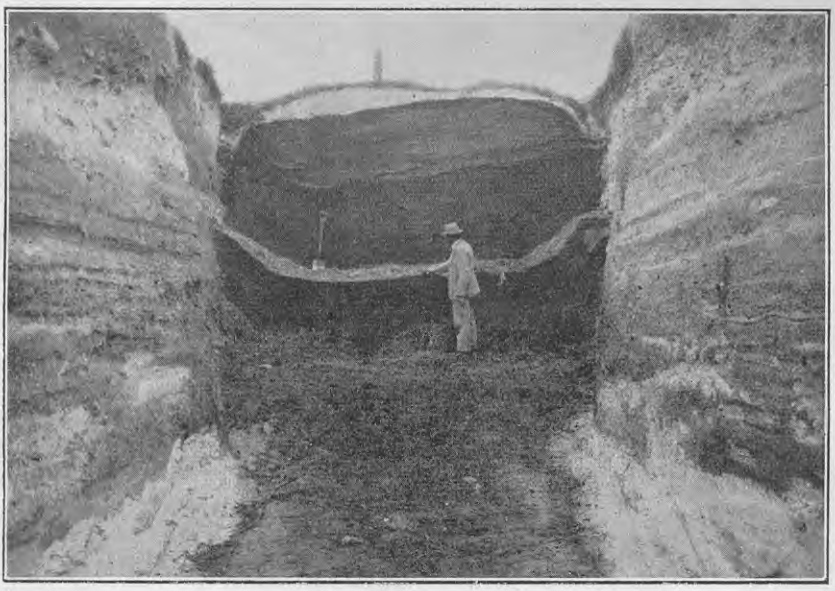

FIG. 16. HILLSIDE ENSILAGE PIT, NGAKURU BLOCK.

Saving of the surplus summer production of grass and clover as silage for winter feeding is an important feature of grassland management on pumice land.

[*Photo by E. Bruce Levy.*

red clover has its uses, provided sufficient stock can be crowded on during the growing period to keep it in check. The heavy red clover growth will carry a large number of wethers and dry cattle, and the tramping and manuring effect of large numbers of stock will rapidly improve a pasture sward. This concentration of stock is one of the most important factors in permanent pasture establishment, and the inclusion of red clover in permanent pastures allows of heavy stocking during the early stages of establishment. Red clover is an important constituent of temporary pasture sowings; the large bulk of feed it produces makes good ensilage, heavy supplies of which are required for winter feeding of dairy stock. Six pounds of red clover per acre should be included in temporary pasture sowings.

White clover makes the pastures on pumice land—without white clover grasses will not thrive. Pumice land is easy to bring in because it will grow good white clover quickly, provided the seed is sown on a well consolidated seed-bed and manured with superphosphate. Frequent Cambridge rolling is required to get the seed-bed sufficiently consolidated for rapid white clover establishment. White clover and superphosphate are essential for the development of the ideal grass and clover perennial sward on pumice land. White clover is a highly palatable species of long seasonal growth, and is capable under manuring of spreading to form a complete surface cover, an important feature in grassing pumice land. It blends in well with the grasses of the sward, and the association with them helps nitrification in the soil, without which healthy grass growth is impossible. White clover is slow to establish on steep hillsides when the Cambridge roller cannot be used. For hillside sowings Lotus major should be included in the mixture as a pioneer clover plant, until the stock have firmed the land sufficiently for white clover to do well.

Alsike clover grows quite as well as red clover, but its use is not recommended for grazing purposes, as its summer growth on pumice land is unpalatable. Milking cows definitely refuse to eat alsike in the late spring and summer unless it is mown and wilted.

Grass Mixtures.

The basis of a permanent pasture mixture for easily ploughable pumice land should consist of certified perennial rye-grass 25 lb., cocksfoot 10 lb., and white clover 2 lb., per acre. For autumn sowings 5 lb. of Italian rye-grass may be added, and where red clover is desired in permanent sowings 2 lb. of it should be included; on undulating country with steep gullies 3 lb. of crested dogstail could be added to assist with the grassing of steep faces. For general conditions a useful permanent pasture mixture will consist of certified perennial rye-grass 25 lb., cocksfoot 10 lb., crested dogstail 3 lb., red clover 2 lb., and white clover 2 lb.—total 42 lb. per acre.

For steep hillsides which can only be ploughed with difficulty and on which the Cambridge roller cannot be used for consolidation, the grass mixture requires the addition of grasses that do not demand high-fertility conditions. Yorkshire fog and brown-top are quite good, and a useful mixture for hillside sowings consists of certified perennial rye-grass 12 lb., crested dogstail 3 lb., cocksfoot 6 lb., brown-top 2 lb., Yorkshire fog 2 lb., red clover 1 lb., white clover 2 lb., and Lotus major 1 lb. The greatest difficulty in establishing pastures on steep hillsides is to get a satisfactory strike of white clover on land that is not well consolidated; Lotus major has proved a good pioneer plant on loose hillside soils.

Time of Sowing.

Permanent pastures on pumice land can be sown in the autumn or the spring. At low elevations where the climate is mild, early autumn sowings are generally the best, but at high elevations—1,000 ft. and over—where early autumn frosts are common, spring sowings are generally the most successful. At the Ngakuru blocks (1,200 ft.) October proved the best month for spring sowing and February for autumn sowings; pastures sown after the first week in March generally suffered badly through frost killing the germinating clovers.

Fertilizers.

Pumice land shows a marked response to phosphatic and nitrogenous fertilizers: potash and lime give little or no visible response. Superphosphate is the most satisfactory phosphatic fertilizer, and when sowing grass 3 cwt. per acre should be applied with the seed and a further 3 cwt. within four months of sowing; this second application encourages a rapid growth of white clover which is so essential to form a complete turf. As a farm practice the use of nitrogenous fertilizers for pasture establishment does not appear to be worth while. Sulphate of ammonia seems to have a retarding effect on white clover growth, although it encourages rye-grass for a short time. It appears that the best practice is to rely on clovers to provide the necessary nitrogen for grass growth.

Management.

Pasture management is important in securing good pastures. Pastures on the pumice land at high elevations are somewhat difficult to manage; the winter is long and comparatively severe, and when spring growth does start it is extremely rapid. Adequate stocking of pastures during the summer necessitates the provision of large supplies of winter feed. Stocking and management may be carried out with milking cows or grown sheep and dry cattle. With milking cows the essentials are fairly close subdivisions, allowing fields to be stocked with ten to fifteen milking cows per acre for short intervals; the use of the mower to control heavy growth of red clover; and the provision of large quantities of hay and silage or roots for winter feeding. The cutting and wilting of the red clover growth for milking cows is important. Growing red clover is not very palatable, and if cows are forced to eat too much of it butterfat production suffers; if, however, the clover is cut and wilted milking cows do remarkably well on it. With grown sheep and two-year-old dry cattle mowing is not required, as this class of stock can be forced to clean up the whole of the heavy summer growth of clover and grass.

(4) The Development of Unoccupied Crown Land.

The Land Laws Amendment Act, 1929, embodied a plan for the promotion of settlement on undeveloped Crown lands. The Minister of Lands is empowered to develop—to grass, fence, drain, and erect buildings on—unoccupied Crown lands prior to settlement. For the carrying-out of this work he was empowered to purchase machinery and other plant, to erect camps, and to farm the land for a period after its initial development. A considerable amount of development work under this Act has been undertaken on the pumice land in the Rotorua district, and experience gained in these large-scale grassing operations has enlarged our knowledge of the principles and practice of grassing pumice country.

The development of Ngakuru Block 1 was commenced in February, 1929, and of Ngakuru Block 2 in November, 1929. To date 4,500 acres have been grassed, 2,000 acres are being used for dairying on which are being milked one thousand cows, and the remaining land is running dry stock. These blocks are situated thirteen to twenty miles from Rotorua, and lie in the basin of the Whirinaki Stream, which flows into the Waikato River near Atiamuri. The land varies in

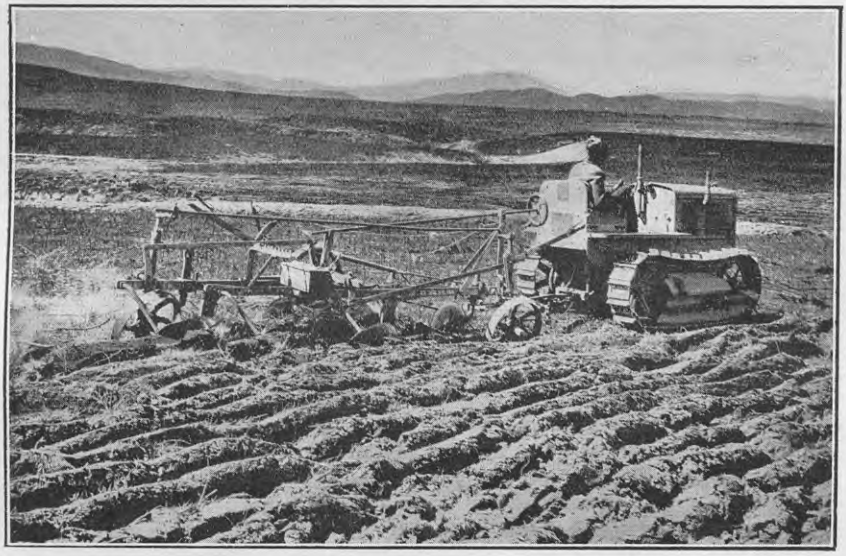

FIG. 17. PORTION OF NGAKURU BLOCK I DURING DEVELOPMENT, APRIL, 1930.

[*Photo by H. Drake.*

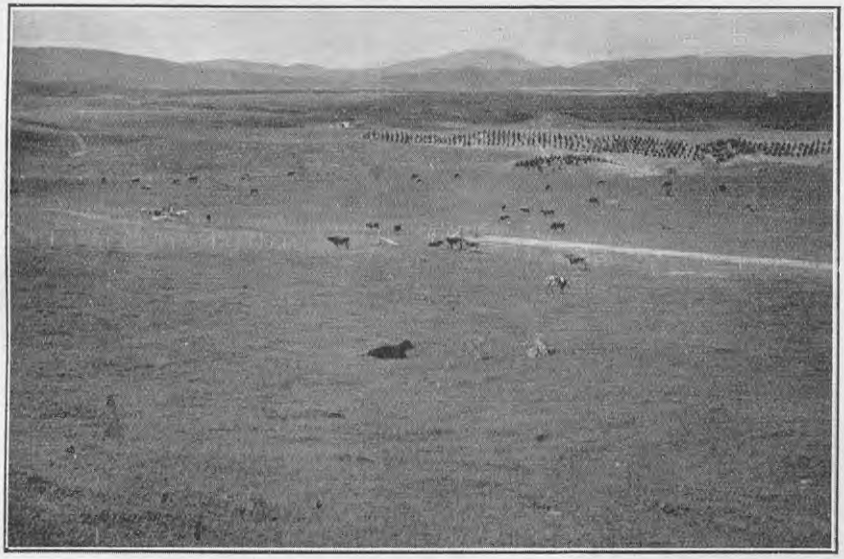

FIG. 18. PORTION OF NGAKURU BLOCK I AFTER DEVELOPMENT, OCTOBER, 1933.

[*Photo by E. Bruce Levy.*

topography from flat to hilly country, with undulating land predominating. The developed land varies in elevation from 1,000 to 1,230 ft. The definite extended practice of sowing down permanent pasture after one ploughing was first tried on Ngakuru Block 1, and, with the exception of a hundred acres or so sown after turnips and temporary grass, all grass has been sown after one ploughing.

More recently an extensive programme of grassing has been undertaken on the Galatea Estate in the valley of the Rangitaiki River. Here a layer of pumice, generally 16 ft. to 20 ft. deep, has been spread over shingle fans of greywacke rock. The land under development is flat and lends itself readily to large-scale tractor cultivation.

(5) Farm Establishment Costs and Pasture Production.

ESTABLISHEMNT COSTS.

People frequently speak of the cultivation, grassing, and fencing costs for the development of any particular class of virgin land as if they were a fixed amount. The actual costs vary on every block of land, depending on the method of treatment, topography, situation, and changing price-levels and prices of particular commodities. The large-scale Government land development operations on pumice land have provided useful data regarding the cost of pumice land development. The development costs for twelve dairy farms on the Ngakuru blocks are given in the accompanying table.

Pastures.—The mean cost of pasture establishment for farms in the table has been placed at £8 5s. 7d. per acre. This is made up of the following items: Clearing, 30s.; cultivation, 40s.; grass seed, 38s.; fertilizers, 57s.

Clearing: The cost of clearing varies with the density and height of the surface covering and method of treatment. Where standing scrub is burnt off several years ahead of ploughing, the cost will not exceed 10s. per acre; when growth is heavy, and cutting and burning and stumping are done immediately prior to ploughing, the cost will vary from 20s. to 30s. per acre.

Cultivation: These costs vary, depending on the topography of the land. On the Ngakuru blocks, where much of the land is steep and a good deal of single-furrow horse ploughing was necessary, the cost of cultivation and sowing was 40s. per acre; on flat land costs are lower, and at Galatea cultivation costs are about 25s. per acre. About one-third of the cultivation costs is for labour; one-third power, either horse feed or tractor fuel; and one-third depreciation and repairs on equipment and machinery. The cultivation of pumice land is very severe on implements; mouldboards, shares, and skeiths wear out very quickly; during sowing operations when the weather is dry the fine pumice dust causes excessive wear on the working parts of drills and broadcasters.

Seed: The cost of grass seed varies from year to year. In years when certified rye-grass seed was dear, seed costs reached 40s. per acre; during later years the cost has dropped to between 20s. and 23s. per acre.

Fertilizers: Cartage costs largely influence fertilizer costs. At least 6 cwt. and in some cases 10 cwt. of super should be looked upon as establishment fertilizer costs. In grassing virgin land of low fertility the most difficult cost to assess is that of raising the fertility of the land to

Summary of Costs of developing Twelve Dairy Farms, Ngakuru Blocks, Rotorua District.

Items.	Costs for Twelve Farms.												Totals.	Cost per Acre.
Area grassed (acres).	(1) 114	(2) 147	(3) 126	(4) 93	(5) 153	(6) 122	(7) 126	(8) 133	(9) 111	(10) 113	(11) 119	(12) 130	1,487	
	£	£	£	£	£	£	£	£	£	£	£	£	£	£ s. d.
Buildings ..	613	353	364	375	625	395	736	410	442	444	421	412	5,590	3 15 2
Drainage ..	..	..	..	..	..	..	7	4	4	4	4	6	29	0 0 5
Fencing ..	631	519	452	498	375	372	330	345	359	378	269	339	4,867	3 5 6
Shelter	44	27	37	26	19	27	33	19	15	23	17	33	320	0 4 4
Tracks	..	3	..	..	..	9	..	3	5	5	10	2	37	0 0 6
Water-supply ..	218	155	176	247	187	132	100	122	132	118	178	134	1,899	1 5 6
Pastures ..	962	1,356	820	791	1,274	1,190	848	1,064	999	1,017	952	1,040	12,313	8 5 7
General overhead	361	314	305	237	315	265	200	203	197	202	178	202	2,979	2 0 1
Totals ..	2,829	2,727	2,154	2,174	2,795	2,390	2,254	2,170	2,153	2,191	2,029	2,168	28,034	18 17 1

a point where pasture production reaches a reasonable level, which for dairying land is 100 lb. to 150 lb. of butterfat per acre. For pumice land this raising of fertility may be brought about either by first establishing temporary red clover pastures or by the application of heavy dressings of superphosphate to permanent pastures established after the first ploughing.

Fencing.—Complete dairy-farm fencing costs from 50s. to 70s. per acre; the farms in the table having higher fencing costs are those on which undeveloped land has been fenced along with the improved land. Shelter protection fences raise the fencing costs, and fencing at 70s. per acre allows of fairly generous protection fences.

FIG. 19. GALATEA ESTATE: CATTLE GRAZING ONE-YEAR-OLD PERMANENT PASTURE.
Photo by E. Bruce Levy.

Water-supply.—The cost of water-supply varies considerably, depending on the source of supply and lay-out of the farm. Generally the costs will vary from 20s. to 30s. per acre, the mean cost for the twelve farms shown in the table being 25s. 6d. Three of these farms are supplied by special pumping plants from streams, one is supplied by a ram, and the remainder with bores at the cowsheds.

Buildings.—The cost of buildings on a farm depends very largely on the cost of the residence. Reasonable four-roomed cottages can be built for £250 to £300; cowsheds for three- or four-cow milking plants range from £110 to £140. Small sheds for implements, and pig-styes, will run into £30 to £40.

Comparative Costs.

It is interesting to compare these costs of Government land development with the costs and experience of private individuals.

