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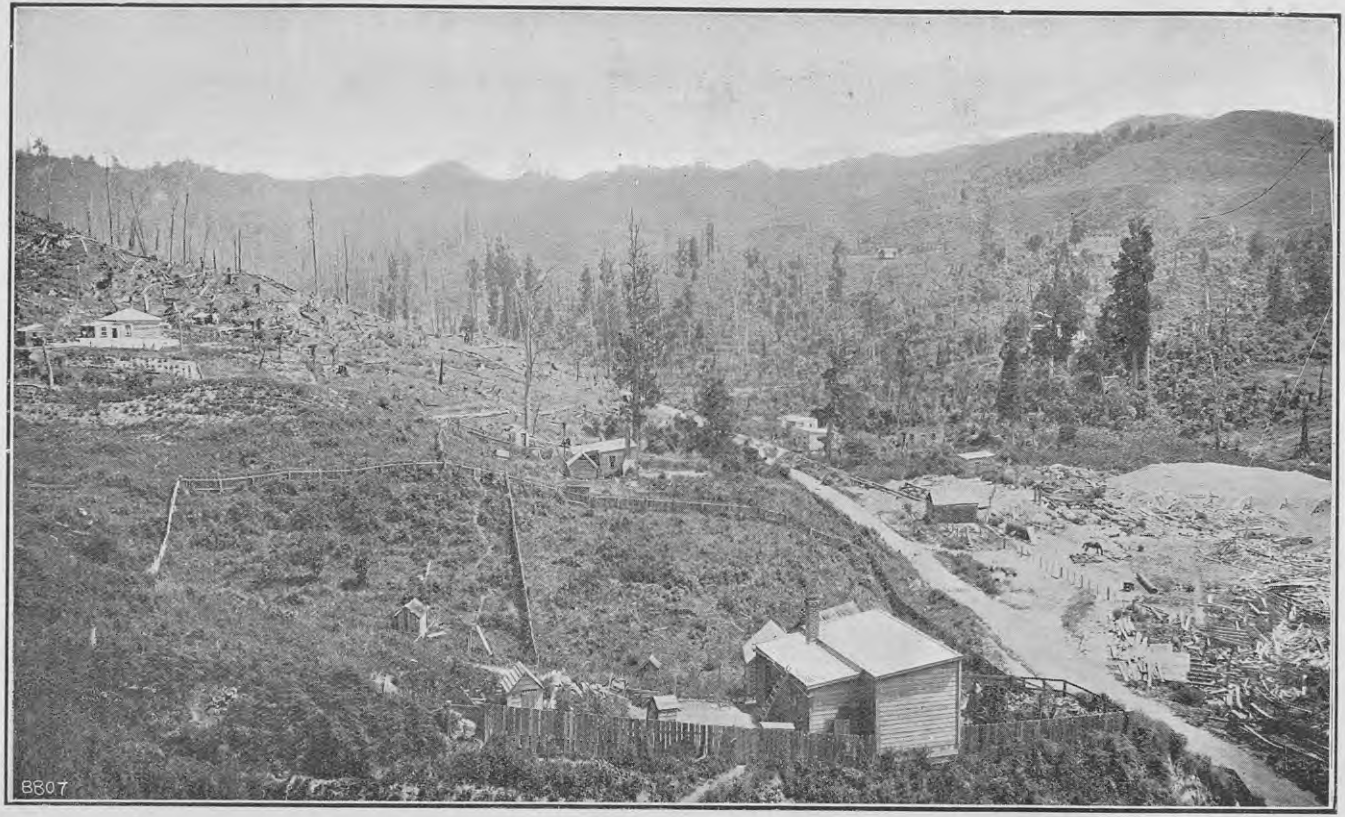
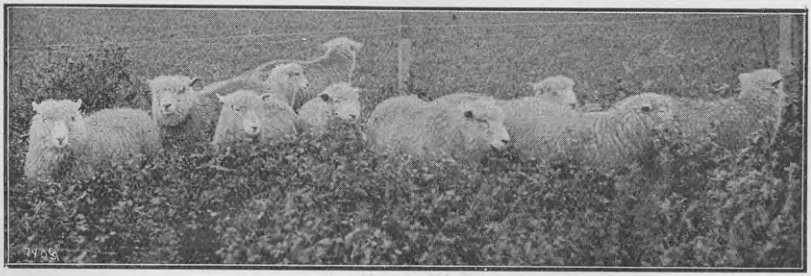


Bush Settlement in the North Island.



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20TH JULY, 1916.

FACTORS AFFECTING METHODS OF FARM-MANAGEMENT IN THE NORTH ISLAND.

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SOIL-FERTILITY.

THE attention of many farmers may have been arrested by two diagrams among the exhibits of the Department of Agriculture at the winter shows this year. These diagrams are a modification of what is known as the "soil-fertility barrel." The barrel is made up of staves of unequal lengths, and each stave represents some factor, such as lime, humus, nitrogen, texture, and so on, which has the effect of limiting the fertility of a particular soil to the extent to which it may be deficient in that soil. The analogy is not altogether a true one, but it serves to impress upon the mind in a graphic manner the fact that, no matter how well constituted a soil may be in all other respects, if one factor be lacking or deficient, productiveness is proportionately diminished. For example, if humus be lacking the

soil is little better than so much ground brick and inactive chemicals, a medium from which only a very low degree of crop-production can be achieved. In one of the illustrations humus has thus been chosen as the limiting factor. The humus-content is supposed to be low — it is figured as being the lowest stave of the barrel — and the highest level of potential profits is reached with the limit of the lime-supply. In the other diagram lime is represented on similar principles as the limiting factor.*

It is quite clear that methods of farm-management, if they are to be successful, must take into consideration these and other fundamental factors governing fertility. The essential facts connected with fertility have frequently been reviewed by agricultural writers and speakers, so that I shall not discuss them at length; but it will be well for me also to add my testimony as to the expediency of current exhortations.

The Humus-supply.—As already indicated, this is a very important matter. Without an adequate supply of humus or mould a satisfactory degree of plant-production cannot be maintained. Fortunately, the North Island being to a very great extent a pasture country, if the soil is kept right in other respects the humus-supply, generally speaking, will look after itself. On the other hand, there are many soils in the North Island of a very light description, lacking in lime and lacking in plant-food, which in consequence are apt to be deficient in humus also, for the one is inseparably associated with the other. A system of farm-management which will lead to an all-round betterment of these soils is required, and I shall offer suggestions along these lines later.

Just here, however, I may put the question, "How is a deficiency in humus to be made up?" The reply which may suggest itself to your mind may be "green-manuring." I am averse to this practice, not because the desired result cannot be achieved in this way, but because, farming being a business as well as a science and an art, the result can be obtained in a more economical way. If a soil is so poor that the range of plant-production is limited to such things as lupins, then these may be grown purely as a green-manuring crop; but, as is more frequently the case with land that has any agricultural value, if food crops such as rape and mustard, red clover, tares, peas, &c., can be grown by suitable manuring even moderately well, it would

* The lime-factor diagram was reproduced in the June issue of the *Journal*, page 490.

be, in my opinion, against the tenets of sound farming to plough them in for the purpose of increasing the humus-supply, even when the intention is specifically to prepare the land for the growth of more profitable crops or of pasture.

When these crops are consumed by sheep or other stock a little over half of the organic matter which they contain is retained in the bodies of the animals; the other half goes to form humus. But this 50 per cent. of organic matter in the form of dung is of much greater value than 50 per cent. of the organic matter of the original crop, inasmuch as it is not so subject to the great decomposition losses which take place when green stuff ferments after ploughing under. Another consideration: the dung is well distributed, whereas the green crop, being lightest on the patches most deficient in humus and heaviest on places already well supplied, tends to still greater irregularity in the fertility of the paddock after straight-out green-manuring. The loss of mineral elements of fertility in feeding off a crop is practically negligible. These are approximately facts from which one cannot escape the conclusion that humus should be maintained by what goes through the body of the animal rather than by ploughing down valuable crops.

The Lime-supply.—This is a matter which has agitated the minds of farmers in recent times from the North Cape to the Bluff. It is right that it should, as, generally speaking, lime is without doubt a very frequently limiting factor in the production of the soil. I am inclined to think that on the drier and freer working soils of the plains districts on the eastern seaboards of both Islands its effects will be scarcely apparent in the actual amount of production of pasture, although an improved quality in the pasture even there may be reflected in better condition of the stock. In nearly every other part of New Zealand systematic liming will be productive of much higher net profits than have hitherto been realized.

As an example of what I mean by "systematic" liming I would state the following case: A pasture has become worn-out and unprofitable. A minimum dressing of 10 cwt. per acre of crushed limestone is applied to it. It is turned over in preparation for a crop of oats or of roots. After these crops have been harvested it is ploughed again with a deeper furrow in preparation for a pasture mixture, with or without rape. A further dressing of 10 cwt. of ground limestone is applied on the ploughed surface, and worked in by subsequent cultural operations. The pasture seeds are then sown. The results that might be expected to follow

such treatment, and which in most instances do follow to an extent which must be seen to be believed, are great growth and vigour of the pasture, and all-round improvement in palatability and nutritive value, as shown by evenness of grazing, greater carrying-capacity, and thrift of stock.

An extended use of lime is certain to be a prominent phase of farm-management during the next ten years or so, and it is certain to lead to a still greater expansion of the stock-raising industry in the North Island, phenomenal as that has been up to the present time. On the western side of the dividing range, at any rate, the benefits are likely to be so pronounced and the exceptions so few that nothing short of the absolute impossibility of procuring lime at all, or at a landed cost on the farm of not more than £2 per ton, should prevent any farmer from making at least a preliminary trial. I know of many cases where other means of improvement, such as deep cultivation, various kinds of manuring, various pasture mixtures, &c., were tried, only to find at the finish that deficiency in lime represented the lowest stave of the fertility-barrel.