Mr. J. B. Campbell gave the following description of pumice land development to the Taupo Railway Parliamentary Committee, 1929 (pages 105 to 106) :—

The block developed by the Matarawa Land Co. contains 5,500 acres, and is situated at Tokoroa, along the route of the Taupo Timber Co.'s railway, about twelve miles from Putaruru. It has many natural advantages. It is practically all flat ; it has no waste unploughable land ; it is watered by two streams ; it is carrying very light top growth ; and it is served by the main Taupo–Hamilton road. The soil is of a light pumiceous nature, covered with an average of about 4 in. of black soil. There is no rubbly pumice land or pure pumice sand on the block. It is about 900 ft. above sea level, with a climate very favourable for farming. The block was acquired by the company in 1914. It was entirely unimproved and in its native state. Its productive value was nil. Work was commenced in 1917. The condition of the land to-day occupied by settlers is that it will carry a cow to 2 acres, and 1,800 cows are being run on 3,500 acres occupied by settlers. . . . The following costs per acre may be of interest: Roading and surveying, £1 ; fencing and shelter, £2 10s. ; water reticulation, £2 ; clearing, 10s. ; manures, £6 ; seeds, £2 ; labour, £4 ; buildings, £5 : total cost of a fully developed farm, £23 per acre. The amount spent by settlers in further improvements was from £2 to £3 per acre, making approximately £25 as the cost of a finished farm.

Pasture Production.

Experience has shown that during the second year of establishment permanent pastures on pumice land will produce 100 lb. of butterfat per acre. With herd improvement and careful management the production can be increased to between 120 lb. and 150 lb. per acre, with annual maintenance of 3 cwt. of superphosphate top-dressing per annum.

MILK FEVER IN EWES.

A RECENT OCCURRENCE IN THE LEVIN DISTRICT.

J. E. McIlwaine, M.R.C.V.S., Veterinarian, Live-stock Division, Wellington.

The condition known as milk fever is one usually associated with dairy cows at or about the time of parturition. There is no reason why a similar condition may not affect other female animals, including the sow, mare, and ewe, although in their case there is the distinct difference that they have not been bred specially for milk production as with the modern type of dairy cow. The writer has, however, distinct recollections of seeing a newly farrowed sow showing all the symptoms characteristic of the early stages of milk fever. This condition, or an analogous one described under the name of "tetany," has been recorded in the case of suckling mares on certain poor hill pastures in Great Britain.

The present case dealing with ewes is recorded on account of certain outstanding features—namely, the length of time between parturition and the onset of symptoms, the mortality due to the condition, and the recovery of the animals which were treated in the usual way.

A telephone message was received on 12th October last that ewes were dying on a farm in the Levin district ; two had died and several others were affected. The affected animals were part of a flock of three hundred Romney ewes with lambs at foot. The ewes were full-mouthed and healthy prior to this trouble, having lambs from

eight weeks old onwards. Some of the lambs averaged about 30 lb. in weight. The flock had been put into a young grass paddock for about three days with a view to eating down a weed which was very prevalent in the pasture. The weed was identified as belonging to the chickweed family and named *Cerastium glomeratum*. The owner suspected poisoning by this weed, and on 11th October the ewes were moved into a young oat paddock. When the flock was moved two ewes were unable to walk. These two died on the morning of 12th October, when five more ewes were down and unable to move. When notice of the loss was received, the owner was advised to move the flock from the oats to an old grass paddock. The farm was visited on the morning of the 13th. Five ewes had died during the previous afternoon and night, making a total of seven deaths, and four more were found down and unable to move.

The affected ewes were discovered in a recumbent position, and when lifted they were unable to stand or move. The body temperatures registered varied from 100·6° to 102° F., which may be described as sub-normal for the ewe (the usual temperature registered in this condition in dairy cattle is a sub-normal one after the stage of excitement has passed). The breathing was very shallow; it could not be described as stertorous, but a distinct gurgle could be heard in some cases. There was a discharge from the nose which had caked and formed a crust at the nostrils. The eye reflex was almost absent, and the ewes could be described as being in a semi-comatose or comatose condition. The udders were soft and flabby and did not contain much milk. In one ewe there was a prolapse of the rectum. The ewes were lying on their side or in a normal position, the hind legs being directed backwards instead of in the normal position.

The trouble was diagnosed as milk fever of a similar nature to that seen in the dairy cow, and the usual treatment of inflation of both halves of the udder was carried out in a similar manner. A small type of teat syphon was procured and both halves of the udder were thoroughly distended with air, the teats being secured by means of a broad tape. In two cases a second inflation was carried out after the lapse of two hours.

In one case an affected ewe got up in less than an hour and walked away, the gait being very unsteady. A second one was also able to get up and walk about two hours after inflation. A third ewe recovered the same evening, and the fourth one, although recovered, was unable to join the flock until the fourth day after treatment. The first two ewes to recover are suckling their lambs; the other two lost their milk and consequently neglected their lambs on account of the slow recovery.

The affected animals were healthy, well-developed, full-mouthed ewes, and had every appearance of being good milkers, as the lambs were doing exceptionally well, some being ready for the spring trade. The Romney ewe is noted for being a good mother on low-lying rich flats such as were present on this farm. The young grass pasture was of a forcing, stimulating nature, having been top-dressed with 5 cwt. of lime and 3 cwt. of superphosphate to the acre. The young oat paddock was also of a stimulating nature, tending to the increased production of milk. The lambs were of such an age as to be able to

drain off all the milk as it was secreted in the gland. This, then, is the possible explanation of the breakdown in the calcium level of the blood serum, resulting in the train of symptoms which are described under the heading of milk fever.

In this case it was impossible to collect blood samples for calcium determination, but should an opportunity again occur calcium determinations will be made with a view to confirming the true nature of the losses and its analogy to milk fever as seen in the dairy cow.

The remarkable point about the mortality is that the ewes had lambed at least two months earlier. This might, however, be expected in the case of ewes, as in the early days young lambs will be unable to draw away all the milk from the udder, whereas at this time the lambs were of such an age as to be able to keep the udder emptied.

A post-mortem examination of the dead ewes was carried out, but, as was to be expected, no gross lesions were found which might account for the mortality. The amount of blood-stained fluid in the abdominal cavity appeared to be excessive. The rumen was almost full of the green oats, showing that the ewes had been feeding up to the time of onset of the trouble. The other stomachs, including the manyplies, were almost empty, showing that rumination had been in abeyance for some time before death. The fourth stomach showed no gastritis, the small intestines and the colon showed no evidence of any inflammatory lesions. The heart appeared normal in every way, the pericardial fluid being in excess of that normally found in this sac. The lungs showed hypostatic congestion.

The most marked lesion (if it could be described as a lesion) was in connection with the liver. This organ presented a distinct pale yellowish colour, was soft and mushy to the touch, and had the appearance of a parboiled liver. This organ was probably affected with cloudy swelling and commencing fatty degeneration. The kidneys were normal in appearance.

After the ewes and lambs were moved from the oat paddock to the old grass pasture no further cases of sickness or mortality occurred; no further cases have since been observed. No doubt blood analyses from the affected ewes would have given the typical low calcium content of the serum which is seen in dairy cows affected with milk fever.

Phormium Hybridization.—Dealing with hybridization in connection with phormium research work during the year 1932–33, Dr. J. S. Yeates reports: "Some of the crossing has been done chiefly with a view to obtaining information on the inheritance of various characters—knowledge which will at a later stage hasten the work of producing superior hybrid plants. One type of hybrid which is very interesting and likely to be useful is that between *Phormium tenax* (the fibrous species) and *Phormium Colensoi* (so-called mountain flax). It has long been obvious that these two species must inter-cross in nature, but now well-grown plants resulting from artificial pollination of *P. Colensoi* by *P. tenax* have been raised. These plants are definitely much more vigorous in growth than other seedlings resulting from self-pollination of the same plant of *P. Colensoi*. In such features as leaf-edge and fibre-strength they appear to be roughly intermediate. The reciprocal cross using *P. tenax* as female parent has also been successful. Several hundreds of these hybrids between the two species are being grown. By inbreeding from them it is hoped finally to secure a good fibre type with the uncoloured and almost unthickened leaf-edge and keel of *P. Colensoi*."

ROOTING HABIT OF NORTHERN SPY APPLE STOCKS.

C. E. WOODHEAD, Plant Research Station, Palmerston North.

IN a previous article in this *Journal*(1) a brief account was given of the rootstock investigations which are being carried out at the Plant Research Station, and reference was made to a botanical study of a large number of stocks grown from root cuttings. During this particular investigation some interesting facts were noted in regard to the vigour and root characters of the Northern Spy stocks which form the greater part of the collection. These stocks, grown from root cuttings, afford an interesting comparison with others of the same variety propagated by the usual method of "layering."

Fig. 1 shows two-year-old Northern Spy stocks grown from root cuttings, and Fig. 2 Northern Spy stocks of the same age produced by layering. There is a marked contrast between the root-systems of the two types; note the strong and almost vertical roots of the former, and the relatively slender and horizontal roots of the latter. The difference in vigour of top growth is equally remarkable, the stocks grown from root cuttings having an average height and girth of 6 ft. 8 in. and $3\frac{1}{2}$ in. respectively, and the layered stocks 3 ft. 8 in. and $2\frac{3}{8}$ in. respectively. The disparity in growth suggests a definite correlation between vigour and type of root-system, with the depth of rooting as the significant factor.

Some four-year-old layered stocks (Fig. 3) show the surface rooting habit still persisting, only a small proportion of the roots exhibiting a downward tendency. These stocks were cut back to ground level two years ago, and the stems are in consequence younger than the roots. Typical trees of the three classes of stock are contrasted in Fig. 4.

It is, of course, possible that with increasing age the present differences in vigour and root habit may become less marked or even be eliminated. Furthermore, tests will be necessary to determine whether the relative vigour of the two types of stock is reflected in the scion. Any conclusions, therefore, drawn at this stage must necessarily be tentative.

The experience of other workers is of interest in this connection. Knight, Amos, Hatton, and Witt (2), in discussing methods of vegetative propagation employed at East Malling, state: "Stools, layers, hardwood and softwood stem cuttings, and root cuttings have all been used to multiply root stocks or varieties on their own roots . . . it is significant to observe here that in the case of a variety (Brom ton) which has been propagated by every one of them, the resulting plant has the same characeristics, by whatever means it is obtained. There is apparently no difference in root character or general vigour, which is thus dependent upon inherent qualities of the plant. This is to be expected, but it is important in view of the necessity of using different procedure for different varieties." Their findings are thus contradictory to those of the writer, but it should be noted that the example given is that of a

FIG. 1. TWO-YEAR-OLD NORTHERN SPY STOCKS GROWN FROM ROOT CUTTINGS.

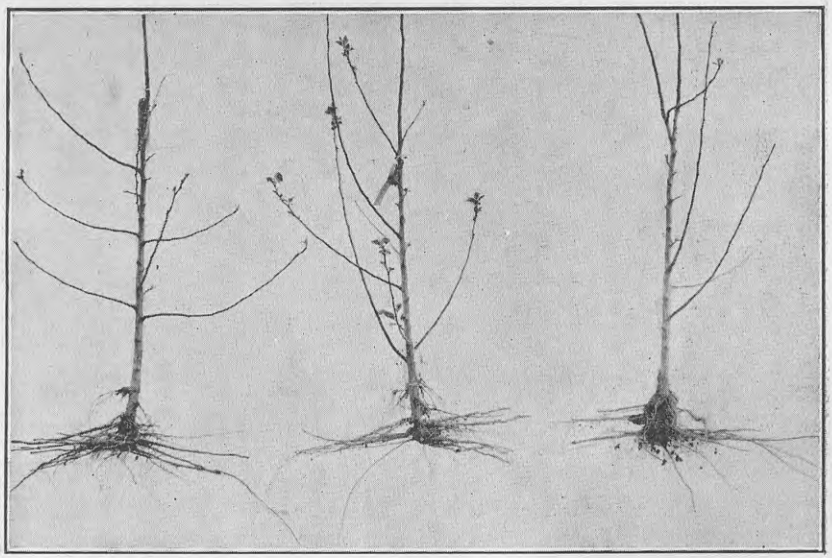

FIG. 2. STOCKS OF THE SAME AGE PRODUCED BY LAYERING.

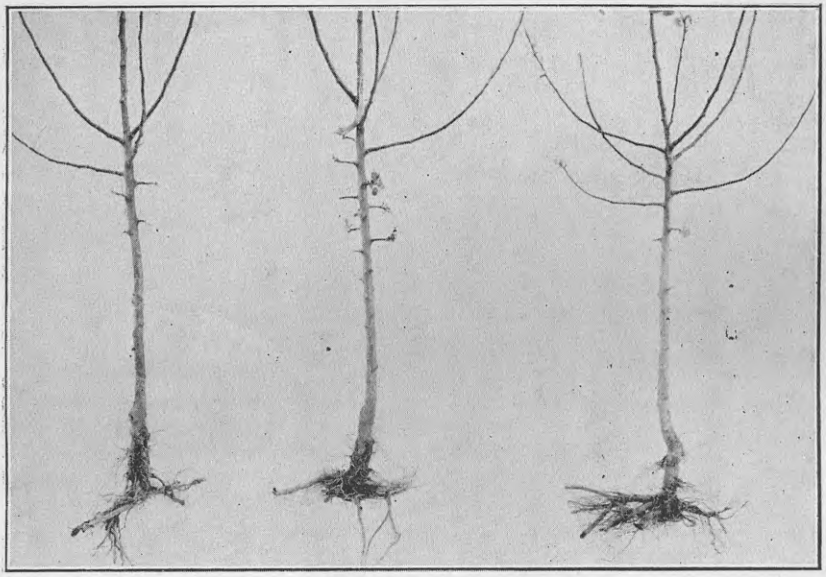

FIG. 3. FOUR-YEAR-OLD LAYERED STOCKS.

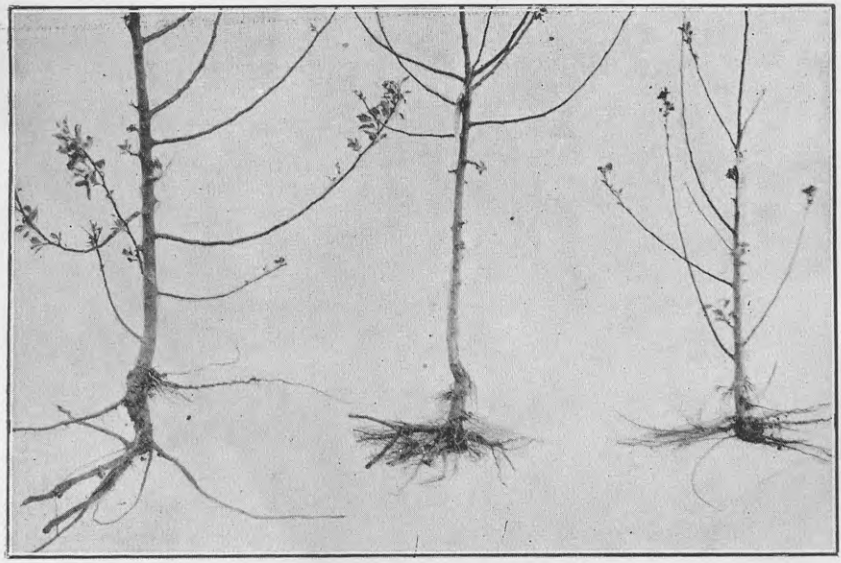

FIG. 4. TYPICAL TREES OF THE THREE CLASSES OF STOCK CONTRASTED.

plum variety. The data given above relative to Northern Spy stocks show that the method of propagation employed has a marked influence on the type of root-system produced, and also suggests (*a*) that the root type bears a definite relationship to the vigour of the stock, and (*b*) that the degree of vigour is in direct ratio to the depth of rooting.

The importance of deep rooting in relation to the vigour and productivity of fruit-trees is shown by Oskamp and Batjer([3]) in a study of the size, production, and rooting habit of apples on various soil-types in New York. They found that "Trees in the better-drained soils root more deeply, as a rule, and even though these deeper roots make up only a small percentage of the total root-system, they seem to have a stabilizing influence on the orchard as indicated by tree size and yield." In New Zealand the fact that the largest trees were almost invariably the deepest rooted was noted by Orchard Instructors in some districts when collecting root cuttings for the present stock survey.

The Northern Spy stock has been thoroughly tested in this country and has many good qualities. It is immune to woolly aphis, and varieties worked on it come into bearing early and produce highly coloured fruit of the finest quality. For these reasons it should not be lightly discarded for stocks of unknown performance under New Zealand conditions. Its one serious disadvantage is that on some types of soil and in combination with certain scion varieties it apparently lacks the vigour necessary to produce a tree of satisfactory size and high cropping capacity. If it can be established that a more vigorous type of Northern Spy stock is to be obtained by propagation solely from root cuttings, the only serious objection to the use of this variety as a stock will be removed.

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Group Control of Mammitis in Dairy Herds.—The Director-General of Agriculture refers to this method in his annual report for 1932–33 as follows: "The grouping system of milking dairy cows, commenced last year, for the control of mammitis in herds has been continued and has given promising results. The scope of this work experimentally is controlled by the staff available, as the arrangement of cows in order established by preliminary microscopic examination of milk and the subsequent examination necessary entails extensive concentration on detail. The reports to hand and covering fifty herds over two seasons show that distinctly beneficial results have been obtained, and the scheme can be definitely advised under ordinary conditions."

STRAIN INVESTIGATION OF GRASSES AND CLOVERS.

(Continued.)

ITALIAN, WESTERN WOLTHS, AND WIMMERA RYE-GRASSES.

E. BRUCE LEVY, Agrostologist, and STEPHEN H. SAXBY, Assistant in Agrostology, Plant Research Station, Palmerston North.

ITALIAN rye-grass, Western Wolths rye-grass, and Wimmera rye-grass are all short-lived species. Italian lasts well for twelve months, Western Wolths for round about six months, and Wimmera about three months. Each species has a more or less specific niche in arable and grassland farming.

The annual crops of the world from a food and clothing point of view are of paramount importance. The annual enables profitable land exploitation over a much wider front than is the case with the perennial. In grassland farming the annual species greatly extend the range of soil types that can be successfully farmed per medium of the grazing animal.

The reason why the annual is successful where the perennial fails, in so far as bulk is concerned, lies in the simple fact that soil aeration and moisture absorption and conservation are improved through the cultivation and soil mulching that precede the sowing of the annual. Artificial manures applied at seeding-down time are incorporated deeper in the soils in contact with soil moisture, and this makes manuring on the drier soil effective and profitable, whereas those manures applied to the dry surface in permanent grassland may be unavailable to the plant. Successful exploitation of the high-producing annual grassland species such as Italian, Western Wolths, and Wimmera rye-grasses therefore demands the annual breaking-up and cultivation of the land prior to seeding. Without this annual breaking-up and cultivation—unless one happens to be farming on soils that are self-mulching during periods of drought, or on extremely fertile soils that are sufficiently fertile to establish the annual from shed seed without the assistance afforded by breaking up and cultivation—the high-producing annuals are of little or no value to the grassland farmer. Perennial species on dry soil or on low-fertility soils are universally low-producing. Their production increases as the available soil fertility increases, until a point is reached where the high-producing perennial species will yield equally, or almost so, to the high-producing annual species, and there is a point in grassland farming where the extra production from the annual species over and above that possible from perennial species on the same soil-type does not pay for the added cost of cultivation, seeding, and loss of feed while the ground is under cultivation. This economic factor really delineates arable farming, short-rotation farming, and permanent grass farming the one from the other.

In short-rotation farming the grassland area on the farm usually rapidly deteriorates in carrying capacity in the second, third, and subsequent years, until it again is broken up in the course of the rotation. The choice of species and strains of these for the short-rotation pasture may, however, greatly influence the production of

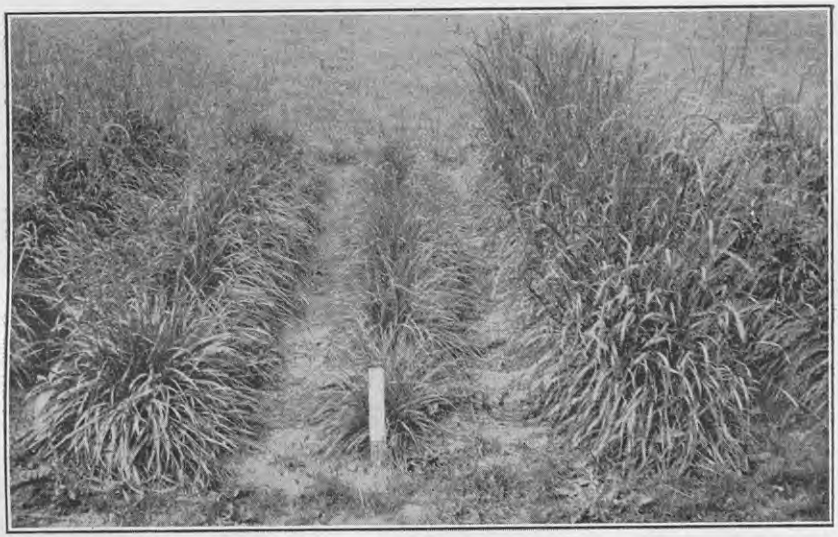

FIG. 1. STRAIN DIFFERENCES IN LINES OF COMMERCIAL ITALIAN RYE-GRASS.

Left—typical New Zealand Italian type; middle—false perennial sold as Italian; right—typical New Zealand Western Wolths type.

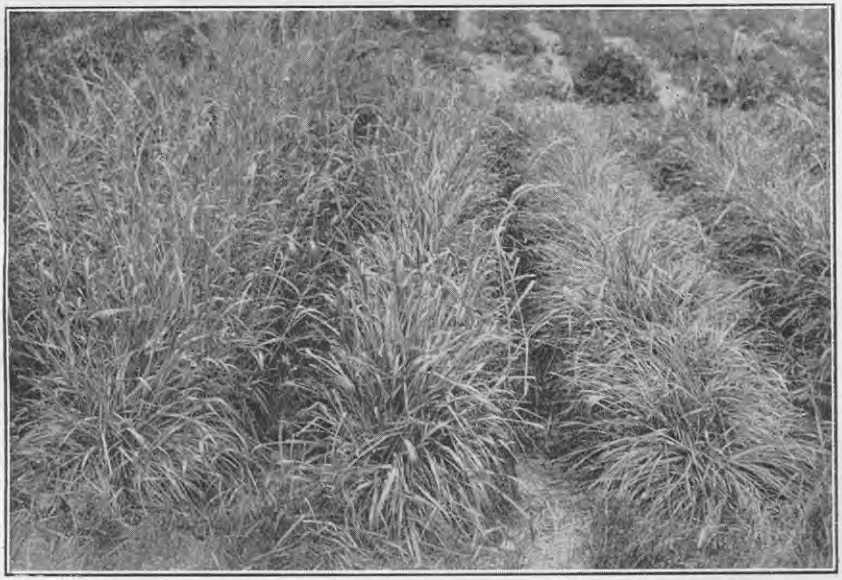

FIG. 2. STRAIN DIFFERENCES IN LINES OF COMMERCIAL ITALIAN RYE-GRASS.

Left—early-maturing Western Wolths type; middle—Italian rye-grass *ex* Welsh Plant Breeding Station, Aberystwyth; right—a dominant false perennial sold as Italian.

[*Photos by E. Bruce Levy.*

the short-rotation pasture in its second and subsequent years, and the writers feel that on many soil-types the grass period in the rotation may be profitably extended by the use of the certified type of perennials.

Certification during the last four years has brought prominently before the grassland farmer the perennial strains of pasture plants, and more particularly perennial rye-grass. In the South Island, prior to certification, the type of perennial rye-grass used was dominantly of an annual nature, and the fact that this type had developed in the South Island, where arable farming is most pronounced, is in itself significant as indicating the very great value of the annual type to South Island conditions in general. In the South, however, the development of the annual type had gone too far (even for the South) in so far that the grassland farmer who really could do with perennial species was unable to rely on the commercial article sold as perennial rye-grass. What the certification system has done is simply to enable the farmer who wants a truly perennial species to buy with confidence on the assurance that he will get what he requires.

Certification in many farmers' minds has also incidentally created the impression that the true perennial is preferable to the annual for all soil types and conditions. Certification has no such aim, and, as results of the present strain investigations will indicate, there is just as great a need for certified good annual types as there is for certified good perennial types; both have their distinct place and sphere of usefulness in grassland farming.

Palatability of Annual Rye-grass compared with Perennial.

The annual rye-grasses while they last are distinctly more palatable than the perennial rye-grasses, given the same soil conditions and identical stage of growth when stocked. False perennial rye-grasses vary in palatability according to the degree of hybridism and according to which parent they resemble. False perennials throwing dominantly to the Italian parent are equal in palatability to Italian itself, while hybrids throwing more to the perennial parent are less and less palatable according to how closely they resemble the perennial parent. Palatability, however, in any one species is relative to stage of growth when eaten. Young, freshly growing herbage in perennial rye-grass is palatable, while poorly grown, stunted, matured herbage is unpalatable. Thus between Italian rye-grass (and its hybrid derivatives) and poorly grown, stunted, matured herbage of the true perennial, there is a wide range in degree of palatability. The normal crops of Italian rye-grass are consumed during the year subsequent to sowing down, and the growth, as a result of cultivation and manures applied, is usually fresh and growing vigorously. Hence the palatability is excellent. In the case of the perennial rye-grass, this is still grazed long after the effects of cultivation have disappeared in years subsequent to establishment, and unless the climatic conditions are such or top-dressing has been such as to maintain a high surface-soil fertility, the growth of the perennial may become yellow, stunted, and mature, with little or no fresh leaf forming. Thus, in comparison with Italian rye-grass, true perennial becomes distinctly unpalatable.

Little or no management is required in the annual rye-grass to keep it palatable. Specialist management is imperative for keeping a

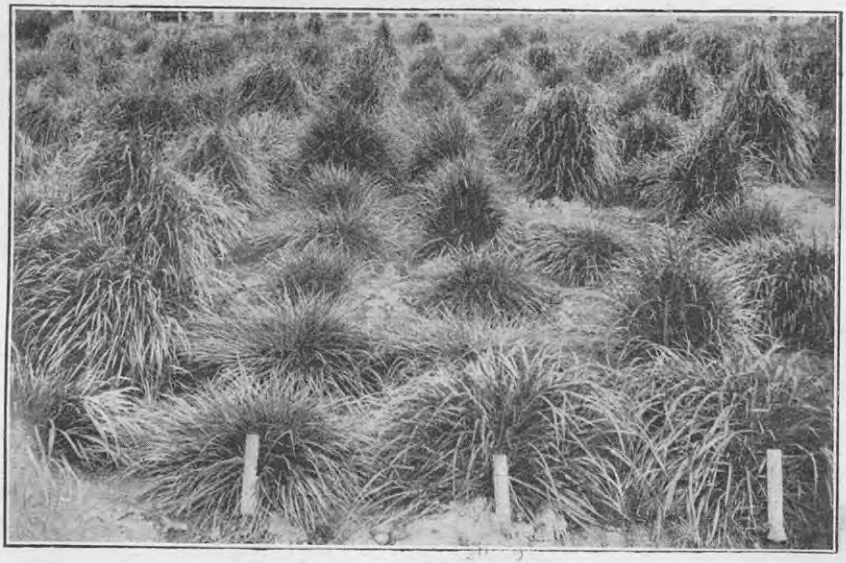

FIG. 3. SINGLE PLANTS OF COMMERCIAL LINES OF ITALIAN RYE-GRASS.

The tall erect plants are Italian or false Italian; the squat and prostrate plants are false perennial.

FIG. 4. SINGLE PLANTS, SHOWING FOUR LINES OF DOMINANTLY ITALIAN RYE-GRASS IN TYPE.

The two middle rows are *ex* two lots from the Welsh Plant Breeding Station, Aberystwyth.

[*Photos. by E. Bruce Levy*

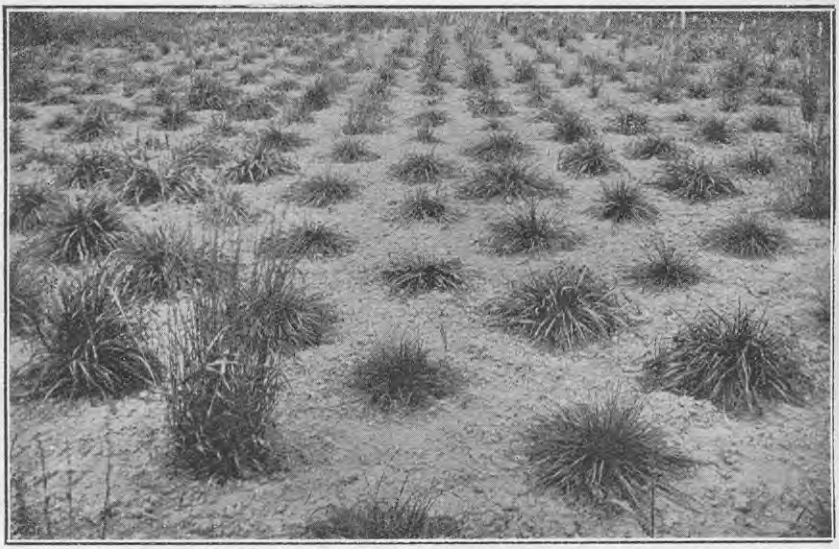

FIG. 5. SINGLE PLANTS OF COMMERCIAL LINES OF ITALIAN RYE-GRASS THREE MONTHS OLD, SHOWING MARKED VARIATION IN TYPE.

[*Photo. by E. Bruce Levy.*

perennial rye-grass perennially palatable. The addition of Italian rye-grass to a mixture of perennial rye-grass and clovers will undoubtedly increase the palatability. For the grazier, therefore, where high palatability is required combined with a pasture of three to four years' duration, a mixture of Italian rye-grass and perennial rye-grass plus clovers should give in the first year at least (or for the normal life of the annual included in the mixture) a pasture almost equal in palatability to a pure sowing of Italian rye-grass, Western Wolths, Wimmera rye-grass, or a bad false perennial; and in the second and subsequent years the farmer must be content with slightly less palatable pastures, the true perennial element of the sward alone surviving, or else be prepared to plough and sow annual and biennial species every two years.

What is really required, then, is a good type of a highly palatable annual and a true perennial that will carry on after the annual has run its normal course. For seed-production purposes, of course, annual rye-grass and perennial rye-grass should never be sown in the same paddock.

Italian Rye-grass (*Lolium multiflorum*).

Of the three types of annual rye-grasses under consideration Italian rye-grass is far and away the most important for New Zealand conditions. It is the basis of all temporary pastures and should be included in all short-rotation pastures in amounts relative to the duration of that pasture. As a component species in the permanent pasture it affords an early bite, and, if kept well in hand by management, has little or no detrimental effects on the establishment of the perennial species in the mixture sown.

Italian rye-grass is suitable for both autumn and spring sowings, and it is one of the most reliable stock crops that can be sown as a supplementary winter and early spring fodder. If sown along with broad red clover, two-year temporary pastures are possible and extremely profitable. Such a pasture gives wonderful winter and early spring grazing. In the peak of the spring production it may be cut as a hay or ensilage crop, and the red clover aftermath is excellent for summer grazing or as a second clover hay crop, or as a special red clover seed crop. For such a pasture 30 lb. of Italian rye-grass and 6 lb. of broad red clover is recommended.

Western Wolths Rye-grass (*Lolium multiflorum* var.).

True Western Wolths rye-grass is quicker to establish but is shorter lived than Italian rye-grass. Its maximum value is for autumn sowing specifically for rapid early winter, winter, and spring feed. Its recovery after six months' grazing, or after an ensilage or hay crop, is extremely poor, and the six months' period must be regarded as its period of maximum production. True Western Wolths is more erect in growth than Italian rye-grass; it tillers considerably less, and resembles more the cereal than does Italian rye-grass. It is quicker-maturing in the spring, and if spring sown it is inclined more to bolt away to seed rather than to leaf. For this reason Italian rye-grass is much to be preferred to Western Wolths for spring sowing.

The experience of New Zealand farmers may not be in entire agreement with this statement, but it will no doubt come as a surprise to many to know that what they have been sowing as Western Wolths is Italian rye-grass, or a mixture of Italian rye-grass dominant with some Western Wolths. So far as the writers can learn as a result of their strain investigation work, there is little or no genuine Western Wolths on the New Zealand market to-day, and it is highly doubtful, provided Italian rye-grass true to name and type is available, whether Western Wolths has a really important role in New Zealand. It will be seen from Table 1 that of eighty-nine lines sent in as Italian rye-grass 25 per cent. were dominant Western Wolths, and 67 per cent. dominant Italian; whereas of thirty-two lines sent in as Western Wolths 22 per cent. of these were dominant Western Wolths and 69 per cent. dominant Italian. From this it will be apparent that as the trade stands at present, commercial lines of Western Wolths and Italian rye-grass may each be served out of the same sack so far as any difference between the two is concerned.

Wimmera Rye-grass (*Lolium subulatum*).

Wimmera rye-grass is extensively grown in Australia, where it is regarded as an important grass for those soil types where short periods of high production alternate with severe periods of drought. Wimmera rye-grass is extremely rapid to establish from seed, it makes a moderately large bulk of fodder, and is the earliest-maturing type of rye-grass yet tested in New Zealand. Its life of useful growth is extremely short, an almost entire death of the sward taking place after the second cut of herbage.

Wimmera rye-grass would appear to be an excellent example of a plant selected by the forces of the environment to qualify for a place

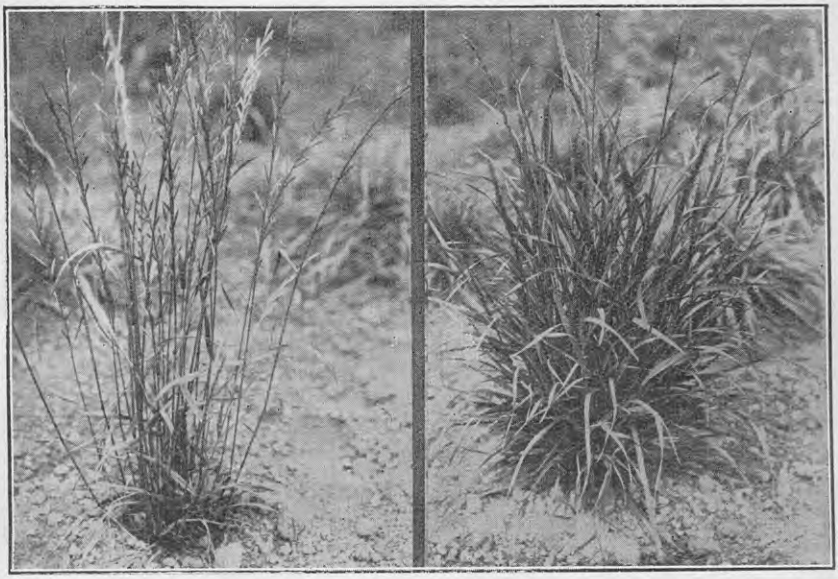

FIG. 6. SINGLE PLANTS SHOWING VARIATION IN TYPE AND RATE OF MATURITY.