Fertilizers.—It has been established, practically beyond question, that of the elements of fertility the most generally and notably deficient throughout New Zealand is phosphorus, supplied to the soil in phosphates of various kinds. Except for a big-money crop such as potatoes, a payable increase from the use of fertilizers containing nitrogen seldom results. Blood, which is a nitrogenous manure, is a constituent of many fertilizers; but except on very light sandy soils subject to heavy leaching it is always more or less doubtful whether its application is worth while. This element should certainly seldom be required in any form under a proper system of farm-management in this country.

Our chief interest centres about the phosphate-supply. Some of our lighter and poorer lands have hitherto required very large applications of phosphates in order to crop or grass at all satisfactorily. The Department's experimental farm at Ruakura is a case in point. On the 22nd November last year one of the paddocks on this farm was sown with rape with 3 cwt. of basic superphosphate per acre. The same paddock in the previous year had been sown in wheat, also with an application of 3 cwt. of basic superphosphate per acre, or a total dressing practically within one year of 6 cwt. of basic superphosphate per acre. The maximum amount of phosphorus which could be removed by the wheat and in the bodies of the sheep which fed off the rape could not have been much more than the equivalent of 1 cwt. of basic superphosphate per acre, which would leave an equivalent of 5 cwt. basic superphosphate per acre in the ground. 3 cwt. of the same manure

applied directly to the succeeding pasture resulted in a good vigorous growth of the grasses and clovers, but where a fresh application of manures was withheld the phosphatic residues from the preceding crops seemed to have little or no effect, the growth being slow and feeble.

What had happened to the residuum of 5 cwt. basic superphosphate to nullify its effect less than a year after its application? We know that very little leaching of phosphoric acid occurs at any time, and if there is a sufficiency of humus and clay in the soil no leaching at all occurs. This Ruakura soil, naturally deficient in these constituents, had been rendered more so in the case of humus by the cultivation of the preceding crops. The humus was at a low ebb, and some slight leaching may have occurred, but certainly not nearly to the extent of removing from the surface soil the equivalent of 5 cwt. of basic superphosphate per acre. As a matter of fact, it has been found elsewhere that, after applying $3\frac{1}{2}$ cwt. of superphosphate per acre annually for forty years, nearly the whole of the unused phosphoric acid remained in the surface 9 in. of soil. We can only conclude, therefore, that the greater part of the two applications at Ruakura was converted into less soluble forms of phosphate, which were too slow in action to maintain a vigorous growth of grass; and this is undoubtedly the fate of much of the phosphatic manure which is applied annually to New Zealand soils.

The aim of the farmer should be, while stimulating the early growth of grass and crops by small to moderate applications of readily available phosphates, to make the unused residuum of fertilizer applications contribute to production by the one and only way to make these more active — that is, by the cheaper expedients of keeping up the lime and humus supplies. If this were done there should be less cause for concern about impoverishment of the land through the grazing of live-stock. We know from experience that land that is left as pasture actually gains in the fertility of the surface soil, this gain being due to the coating of organic matter derived from the pasture and from the droppings of stock, from the accumulation of nitrogenous compounds derived from the atmosphere, and from the mineral matter brought up from the depths of the soil. If these elements of fertility are rendered active by an occasional dressing of lime, a progressive state of improvement is bound to follow for many years. Doubtless this improvement is effected to some extent by drafts made upon the phosphate-content of the soil and subsoil; but even this appears insignificant in the light of the fact that a mature sheep sent off the farm takes with it no more than a pound or two of phosphoric acid.

CROP ECONOMICS.

So much for this brief discussion of a few of the contributory factors to fertility; but knowing what is essential thereto, and having the means of commanding it, the farmer has only very partially acquired the secrets of his business. Given a soil rendered suitable for production by nature or by the application of enlightened methods, there remains a vast category of points to be decided: What to grow; how to grow it; when to grow it; how to use the immediate product of the soil to the best advantage; how far it is wise to spend money in increasing production; in what directions to spend it; and so forth. I shall endeavour within the space at my disposal to deal with some of the more important of these matters.

"What to grow" is a fundamental question, and as a preliminary to answering it let us see what the farmers of the North Island actually do grow. From the agricultural and pastoral statistics available I have made calculations showing the approximate allocation of live-stock in terms of sheep, ploughed grass, surface-sown grass, unimproved land, cereals, roots and green crops, and orchards and plantations, over an average 1,000 acres in each of the land districts of New Zealand. The position is shown in the following table:—

Table 1, showing the Approximate Apportionment of an Average 1,000 Acres of the Land in Occupation in each of the Land Districts of New Zealand.

Province.	Carrying-capacity.	Ploughed Grass.	Surface-sown Grass.	Un-improved.	Cereals.	Roots, Forage, Crops, and Fallow.	Orchards and Plantations.
1,000 acres.	Sheep.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
Taranaki ..	2,100	150	600	221	8	19	2
Wellington ..	1,900	80	612	284	8	14	2
Hawke's Bay ..	1,580	112	440	427	7	12	2
Auckland ..	1,260	103	326	545	7	15	4
Canterbury ..	930	220	78	580	73	44	4
Nelson ..	620	60	180	731	13	10	6
Otago ..	580*	103	29	820	24	23	1
Southland ..		230	40	632	45	52	1
Marlborough ..	530	41	173	764	15	6	1
Westland ..	240	10	76	911	less than 1	less than 2	less than 1

* Otago and Southland combined.

An analysis of two statistical summaries, 1906 and 1911, for the North Island, indicates the trend of farming, and is shown in Table 2.

Table 2, Changes in Apportionment of an Average 1,000 Acres of the Land occupied in the North Island between the Statistical Periods 1906 and 1911.

North Island.	Carrying-capacity.	Ploughed Grass.	Surface-sown Grass.	Un-improved.	Cereals.	Roots, Forage, Crops, and Fallow.	Orchards and Plantations.
	Sheep.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
1,000 acres in 1911	1,550	110	440	424	8	15	3
1,000 acres in 1906	1,320	100	429	430	7	11	3

The central facts borne out by these figures are the paramount position of pasture and the almost negligible place of crops. That this is not merely a phase of development of the North Island is indicated by the fact that during the five-year statistical period the relative positions of grass and crops has remained practically unchanged. Down to the present time I have not been able to discover any general evidence of a turn in the tide. In fact, the effect on labour-supply of the Great War is certain to result in a still further reduction in our crop areas. These are facts with which we are all more or less familiar, but I for one, although knowing full well the importance of grass on the farm economy of the North Island, would hardly have credited an unsupported assertion that cropped areas constitute no more than, for example, $3\frac{1}{3}$ per cent. of the improved land of Taranaki. There are many who would consider this a state of things to be deplored, and to be remedied in the interests of the country with all possible speed. Is it or is it not bad? That is a question that it may be worth while to inquire into.

The first point to determine is the relative production of food for stock on pasture as compared with the food-production for stock on land under crop. Ordinary two-sheep pasture produces fodder at the rate of about 9 tons per annum. The same land under forage crops as ordinarily grown might produce an average of about twice that amount; and such an estimate certainly does not, all things considered, underestimate the degree of production under average circumstances. Granted that it is thus made possible to carry another two sheep per acre, the gross return therefrom will scarcely suffice to meet the expenses of growing even the cheapest of forage crops and leave a margin of profit.

To take concrete cases: At Moumahaki Experimental Farm a paddock of 7 acres 2 roods 15 perches seeded to oats and tares in May, 1915, carried live-stock up to the end of December,

equal to 3·2 sheep per acre for the year. The cost of growing the crop, including the rental value of the land during the months occupied by the crop, was not less than £3 per acre, a charge against one sheep of 19s. per annum for food alone. Another paddock of 5 acres 3 roods 7 perches, in pasture during the same months, carried stock in terms of sheep at the rate of 2·5 per acre per annum for the same period. The cost per acre, again including the rental value of the ground for the grazing-period, would not exceed £1 5s., a charge against each sheep of 10s. per annum for grazing. This was the most costly pasture-grazing of any of the grass paddocks on the farm; but, even so, the comparative results are against the growing in this district of a forage crop for grazing during the period specified. A further paddock of 9 acres and 7 perches, in five-year-old lucerne, during the months of September, 1915, to April, 1916, carried and fattened sheep at the rate of six sheep per acre per annum; and from this area during the same months was harvested 9 tons per acre of surface-dry and wilted forage, representing a further carrying-capacity of two sheep per acre for the year. At a moderate estimate of one sheep per acre per annum for the grazing available from May to August inclusive, the total carrying-capacity would amount to nine sheep per acre. The paddock was sown in plots of a number of varieties of lucerne, and if it had all been sown in the Hunter River variety the stock would probably have been increased by two sheep per acre for the year. The cost of this grazing, assuming that lucerne remained good for no more than six years after establishment, would not exceed £2 10s. per acre, or a charge of 5s. 6d. per sheep for one year, while the acreage profit was greatly increased.

From the Ruakura Farm of Instruction one or two interesting examples may also be quoted. A paddock of 20 acres devoted to rape and mustard carried sheep from 1st October, 1915, to 15th March, 1916, at the rate of 4·5 head per acre per annum. The cost of the crop would be about £3, or 13s. 4d. per sheep per annum, and the crop was a very good one. Another paddock adjoining, in old pasture, area 26¾ acres, during the same period carried sheep at the rate of three per acre per annum, at a cost not exceeding 20s. per acre for the period, equal to a charge of 6s. 8d. against each sheep for the year. Other examples might be quoted, all bearing out the same fact that when the increased cost of production is reckoned with stock cannot be profitably maintained on specially grown fodder crops as compared with pasture — the one exception being the

A SOUTH TARANAKI LANDSCAPE.

perennial crop lucerne, with its large power of producing, as compared with annual fodder crops, at a relatively low cost.