Both plants are regarded as belonging to the Western Wolths type. The plant on the left gave no recovery after cutting.

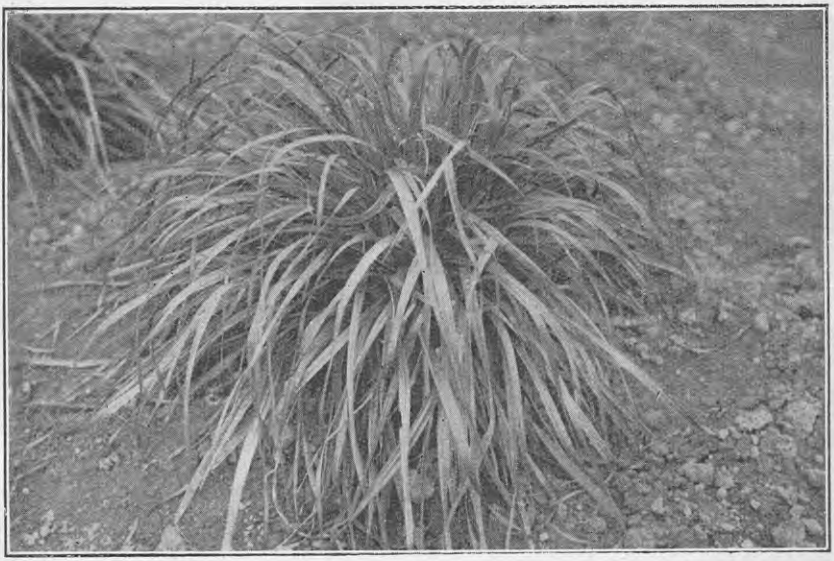

FIG. 7. TYPICAL DENSE LEAFY PLANT OF SAME AGE AS PLANTS SHOWN IN FIG. 6, CONSIDERED A TYPICAL LEAFY ITALIAN TYPE.

[*Photos. by E. Bruce Levy.*

within that environment. The Wimmera rye-grass belts in Australia are essentially drought susceptible areas of fertile soils during a few months of the year when there are sufficient rains to make that fertility available. A plant to exploit such short periods for possible growth must establish rapidly, grow rapidly, and come to maturity rapidly, so that it may ripen and shed its seed prior to the cessation of growth. The seed tides over the difficult drought period, however long, and springs into life again as soon as rains fall. A perennial species under these conditions would perish, and slower-maturing annuals, such as Italian rye-grass and Western Wolths, that did not ripen their seed during the short growing period would also perish in so far as no mature seed would be produced and shed before the drought began in earnest. There is possibly no soil-type in New Zealand where the growing season is so short that the long-maturing strains of annuals such as Italian cannot ripen their seed, and hence it is obvious that there is no place in New Zealand for such early-maturing and such short seasonal-growth annuals as Wimmera rye-grass, when annuals of a longer leaf-producing period will thrive.

There is also an important ecological fact to be borne carefully in mind in relation to annuals such as Wimmera rye-grass, and possibly subterranean clover. These annuals are really high producers, and high production is possible only when such annuals are supplied naturally or artificially with a plenteous food supply. Many of the Australian soils are what are termed self-mulching—free soils that break into powder when dry, rather than cake like cement as in the case with many soils during a dry period. In the Australian self-mulching soils the limiting factor to growth is moisture. When rain falls these self-mulching soils are highly fertile, and they remain fertile while moisture is present. Because an annual plant does well under such conditions it does not necessarily follow that it will do well when sown out on dry hard soil conditions, nor would it be expected to re-establish from shed seed wherever the self-mulching conditions are absent. If it did successfully re-establish itself its subsequent growth would be stunted and the production low.

This point is particularly stressed in view of the possibilities of importations of Wimmera rye-grass for the poor hard soils in New Zealand. There is no soil-type in New Zealand known to the writers where Wimmera rye-grass would prove superior to Italian rye-grass. Wimmera rye-grass in our trials at Palmerston North is the poorest rye-grass yet tested. It is less persistent even than the New Zealand bad false perennial.

Strain Trials.

Strain investigation into the types of Italian rye-grass was commenced in 1928 at the Plant Research Station, Palmerston North. It has been the usual practice to sow all lines in 15-link rows. For the first year this method is quite reliable for classification into types and for measuring hay yields. For periods of more than a year the method is not suitable, as the less persistent types of plants die out and the more persistent types tiller out and fill up the empty spaces. For this reason plots have been sown and single plants have been put out for trials lasting more than a year.

Up to the present time 148 lines have been tested. Very few lines tested have proved to be anything like purely of one type, the only ones approaching type purity being seven lines of Wimmera rye-grass and two lines of Western Wolths type, one of these being a line of Garton's Express rye-grass and the other a single-plant selection made near Auckland.

The variation in type from both line to line and within each line is very wide. The following table shows the variation in type of lines which were received as Italian rye-grass and Western Wolths :—

Table 1.—Showing Type Analysis of Commercial Lines sold respectively as Italian Rye-grass and Western Wolths Rye-grass.

Sample sold as—	Percentage of Lines dominantly of Western Wolths Type.	Percentage of Lines dominantly of Italian Type.	Percentage of Lines dominantly False Perennial.	Number of Lines tested.
Italian	25	67	8	89
Western Wolths ..	22	69	9	32

This table definitely shows that there is virtually no difference between commercial Italian rye-grass and commercial Western Wolths, and that a purchaser has no guarantee as to which he is getting when buying one or the other.

Yield and persistency trials have been carried out in rows and single plants, and Table 2 gives the relative value of these types. Ordinary Italian is placed at 100 in each case.

Table 2.—Showing relative Behaviour of Annual Rye-grass Types over a Period o Twelve Months.

Type.	First Six Months —Hay Yield.	Recovery after First Hay Cut.	Second Cut —Hay Yield.	Percentage of Death after First Year.*
Italian	100	100	100	4
Western Wolths ..	128	32	63	51
Wimmera	No data	1·8	0	100

* Surviving plants include many showing poor vigour at this stage.

This table clearly indicates the superiority of the Italian rye-grass over the Western Wolths type where one to two-year pastures are laid down, the Western Wolths producing more than the Italian type in the first six months only. The Wimmera rye-grass for the first two months probably outyielded both Italian and Western Wolths, but the poor recovery after cutting minimizes its value where the climatic conditions suit Italian rye-grass and Western Wolths.

Single-plant Study.

Twenty plants of each of thirty-one lines were put out as spaced single plants for the purpose of analysing the plant types of various lines. The plants were placed in three wide groups as follows :—

(1) Western Wolths type : Open, quick-maturing, free-seeding type. This type gave a good yield to begin with, but after seeding the majority of the plants died.

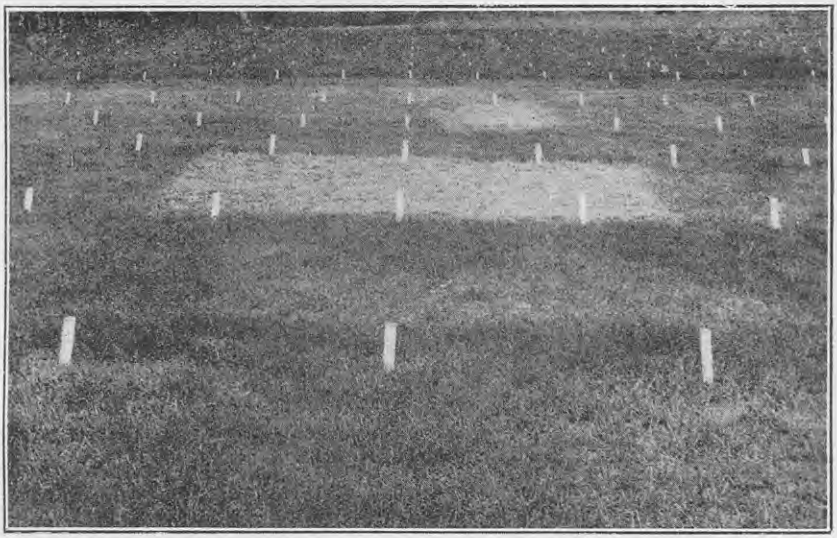

FIG. 8. DEPICTING LOW PERSISTENCY OF WIMMERA RYE-GRASS IN TRIALS AT PALMERSTON NORTH.

The three middle plots behind the second row of pegs from the front are lots of Wimmera rye-grass sown broadcast and have failed to survive the second cut. The plots behind the first row of pegs are certified perennials.

[*Photo. by E. Bruce Levy.*

(2) Italian rye-grass type: Dense, later-maturing type. Very leafy. Quite a good seeder. Recovered well after first and subsequent hay cuts.

(3) False perennial rye-grass as impurities: These plants ranged from a good false perennial to the worst false perennial, some of which resembled false Italian rye-grass rather than false perennial.

An analysis of these types in all lines tested as single plants gives the following average percentages of the dominant types that occur in a composite lot of commercial samples: Italian rye-grass, 63 per cent.; Western Wolths, 19 per cent.; false perennial, 18 per cent.

Table 1 indicates, however, that individual lines sold as Italian rye-grass may either be dominant Italian, dominant Western Wolths, or dominant false perennial, and this is true also of Western Wolths. There is no doubt that it is just as important for the farmer to be able to buy, and the seed-merchant to handle, the various annual rye-grasses with the same degree of confidence as they can now buy and handle perennial rye-grass under certification.

Work is now in hand to locate good types of Italian rye-grass within New Zealand and from overseas, and to work up good strains for distribution later under certification. So far, it must be said that the New Zealand strains are not so satisfactory in general from a type point of view as those secured from overseas, but the number of lines tested from overseas is too small for making definite comparisons. Station-bred lines from the Welsh Plant Breeding Station are doing well in New Zealand, and reports from Great Britain would indicate that the Welsh-bred strains are also doing better in Great Britain than the New Zealand strains. This is not to be wondered at in view of the strain analysis shown above.

FURTHER OBSERVATIONS ON SLOW DEVELOPMENT OF ACIDITY IN CHEESE MANUFACTURE.

H. R. WHITEHEAD, Dairy Research Institute (N.Z.), Palmerston North.

TROUBLE due to the occurrence of so-called "non-acid" milk is so common in cheese factories that the necessity for full investigation on the underlying cause or causes hardly needs emphasis.

In a previous article(1) it was shown that in one instance, the phenomenon of non-acid milk occurring in a cheese factory was due to the presence of a special type of bacterium in the milk brought to the factory by one supplier. Recently, a similar organism has been isolated from another sample of milk (from quite a different locality). In this case, although the main effect is the same, there is a difference in the mode of action of the organism which is of additional interest in connection with the cheesemaking process.

Some milk samples were procured from a dairy factory during April, 1933, originally for the purpose of a chemical investigation. As a matter of interest, the portions of milk which remained after the amounts needed for chemical analysis had been taken were pasteurized at 145° F. for thirty minutes and subjected to a vitality test, one starter culture being used for all the samples. Most of the milks gave normal acidity increases in the test, but in one sample there was practically no increase in acidity in the period between the two readings. A little of the raw sample still remained, so the milk was plated on yeast whey agar in an attempt to isolate any bacteria which were similar in reaction to the organism which had previously been shown to produce the non-acid substance in milk. There was a copious growth on the agar plate inoculated from the milk sample, and about a dozen small colonies similar in appearance to those produced by lactic streptococci were picked off into milk.

By the performance of vitality tests on milk samples in which these pure cultures had been grown, it was found that several of the strains of bacteria produced a typical non-acid reaction, *provided that the milk in which they had been grown was subsequently pasteurized.* The results of a typical experiment will serve to indicate the usual findings.

A sample of fresh uncooled milk, direct from the Massey Agricultural College cow-shed, was divided into two portions. One portion was inoculated with a culture of one of the strains of the bacterium (D1) isolated from the abnormal milk; the other was retained as a control. Both portions of milk were allowed to stand at room temperature overnight. Next morning the control milk contained 960,000 bacteria per cubic centimetre by direct count; it decolorized methylene blue in four hours at 37° C.; and its acidity was 0·17 per cent. calculated as lactic acid. The inoculated milk contained 186 millions of bacteria per cubic centimetre; it decolorized methylene blue in ten minutes; and its acidity was 0·25 per cent. One-half of each batch of milk was pasteurized at 145° F. for thirty minutes, and then all four samples were subjected to a vitality test with the use of the same normal starter culture throughout. The results are given in the following table:—

Table 1.

	Acidities as Percentage of Lactic Acid.			
	Inoculated, Raw.	Control, Raw.	Inoculated, Pasteurized.	Control, Pasteurized.
First acidity reading ..	0·42	0·38	0·13	0·38
Second acidity reading ..	0·63	0·72	0·14	0·72
Increase	0·21	0·34	0·01	0·34

It will be observed that the inoculated milk in the raw state gave an acidity increase only slightly lower than that given by the control (in some experiments, where a less extensive growth of the organism D1 occurred in the milk overnight, the acidity increase in the inoculated raw milk was actually higher than that in the control). On the other hand, it is evident that the inoculated milk inhibited acid production entirely after it had been pasteurized. This difference in result between the raw and pasteurized samples might be accounted for by the fact that the bacterium D1 formed quite an appreciable amount of acid by itself when grown in milk, unlike the organism described in the previous article, which formed acid only very slowly. It is possible, however, that the non-acid substance is not fully formed in its potent state until the milk is heated.

Whatever may be the explanation, the foregoing results indicate quite clearly why no particular difficulty had been experienced with the original abnormal milk in the factory from which it was obtained—for the factory was making *raw-milk* cheese. Had the milk been pasteurized it is certain that slow vats would have been experienced, the extent of slowness depending on the proportion of the milk in any particular vat. A further sample of milk was obtained from the same supplier about a month later, and there was again no difficulty in isolating an organism which would render non-acid any milk in which it was grown. This is an indication of how persistently such organisms may be found in the milk of certain suppliers. Unfortunately, just at the time the last sample was obtained, the supplier in question ceased to bring his milk to the factory, as it was the end of the season. It was therefore impossible at the time to follow up the matter any further.

Both of the organisms found to produce the non-acid phenomenon in milk have proved on examination in the laboratory to be lactic streptococci, indistinguishable in most respects from the bacteria which constitute the normal population of starter cultures. They differ solely in their power of producing during their growth in milk some substance which acts as a powerful inhibitory agent on the subsequent growth of normal lactic streptococci. It has also been found, in experiments carried out up to the present, that the inhibitory substance formed by these two peculiar organisms acts only on the lactic acid bacteria; it has no restraining effect on *B. Coli* or on *B. Subtilis*.

The importance of these abnormal streptococci in dairy work hardly needs emphasis, for it is evident that anything which hampers the normal development of acid in the process of cheese manufacture is likely to have an adverse influence on the quality of the cheese. Factory-managers

who experience trouble with non-acid milk are usually able to narrow down the probable source to the milk of three or four suppliers. Vitality tests carried out on these few milks should then show exactly which milk or milks are responsible. But it is essential, in view of the discovery of this second type of organism described in the present article, that the milks should be tested in the pasteurized as well as in the raw state. This certainly involves more trouble, especially where facilities for such work in the factory are meagre; but it should be possible to devise some rough method for the pasteurization of the small batches of milk at 145° F. for thirty minutes; even a pasteurization carried out by raising the milk to 150° F. and then cooling immediately will serve. Having found which milk supply is at fault, every effort should be made to induce the farmer to adopt cleanly methods of milking and to cool the milk efficiently. Even if the bacteria responsible for the trouble cannot be eliminated entirely from the milk, efficient cooling will check their growth overnight and reduce their effect to a minimum. If the milk will not decolorize methylene blue in four or five hours, it cannot give rise to the type of non-acid trouble described in the present article, for there will not be a large enough number of the abnormal streptococci present.

It would also appear to be extremely important that the factory-manager should make sure that the milk he is using for the preparation of his starter is not infected with the organisms which produce the non-acid reaction, for it is obvious that even after an efficient pasteurization such milk will not permit a normal growth of the starter bacteria in it. It is desirable therefore that he should occasionally perform a vitality test (using an active starter) on the milk which he selects for the preparation of his bulk and mother-culture starters. The trouble involved is small compared with the difficulties in manufacture which may be avoided.

REFERENCE.

(1) WHITEHEAD and RIDDET: *N.Z. Journal of Agriculture*, April, 1933, Vol. 46, p. 225.

Spreadability of Butter.—Referring to work on this problem by the Dairy Research Institute at Palmerston North in 1932–33, the Research Committee reports: "Experiments indicate that butter made from cream which is cooled relatively slowly in the last stages of the process is more spreadable than that made from cream cooled very rapidly after a temperature of about 55° F. is reached. Efforts, however, made to improve spreadability showed that great care needs to be taken to avoid greasiness of body. Further experimental work is necessary before the technique can be applied in factory practice. It has also to be pointed out that any modification in present methods of manufacture should only apply to butter which would be marketed in Great Britain during the winter months."