On rich dairying land, which is usually considered capable of close settlement by cultivation, the case is still worse for cropping. The best of the land of this description will grow upwards of 30 tons of grass per annum, and there are few annual forage crops on the same land which will exceed this yield of forage by as much as one-half; and even lucerne sinks in importance below the value of pasture under these circumstances.

In making this general statement on the economy of grass-farming, I do not lose sight of the fact that forage and root crops may have special values at special times. For example, while the average annual production of pasture is satisfactory on a cost basis as compared with crops, the growth of grass is not continuous; whereas for profitable dairy-farming it is of the highest importance to maintain the milk-flow at its highest possible level from the beginning to the end of the season. This cannot be done on grass alone, and if specially grown crops were not available at times the milk-yield would be checked and would fail to make a satisfactory recovery with the subsequent freshening of the grass. So also in the case of sheep, while comparatively cheaply provided grass must be our mainstay, it will always be expedient to resort to special crops for rapid fattening and to supplement pasture grazing at special periods of the year. In the cases cited from the Ruakura Farm, for example, the monthly stockings on rape and grass were as follows:—

Month.	Sheep per Acre per Month on Grass.	Rape.
December	8·3	11·5
January	5·0	26·0
February	1·4	9·0
March	3·0	6·5

So far as the dairying and stock-raising industries are concerned, I think that a very small ratio of special-purpose crops to grass spells the highest economy and the greatest net profit under average farming conditions; but whether such a ratio as 3½ per cent., the average of Taranaki, is one to be satisfied with is a more difficult matter to decide. The ratio must obviously vary according to the situation of the farm and the quality of the land. It would appear that only in the case of poor, light land should extensive cropping combined with treatment calculated to increase fertility be undertaken. In that case it would be warranted not as a permanent practice, but only for

the purpose of bringing the land into a condition to sustain long leas of remunerative pasture; and this object should be achieved as much as possible by the use of forage crops, such as red clover, which will stand extended grazing, and which can be in many cases grown at the cost of little more than the seed by sowing with an oat crop or on stubble, and the rape, kale, and mustard category of crops, which are also cheaply grown.

I have pointed out as an exception to the average run of forage crops, lucerne, which as a semi-permanent crop on all suitable land yields large returns at low cost. The advocacy of lucerne-growing in New Zealand is now of old standing, and it loses nothing in insistence as time goes on. As in the case of the lime question, there is so little doubt as to the benefits that the farmer who neglects to test it by proper methods fails altogether to realize the possibilities of profit from his farming operations.

To revert once more to the subject of pasture: It has been admitted, and can hardly be questioned, that the total production of land under grazing-crops is approximately double what can be achieved from pasture, and hence it would appear at first glance that the creation of pastures and the severe limitation of cultivation is a bad thing from a national point of view. But, as Mr. Martin J. Sutton has expressed it, "until it is considered reasonable that men should beggar themselves for the national good, cultivators must be free to farm in the way that promises the best return for the capital, skill, and labour devoted to the business."

ROTATIONAL CROPPING.

I had intended originally to consider the subject of more definite rotations as a means of systematizing farm-management, but in the light of the foregoing considerations there does not appear to be any solid reason for the adoption of rotational farming in the North Island generally. A satisfactory rotation system pursued for a time would undoubtedly tend to a permanent improvement of much of our poorer lands. In fact, it would appear to me that farm-management on these lands must develop along the lines of a system of alternate husbandry embodying the cultivation on a rotational basis of oats, clovers, and forage and root crops, accompanied by judicious liming and manuring, to enable them after such a course of treatment to be sown in grasses and clovers, which will remain productive for a series of years. Such a system is frequently successfully applied to bush

land in transition, where a certain area is being stumped every year. A root crop or other forage (including maize), followed by oats for grain and chaff, and that in turn by rape or barley for grazing along with the pasture mixture to form the basis of a long and profitable pasture, is undoubtedly an excellent system to pursue. In either case, notwithstanding the relative unprofitableness of some of the crops grown, it is beyond doubt a much wiser course to pursue than any vain attempt to make bad pastures good by top-dressing, when the real trouble is due to weeds and inferior grasses and pasture plants induced by bad soil-conditions.

It may be interesting for readers to know that at the Weraroa Experimental Farm (although the latter is, to my mind, essentially permanent-pasture country) investigations have been initiated having for their object the determining of the absolute cost of production and the net returns from land under various systems of farm-management. These systems include,—

(1.) A rotation consisting of oats for grain and chaff. Catch forage crops on stubble, followed by summer forage crops for supplementing pasture and for conserving as ensilage; after which the and is laid down to pasture for six years.

(2.) Another rotation: Roots. Oats for grain and chaff, followed by grass sown down with a grazing-crop as temporary filler in two divisions, one division being down for six years, and the other division broken up at the end of the fourth year and devoted for the two remaining years to temporary grass for hay sown down with a forage crop.

(3.) Permanent pasture embodying top-dressing trials for the maintenance thereof in full production, together with a small area under a fixed rotation of forage crops — hay, roots, oats for chaff.

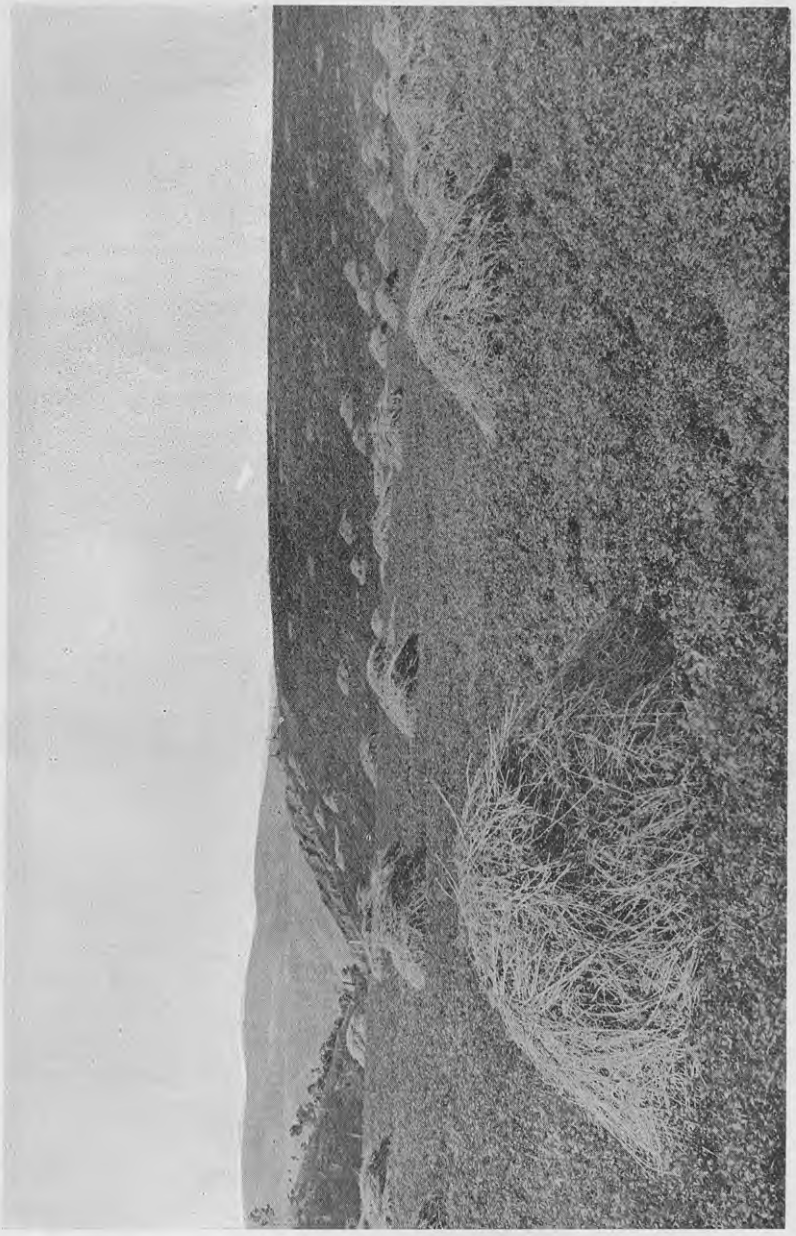
(4.) Lucerne for the intermittent fattening of store stock, and as an adjunct to general farm economy.

(5.) Crop rotation in connection with pig-raising.

(6.) The growing of grasses and clovers for seed-production, accompanied by stock-grazing during the months when the paddocks are not closed up for seed.

(7.) A rotation including only sale crops, such as certain cereals, peas, tares, certain forage and root crops for seed, and potatoes.

A very exact system of book-keeping and recording has been devised and put in operation for the purpose of securing reliable



A LUCERNE CROP AT MOUMAHAKI.

data on the many points at issue, and it is intended to correlate our results with results obtained under different methods of management in ordinary farm practice by a system of special farm surveys and records of selected farms, which are also being set in train. From year to year and from one rotation period to another very important results must certainly accumulate along these lines, and I trust to have opportunities of reporting progress from time to time.

SALE CROPS.

To return to my main theme: I have not thus far expressed any opinion on the possibilities of higher profits being derived from the raising of cash crops—that is, of crops other than those grown for the maintenance and fattening of stock. Potatoes are grown for this purpose, and when their cultivation is undertaken with thoroughness and with knowledge there is little doubt that they may average out at a handsome degree of profit. Potatoes are a crop, of course, which could be very easily overdone, but we have not yet by any means reached the limit of their profitable production in the North Island. Other crops which have been suggested, and in some quarters strongly advocated, are industrial crops, such as *Linum* for fibre-production, sugar-beet for sugar, and colza for oil.