Chemical Control of Noxious Weeds.—The Director of the Fields Division reports that several new specifics were tried experimentally during the past year, but generally they proved useless for the purpose. In addition, several further tests were made with chlorates, and these went to show that sodium chlorate is still the most efficacious and cheapest for the treatment of ragwort. Occysol was further tested, and gave very good results at a strength of 5 per cent. Calcium chlorate at the same strength gave about an 80-per-cent. kill.

GRAZING TRIALS IN CANTERBURY TO COMPARE CERTIFIED PERENNIAL WITH ORDINARY RYE-GRASS.

R. McGILLIVRAY, Fields Superintendent, Department of Agriculture, Christchurch.

IN view of the prominence given to the inferiority of typical Southern so-called "perennial" rye-grass, compared with that produced in Poverty Bay and Hawke's Bay, as a result of the work carried out at the Plant Research Station at Palmerston North, it was considered necessary to get some definite measure of their relative merits in Canterbury under typical grazing conditions. It was only natural that local pride of the Southern growers of rye-grass should cause them to feel somewhat indignant at the condemnation of their strains as regards the perennial character; and while the demand for certified rye-grass induced many growers to lay down areas specifically for seed production purposes, there was a lack of appreciation of the value of the certified strains for grazing purposes in the South Island.

From experience gained through fifty-two simple trials, distributed from one end of New Zealand to the other, sufficient evidence was available to forecast that the superior yield and persistency of the certified type of rye-grass could be established in Canterbury without the need of a highly accurate method of measurement of the results. The chief difficulty was to decide on a line of Southern rye-grass which could be viewed as representative. The original trial of 522 lines of Southern seed conducted by the Agrostologist at the Plant Research Station revealed the fact that of these not a single line from the South Island could be viewed as up to certification standard, based on the type and performance of the Hawke's Bay and Poverty Bay strains. Certainly a small proportion (approximately 3 per cent.) were classed as true perennial, but even these showed a weaker constituted type when compared the whole year round both as broadcast plots and as single plants. Of the remainder, approximately 10 per cent. were a better class of false perennial, and 87 per cent. short-lived and very inferior after three to four months' growth.

The mixing of a number of lines purchased from merchants as "perennial" rye-grass seemed to be the most satisfactory procedure in arriving at what seed should be used to represent the Canterbury rye-grass. In consequence of the inclusion of both the bad and the better types of "false" perennials, the pastures sown with the Canterbury mixture were decidedly better after one year than would have been the case had one of the 87 per cent. of bad types only been selected, but were worse than if one of the 13 per cent. of better types only had been used. Further, in both areas a good seeds mixture was sown additional to the rye-grass, including cocksfoot, crested dogstail, white clover, red clover, and Poa trivialis. Some of these additional species have established and

have spread and filled up bare spaces in the area sown to Canterbury rye-grass, more so than in the area sown to certified rye-grass, and this feed has materially helped to make the carrying capacity higher in the case of the Canterbury area than would have been the case relatively had a more typical Canterbury pasture mixture, consisting dominantly of rye-grass and clover, been sown.

It should be pointed out that where rye-grass is being sown for grazing, or for grazing and seed production, as distinct from sowing only for the production of seed, such sowings should include white and/or red clover, and under most conditions cocksfoot as well, excepting that cocksfoot may interfere with seed production later on, more particularly in the case of white clover, and especially so on the heavier land. The difficulty of getting a good white clover, rye-grass, and cocksfoot association on the lighter to medium Canterbury soils is great, but because of its important bearing on palatability and the general thrift of the grasses, as well as on the soil fertility, every endeavour should be made to get white clover established along with the rye-grass.

It was fully realized by those planning the trials that they would not give information regarding the relative meat or wool production capacities of the two types of rye-grass as dominants in the mixtures. The satisfactory determination of such points, because of the time and attention required, would have necessitated methods too involved for trials conducted in co-operation with farmers. The evidence of these trials up to the present, as shown in this article, indicates the undoubted superiority of certified rye-grass over the non-certified types used in these trials, and is sufficient to justify the use of certified seed wherever perennial rye-grass is being sown.

The six grazing trials of certified versus ordinary Canterbury perennial rye-grass conducted in Canterbury by the Fields Division have now reached a stage when a definite interim report can be furnished on their condition and stock-carrying capacity.

It should be stated at the outset that the trials were arranged for the purpose of ascertaining the relative grazing and persistency values of certified perennial and ordinary Canterbury rye-grass sold as perennial rye-grass. Two trials were laid down in March, 1930, and later in that year four other similar areas were established. The names of the co-operating farmers and location of trials are as follows: I. K. Buchanan, Irwell; A. R. Hislop, Amberley; G. Hall, Hororata; H. Wright Johnson, Dunsandel; Hunter Morris, Winchmore; W. L. Hay, Waimate. Each trial consists of a pair of fields which, prior to the trial, were one uniformly treated field. The trial fields are each 3 acres and are designated "A" and "B."

Field A in each case was sown with the following mixture: 25 lb. certified rye-grass, 12 lb. Akaroa cocksfoot, 3 lb. crested dogstail, 2 lb. Poa trivialis, 2 lb. N.Z. white clover, 3 lb. N.Z. red clover, making a total seeding of 47 lb. per acre. Field B had a similar seeding, but Canterbury perennial rye-grass was substituted for the certified type in the mixture. In the first two experiments

laid down (Messrs. Buchanan and Hislop) the rye-grass used consisted of a blend of four lines of certified perennial rye-grass from Hawke's Bay, and a blend of twelve lines in the case of the Canterbury type. In the other trials under review the certified seed of the Hawke's Bay type consisted of a blend of thirty-two lines, and the Canterbury of a blend of twenty lines.

In all cases the fertilizer used at the time of sowing was ammoniated superphosphate, applied at the rate of 2 cwt. per acre. The establishment of the areas could, on the whole, be considered satisfactory, although growth in some cases was seriously retarded by the dry weather experienced soon after the laying down was completed.

The grazing of the fields was carried out under a system of alternate grazing and spelling, and in order to obtain full utilization of the pastures the areas were often stocked with sheep at the rate of from twenty to forty per acre. In this way growth was in most cases rapidly fed off. The plants were then allowed to recover before being again stocked. In the main the Canterbury type of rye-grass proved the more rapid in establishment and in the providing of feed, but after the first few grazings the reduction of rye-grass in most of the Canterbury areas was apparent, and after the first year the death rate of plants was high. The certified type has proved much more persistent, and has provided a reasonably good sward despite the intensely dry spells experienced since the areas were laid down.

In the various grazing trials the difference in sward became most apparent during the autumn of 1932. The rye-grass on the "B" fields showed a definite thinning, and clovers (also to some extent cocksfoot) took up the running, and in the following autumn and winter fully 50 per cent. of the feed was being produced by pasture constituents other than the rye-grass.

During this time the "A" fields in each trial showed a fairly good sward of rye-grass, and there was practically no reduction of the amount of rye-grass, the growth of which, however, definitely depressed the establishment of both the clovers and the cocksfoot.

The certified type has showed to advantage on the lighter types of soil, as well as on the heavier types, while the Canterbury rye-grass has been practically a failure on the lighter types, but has held somewhat better on the heavy soils.

The management of the true type of perennial rye-grass calls for decidedly better control than is necessary in the case of the ordinary Canterbury type. This was clearly demonstrated in some of the trials. When the "A" fields were grazed when growth was about 2 in. high, control was most satisfactory, while in cases where a growth of 4 in. to 5 in. or more was allowed good utilization by sheep was not so readily obtained.

Observations on the Individual Trials.

I. K. Buchanan, Irwell.—The area on this farm was laid down in March, 1930. The germination of all seeds was remarkably good, the most striking thing about the fields in the early stage being the comparatively rapid growth of the Canterbury type and the light green colour of the foliage. This type was ready to graze approximately

three weeks before the certified type. At this period, however, some heavy rain was experienced, and the grazing could not be carried out at the correct time. From the New Year onwards the weather conditions were extremely dry, and the drought continued well into the winter. During January the fields in both the certified and Canterbury areas were closely grazed, and with the succession of extremely drying winds the areas became badly cracked, and there was a death rate of plants in the Canterbury area. During the dry spell the certified rye-grass area began definitely to show its superiority over the Canterbury type. In June an examination of the area showed that the mortality of the plants in the Canterbury area had been very considerable, although the remaining plants appeared to be doing well. An eye estimate of the percentage of the pasture constituents, carried out in October, 1930, showed that in Field A about 85 per cent. consisted of perennial rye-grass, while in Field B about 73 per cent. consisted of perennial rye-grass, with 3 per cent. of red and white clover in Field A and about 10 per cent. in Field B. A close examination of the pastures in March, 1932, showed very plainly that the rye-grass in Field B was dying out, and being replaced by a fair amount of red and white clover, cocksfoot, and weeds. At the same time Field A showed a strong sward of rye-grass in which the mortality was negligible, but the establishment of other grasses appeared to have been retarded by the strong competition of the good type of rye.

A. R. Hislop, Amberley.—This area was established at the beginning of April, 1930, and almost from the commencement dry weather was experienced. The germination of the rye-grass, considering prevailing conditions, was very fair, and the sward could be considered fairly good. An eye estimate of the pasture composition, made in October, 1931, showed some interesting differences in the two fields. In Field A about 80 per cent. of the cover consisted of perennial rye-grass, with about 11 per cent. of bare ground. In Field B 60 per cent. of the cover consisted of perennial rye-grass, with 30 per cent. of bare ground. Red and white clover together occupied about 6 per cent. in each case. This area throughout has been subject to extremely dry conditions, and the amount of grazing has not been so great as would have been the case had normal conditions prevailed. The area at date of writing is in fairly good condition, with the certified area showing up well.

G. Hall, Hororata.—The trial on this farm was laid down on 27th November, 1930, and was fortunate in getting a certain amount of showery weather at time of sowing, with the result that an excellent strike was obtained in both fields. Dry weather conditions followed, but the plants had maintained a fair hold of the soil and on the whole establishment was good. Dry weather continued until well into the winter, and there was a certain amount of death-rate in the rye-grass in Field B. In March, 1932, an examination of both fields showed that about 50 per cent. of the rye-grass plants in Field B had succumbed to the drought of the summer and autumn. In Field B clovers and cocksfoot were making good growth, but it was noticeable that there was less clover in Field A, which at this time had a dense sward of perennial rye with little else showing. The competition of the rye-grass had definitely depressed the growth of the other constituents of the pasture.

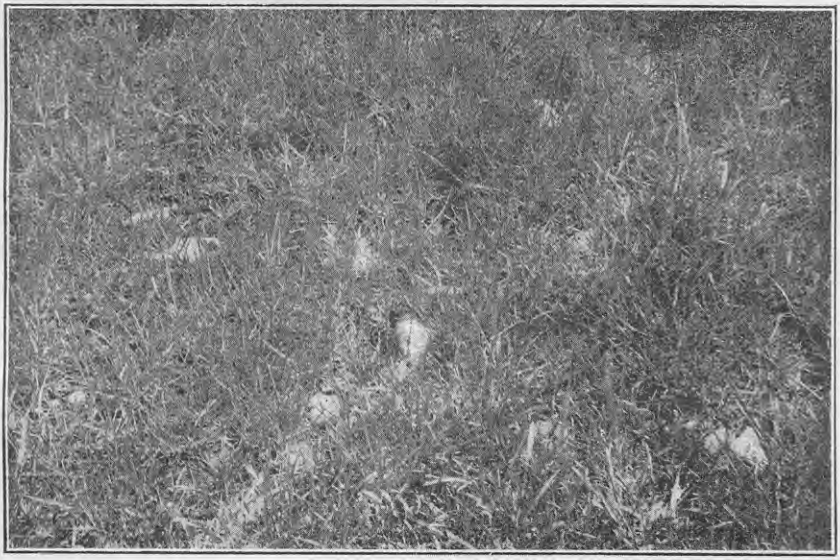

FIG. 1. CLOSE-UP VIEW OF SWARD IN CERTIFIED RYE-GRASS FIELD IN TRIAL ON FARM OF MR. HUNTER MORRIS, WINCHMORE.

Perennial rye-grass dominant; cocksfoot sub-dominant, with fair amount of white clover and suckling clover.

[Photo taken on 7/11/33 by E. Bruce Levy.

FIG. 2. CLOSE-UP VIEW OF CANTERBURY RYE-GRASS FIELD IN SAME TRIAL AS FIG. 1.

Cocksfoot dominant, with rye-grass and white clover sub-dominant.

[Photo by E. Bruce Levy, 7/11/33.

H. Wright Johnson, Dunsandel.—This area was laid down on 7th October, 1930. Dry weather set in practically from the time of finishing sowing, and continued for several months. There was a poor strike of rye-grass in both fields, but rather better in the area sown with certified rye-grass than in the Canterbury area. Owing to weather conditions growth was slow in both fields, but the Hawke's Bay area withstood the drought much better than did the Canterbury area. In August, 1931, the certified rye-grass area showed much more growth than the Canterbury, but neither pasture was good. This area was most unfortunate, in that it missed a number of showers experienced in other districts of Canterbury, and since its inception it has hardly received the benefit of a good rainfall.

H. Morris, Winchmore.—The trial on this farm was laid down on 31st November, 1930. Very dry weather was experienced and establishment was slow. Field B showed most growth in the early stages. Some rain fell in February and both areas benefited greatly. Little difference was noticeable between the two areas, although Field B had slightly more growth than Field A. An examination of the area in October, 1931, however, showed that Field A had made a comparatively good establishment of rye-grass which had tillered out into a fairly good pasture, while in Field B the rye-grass was spindly and prostrate in habit and there was more bare ground to be seen than in Field A.

W. L. Hay, Waimate.—This areas was laid down on 17th October, 1930. The conditions following sowing were very dry, and it was some considerable time before establishment took place and grazing could be done. In the February following sowing, the certified area was much denser in sward and of a darker green colour. Field B was inclined to run away to seed and to show a fair amount of bare ground in the pasture. In November, 1931, both fields were feeling the effects of the drought badly. Field A was dark green in colour when compared with the steely grey of the Canterbury area. A considerable clover growth was present in Field B, but the growth of rye-grass in Field A was such that it had depressed the clover growth. Rain fell in February, 1932, with the result that there was a strong growth in both fields, but especially in Field A, which had shown practically no death of rye-grass during the long dry spell experienced. The rye-grass in the Canterbury area had thinned out, and there was consequently much bare land showing. Cocksfoot was vigorous, and clover came away very well in Field B.

General Summary of Interim Results.

The accompanying table gives a general summary of the results to 30th June, 1933, showing the carrying capacity of each of the fields for each season and for the whole period during which the experiments were carried out.

When the results for the whole period during which each experiment has been carried out are considered, the fields sown in certified rye-grass have in all cases carried more stock than the Canterbury rye-grass fields. These increases expressed as percentages of the

Interim Results of Rye-grass Trials.

Seasonal Periods on each Farm.	Days.*	Carrying Capacity of each Type of Rye-grass in Sheep per Acre.†		Increase (+) or Decrease (−) in Carrying Capacity of Certified over Canterbury Rye-grass, in Sheep per Acre.
		Certified.	Canterbury.	
G. Hall, Hororata.				
(1) 27/11/30 to 30/6/31 ..	216	4·3	2·7	+1·6
(2) 1/7/31 to 30/6/32 ..	366	4·4	2·0	+2·4
(3) 1/7/32 to 30/6/33 ..	365	3·4	2·0	+1·4
Results to 30/6/33 ..	947	4·0	2·2	+1·8
T. K. Buchanan, Irwell.				
(1) 30/3/30 to 30/6/31 ..	457	4·1	3·8	+0·3
(2) 1/7/31 to 30/6/32 ..	366	5·0	2·7	+2·3
(3) 1/7/32 to 30/6/33 ..	365	3·2	3·5	−0·4
Results to 30/6/33 ..	1,188	4·1	3·4	+0·7
A. R. Hislop, Amberley.				
(1) 4/4/30 to 30/6/31 ..	452	1·3	1·7	−0·4
(2) 1/7/31 to 30/6/32 ..	366	2·3	1·6	+0·7
(3) 1/7/32 to 30/6/33 ..	365	3·2	2·1	+1·1
Results to 30/6/33 ..	1,183	2·2	1·8	+0·4
H. Wright Johnson, Dunsandel.				
(1) 7/10/30 to 30/6/31 ..	266	1·4	0·9	+0·4
(2) 1/7/31 to 30/6/32 ..	366	2·0	0·9	+1·1
(3) 1/7/32 to 30/6/33 ..	365	2·2	1·8	+0·5
Results to 30/6/33 ..	997	1·9	1·2	+0·7
H. Morris, Winchmore.				
(1) 30/11/31 to 30/6/31 ..	212	1·6	1·7	−0·1
(2) 1/7/31 to 30/6/32 ..	366	3·2	3·2	+0·1
(3) 1/7/32 to 30/6/33 ..	365	3·7	3·0	+0·7
Results to 30/6/33 ..	943	3·0	2·7	+0·3
W. L. Hay, Waimate.				
(1) 17/10/30 to 30/6/31 ..	256	2·1	2·5	−0·4
(2) 1/7/31 to 30/6/32 ..	366	4·4	2·8	+1·6
(3) 1/7/32 to 30/6/33 ..	365	3·7	3·3	+0·4
Results to 30/6/33 ..	987	3·5	2·9	+0·6

* The number of days in the first period in each experiment was taken from the date of sowing. This accounts for the relatively lower carrying capacity in the first period in some of the trials in which pasture establishment was retarded through dry conditions.

† It must be understood that "sheep per acre" do not represent continuous carrying of number of sheep per acre stated. This method of expressing the carrying capacity is adopted for convenience and to enable the carrying capacities to be expressed in familiar terms. Grazing was carried out under a system of intermittent grazing and spelling, the rate of stocking during the actual grazing periods being a high one as a rule—about twenty to forty sheep per acre. Sheep per acre are calculated from sheep-days per acre, which represent the number of sheep per acre multiplied by the number of days' grazing. By dividing sheep-days per acre by the total number of days in each year or other period stated the equivalent in sheep per acre is obtained.

carrying capacities of the Canterbury rye-grass fields are as follows: Experiment on farm of G. Hall, Hororata, 82 per cent. increase; I. K. Buchanan, Irwell, 21 per cent. increase; A. R. Hislop, Amberley, 22 per cent. increase; H. Wright Johnson, Dunsandel, 58 per cent. increase; H. Morris, Winchmore, 9 per cent. increase; W. L. Hay, Waimate, 21 per cent. increase.

Combining all trials the percentage increase in grazing of the certified rye-grass over the Canterbury rye-grass is 31 per cent.

Thanks are due to those co-operating farmers who by their help and keen interest enabled these trials to be carried out successfully on their farms.

Messrs. Gorman and Saxby, of the Plant Research Station, and the instructors in the different districts were keenly interested in the experiments and co-operated to the fullest possible extent.

A NOTE ON LENGTH OF OESTROUS CYCLE AND DURATION OF PREGNANCY IN ROMNEY EWES.

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THIS note is intended to supplement the records published by Mr. D. A. Gill in this *Journal* for November, 1933. The sheep were again Romneys, being cull studs or flock (non-stud) ewes from stud-breeders, or bred on the College farm from such animals. As at Wallaceville, the figures presented are to be regarded as the by-product of a piece of research.

In certain breeding work in 1931 it was necessary to know the length of the gestation period. Matings of like with like were made for several different fleece types, so that seven rams were being used with little more than a hundred ewes. The ewes were therefore kept in a paddock with teasers smeared over the brisket in the usual way with a coloured preparation. The ewes were constantly under the observation of Mr. R. Dossor, who was in charge of them. As soon as a ewe was found to have been marked by a teaser she was taken to the yards and served by the appointed ram. After service the ewes were kept away from all rams for a couple of days or so, and then placed in another paddock with teasers smeared with a preparation of a different colour.

LENGTH OF OESTROUS CYCLE.

Twenty-three ewes returned once to the ram and seven a second time, so that thirty-seven records were obtained of the interval between the beginning of one period and the beginning of the next. One interval was quite exceptional, being only seven days, to the great surprise of Mr. Dossor. With the procedure described there was, of

course, no doubt about the two services. This ewe returned a second time, twenty days later, and proved empty. Omitting the one exceptional figure the records are as follows :—

Interval in Days.	Number of Returns.	Interval in Days.	Number of Returns.
14	1	18	3
15	1	19	1
16	13	20	2
17	14	21	1

The average for the above 36 figures is just under 17 days.

For ewes that returned twice the intervals, in days, were as follow, the first interval being given first : 14 and 15, 16 and 16, 16 and 17 (twice), 17 and 17, 18 and 17, as well as 7 and 20.

Duration of Pregnancy.

My records for the duration of pregnancy run very parallel to those of Mr. Gill. There was less variation in the times than I had hoped, the shortest being five days less than 149 days, and the longest four days more than that time. The purpose of the investigation was to look for a possible correlation between the length of gestation period and the intensity of the pre-natal check revealed by the fibre type array on the standard position on the back. (This *Journal*, May, 1933 and *New Zealand Journal of Science and Technology*, XIV, 6, 1933.) I had wondered whether a short gestation period might result in a slight pre-natal check, a longer gestation period in a more intense one, but no correlation of this kind was revealed. The data are as follows :—

Duration of Pregnancy, in Days.	Number of Ewes.	Single Births.	Double Births.	Triple Births.
144	1	..	1	..
145	3	3	..	..
146	9	5	4	..
147	15	8	6	1
148	22	16	6	..
149	19	15	4	..
150	18	14	4	..
151	14	11	3	..
152	3	3	..	..
153	3	1	2	..

The average for 107 ewes is 148·7 days, which is in exact agreement with Mr. Gill's figure.

Supplies of Limonite Ore.—Samples of limonite from a number of localities, several being in the vicinity of Rotorua, have been examined by the Chemistry Section, Department of Agriculture, as to suitability for stock-lick purposes. The majority have been of too low grade, or present in insufficient quantity, to be able to compete with the Whangarei material, the only exception being a very high-grade ore from Okaihau, Bay of Islands.

Inoculation of Lucerne.—The Mycology Section of the Plant Research Station reports that during the year 1932–33 cultures of the lucerne nodule organism were distributed in quantity sufficient to inoculate 69,500 lb. of seed, showing an increase of 80 per cent. over the previous season. The cultures were forwarded to 1,037 farmers, an increase of upwards of 40 per cent.

SEASONAL NOTES.

THE FARM.

The Pastures.

THE harmful effect of any weakness which originates in a permanent pasture at the time of its establishment is likely to be perpetuated throughout its life, or to be removed only at considerable expense by repair or replacement. Hence, now that greater permanence in pastures is more readily obtainable, it becomes particularly advisable to prevent any avoidable weakness developing in a sward at the time of establishment.

Among the basic causes of poor pasture establishment is the sowing of seed on poorly tilled ground—ground in a loose, lumpy condition instead of fine and firm. The relatively small size of important kinds of persistent pasture plants is surely indicative of the need of a firm, fine seed-bed as a means of avoiding both the unduly deep and the unduly shallow covering of seed that necessarily results in rough, loose soils.

Another cause of poor establishment is late sowing of seed, which seems to be more commonly operative than many farmers realize. Because lateness of sowing seldom leads to a complete failure, there seems to be an undesirable tendency to overlook the harm that results from it. But while this harm does not command attention in the way that a complete failure would, it certainly at times is great enough to warrant the care necessary to avoid it—it may consist of a thinning out of clovers, and of such slow, puny development of other plants that weeds are given a greater chance of becoming prominent.

The point of current moment is that both poor seed-beds and late sowing often may be traced to the starting of preparatory cultivation at too late a date. This cultivation of land which is to be sown in permanent pasture in the autumn should now be kept in mind. If tillage is hurried, the action of natural weathering agencies, which is known to be of great value in producing the fine, firm seed-bed suited to successful pasture establishment, is correspondingly reduced and alternative methods of obtaining such a seed-bed are relatively ineffective and costly. These facts show the advisability of commencing the preparation of land for new pastures at least a few weeks before sowing, if possible. If pasture is to follow an arable crop eaten off by sheep it is often sound practice, provided the land is reasonably clean, to disk rather than to plough; the additional firmness of seed-bed given by the disking may readily be an advantage, and the extra fertility provided if the animal manure is retained at the surface is where it most readily benefits the young pasture plants.

Often there are serious faults in the seed mixtures used or recommended for permanent pastures. These faults arise generally from failure to recognize the way relatively recent developments, such as top-dressing and the use of superior strains of plants, should be considered in drawing up a pasture seed mixture. Such faults may be avoided by seeking advice from district officers of the Fields Division. Sometimes what is recommended in advice cannot be done properly at short notice, and so it is advisable to obtain the advice in good time. The advent in recent years of commercial supplies of certified seeds has intensified the desirability of obtaining such advice, without which it is known that the fullest possible value for money expended has not always been received. In purchasing seed it is too

often overlooked that its true value cannot be gauged reliably by its appearance, and that there should be no need to attempt to gauge the value of seed by this unsatisfactory means. The preferable alternative method is to purchase seeds on the basis of their established germination, strain, and purity in the way that is possible as the result of official services.

Occasionally it is advantageous to thicken naturally the swards of weak, open pastures by allowing them to reseed themselves in the summer. But satisfactory improvement of swards in this manner can occur only if an appreciable number of suitable, useful pasture plants are already present. When the seed has ripened on such pastures drastic harrowing is advisable to cover the seed, but such harrowing should not be done until rain sufficient to establish the seedlings safely may reasonably be expected. The building up of pastures by natural reseeding in the manner just described usually should not be followed unless the renewal of the pastures by ploughing and resowing is impracticable.

Generally it is particularly desirable to avoid the development of stemmy, coarse growth of young permanent pastures during their first summer. The development of such growth may readily lead to the weakening or destroying of certain species which, though relatively slow in growth in their early stages, are of distinct value in permanent pastures. When the growth of young pastures under grazing cannot be controlled sufficiently by the stock available, "topping" with a mower as described in these notes in October should be practised.

Pastures from which hay or silage has been saved may be expected to respond profitably to a dressing of superphosphate applied as soon as possible after the mown material has been removed. The greater aftermath of fresh feed which can, at times, be obtained by this means is likely to be especially valuable because it becomes available when leafy highly digestible feed frequently is urgently needed and is not readily provided otherwise. This commonly happens between the decline in leaf production of pastures and the becoming available of such crops as soft turnips. While top-dressing after mowing is likely to be useful, irrespective of the stage of maturity at which the sward was mown, pastures mown at a comparatively immature stage have more vigorous aftermaths than similar ones mown at a later stage. The former generally give the greatest immediate return from top-dressing after mowing, but those mown at an overmature stage are likely to be weakened and so in greater need of strengthening by suitable top-dressing.

Utilization of Special Summer Feed.

When special summer feed has been grown to supplement the pastures, frequently a start with the feeding of it to "wet" stock is not made early enough. On many dairy farms from Christmas onwards pastures by themselves do not provide suitable rations for cows of reasonable productivity. There is evidence that, at this season, the butterfat production of well-fed cows of satisfactory dairy character would fall at the monthly rate of 4 to 7 per cent. according to the date of calving. Actually, in some of the main dairying districts the fall in production commonly is at the rate of 10 to 17 per cent. monthly; it is therefore more than twice as rapid as evidence suggests it need be.

An unnecessarily rapid decline in production at this period of the year is of more than current moment, because it is practically certain to be reflected in a correspondingly lowered production during the remaining months of the producing season. Many farmers believe they feed their cows well at the season specified, and will be inclined to

question whether it is possible to reduce the rate of fall in production to 4 to 7 per cent. monthly. These farmers often are misled by the amount of herbage on the fields into believing that the requirements of the stock are being well met. Actually, the stemmy pastures that are of common occurrence are faulty in respect to both their digestibility and their balance of nutritive material. The only way to provide a really good ration for milk production is to feed leafy non-stemmy herbage which, if not available on the pastures, may be supplied by the use of special crops such as young green lucerne, early quickly maturing soft turnips, and fresh aftermath of pastures.

The crucial point is that poor quality in feed is probably a more frequent cause of unduly rapid decline of yield in summer than is poor quantity. The need by dairy cows for leafy, well-balanced, digestible feed in summer is duplicated by the need of calves, which ultimately will repay the provision at this stage of short, fresh, clean grass.

If soft turnips are being carted out to stock, it is usually advisable to scatter them well over the field, but if the sward of a particular area requires building up, then it will probably be well to concentrate the feeding-out of the roots on that area.

Often the earlier sown rape crops will be ready for feeding off in January. Lambs on rape should have a run-off on pasture, and when the feeding of the rape is being commenced, they should be allowed on it only for a short time.

Because of the invasion of weeds, young lucerne sown in November or December may require mowing towards the end of January. It is better not to mow young lucerne so early unless weeds are threatening to outgrow the lucerne plants, and thereby to rob them of the supply of light and moisture. The leaving of the lucerne unchecked at this stage, if weeds permit, favours the development of a vigorous, extensive root system which is of considerable value in subsequent competition with invaders. Unless unusually dry conditions prevail, it is often advantageous to top-dress lucerne with superphosphate at the rate of 2 cwt. to 3 cwt. to the acre after it has been mown in midsummer.

In order to obtain the best result from millet, feeding of it should start when the crop is 6 in. to 8 in. high. When it is fed at this stage of development it will subsequently shoot out and give a valuable second growth.

Forage-crop Considerations.

Often in January it is possible to estimate whether there is promise of an adequate supply of feed for winter and early spring, for which periods there is still time to make additional provision. A suitable crop is temporary pasture consisting of 25 lb. to 30 lb. of Italian or Western Wolths rye-grass and 4 lb. to 6 lb. of red clover to the acre, sown in late summer or early autumn. This must be sown early to ensure that it contributes substantially to the winter supply of feed, and it can be counted on, under normal circumstances, to yield a heavy hay or silage crop in the following summer.

When the land available for emergency winter feed production will be required for spring sowing, then Algerian oats or Black Skinless barley may suitably be employed instead of temporary pasture; both cereals require about 2½ bushels of seed an acre. Often the fullest benefit from autumn sown temporary pastures or cereals for green feed is not obtained because sowing does not take place early enough; this is specially so in the South Island.

Turnips and swedes which are still to be sown at the New Year should be sown at the earliest opportunity; Hardy or Imperial Green Globe is suitable for January sowing. In most places after the middle

of January it is safer to sow turnips than swedes, because the turnips develop more quickly and do not suffer so severely as swedes from insect pests in summer and autumn. Both turnips and swedes will usually respond well to a dressing of 2 cwt. to 3 cwt. an acre of fertilizer in which superphosphate is prominent, and in which bonedust often profitably may be included, especially if the land has just grown other arable crops.

General Cropping Work.

A special endeavour to cut cereals at a suitable stage of ripeness is well warranted. The best stage at which to cut wheat is when the green colour has been replaced by yellow in the section of the stem between the top knot and the heads of about 99 per cent. of the straws. At this stage all knots are still green and no dough can be squeezed from the grain, which, however, is still soft enough to cut with the thumb nail.

Generally, oats should be cut just when they have a uniform yellowish appearance and before the final touch of green has disappeared. At times oats are cut too ripe when they are to be used for chaff, for which they can, with advantage, be cut slightly earlier than the stage just described. Barley for malting is not cut until it is dead ripe.

Although sowing of lucerne in November and December is generally preferable, in many districts, if necessary, it may be sown successfully in January.

Potatoes normally warrant considerable attention at this season; hoeing and weeding, moulding up, and spraying for late blight (*Phytophthora*) will often be needed. Especially in districts in which blight has been severe in the past, spraying proves most useful when employed to prevent instead of to reduce attacks of blight. Detailed information about the correct use of sprays, which is important, is obtainable on application to the Fields Division.

Summer cultivation is of particular importance as a means not only of suppressing weeds, but also of conserving the supplies of moisture in the soil. A loose layer of soil on the surface of a field checks the passage of moisture to the surface, where it is lost by evaporation, and thereby makes more moisture available for the use of crops. This effect of cultivation is of especial moment in the extensive portion of New Zealand in which the annual rainfall is 35 in. or less. Summer cultivation of such crops as mangels, potatoes, carrots, and swedes, sown in rows wide enough apart to allow of intertillage, is especially valuable.

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

THE ORCHARD.

Spraying Operations.

ON no account should spraying operations be suspended at this time of the year, neither should the period between sprays be unduly delayed. It must be remembered that with the advance of summer the fruit is rapidly swelling; therefore, in order to ensure that the whole surface of the fruit and foliage is at all times adequately covered with a film of poison (lead arsenate) for the control of codlin-moth and leaf-roller caterpillar, &c., and an effective fungicide (lime-sulphur plus colloidal sulphur) for control of black-spot and powdery mildew, a close adherence to the recommended spraying programme is still necessary. The combination spray which includes the above mentioned compounds, as advised in last month's notes, is recommended for use until about fourteen days prior to picking.

In view of the fact that the commencement of the holiday season is close at hand, orchardists are advised to arrange their spraying schedule so as to make an application as close as possible to Christmas Day; this should ensure an adequate protection during the holiday season, even should festivities be prolonged. Red mite will probably be on the increase about this time owing to the summer eggs having hatched or being about to hatch, and as the natural dropping of fruit will be over towards the latter part of the month, an application of summer oil 1 to 2 per cent. is recommended. Two applications at ten-day intervals should suffice for the control of mites, as well as scales and woolly aphis.

Orchardists are requested not to simply make two applications as advocated above and take it for granted that the desired result has been achieved; rather they should examine a tree here and there, and if mites are still in evidence it is obvious that at least one more application of summer oil is necessary for a complete or satisfactory control. As many of the mites are to be found on the underside of the foliage, care should be taken to make certain that both sides of the leaves as well as crotches and all other tree parts are evenly covered with the specific, otherwise a complete or even a satisfactory control will not result.