In general, the cost of production of these crops, the capital and labour involved, the risks of partial failure, and the necessary preliminary industrial development are all factors militating against success; while, on the other hand, we shall not—to use a colloquialism—be "up against it" in the matter of utilization of our agricultural lands so long as our dairying and stock industries remain at a profitable level, which promises to be the case for many years to come. Take the case of *Linum* for fibre, for example. At the present time first-grade Irish-grown scutched fibre is making £150 per ton, and the prospects have improved to such an extent that Canada is now developing considerably a flax-fibre industry, while representations have also been made for the promotion of flax-growing for fibre in New Zealand. Before any move should be made in this direction it ought to be reasonably certain that the business would be an unusually remunerative one. Now, the facts are that *Linum* for fibre is a very risky crop to grow and to handle. 5 cwt. per acre of scutched fibre is a very good yield. The cost of growing and preparing a crop in New Zealand, including the laborious operations of hand pulling, retting, &c., would amount to about £15 per acre, possibly considerably more. The cost of scutching in Ulster used to be 8s. per cwt. of scutched

flax, the tow being claimed by the millers. At New Zealand rates of labour the cost would be very much higher. Moreover, it would not be wise to start an industry on the basis of the present price for first-class Irish-grown scutched fibre. Altogether, the growing of this and other crops which require at the back of them an industrial organization, which we do not at present possess, can hardly be considered to come within the scope of practical farm-management in New Zealand.

ROTATIONAL GRAZING OF PASTURES.

Before concluding I may make a few observations on the rotational grazing of pastures. We all know that continuous light stocking of grass land is bad for the pasture, and an altogether uneconomical method of using it. This patent fact seems to have led some to argue that the opposite extreme — subdivision into many small paddocks—is the proper course to adopt.

Experience teaches one to avoid being overemphatic about anything connected with farming, but my knowledge on this point satisfies me at present that the following statements are true :—

1. Subdivision progressively increases the cost per acre of erecting and maintaining fences.

2. Where stock are shifted to fresh ground they are apt to wander around before settling to feed, particularly in small paddocks, in which much of the feed is consequently trodden and soiled before it can be used. This does not happen to anything like the extent in a paddock of decent size.

3. Grass has ample time to freshen and recover when four changes at the outside—that is, four grazing-paddocks—are provided. The better the land the more rapidly pasture will freshen after the removal of stock, and consequently less subdivision is required.

4. I have compared the carrying-capacity of an area of 25¼ acres divided into six small paddocks, at our Ruakura Farm, with similar but larger areas of pasture of value not greater than the above, and find that the small paddocks do not carry a proportionately heavier stocking. During the past year the first-mentioned paddock in six subdivisions carried stock equal to three and three-eighths sheep per acre per annum for the months September, 1915, to May, 1916, and, except during the month of December, chaff, crushed oats, and hay were fed in the paddock. The adjoining paddock of 18½ acres, undivided, carried during the same period three and two-eighths sheep per acre, although this paddock had less natural advantages than the other, and supplementary feeding was confined to the months September, April, and May. Field

No. 13, 26¾ acres, during the same period carried sheep equal to four per acre without any other feeding except mangels in September. I admit that the comparisons are not altogether fair, but if anything they favour the subdivided paddock.

SUMMARY.

To sum up, my observations lead me to the conclusion that farm-management in the North Island should take account of the following considerations :—

1. Good pasture is, and must continue to be, the mainstay of the North Island farmer.

2. Most good pastures may be further improved in nutritive value, if not in actual production of herbage, by periodic applications of crushed limestone.

3. Inferior pasture everywhere should be renewed by liming, cropping, manuring, and regrassing after a second application of crushed limestone. In this connection it may be noted that green-manuring is not usually an economical practice.

4. On light land these successive stages of improvement should automatically bring about a rotational system, including growth of oats, inexpensive forage crops, and pastures of longer or shorter duration, according to circumstances.

5. If lucerne can be grown, the maximum of profits cannot be realized without it.

6. Beyond a very narrow limit, profits recede as cultivation extends and pasture areas are reduced.

7. Nevertheless, exclusive reliance on pasture, or pasture together with fattening crops or transition crops for dairy stock, is not judicious. There is ample justification on economic grounds for the extension of the practice of preserving fodder as hay and ensilage, and the feeding of these and of home-grown chaff to all classes of stock when the inevitable need arises (which involves more general provision of feed-racks and troughs). The adoption of this course, while being of undoubted advantage to the individual farmer, would at the same time benefit farmers as a whole by exerting a steadying influence on stock values, at present subject to dangerous and disturbing fluctuations, which, whether up or down, restrict production, for they check the raising of young stock

8. Where unsatisfactory results follow the grazing of pastures which are divided so as to allow of four changes, it is better pasture or more stock—not more fencing—that is needed.

NOTE.—The substance of the foregoing article was given as an address at the winter show conference of the National Dairy Association, at Palmerston North, June, 1916.

POINTS IN BUTTER-FACTORY MANAGEMENT UNDER HOME SEPARATION.

G. M. VALENTINE, Dairy Instructor, Auckland.

THE change that has taken place in many districts in New Zealand from the whole-milk system to home separation has necessarily been accompanied by alteration in the methods of handling. The question arises whether those methods are all they should be. Among factory-managers themselves considerable difference of opinion exists on the various points involved, and it is with a view of helping to elucidate these points that these notes have been written.

While one factory shows a moisture-content of 13·30 per cent. and an overrun of 23 per cent., another has 14·29 per cent. of moisture and an overrun of 16·90 per cent. Obviously both are wrong. As the actual unavoidable losses in a well-equipped home-separation factory are reduced to a minimum, the largest being probably the overweight given in packing the butter, there must be serious defects in methods which bring about such results. The avoidable losses or gains are the result of mistakes in weighing, sampling, and testing of cream, and low moisture-content of butter.

WEIGHING, SAMPLING, AND TESTING CREAM.

Where milk is received a mistake of 1 lb. in weighing is a comparatively small matter, and the sampling is simple, as every can is tipped. With cream it is much more serious, as cream is relatively ten times more valuable than milk. A mistake of 1 per cent. in weighing will make a difference of approximately 1·2 per cent. in overrun either way.

To ensure correct weighing of home-separated cream it is absolutely necessary to have every can conspicuously marked with the name or number of the supplier and the weight of the can. The plan of substituting a number for the supplier's name is becoming very popular, has many points of advantage, and, if painted on the can in fairly large figures, simplifies handling. Thus, 146/20 will represent the supplier's number and the weight of the can. By having the sample-bottles numbered to correspond a stranger can go on to a receiving-platform and take in a day's cream without

any chance of error. The daily docket showing gross, tare, and net weights will help to prevent mistakes, and assist in tracing them if made.

Probably the plan most generally followed on a home-separation-factory platform where cream is received in wagon or truck loads is to sort out all the cans in the same rotation daily. The lids and floats are then removed, floats scraped, and the cream stirred and sampled. If thirty suppliers are represented, thirty trips have to be made to the sample-cabinet, and frequently before the last can is reached the curd has had time to settle to the bottom, resulting in a high test. The plunger and sampling-dipper follow round the rotation, and are dipped into a 25-per-cent. cream from a 50-per-cent. without rinsing. The cans are then carried to the scales, weighed, tipped, and steamed. A dirty hand instead of a squeegee is still often used to scrape the floats.

About the only advantage that can be claimed for this system is that the figures are in the same rotation daily where dockets are used. The advantage is more than balanced by the greater effort required to sort out full cans than to sort out figures.

The system which appeals to me as giving the best results with a minimum of labour in a moderate-sized factory is one under which the booking-desk, scales, and sample-cabinet are as close to the receiving-vat as possible. The cans are taken as they come, placed in the scales, and the lid and float removed and scraped. The cream is weighed, sampled, graded, booked, and tipped into the vat, the can being placed on the steamer ready for the man washing up. Where a big pasteurizer is in use these various operations will necessarily be performed by several men, each doing his part. Under this system a smaller receiving-platform is required, and there is no unnecessary handling of full cans.

The sampling is done immediately after the cream is stirred and the sampler and plunger can be rinsed between each weighing. Steaming the cans after they are emptied is much better than rinsing, and there is less waste of cream, less handling of unnecessary water afterwards, and the work is much cleaner.

There are still a number of factories where the sample-bottles are not numbered. The managers concerned argue that by keeping the bottles in rotation the numbering is not necessary, as no mistakes are made. As mistakes are made in those factories where numbers are used, no further argument is necessary to prove that the same thing happens where numbers are not used. Some object that when numbers are attached the bottles are a trouble to sort out after they are washed. This can be overcome by grinding a

rough place on each bottle with an emery stone and writing the numbers on in pencil. The bottles can then be removed for testing, and even if mixed no harm is done if corresponding numbers are written on the testing-bottles also when testing.

Various styles of sample-cabinets are in use, a chest of drawers, in my opinion, being as good as any. Each drawer can be made to represent a district, and the drawer can be used to heat the samples in when testing.

Only the highest grade of scale is good enough to weigh cream-samples, and speed must be secondary to accuracy. The scale should be sensitive to one drop of cream. The reading of the tests is now seldom done without the use of coloured oil or super-fatted alcohol to level off the meniscus. The mistake of using the oil too cold is sometimes made, however. It should be slightly hotter than the fat-column—say, 145° F.

The importance of extreme care in testing cannot be too strongly urged. The supplier must trust to the factory-manager for a fair deal, and, unfortunately, testing-day is usually an extra, and to be got through with an effort. There is a good deal to be said in favour of the independent tester from the point of view both of the manager and of the supplier. A mistake of 1 per cent. in a 40-per-cent. test represents 2½ per cent. of the total butter-fat, and 3·05 in overrun.

NEUTRALIZING AND PASTEURIZATION.

The only reliable system of neutralizing cream is by means of the double vat, and the vat should be of such size that the pasteurizer will empty it in about forty-five minutes, otherwise the acidity will be found to rise before the cream is all through. The practice of tipping a few cans of cream and then adding some soda can never be relied upon to give the acidity aimed at.

Various calculations are in use to ascertain the amount of neutralizer necessary to reduce the acidity of the cream to the desired point—all of them more or less useful as a guide, but not to be relied upon for accurate results. A change in the brand of soda, neglect of proper stirring of the cream after adding the soda, mixing the soda with hot water, and many other things, may quite upset the calculation.

By the use of a double vat the first sections can be filled to a given mark which will approximate the same weight of cream daily. A little practical experience and tabulating of results will soon give a table of quantities of soda required to reduce the acidity to the desired point with cream varying in ripeness from

day to day; but only the frequent use of the alkaline test will show whether the result aimed at has been attained, and any variation can be corrected by the addition of a little more cream or soda. By repeating this procedure with each section of the vat alternately an even acidity can be obtained right through.

With a single vat such correct regulation is not possible. Unless the greatest care is taken the acidity of the cream leaving the cooler may be 0·4 at one stage and 0·1 shortly afterwards; and though a sample taken from the ripening-vats may show somewhere near the right average acidity the quality of the butter will suffer. The point to remember is that practically the whole of the work performed by the soda is done while the cream is passing through the pasteurizer, and hence no averaging-up in the vats afterwards is of any use.

The use of a neutralizer has only been made possible by the adoption of pasteurization, and it depends for success upon the same conditions which make for success with the latter process—namely, the application of heat to every particle of cream passing through the machine. When installing a pasteurizer it is a good practice to allow an ample margin over the quantity the machine is required to do. A machine with a capacity of 1,000 gallons per hour will do more thorough work if only called upon to put through 750 gallons, and will do it at a less cost for steam.

The speed should be regulated so that the cream is spread over the heating-surface in a thin layer, thus ensuring the easy transfer of heat to the cream. The danger of the casein burning on and scorched flavour at high temperatures will be reduced, and a thorough utilization of the soda will result. This speed may be anything from 200 to 350 revolutions per minute, depending on the make and size of the machine, and can be judged by the amount of cream left in the pasteurizer. A slow-running pasteurizer will have a greater body of cream in the machine, and though the outside which comes into direct contact with the steam may be scorched, the inner portion is not thoroughly pasteurized, and the soda will not have been completely used, which may result in soda flavour. An intermittent delivery of cream from the pasteurizer indicates that the speed is too slow.

Better results will be obtained, and economy in fuel will result, if exhaust steam is used for pasteurizing. There is less danger of burning on, and an even temperature is more easily maintained, as the pressure of steam is not so much affected by the variation of the pressure on the boiler. The exhaust should also be used for

heating water for boiler-feed and washing-up purposes. A three-way cock will make it possible to use the exhaust for both purposes.

COOLING AND THE REFRIGERATING PLANT.

Economy in cream-cooling is a very much neglected point in many factories. The first cooler should be of such a size that the cream when leaving it is not more than 4° above the inlet water. If this result is not obtainable the cooler is not large enough, and work will be thrown on to the refrigerator unnecessarily. The second cooler must be large enough to allow of any temperature desired being obtained by regulating the flow of chilled water. The chilled water, if lower in temperature than the ordinary water, can then be pumped back to the chilled tank. The practice of filling a vat up with cream at a temperature as high as 70° to 80° and depending on the refrigerator to cool it is altogether too expensive and disastrous to quality when handling home-separator cream.

The refrigerator is perhaps the most neglected machine in the average factory. Too often there is more air than ammonia in the system, and if free from air the ammonia is deficient. In about nine cases out of ten where a machine is working badly air in the system is the cause, and in the tenth case it is usually a lack of sufficient ammonia. The refrigerator should be kept working at its full capacity, and if the work can be got through in eight hours it is a waste of steam to run it ten hours at less than it is capable of doing. Fifteen minutes spent in adjusting the valves in the morning may save two or three hours' refrigerating at the end of the day, and the fuel bill will be considerably lighter. The old theory that a machine works best at a certain back pressure, irrespective of the work in hand, dies hard. The back pressure must be regulated to correspond with the temperature of the material to be cooled. For example, a tank of brine at 65° may require a back pressure of 40 lb. to do the best work; but if the brine in the tank is at 40°, 15 lb. may be sufficient.

The common mistake is to work the dry-compression machines too hot and the wet-compression too cold. The former results in a too-small flow of ammonia, which takes up all the heat it is capable of absorbing before it has travelled far through the coils, and the heat on the compression side will be very high. In the second case, the flow being too great, the evaporation of the liquid is not completed by the time it gets through the coils. In other words, a portion of the ammonia which has passed through the coils has not been made use of. This reduces the capacity of the

machine, and results in the compression side being too cold for the water on the condensers to extract very much heat. Generally speaking, when starting in the morning, it is a good practice to give a machine all the back pressure it will carry, and to gradually close down the valves as the work is got in hand. The sooner a dry-compression machine freezes through to the main return pipe, and the sooner a wet-compression machine freezes back to the expansion-valve, the better. The fact that a return pipe shows frost does not prove, however, that a machine is doing its best work. It shows that the returning ammonia is below freezing-point, but does not show how many degrees below.

Many of the older cream-vats in use have very little expansion-coil, and cause expense in cooling. It pays to have more coil put in, and at least 9 in. of 1 in. coil to a gallon of cream should be provided.

When the refrigerator was first introduced into butter-factories the brine-wall was the popular means of cooling insulated rooms. This system has the advantage that it will keep the room down for a time after the machine has stopped, but it causes dampness. The very shallow drip-tray provided very soon filled up, or was neglected and ran over, and the floor of the room was soon spoiled. A better idea is a wooden tray about 3 in. deep, and provided with a pipe carried through the cool-room wall to allow the water to flow away as it accumulates.

Coils have largely replaced the brine-tanks of late years, and they are usually hung on the walls with wooden baffles in front to cause a circulation of air. Where the height is available they are sometimes placed in an insulated chamber on top of the cool-room, the air being circulated by means of a fan. The drip-tray is also necessary where coils are used. Coils have the advantage of cooling a room more quickly than a tank, but do not hold it down so well as a brine-tank after the refrigerator is stopped. They give a very much purer atmosphere in a cool-room, and are not so liable to cause dampness. About 9 in. of 1 in. coil to every box of butter is necessary in a cool-room.

The ordinary square 400-gallon tank without insulation of any kind is still in use for chilled water, and is a source of considerable loss during the season. As a rule it is placed up in the ceiling, where all the hottest air in the factory collects. If iron is used it must be insulated, but with wooden tanks of 2 in. to 2½ in. timber insulation is not so necessary. A foot of piping to a gallon of water is not too much to allow, and a big saving can

be effected if all the ammonia returns are passed through it especially with the dry-compression machines.

FUEL AND STEAM PLANT.

The ever-increasing cost of fuel makes the latter a point requiring attention. Suction gas is coming more into use where the output warrants it, but in small factories it is doubtful whether there is any saving, provided the boiler is of a good type, well built in, and is properly fired. To make the best use of steam plant, however, the exhaust steam must be used for pasteurizing and heating the water for boiler-feed and washing-up purposes. Some still hold that the boiler-tubes only want cleaning when they are dirty—"dirty" meaning when the soot is beginning to interfere with keeping up steam. The number of times the tubes require cleaning daily depends upon the kind of coal used, but they should certainly be done once. Leaking steam-valves run away with a lot of fuel, and with the renewable seated valves of various makes now obtainable there is no excuse.

CHURNING AND MOISTURE-TESTING.

All these losses are small, however, compared with what is possible through neglect in churning. Practically every factory-manager, if asked the moisture-content of his butter, will tell you "about 15 per cent.," but very few average that for the year. The moisture test was first introduced as a safeguard against getting over 16 per cent., and by some it is still looked upon in that light only. It is a fact that there are still factories where butter is packed without a test for moisture being made, and I have tested samples which have contained only 13 per cent. This is a very serious loss to the factory. On the other hand, to get over 16 per cent. and risk prosecution at the hands of the grader, or, worse still, to have the London buyer prosecuted, is more than any factory can afford. There is only one safe course, and that is to test every churning, and aim at 15 per cent. of moisture. To go over that figure is to risk getting a salvy, overworked butter, and frequently exceeding 16 per cent.

There are various methods which can be followed in handling a churn to ensure a fair moisture-content without overworking, and any remarks made here apply to the open-worker pattern of churn. Whatever method is followed, the buttermaker should be able, with a little experience of his conditions, to bring each churning up to the stage where the first test is made with very little variation in

the moisture-content. A churn running at one and a half revolutions or less per minute on the working-gear will probably have the butter worked sufficiently before 15 per cent. of moisture has been reached, unless the butter is very soft. This is because the churn is travelling too slowly to carry the water up on to the worker. Two revolutions per minute is a nice working-speed, and I have found the following system of working satisfactory:—

After running off the wash-water, put the churn on the slow gear and salt while running. Then throw in the fast gear and knock the butter together. After putting in the worker, work to the stage where judgment will tell you that it is time to make a moisture test, usually when the butter begins to roll over without the rolls breaking and has a tough appearance. How long this will be will depend upon the season of the year, size of the churning, cream-temperature, &c. Now stop the churn, with the drain-plug down, and take a sample of butter and test it. If it shows nearly 15 per cent., run off the water which will have collected in the bottom of the churn while the test is being made. Then give the churn a few revolutions to dry off the free moisture, and it will be found that when a final test is made the moisture-content has risen about 0·5 per cent. above the trial test. Should the first test show a low percentage of moisture a little experience of the conditions will show how much more working is needed, and it may also be necessary to make a second test before finishing. A further test taken from the box the following day after the butter has stood twenty-four hours in the cool-room will ensure greater accuracy.