Stone fruits should still receive attention by periodical applications of the combination spray—*i.e.*, lime-sulphur 0·083 per cent., plus colloidal sulphur 2 lb., per 100 gallons of water, for control of brown-rot, shot-hole fungus, and leaf-rust. Should black or green aphis become troublesome, apply 1 per cent. summer oil; this may be repeated in four or five days' time if insects persist. Cherry growers may be troubled with slug worm just prior to picking, in which case a hellebore-powder spray should be substituted for arsenate of lead; this compound is fairly effective in controlling slug and does not stain the fruit. After the fruit has been picked, it is advisable to spray thoroughly, using arsenate of lead, 1 lb. in every 100 gallons of water.

Spray plum trees with arsenate of lead 1 lb. plus 3 lb. hydrated lime per 100 gallons water for control of leaf-roller caterpillar. Peaches, nectarines, and apricots infested with leaf-roller caterpillar may be sprayed with 1 per cent. summer oil, as these trees will not tolerate arsenates.

Handling the Stone-fruit Crop.

No doubt in many of the orchard districts the stone-fruit crop will now be about ready for harvesting, and growers are urged at this stage to realize the importance of placing their fruit before the public in the most pleasing and attractive manner possible.

This can only be done by extreme care and attention to detail in picking, grading, packing, and the use of clean, well got up cases. It is a well-known fact that as the honey-bee is attracted to a highly coloured flower so is the fruit consuming public attracted too, and will pay more per case or per pound for a pleasing, well got up package of fruit. In the first instance, a new clean case, cut to standard specifications and lined with white or coloured paper, will go far in setting off to the best advantage the fruit contained therein, while a pleasing label with the grower's number printed thereon attached to each end will undoubtedly enhance its attractiveness.

The fruit should be picked and handled with the greatest of care, and only good, sound fruit, evenly sized and graded, packed for market. Bruised, overripe or skin punctured fruit should be discarded, as it will not keep for more than a few hours before brown-rot and mould, &c., set in. The latter remark refers to all fruit not hand picked, such as windfalls and fruit dropped when picking; it also includes broken-skinned

fruit. Although damaged fruit should on no account be placed on the market, it need not necessarily be wasted and thus become a total loss to the grower; if sold privately for immediate use it can be utilized for making jam or preserves.

The degree of maturity at which the fruit should be gathered is a very vital question that can only be decided after taking into consideration the distance it must travel before reaching the point to which it is consigned. If immature when picked the fruit will not develop its full characteristic flavour, nor will it carry that bright fresh colour that lends to its attractiveness. On the other hand, if picked overripe the fruit quickly becomes mouldy and more or less rotten, and often reaches its destination with juice oozing from the container.

The correct degree of maturity for picking should be decided to a certain extent by the general appearance and feel of the fruit. A gradual change in colour takes place once the fruit has reached the ripening stage. Apricots, for instance, will gradually change in colour until they show a tinge of yellow over most of the fruit; peaches and nectarines will change to a golden yellow, or silvery yellow, according to the variety, while plums change to yellow or red according to the variety. The fruit should not be gathered before this change in colour takes place; at the same time care must be taken to see that it is gathered before it becomes soft, unless, of course, it is intended for immediate use. Cherries may be allowed to remain on the trees until fairly ripe. Undue handling destroys the bloom of the fruit and should be avoided as much as possible.

Budding.

Budding operations may be carried out in the following order: Cherries in December; apricots early January; plums, apples, and pears latter half of January; nectarines and peaches latter half of February and March. This is the only method and opportunity, as far as the current season is concerned, of reworking trees where grafts have failed, or working young stocks grown for the purpose.

Thinning and Cultivation.

If the natural dropping of fruit has ceased, thinning should be pushed on with all reasonable speed, as directed in last month's notes.

Cultivation should be continued as long as it is possible to do so without injuring the trees and fruit.

—J. W. Whelan, Orchard Instructor, Palmerston North.

Citrus Culture.

Every effort should be made to continue with cultivation work, especially as the spring has been such a moist one in most of the citrus areas, with a possibility of a dry spell to follow. With the lack of necessary cultivation the trees are bound to suffer through want of moisture, and where trees have blossomed heavily a large proportion of the flowers will fall without setting fruit.

A study should be made of individual trees, and where a heavy blossoming has taken place the trees should receive further assistance in the form of sulphate of ammonia or nitrate of soda. This could be applied at the rate of 2 lb. to 4 lb. per tree, according to its age and size, and if worked in would become immediately available.

In the case of young planted trees, these should be given every chance to develop; all superfluous shoots should be rubbed off, and any strong perpendicular shoots not required for the framework of the tree should be removed so as to encourage side growth, but where required for formation work they should be lightly tipped to ensure stability.

A careful watch should be kept for young borers, and as soon as the result of their work is noticed the twig should be removed and the grub destroyed before it penetrates to the larger limbs. Where its castings show the larger limbs to be infected, it can be treated by injecting benzine into the holes and plugging them with soap or putty.

Continue spraying with bordeaux where necessary for the control of verrucosis and grey scab; and where scales and thrips are troublesome apply white oil and nicotine sulphate as mentioned in previous notes.

—L. Paynter, Orchard Instructor, Auckland.

POULTRY-KEEPING.

Management of the Growing Pullets and Cockerels.

Now is the time when the poultry-keeper must exercise a close study regarding the requirements of the birds of different ages on the plant. Many poultry-keepers, at this season of the year, make the mistake of feeding both the growing and adult birds on the one class of food. Too often the morning mash contains a high proportion of forcing material, such as meat, meat-meal, &c., this being supplied to all the flock irrespective of age, sex, and the object aimed at.

It is always a wise course to force all the eggs possible out of laying hens which are not intended for future breeding purposes, especially from those it is intended to cull in the autumn before they are sent to market. In the case of the growing pullet, however, forcing food should be sparingly provided, or the birds are apt to mature at too early an age, meaning that they will never grow to a desired size or lay a good marketable egg—or, indeed, an egg fit for the renewal of stock. Obviously the fact that a pullet comes to maturity at a very young age indicates that the reproductive organs have developed before it has had time to build up a good frame, and this should be avoided at all costs, in view of the decided tendency for many of our useful poultry stock to become weedy and much below the standard weight of their breed, and producers of small sized eggs. When it is observed that pullets are showing signs of reaching maturity before a desired age has been attained, all forcing foods, such as meat, should be cut out of the ration.

With a view to retarding early laying, which is undesirable until the birds have reached an age of six months, shelled plump oats may with advantage be their chief diet. Never feed unshelled poor-quality oats because they are cheap to young stock in particular. These consist very largely of husks which have no food value, and in addition are apt to cause gizzard compaction and consequent mortality. Especially does this apply where the birds are not supplied with ample sharp stone grit.

On no account should growing pullets be kept in quarters which are too confined, or under what might be termed hot-house conditions. The covered-in house is an ideal place for the laying pullet, especially where winter eggs are the objective, but for the growing pullet too much range cannot be provided.

While the laying hen and the growing pullet require different food and treatment at this period of the year, the same applies in equal force to the future breeding cockerels, and those intended for the table, if the objects aimed at are to be achieved. The prospective breeding cockerels should be fed and managed in such a way as to keep them steadily growing, and everything possible be done to promote good health and constitutional vigour. As is the case with the growing pullet, a good range under the most natural conditions possible, in conjunction with a non-forcing diet, will go a long way towards the attainment of sound development.

On the other hand, the cockerels intended for the table should be fed and managed in such a way that they will rapidly develop and be in a marketable condition at about five months old. The aim should be to bring the birds to a prime stage with their chicken flesh still on them. With this in view, the ration should consist chiefly of soft food after the birds are about four months old. A suitable mash comprises two parts of bran and one part each of finely ground wheat-meal and maize-meal, with 5 per cent. by weight of meat-meal added, the whole being moistened with hot water or skim-milk, and mixed into a crumbly mass. Feed three or four times a day as much as the birds will clean up without waste. Green stuff such as silver-beet, cabbage, &c., should be daily and liberally fed.

It is next to impossible to fatten cockerels on free range, and they should be placed in confinement in a suitable house with a run giving opportunity for only limited exercise. The production of a maximum weight of flesh in a minimum period is the ideal to be aimed at when priming a table cockerel.

It goes without saying that the sexes should be separated as soon as they can be determined, which will be to the advantage of both cockerels and pullets.

Marking Chickens.

If a poultry plant is to be conducted on proper lines the poultry-keeper should know the exact age of all the birds on the place. It is no use trusting to the eye in this respect. It should be remembered there is no definite outward signs by which the ages of hens can be determined, apart, of course, from their general appearance to the eye of the experienced poultryman. Generally speaking, the condition of the breastbone will indicate whether the bird is a first season one or older. In the former, the end of the breastbone is much more flexible than is that of a two- or three-year-old bird, but apart from this it is almost an impossible matter to tell with any degree of certainty the age of a fowl. The only safe course for age determination, therefore, is to mark the web of the foot with a punch. Chickens may be marked immediately they leave the incubator, and a punch for the purpose can be obtained for about 2s. 6d.

It is not only necessary that the birds should be marked for the sake of age determination, but the progeny of selected birds should also be specially toe-marked. The marking must be done on a system and a register kept of the different markings. In this way the chicks can be all run together or in large lots, while the birds bred from special strains can be distinguished at a glance. Where no system of marking is employed, confusion and annoyance are often caused in the vain endeavour to pick chickens from particular matings which have become mixed up, while the same may be said in regard to ascertaining the ages of adult birds at culling time.

Leg Weakness in Chicks.

If the chickens are losing the power of their legs and develop a wobbling walk, it usually indicates that they are huddling at night and require more warmth. This trouble is often intensified by the lack of sufficient bedding material under the hover, especially where the floor is very smooth. The constant slipping on the smooth surface in their endeavours to secure an inside position, which is the warmest, has the effect of spreading and weakening the delicate legs. On the first sign of this condition being observed, additional warmth should be applied. If the chickens are provided with the degree of warmth demanded by instinct, together with ample bedding material, so that a good foothold

can be secured, it will not only induce the young birds to spread out, but will also greatly assist in preventing them from slipping, with its consequent bad effect on the legs.

Speaking of leg-weakness, too many people fail to realize the value of freshly broken sea-shell for their chickens as a means of preventing this trouble. Right from the start, and throughout all stages of their development, it should be in reach of the birds to pick at. If chickens are to develop the desired thickness and quality of bone it is imperative that they be provided with material containing a liberal supply of lime. Indeed, it is safe to say that much of the leg-weakness that occurs in growing chickens would be unheard of if the value of sea-shell as a means of preventing the trouble were better realized.

Broody Hens.

A matter that should be now attended to is the removal of broody hens from the nest to the broody-coop, a box raised from the ground with slats on the bottom, or such a structure as that illustrated in the Department's Bulletin No. 66, for there is nothing which encourages vermin so much as a hen sitting on the nest. Again, the longer a hen is allowed to sit the longer will be her broody period. A bird in the broody stage does not come off to feed as she should, and consequently gets run down, and if she undergoes this treatment for any time she will not be in a fit condition to lay well when she is over the broody fit. This not only means a loss in eggs, but the breeding of insect pests is also encouraged. Do not adopt the weak policy of starving the broody hen. On the other hand, give her as much food as she can eat, in order that egg-laying may be resumed in the shortest time possible.

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

THE APIARY.

Returning Swarms to Parent Hives.

SWARMS in January are of little value except as increase for the next season, and should be returned to the hives whence they originated if these can be traced. It is a good plan to kill the old queen in the swarm when returning it, at the same time destroying all but two queen-cells in the parent colony. If the hive is cramped an extra super may be given, and with this inducement the colony will usually settle down at once to work.

After-swarms should always be returned to the parent hive. They are easily disposed of even if the beekeeper does not know whence they came. If they are shaken through an excluder into an empty super the virgin queen or queens can easily be picked out as they attempt to force their way through, and once these are removed the bees will return to their old home. The young queens can then be used to replace poor queens in the apiary. It is an excellent plan to have one or two queen-cages always on hand. The young queens can each be confined in a separate cage, and when the queen to be destroyed is removed the closed cage containing the virgin can be placed on top of the frames and left there for twenty-four hours, during which time she will be fed by the bees in the hive. At the end of twenty-four hours she can be released and allowed to run down into the frames, when she will be accepted by the bees.

Ventilation.

The matter of ventilating the hives should by now be receiving every attention. Every means should be used to ensure the bees having an abundance of fresh air day and night. All weeds and other obstructions

should be removed from the fronts of the hives, and the entrances enlarged as much as possible. In extreme cases the hive-bodies should be raised from the bottom-boards by means of small blocks of wood. On no account should the bees be allowed to cluster outside the hives, and wherever they show a tendency to excessive fanning steps should be at once taken to increase the supply of fresh air to the colonies.

Efficient Use of Supers.

One of the necessities of a well-regulated apiary is an abundance of supers when the honey-flow is in full swing. Every inducement should be given the bees during the often brief season to gather in every available drop of nectar. No beekeeper with business acumen will allow his bees to loaf or cluster outside the hives for lack of storage room. It is well when adding extra supers to place them between the brood-chamber and the first super, or at least to raise a few frames of honey from the first super into the second when adding the latter.

It should be understood, however, that supering must not be overdone and the bees disheartened by being given too much work at one time. On no account add a second super until the bees are well at work in the first, and in cases where the colonies are only building up well at the beginning of the honey-flow—that is, where a poor colony has been requeened and the new queen's brood has not as yet hatched—it is an excellent plan to tier up with half-stories. Many an apiarist has had a moderate return from a small colony with half-stories, when it is doubtful if any return at all would have been obtained by the use of full-depth supers.

Queen-excluders.

January is the month when queen-excluders are of most use, especially in Southern districts. Whatever their disadvantage may be in some localities, in the South they have proved their efficacy in enabling extracting to be finished before the hot weather goes, without the destruction of any brood whatever. Excluders should never be used for general purposes until the main honey-flow is in full swing. By that time the bees are used to working in the supers, and with nectar in abundance to be had all around them they will work cheerfully right through the hive, passing through the holes in the excluders as if no obstruction existed.

The best method of using the excluders is as follows: All sealed brood should be raised above the excluder, and the queens confined below on drawn-out combs. The brood above the excluder should be watched for a few days in case any eggs have been elevated, as the bees will sometimes attempt to raise queen-cells above the excluder. If this happens the queen-cells should be destroyed, as the queens which would emerge from them would not be able to pass through the excluders to get mated, and would in time develop into drone-layers. By providing the queen with plenty of empty combs she will be able to cultivate laying at a sufficient rate to keep up a supply of workers, and as the brood hatches out in the upper stories the cells will be at once filled up with honey.

Excluders are often condemned as being productive of overswarming, but in many localities swarming ceases automatically as soon as the main honey-flow commences, and if the queen is allowed plenty of room in the brood-chamber, and the brood in the supers carefully watched for the production of queen-cells, very little harm can come from the use of excluders, while the immense advantage of being able to extract combs entirely free of brood is worth a great deal to the apiarist at his busiest season.

Foul-brood and its Treatment.

Foul-brood, unfortunately, is all too common in some localities, and in consequence beekeepers may at any time have a visitation. No one, however, should look upon foul-brood as a necessary evil—it can be cured. It is unknown in some parts of New Zealand, some apiarists who have been keeping bees for ten years or more never having seen it. Other districts that have in the past been troubled with the disease are now free from any sign of infection.

There is therefore no excuse for the presence of foul-brood in apiaries situated in open country; its presence is explained by carelessness on the part of the beekeeper. There is no remedy for American foul-brood superior to the McEvoy treatment, which has been frequently described in the *Journal*, and is more fully dealt with in the Department's Bulletin No. 119, "American Foul-brood in Bees and its Treatment," which can be obtained free on application. Carelessness in dealing with foul-brood must result in heavy losses, and eventually in the destruction of the whole apiary. Make a point of treating any colonies found to be infected; though there may be only a few cells of disease showing, the infection is there, and it is not safe to trust to any methods less than the full McEvoy treatment. On no account put supers on infected colonies; this will only increase the quantity of material that must eventually be destroyed to ensure the eradication of the disease.

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

HORTICULTURE.

Vegetable Culture.

THE planting out of such winter crops as celery, leeks, savoy, and red cabbage, broccoli, cauliflower, and kale should now be completed; also sowings of shorthorn carrots, globe beet, spinach, parsley, dwarf beans, early-maturing peas, yellow turnips, and salads; also, in dry districts, silver-beet for spring cutting.

Pinch out the tips of leader growth on marrows, pumpkins, cucumbers, and other gourds to induce the formation of fruiting laterals.

Keep celery crops well supplied with water. Generally an occasional light dressing of nitrate of soda to stimulate growth will be beneficial. Keep a sharp look out for celery-spot disease, and apply bordeaux promptly at its first appearance, repeating it as necessary at intervals of about three weeks. A suitable bordeaux formula is 3 lb. bluestone, 4 lb. hydrated lime, 50 gallons of water; washing soda may be substituted for the lime, and is preferable for later applications, as it is less unsightly.

If warm humid weather is experienced late-blight of potatoes may now be expected, and crops will require the protection of a bordeaux spray; a 3-5-40 formula will be suitable for this purpose. Hot water may be used for dissolving the bluestone crystals quickly. Careful mixing and thorough application are necessary for success. Repeat the application after an interval of about three weeks. If a crop is badly attacked by the disease the tops should be cut with a scythe and removed; but the potatoes should be dug soon after, unless the weather is dry, or second growth will soon commence.