The value of moisture-testing depends, of course, on whether it is accurately done, and if proper care is not taken it may as well not be done at all. Considering the amount involved, it is astonishing to see the lack of appliances at some factories, and the rough-and-ready way in which moisture-testing is done. The scales must be of the best and a full set of weights kept, and the mug must have no cavities to hold moisture. The mug must be thoroughly dry before starting, and should be balanced cold, and also be allowed to cool before weighing, after roasting off. The difference between a hot and a cold mug will depend on the mug, and may be up to 0·8 per cent. Reading hot is allowable for a trial test, but is not accurate enough for fine work.

A loss of 1 per cent. through deficiency in moisture will cause a difference of 1·45 per cent. in overrun with a butter containing 82 per cent. of fat. To put it in another way: if you have a butter containing 83 per cent. of fat, 14 per cent. of moisture, and

3 per cent. of salt and curd, your overrun is 19 per cent. By increasing the moisture to 15 per cent. you reduce the fat-content of the butter to 82 per cent., and your overrun will be 20·45. Approximately, a loss or gain of 0·25 per cent. in moisture will make a difference of 0·36 per cent. in overrun.

THE DAILY RECORD.

Keeping a record of the work done daily in the factory has much to recommend it, and if accurately carried out it will often be the means of tracing any defect. Taking moisture-content as an example, we will assume that 100 boxes of butter have been made during a certain period, and that the average moisture-content is 15 per cent. Allowing 3 per cent. for curd and salt, the butter would contain 82 per cent. of fat. If there was no loss in handling the overrun would be 21·95 per cent. If the overrun is only 20 per cent. the loss in handling must have been about 1·5 per cent. of the total butter-fat bought. Should this vary to any extent from one period to another, you have then something to go on to locate the leakage. It is the prevention of leakages which makes the difference between good and bad management.

Ciddendum. — When using exhaust steam for pasteurizing it is necessary to attach an oil-trap to the steam-pipe leading from the engine to the pasteurizer. Unless this is done the cylinder-oil will adhere to the inner wall of the steam-jacket of the pasteurizer and thus interfere with the capacity of the machine.

Harrowing Pastures.—Almost the whole of the grass land at Ruakura received a stroke of the chain harrow in May. Where the pasture has been heavily stocked the chain harrow does as much good as a top-dressing. For this work the combined tripod-and-chain harrow cannot be too highly recommended. The chain harrow alone is apt to run over manure which has been lying for some time and become set, and the work is therefore not done so effectively. The combined tine-and-chain harrow may be recommended. This is a locally made harrow, and has been in general use on this farm for many years. With the tines turned down this harrow makes a first-class job on grass land, and when turned over it is one of the most useful implements for harrowing out weeds in the orchard.—A. W. GREEN, *Manager, Ruakura Farm of Instruction.*

PART OF THE HORTICULTURE DIVISION'S WINTER SHOW EXHIBIT, 1916.

The fruit shown consists of the varieties of apples and pears recommended for planting for export and local markets.

PRESENT AND FUTURE SOURCES OF HONEY IN NEW ZEALAND.

A. H. COCKAYNE, Biologist.

IN all agricultural industries the production of the raw materials on which the industry depends is of paramount importance. In this respect beekeeping is no exception to the rule, and thorough study of the sources of supply of the raw material, and of methods tending towards increasing them, should be of great value.

Beekeeping is one of the few rural industries where the production of the raw material is not generally carried out directly by the person particularly interested. In certain cases the apiarist may also be a farmer, but this is rare, and the beekeeper in general relies for his supplies of nectar on plants that may comprise either the natural vegetation of the district or crops (intentional or unintentional) grown by the farmer. From time to time suggestions have been made for the growing of special plants for the express purpose of honey-production. It can, however, be said that, with extremely rare exceptions, the growing of crops for the sake of their nectar alone is not a payable proposition. Thus, if the bee-farmer attempts to produce his own bee pasture he must select such crops as are themselves payable, and the nectar produced should be looked upon as a by-product. In such cases the beekeeper has to combine the duties both of an apiarist and a farmer, and as the management of bees and the work of preparing the honey for market will fully occupy the whole of his attention, such dual-purpose bee-farmers are unlikely to be uniformly successful.

Therefore the bee-farmer is forced to rely almost entirely on the natural honey resources of his locality, and on the honey-plants that come within the scope of ordinary farming operations. It might be said that the apiarist, having virtually no control of the matter, need give no attention to the sources of supply, as such are factors beyond his jurisdiction. This, however, is not true, and the beekeeper should at the least pay particular attention to the general trend of agricultural development, and encourage with all his power any methods that are payable to the farmers and at the same time are likely to increase the honey-yield of

a district. The farmer naturally will not grow crops that are primarily only of value to apiarists, but his attention can well be directed into channels highly profitable to himself and indirectly of great benefit to the bee industry.

It is thus seen that a consideration of the general trend of agricultural development in New Zealand, and in what directions these can be correlated with beekeeping, is very necessary in dealing with the sources of honey. What may be termed the botanical side of beekeeping has not as yet been given the full attention it warrants. This is due very largely to the fact that failure, so far as profit is concerned, has been the rule with regard to the specific growing of honey-yielding vegetation. The beekeeper simply trusts to luck for his nectar-supplies, locating himself, of course, in what are known as favourable districts, but making few attempts to regulate the agricultural development of his locality in directions beneficial in the supply of this all-important raw material on which his livelihood depends. Before enumerating some phases of soil-utilization that may benefit the honey industry it will be well to briefly deal with the natural honey-sources.

NATURAL HONEY-SOURCES.

Honey produced from the nectar of natural vegetation may be classed under the generic name of bush or wild honey, and this includes not only the honey harvested from forest, but also that from the natural open and heath lands.

The following is a partial list of the main native honey-plants: Manuka, various species of rata, various species of Senecio, Olearia, and similar composites. (The composite or daisy family are nearly all important honey-plants, the introduced catsear being especially notable in this respect.) Phormium, cabbage-trees, some buttercups, Parsonsia, willow-weeds (especially in swamps), Rubus, Gaultheria, Fuchsia, certain Veronicas, Avicennia, Clematis, rewarewa, Loranthus, mahoe, Astelia, Bulbinella, and Maori onion. There are, of course, many others that play a certain part in honey-production. Manuka, rata, cabbage-tree, Phormium, and perhaps coastal-forest trees like mahoe, kohekohe, and Fuchsia, together with the composites, can be looked upon as the most important.

Bush honey is almost always of poor colour, and pure manuka honey is extremely difficult to extract. Southern honeys reputed to be gathered from manuka have frequently a large admixture of other nectars. In passing it will be well to mention that certain bush honeys are reputedly poisonous, and authentic cases

of poisoning appear evident. I am, however, rather dubious as to whether the nectar of the plants suspected really is the cause of the trouble. It is difficult to locate the source of bush honeys with any degree of certainty, pollen-grain examination not being very satisfactory when a large number of species have contributed to the sample.

The amount of honey produced from natural vegetation is large, but as time goes on this source will, through the breaking-in of forest, manuka, and swamp lands, steadily become less and less. It is certainly towards the flora of the lands under occupation that one must turn in order to determine the source of the higher-grade honeys and to certain special developments of soil-utilization that may lead to improved conditions so far as honey-production is concerned.

I would like to point out here that it is the custom to treat nearly all the better-coloured lines of honey as white-clover honey. The term has to a large extent become a trade one, and it by no means follows that all white-clover honeys are mainly gathered from white clover. In certain cases catsear nectar is really the more important one from which such honeys are made, and various members of the composite, leguminous, wild borage, labiate, and crucifer family provide honey that on general appearance could be called white-clover honey. Clovers (and more especially white clover), alsike, suckling, lotus, trefoil, and lucerne (especially in a pastoral country like New Zealand) will probably in the future always supply the bulk of the honeys, but the important part played by other groups of plants should not be overlooked.

FORESTRY.

Each year from two to three thousand acres of land are forested by the Government, and the annual foresting and plantation-work of local bodies and private individuals runs into many hundreds of acres. Forests are the longest maturing of any agricultural crop, and the attention of beekeepers has been in other countries directed from time to time to the problem of whether beekeeping and afforestation can be combined. Before detailing any possibilities in this connection with regard to New Zealand it will be well to outline briefly the general trend of afforestation in New Zealand. The report of the Forestry Commission (1913) clearly demonstrated that the only trees likely to pay in forestry operations are those of short duration, half a century being placed as the maximum period for any planted forest crop. Again, the main types of trees required are those providing a

rapid growth of timber suitable for constructional and conveyance purposes, and those of a hardwood nature suitable for withstanding long periods of exposure. For constructional and conveyance purposes various pines are the most suitable for New Zealand conditions, especially such a rapid-growing species as *Pinus radiata*, better known as *Pinus insignis*. For hardwood purposes various species of Australian eucalypts stand out as pre-eminent.

So far as the pines are concerned, they are valueless for bee-farming purposes, being nectarless and producing a resinous pollen unsuitable for bee-fodder. All the species of Eucalyptus secrete nectar abundantly, but in general the quality of the honey is inferior, of bad flavour, and difficult to extract. In this latter respect it resembles pure manuka honey, and it is interesting to note that the manuka and the gums are botanically related. It would appear as though the gums were not suitable for honey-production, but the quality produced by different species varies enormously. It is quite probable that certain species would produce good marketable honey, as is the case with *E. rostrata*. If certain species combine good timber and honey production it would certainly be advantageous to restrict the planting to these. This matter requires careful investigation, and such an inquiry is recommended to beekeepers' organizations. Again, certain species of acacia might be found to combine good timber- and honey-producing qualities.

It will thus be seen that I am not very enthusiastic on the part that afforestation in New Zealand may be made to play in the furtherance of the bee industry. Certain trees like the false acacia (Robinia) might, however, be profitably planted and fulfil the dual purpose of providing fencing-material and bee-forage, as has been done with this tree on an extended scale on the sandy soils of Hungary. It may be asked, Why not plant important nectar-producing trees like the limes, perhaps better known to beekeepers under the name of basswoods? The answer is that broad-leaved trees of this description are unsuitable for general planting in New Zealand, and efforts in this direction have been quite unsuccessful in the past. The limes are not tolerant of exposure, and even for street or avenue planting are far excelled by many other trees, such as the Oriental plane. In sheltered situations limes have grown well, and many beautiful trees of both the European and American lime may be seen as specimens, especially in Christchurch gardens; but on the whole they can be looked upon as quite unsuitable for forestry purposes. From the beekeepers' standpoint the timber is valuable, but not more so than many other quicker and more readily grown trees.

It is possible that certain species of willows might prove valuable, but their timber is not of such general utility as that of either poplars or pines.

Let it be understood that I am fully seized of the importance of deriving revenue from forest-trees during the long period between planting and conversion. If such could be accomplished, that bugbear of forestry — compound interest — might be obviated; but with the exception of the eucalypts — and with them even it is more or less conjecture — there appear to be no trees suitable for extensive general planting that might combine timber and honey production. Of course, for ornamental planting, and to a limited extent in plantation-work, certain nectar-producing trees, such as the acacias, false acacias, willows, and perhaps in special localities limes (especially of the smaller-leaved and more readily grown European species), might be planted. Other trees naturally suggest themselves for this limited purpose, but their extensive planting need not be entertained.

SEED-RAISING.

Seed-raising opens up a very promising field for the apiarist. This is especially true of the growing of clover of those types suitable for honey-bee forage. Each year about 300 tons of the smaller-seeded clovers are annually imported, and there seems to be no valid reason why all the required local supplies should not be grown in the Dominion. If this were done about 5,000 acres additional to that already devoted to these crops would consist of pure clover, and provide excellent bee-forage. To the clover-grower the presence of bees is indispensable, so that in this respect clover-seed growing would be mutually beneficial both to the apiarist and to the seed-raiser. Another seed which is largely imported and which should be grown locally is rape, a valuable honey-producer. Between 600 and 800 tons is annually brought into the country, and were the seed grown here some 2,000 acres of high-class bee-pasture would be secured. Certain crops such as buckwheat might be thought offhand as likely to prove valuable, but there is no likelihood of this crop being grown except in extremely limited amounts. Still, an increase in clover-seed production and the development of the rape-seed-growing industry would of themselves materially increase the honey resources of the country.

INCREASING THE CLOVER-CONTENT OF PASTURES.

An increase in the clover-content of New Zealand pastures would enormously increase the nectar-supply for honey-production. In this connection nearly all the species of short-tubed clovers are valuable,

the most important, however, being white clover, alsike, trefoil, and perhaps some of the hop trefoil, lotus, and suckling-clover types. Red clover, of course, until such time as a race of honey-bees with longer tongues or a race of clover with shorter flower-tubes is evolved, is of no value in this connection. In certain dry seasons, when the red-clover flowers are small, a certain amount of nectar may be gathered from them by honey-bees, but this condition is too unusual for red clover to be looked upon as of any value.

It is highly probable — and the experiments at present being carried out at the Department's farms will determine this point— that an increase in the clover-content of pastures is a desirable feature. This should be more particularly true of pastures of a temporary or semi-permanent nature, and such types of pastures are on the increase. I look upon increasing the clover-content of pastures as probably the greatest forward movement that could be given to beekeeping, and apiarists should be well advised to study this question in their respective districts, and determine from the farmers' point of view whether to increase clovers in pastures is a payable policy to adopt. It cannot be too strongly impressed that an increase in bee-forage must be correlated with some advantage to the farmer before he will adopt any method that may indirectly secure this end.

On the whole the pastures of New Zealand must be looked upon as the main bee-forage. That in this respect they are easily capable of being improved can be seen by the fact that the total number of bee colonies in New Zealand is less than 80,000, and the sown pastures occupy some 16,000,000 acres, or one colony to every 200 acres of pasture. Moreover, this does not take into consideration the large number of colonies that gather from natural vegetation. With regard to grass lands, those devoted to cattle are in general better from the apiarist's standpoint than sheep pastures, as with the latter the close cropping of the turf lessens flower-production. The general trend of the better-class lands towards dairying should prove valuable to the beekeeper, provided there is a tendency towards increasing the clover-content of the pastures. The high prices of clover-seed during recent years has, however, led to a curtailment of the quantities used, but such prices need only be looked upon as temporary.

LUCERNE-GROWING.

One of the most important agricultural movements in New Zealand, although as yet quite in its infancy, is the cultivation of

lucerne on an extended scale. This plant is probably destined to become the premier agricultural crop in all districts suited to its production. From the beekeepers' point of view lucerne is extremely valuable, yielding as it does large supplies of nectar during the greater part of the summer, and rarely failing in its annual supply once the crop has been established. The honey is rather light in colour, but this is not a serious defect, and the flowers produced after midsummer yield a darker honey than those produced earlier. The main objection to the growing of lucerne from the apiarist's point of view is that the crop is likely to be very largely used as a grazing one and be kept closely cropped, thus limiting the production of flowers. It is, however, certain that a great deal will be cut for hay, and although for this purpose the crop should be cut soon after the expanding of the flower-buds, n many cases crops would yield large amounts of nectar before being cured into hay.

Again, with an increase in lucerne-growing, seed crops will be numerous, and these will provide magnificent bee-forage. Beekeepers are well advised to do all in their power to foster the growing inclination of farmers to cultivate lucerne on an extended scale. The direct advantages to the apiarist are so great that work in this direction is as important as any I can think of in furthering the honey industry. The virtually unfailing source of nectar which this plant is capable of supplying in New Zealand renders it particularly important, all beekeepers knowing the difficulty with what are termed "bad seasons" in regard to most honey-plants.

ORCHARDING.

To any one acquainted with the modern development of agriculture in New Zealand, that of fruitgrowing naturally occupies an important position. By the beekeepers, however, orchards are not looked upon with the favour that might be expected when viewing one in full bloom in the spring. Commercial orchards are now planted with few varieties, and the blossoming period is short. For the greater part of the year an orchard provides exceedingly bad bee-forage, except in those instances where cultivation is neglected, and honey-producing weeds such as yarr, smartweed, fumitory, shepherd's purse, thistles, and groundsels are produced in abundance.

The fact that neglected orchards are better from a beekeeper's standard than properly cultivated ones suggests the idea that the use of certain cover-crops in orchards might lead to their becoming valuable from a honey-producing point of view. At the same time

they would be important in improving the fertility of the soil. This is a matter to which the Horticulture Division of the Department has given considerable attention; but, of course, the main objection is that most cover-crops require to be ploughed in before having completed flowering. This difficulty might be got over by using comparatively low-growing plants, even if on ordinary farm lands they are looked upon as weeds. Smartweed and yarr have always impressed me in this particular. With regard to yarr, troublesome weed as it is, it is a valuable honey-producing plant, a fact which Southland apiarists know full well. Crimson clover and certain vetches such as grass-peas are suggested as useful honey-producing leguminous orchard cover-crops.

If some method of increasing the period during which bees may profitably work in orchards is not formulated, such areas must be ranked as of little importance for honey-production, and as bees should always be kept in or near orchards for pollinating purposes this would be very regrettable.

LIVE FENCES.

Live fences are not particularly favoured in New Zealand, but their capability of producing supplies of nectar should not be overlooked. One has only to think of the value of the African boxthorn in the production, in combination with white clover, of much of the excellent Taranaki honey to appreciate the value of live hedges of useful honey-plants. Unfortunately, the main plant originally used for this purpose in New Zealand — gorse — does not appear to be a large nectar-producer, and in this it seems to behave differently to what it does in other lands. It is, however, valuable from the pollen point of view. Hakea, although a noxious weed in the districts where most abundant, yields considerable quantities of nectar. In many localities certain species of barberry and hawthorn have been popular for fences, and are useful honey-plants. The tagasaste, again, is reputedly valuable. In general, however, the trend is towards the elimination of live fences and their substitution, so far as shelter purposes are concerned, by plantations of trees that are of no moment in honey-production. Still, so far as the beekeeper is concerned, he should favour living fences when they are composed of honey-producing plants. It is not, however, really known whether they are an economic proposition in such a country as this where labour is neither easily nor cheaply available. Whether, therefore, their value fully compensates for the expense of keeping them in order has yet to be determined.

WASTE-PLACE PLANTING AND WEEDS.

In considering the feasibility of profitably growing any special crops for honey-production alone one is forced to admit that the only case in which this is at all practicable is with regard to waste land, especially waste sandy land near the sea. If it is possible merely by surface-sowing a few pounds of cheap seed to produce a permanent crop rich in nectar, then possibly such an operation is justified. Melilot clover is especially suggestive in this connection, and certain of the brooms also might prove valuable. With regard to the latter, ordinary broom is a noxious weed in many districts, and this brings me to the point of the really great part that weeds, or at least plants not intentionally cultivated, play in our present honey-production. Looking up the Noxious Weeds Act, I noticed that out of thirty gazetted noxious weeds no less than twenty are good honey-plants. One has only got to think of the value of the following plants in order to appreciate the part played by weeds: Catsear (probably as important as white clover), capeweed, dandelion, hawkbit, ragwort, smartweed, yarr, blackberry, Californian thistle and other members of the thistle family, wild turnip, shepherd's purse, viper's bugloss, burr clovers, melilot, ox-eye daisy, pennyroyal, and a host of others.