In a dry season the potato moth is liable to attack the crop. This is best prevented by covering the tubers well when ridging up, and, when digging, to bag up the potatoes dug each day so that this night-flying moth is unable to deposit her eggs upon them. Infected shaws should be burnt, and small potatoes and waste should not be

left lying exposed to carry the pest over for another season. When such precautions are taken the larvæ of this moth do little damage; without them, serious losses have been reported from the warmer districts.

Onions, shallots, and garlic should be harvested as soon as they show signs of ripening. This has to be done rather smartly in humid districts, or growth readily recommences, elsewhere harvesting is not so urgent. Dry the bulbs off well, trim them, and store in a dry well-ventilated shed. If rain falls while they are drying the bulbs are apt to be discoloured; every care should be taken to dry them off quickly and secure a bright attractive sample. Decay during storage is often due to bruising; this is easily done by rough handling.

In the warmer districts it is customary to make a sowing of onions about the month of March for planting out in July. The mild-flavoured bulbs of the Rocca or Tripoli class are very suitable for this crop; their mild flavour and tender flesh make them very suitable for salads, either in a young stage of growth during the spring or when mature. Arrangements should now be made for preparing a piece of ground for raising the seedlings.

Another important crop is the cabbage for spring cutting. These are usually sown in February and planted out in April. The seed-beds should now be prepared. A good dressing of finely ground bone-dust turned under and a top-dressing of lime hoed in will often be suitable.

It has been said that the mechanical state of the soil is more important than its chemical condition. However that may be, the dry weather is proving that heavy land in a poor mechanical state is unproductive. The mechanical condition of heavy land may be improved by a dressing of lime, and in some instances this is required annually; by turning in humus, which is often very scarce; and by carefully leaving the land alone when it is in a wet condition. Those who are cultivating land of this class should give this matter careful consideration, as it is fundamental to good cropping.

The Tomato Crops.

The unfortunate loss of fruit crops of all kinds through severe late frosts is likely to create a stronger demand for the produce from tomato crops which have survived the experience. Every care should be given them if they are to meet the demand. Light cultivation to avoid disturbing the roots, when the plants are well established, would often be beneficial in the place of the deep cultivation sometimes given; and a dressing of sulphate of potash applied when black-stripe disease makes its appearance would be suitable treatment, especially if the crop generally is in vigorous condition. Also, carefully avoid spreading the disease when trimming. The dietetic value of the tomato is becoming more widely known, and a steady supply evenly distributed on the market should return a credit balance this season.

Small Fruits.

When the fruit from raspberry and loganberry plantations has been harvested it is advisable to cut out the canes and vines that have fruited, as they have done their work and are of no further use. Being the older wood on the plants they are most likely to be infected with pests or diseases, and their early removal and burning will do much to prevent the spread of disease. The removal will also facilitate the ripening of the young growth and buds which are due to fruit next year, and the effective application of sprays for the control and prevention of any disease that may be present or threatening. These and other small-fruit crops are commonly affected with leaf-spot fungus diseases, scale insects,

and the larvæ of the clear-wing moth, from which a lime-sulphur and arsenate of lead spray will now afford them considerable protection. The growth on black currants that has carried the crop just harvested may also be cut back to a bud at the base, and burnt, with similar advantages. It is the strong young wood of the present season's growth that will best bear the crop next year.

The Homestead Garden.

In rather a dry soil and warm situation, but exposed to heavy winds, Spanish broom is making a fine display, which is greatly enhanced by its strong perfume. Under the generic names of Cytisus, Genista, and Spartium the brooms are worthy of more attention where such localities are to be planted; they look well associated with the blue *Ceanothus azureus* and *C. Veitchianus* from Mexico and California, which enjoy a similar situation. Besides the fragrant Spanish broom, *Genista fragrans*, above-mentioned, there are the white, *Genista monosperma alba*, and crimson, *Genista Andreana*—the latter discovered some years ago by M. Edouard Andre in Normandy; and many fine hybrids. They dislike disturbance about the roots when established, and have an antipathy for lime. They give a wonderful response to pruning done after flowering by removing most of the shoots which have blossomed. The oleanders, *Nerium oleander*; tamarisk, *Tamarix gallica* and *T. japonica*; *Diosma ericoides*, which is most fragrant under such conditions; and, best of all, our own pohutukawa, *Metrosideros tomentosa*, all flower well and flourish in such a locality. Some palms also flourish in such an environment, for while many kinds demand a rich moist soil in a shaded, sheltered position, the fan palms (species of Chamaerops) and the Canary palm, *Phoenix canariensis*, flourish in the sun and wind without disfigurement, but they are rather thirsty subjects. The silver-tree, *Leucadendron argenteum*, a native of Table Mountain, Cape Town, in such a locality has conditions that suit it exactly.

Where a new garden is to be made, the cultivation of the soil and the formation are best commenced as soon as the land is sufficiently moist for digging, as time is necessary to permit it to sweeten and settle down firmly and to permit occasional cultivation to destroy weeds—all important preliminaries in successful garden building. Sowing lawns in early March and planting towards the end of May are approximate dates for those important operations here; but do not be tempted to commence them before the land is ready, a very common cause of disaster, so many people finding it hard to learn that to be successful in this matter one must co-operate with and not attempt to coerce nature; for doing the latter there is not the least possible chance. It is necessary to complete the preparation of the ground in a proper manner before sowing down permanent lawns or planting trees and shrubs, even if a season has to be "missed."

An important feature in the lay-out is the selection of suitable levels and grades for the surface of walks, lawns, and borders. In this, surface-water must receive consideration, as good drainage is essential, but the general appearance of the garden also depends on a wise selection of surface grades; for these reasons very careful consideration should be given to the subject.

Rambler roses as soon as they have flowered should have the old canes which have flowered completely removed, and young growths for flowering next season should be tied in to replace them. If young growth is not available the old wood may be retained and the flowering laterals shortened. When young growths are superabundant tie in the best, as far as they are needed, and cut out the remainder.

At this season carnations are layered, and cuttings are struck in a sandy loam in a shaded frame. Chrysanthemums last season were often

disappointing, owing to aphis and other insect pests becoming established on the plants and later in the blossoms. Prompt application of a nicotine spray should be made at the first sign of an attack, as when well entrenched it is most difficult to destroy them effectively.

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

ESTIMATES OF THE SEASON'S LAMBING.

FOLLOWING are estimates of the current season's lambing in New Zealand computed from estimated average percentages furnished by Inspectors of Stock. Corresponding figures for the five previous years, together with the actual number of lambs tailed therein, are also given for comparison.

Year.	Number of Breeding-ewes.	Estimated Average Percentage of Lambing.	Estimated Number of Lambs.	Actual Number of Lambs tailed.
		NORTH ISLAND.		
1933 ..	9,318,941	91·23	8,502,050	..
1932 ..	9,170,996	89·16	8,177,657	7,988,569
1931 ..	9,247,005	86·49	7,998,247	7,813,887
1930 ..	9,312,461	83·19	7,747,274	7,710,370
1929 ..	8,820,536	87·56	7,723,523	7,817,177
1928 ..	8,211,878	84·61	6,948,380	7,286,284
		SOUTH ISLAND.		
1933 ..	7,890,756	88·14	6,955,252	..
1932 ..	7,892,064	88·42	6,978,494	7,027,059
1931 ..	8,361,724	87·13	7,285,914	7,161,104
1930 ..	8,251,714	84·43	6,967,041	6,817,939
1929 ..	7,787,619	89·87	6,998,691	7,070,422
1928 ..	7,322,173	87·74	6,424,887	6,569,674
		DOMINION.		
1933 ..	17,209,697	89·82	15,457,302	..
1932 ..	17,063,060	88·82	15,156,151	15,015,628
1931 ..	17,608,729	86·79	15,284,161	14,974,991
1930 ..	17,564,175	83·77	14,714,315	14,528,309
1929 ..	16,608,155	88·65	14,722,214	14,887,599
1928 ..	15,534,051	86·09	13,373,267	13,855,958

District Estimates.

The following table gives estimates of the current (1933) season's lambing for the several sheep districts :—

Sheep District.	Number of Breeding-ewes.	Estimated Average Percentage of Lambing.	Estimated Number of Lambs.
Auckland	1,783,450	88·71	1,582,115
Napier-Gisborne	3,943,718	88 70	3,498,173
Wellington - West Coast ..	3,591,773	95·26	3,421,762
Marlborough-Nelson-Westland	767,867	76 96	590,919
Canterbury-Kaikoura ..	3,396,693	85 97	2,919,993
Otago (including Southland)	3,726,196	92·44	3,444,340
Dominion	17,209,697	89·82	15,457 302

—*Live-stock Division*

WEATHER RECORDS: NOVEMBER, 1933.

Dominion Meteorological Office.

FROM the meteorological point of view November was a quiet month. Southerly or south-easterly winds were unusually prevalent and were responsible for temperatures being rather on the cold side. There was a better distribution of rainfall than in October, but Nelson and Marlborough again experienced a serious shortage. The heavy rains in Canterbury in the early part of the month saved the situation there, particularly as regards wheat crops. The late frosts of the 22nd and 23rd caused considerable losses of potatoes, tomatoes, spring vegetables, and small fruits.

Rainfall.—Rainfall was above average north of Auckland, in the Bay of Plenty, and eastern districts of the North Island, and in most of Canterbury and Otago. In the Waikato, Taranaki, the Manawatu, the Wairarapa, Westland, Southland, and particularly Nelson and Marlborough, it was considerably below average. There was an absence of warm north-westerly rains.

Temperature.—Temperatures were above normal from Auckland northwards and west of the ranges in the North Island, but east of the main range they were below. The Hawke's Bay and Poverty Bay areas had very cold weather for the time of year. In the South Island, Central Otago had a warm month but the remainder a cold one. The frosts of the 22nd and 23rd were unusually severe for so late in the season. In South Canterbury and Otago that of the 22nd was the more severe, but thence northwards, in North Canterbury, Marlborough, Wellington, and Hawke's Bay, it was on the 23rd that the damage was done.

Sunshine.—There was less sunshine than usual over the greater part of the North Island, and especially the east coast, owing to the dull weather brought by the persistent southerly and south-easterly winds. From Wellington southwards, however, the normal was exceeded at most places by large amounts. Lake Tekapo recorded 285·5, Nelson 271·0, and Blenheim 254·0 hours.

Pressure Systems.—During the first three days pressure was high and the weather fine generally.

Between the 3rd and the 6th a cyclone moved down from the north on to New Zealand, becoming more extensive in the process. This storm produced general rains, which were of very great value to the country. The heaviest fell on the 5th, when the storm was in the form of an irregular cyclone covering the central portion of the Dominion. The principal wheat-growing areas of Canterbury received between 2½ in. and 5 in. Large amounts were recorded also in eastern Otago and in Hawke's Bay. In the latter district there were heavy thunderstorms. Though cold weather followed it, and there was snow on the high levels, especially in Canterbury, the rain was a fairly mild one. North Auckland had heavy rain in the early part of this storm.

About a week later, on the 11th to 12th, another depression caused widespread rain, Canterbury again having heavy falls. This depression was of the westerly type, but a cyclone developed in its northern portion.

The third storm system occurred between the 20th and 24th. Following the passage of a westerly depression on the night of the 20th, a series of cyclones developed over the northern part of the Tasman Sea and passed to the north of the Dominion. Rains were again fairly general, but the parts principally affected were the northern and eastern portions of the North Island. From the morning of the 22nd cold southerly or south-easterly winds prevailed over the greater part of the country.

A somewhat similar type of weather was experienced from the 27th to the 30th, but on this occasion there was very little rain in the South Island and the cold was much less severe.

Wellington, 5th December, 1933.

Solidified Molasses for Stock Licks.—The Department's Chief Chemist reports that solidified molasses has been tried as a vehicle for mineral licks, being roughly powdered and mixed with limonite, bonemeal, &c., and rapidly setting again to a cake on exposure to the air. In this form it is readily licked by cattle out of covered troughs, and should be useful if marketed at a low enough price.

RAINFALLS FOR NOVEMBER, 1933, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average November Rainfall.
North Island.				
	Inches.		Inches.	Inches.
Kaitaia	4·12	14	1·80	2·91
Russell	8·33	13	3·55	2·38
Whangarei	7·00	17	2·75	2·90
Auckland	2·48	15	0·92	3·31
Hamilton	2·54	7	0·73	4·09
Rotorua	4·91	14	1·20	4·14
Kawhia	3·01	10	0·94	4·55
New Plymouth	3·33	16	0·98	4·82
Riversdale, Inglewood	4·70	16	1·03	9·22
Whangamomona	..	..	..	7·51
Hawera	1·53	9	0·57	3·90
Tairua	5·24	13	2·34	3·78
Tauranga	6·00	17	1·64	3·31
Maraehako Station, Opotiki ..	4·86	14	1·18	3·23
Gisborne	1·28	6	0·85	2·92
Taupo	2·55	17	0·58	3·51
Napier	2·38	13	0·90	2·43
Hastings	2·08	10	0·59	1·85
Whakarara Station, Kereru ..	3·55	17	0·75	..
Taihape	2·65	15	0·54	3·52
Masterton	1·39	8	0·53	2·75
Patea	2·31	7	1·14	4·07
Wanganui	1·67	7	0·60	3·27
Foxton	1·62	6	1·08	3·28
Wellington	1·58	9	0·45	2·90
South Island.				
Westport	6·15	14	1·52	8·85
Greymouth	6·13	13	1·47	9·01
Hokitika	6·27	13	1·14	10·73
Ross	7·44	9	1·75	13·95
Arthur's Pass	6·15	8	1·85	16·14
Okuru	..	..	..	12·99
Collingwood	3·67	10	1·00	7·16
Nelson	1·17	10	0·45	2·99
Spring Creek	1·06	8	0·36	2·45
Hanmer Springs	3·11	8	0·69	3·61
Highfield, Waiau	2·82	7	0·82	2·54
Gore Bay	2·61	8	0·96	2·18
Christchurch	1·62	6	1·00	1·92
Timaru	4·77	6	3·09	1·91
Lambrook Station, Fairlie ..	5·24	6	2·86	1·97
Benmore Station, Clearburn ..	2·29	6	1·07	2·05
Oamaru	4·19	8	2·64	1·91
Queenstown	2·07	6	0·58	2·74
Clyde	1·99	5	0·67	1·35
Dunedin	4·98	13	1·83	3·25
Wendon	3·25	9	0·71	2·78
Gore	..	..	..	3·23
Invercargill	2·54	19	0·62	4·41
Puysegur Point	4·08	14	1·23	8·35
Half-moon Bay	2·91	15	1·01	5·79

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.

HORSE WITH NASAL CATARRH AND COUGH.

"HORSE," Eltham:—

I have a draught horse with a bad cough and a discharge of thick matter at the nose. Can you tell me the cause and cure for this? Is it contagious? The horse appears to be quite well otherwise.

The Live-Stock Division:—

Your draught horse is apparently affected with nasal catarrh, in all probability due to the dust contained in the chaff at this season of the year. The cough is in all probability due to the same cause. On the other hand, the horse may be affected with emphysema of the lungs, commonly known as "broken-wind." In the latter case, in addition to a short cough, the symptoms of broken-wind may be recognized by a heaving at the flank resembling a double expiratory effort. In broken-wind the symptoms are more pronounced when horses are feeding on dry dusty feed. In either case it is advisable to give as much green feed as possible. It is also advisable to dampen the chaff by spraying it with water to which some molasses has been added. The affection is not contagious, and may be alleviated by the above measures.

CONTROL OF SMALL BROWN BEETLE.

J. F., Kaitaia:—

Could you give me an idea of how to get rid of a small bronze beetle. They are doing a lot of damage to my small home orchard and other plants. We have sprayed with arsenate of lead, also nicotine sulphate, but they are still chewing away contentedly. They seem to leave the peaches and nectarines alone.

The Horticulture Division:—

Fruit trees and shrubs growing among rough growth, or with rough growth in the vicinity, especially when the locality is also warm, are very subject to the attack of the small brown beetle, *Eucolaspis brunnea*, during the summer. Where the conditions are very favourable to the insect, satisfactory control is not always obtainable by present known methods. The maintenance of a clean fallow for the greater part of the year has given best results in controlling this pest, as with other soil insects. Arsenate of lead sprays are useful if thoroughly applied, but tight apple clusters should be thinned so that the spray may reach the base of the apple about the stem. The beetles are on the wing usually from November to January, and attacks are best prevented by spraying early in that period.

Xanthine Calculi in Sheep.—The kidney of a sheep forwarded last season by the Meat Inspector, Moerewa Freezing Works, North Auckland, was found to contain several large calculi consisting of xanthine, this being the first record of this type of calculus among stock in the North Island.

Gisborne Flood Silts.—In the vicinity of Patutahi, Gisborne, floods during the past year left a deposit of silt of varying thickness affecting an area of over 4,000 acres, and representative samples were analysed by the Department's Chemistry Section. These soils, which were classified as silt loams, contained an average of 2·5 per cent. of calcium carbonate, and were plentifully supplied with total lime, magnesia, and potash. The citric-soluble phosphoric acid was also above the average.