It is clear that the modern trend of agriculture will be in the direction of very greatly reducing the amount of our weed flora at present available as bee-forage. Extraordinary as it appears, the systematic control of weeds, important as that work is to the country as a whole, would, unless their place be taken by equally valuable honey-plants, prove quite harmful to the bee industry. However, certain weeds such as catsear, which forms an integral part of all pastures on certain types of land, will always be with us.

CONCLUSION.

In conclusion, I would again urge on all beekeepers the importance of keeping an eye on the general trend of agricultural development. It may be shown to be quite feasible to modify certain agricultural operations with good results from the apiarist's point of view, and it is one of the duties of the beekeeper to prove that such modifications are payable propositions from the farmer's standpoint, apart from being of value to the honey industry. If this is done systematically and thoroughly there seems little reason why the sources of honey-supply should not be very appreciably increased.

NOTES ON SOILS ANALYSED.

B. C. ASTON, F.I.C., Chemist.

THE results of the analyses of certain samples received during the past three years are here collected. Many of these are of considerable interest, but as they refer to types already investigated, to isolated types requiring a preliminary report for some Government officer or for some special reason, and there is not sufficient information to warrant more than brief notice here, it is deemed advisable to publish them together in order that the results may be placed on record. (See accompanying table.)

Mokotua, Southland, soils (C1189/1–2) were analysed at the request of the Live-stock Division to ascertain if any cause could be found for the unthrifty condition, terminating in scouring, anæmia, emaciation, exhaustion, and death of cattle fed on the pasture and turnips grown on this land. These soils are lower in available phosphoric acid than the majority of Southland soils which have been analysed, and the lime-magnesia ratio is unbalanced. No. C1189/2 was from a grass-paddock, No. C1189/1 from a turnip-field.

Cape Farewell, Collingwood, soils (D105/1–4) are samples analysed at the request of the Live-stock Division in order to ascertain whether any cause existed for a deficiency disease in sheep pastured on the land. It will be seen that the total and available phosphoric acid is very low, and the available iron is also low, while the potash is present in good amounts.

Kohatu, Motueka Valley, Nelson, soils (D1020).—This is another instance of a soil having an unbalanced lime-magnesia ratio when extracted by strong acid, though the reverse is the case when weak acid is used. The matter is fully discussed in the *Journal* of the Department for December, 1915 (Vol. xi, p. 498). The Fields Instructor in forwarding this sample reported, "The top soil averages 6 in. deep, and will not grow anything but native grass (very short), poor fern, and stunted manuka. This poor area is well defined, and in places the boundary is almost a straight line. When it is cultivated it will not grow either root or corn crops, and after cultivation goes back into native grass and fern. There is a considerable area of similar country in the valley."

It will be noticed that this soil is well supplied with plant-food, especially phosphoric acid, both total and available; therefore the only reason apparent for the sterility is the unbalanced lime-magnesia ratio. The matter is being further investigated.

Coonoor, Puketoi Hills, Pahiatua, soil (D1210) was analysed to ascertain the cause of failure of a turnip crop. This soil has a slightly unbalanced lime-magnesia ratio, a character it shares with most Wairarapa soils.

Blueskin, Otago, soils (D1233/1–4) were analysed for the Justice Department. They are from estuarial land, and show a high percentage of available phosphoric acid and a higher percentage of available potash, whereas the total phosphoric acid and potash are normal. This peculiarity is one usually found in soils which are subject to intermittent action of sea-water, which, as has been previously pointed out, is a powerful indirect fertilizer.

Mendip Hills, Cheviot, Canterbury, soils (E57/1–2).—These were analysed at the request of the Live-stock Division. Hoggets grazed on this land developed lung and stomach worms. This land has grown grass for twenty years, but has never been cropped. The analysis shows a deficiency of available phosphoric acid.

Hokitika, Westland, pakihi soils (E107/1–3), are samples analysed at the request of the Fields Division. These soils are typical of the pakihi country (described fully in the *Journal* of this Department for September, 1913, p. 295, and the Annual Report for 1909, p. 464). There is said to be 70,000 acres of this type of soil, characterized by wetness, sourness, and great deficiency of mineral plant-food, available and total.

Burwood, Canterbury, soil (E582) was analysed for the Education Department. This soil is well supplied with plant-food.

Kapuka, Southland, soils (E708/1–4), analysed for the Live-stock Division, in connection with mortality in lambs, are generally low, and sometimes deficient, in total and available phosphoric acid.

Turakina, Wellington, soil (E799) was analysed for the Horticulture Division. It was reported to have been heavily manured, and was found to be well supplied with mineral plant-food.

Wairoa, Hawke's Bay, soils (E963/1–3).—These were analysed for the Fields Division, being land where plot experiments were being conducted. The analysis shows them to be deficient in available and total phosphoric acid, the other essential plant-food ingredients being present in fair to good amounts.

Waitakaruru, Hauraki Plains, Auckland (E967).—This soil was analysed for the Fields Division, it being taken from a farm only two miles from the sea in the Piako district, and therefore subject up till quite recently to periodic inundation by the sea. The excess of available potash and phosphoric acid already mentioned as characteristic of estuarial lands will be noticed. The soil is typical of others described in the article on the Hauraki Plains in the Department's *Journal* for June, 1914, p. 565.

Analyses of Soils.

(Results are percentages calculated on the soil dried at 100° Centigrade.)

Laboratory No.	Locality.	Description.	Volatile Matter.		Total Nitrogen.	Citric-acid Extract in Twenty Hours. (Dyer's Method, Hall's Modification.) "Available" Plant-food.			Hydrochloric-acid Extract. "Total" Plant-food.				Footnotes.
			At 100° C.	On Ignition.		Potash (K_2O).	Phosphoric Acid (P_2O_5).	Colour of Extract on Ignition.	Lime (CaO).	Magnesia (M_2O).	Potash (K_2O).	Phosphoric Acid (P_2O_5).	
1189–1	Mokotua, Southland ..	Light yellowish-brown clay	13·63	17·07	0·230	0·013	0·009	..	0·26	0·43	0·14	0·10	(*a*)
1189–2	,, ,, ..	Ditto	15·17	15·98	0·290	0·015	0·010	..	0·29	0·48	0·14	0·11	(*a*)
D 105–1	Collingwood, Nelson ..	Fine sandy loam ..	4·96	7·27	0·250	0·020	0·010	..	0·44	0·28	0·33	0·04	(*b*)
105–2	,, ,, ..	,, ..	9·06	6·59	..	0·020	0·012	..	0·62	0.36	0·33	0·05	(*c*)
105–3	,, ,, ..	Coarse sandy loam ..	6·95	7·17	..	0·036	0·007	..	0·49	0·27	0·25	0·04	(*d*)
105–4	,, ,, ..	,, ..	6·06	6·88	..	0·019	0·012	..	0·58	0·35	0·25	0·05	(*e*)
1020	Kohatu, Nelson ..	Fairly friable grey soil	2·68	6·41	0·140	0·017	0·041	..	0·83	4·02	0·18	0·10	(*f*)
1210	Coonoor, Pahiatua ..	Brown clay soil ..	9·56	13·91	0·370	0·030	0·027	Brown ..	0·57	0·71	0·43	0·17	
1233–1	Blueskin, Otago ..	Quartz sand ..	2·66	11·44	0·294	0·025	0·005	..	0·25	0·19	0·13	0·06	(*g*)
1233–2	,, ,, ..	Yellow sandy soil ..	1·78	1·37	0·031	0·064	0·042	..	0·37	0·30	0·13	0·08	(*h*)
1233–3	,, ,, ..	Grey sandy soil ..	3·18	2·58	0·037	0·110	0·048	..	1·12	0·73	0·26	0·14	
1233–4	,, ,, ..	Light-brown sandy soil	2·64	2·41	0·052	0·123	0·029	..	0·28	0·25	0·32	0·12	
E 57–1	Mendip Hills, Cheviot, Canterbury	Light-brown fine sandy clay soil	21·18	8·14	0·252	0·005	0·007	..	0·41	0·28	0·26	0·08	
107–1	Pakihi lands, Hokitika, Westland	..	1·77	8·93	0·229	0·018	0·002	..	0·06	0·05	0·06	0·01	
107–2	Ditto	..	6·10	8·44	0·185	0·011	Trace	..	0·05	0·05	0·05	0·01	
107–3	,, ...	..	33·64	22·15	0·551	0·018	Trace	..	0·08	0·06	0·10	0·01	
582	Burwood, Canterbury..	Brown fairly friable soil	2·93	9·46	0·312	0·027	0·027	Light brown ..	0·89	0·60	0·42	0·16	
708–1	Kapuka, Southland ..	Brown fairly friable loam	24·12	11·04	0·300	0·017	0·010	Light brownish-grey	1·17	0·73	0·23	0·09	
708–2	,, ,, ..	Ditto	27·74	12·05	0·340	0·021	0·010	Light brown ..	1·03	0·51	0·19	0·10	
708–3	,, ,, ..	,, ...	26·59	11·91	0·320	0·018	0·017	Reddish brown	1·20	0·59	0·21	0·09	
708–4	,, ,, ..	,, ...	25·01	10·80	0·280	0·017	0·009	Light brownish-grey	1·17	0·62	0·22	0·07	

799	Turakina, Rangitikei ..	Grey clay soil ..	3·45	7·62	0·228	0·024	0·060	Brown ..	1·01	0·40	0·10	0·21	
963–1	Wairoa, Hawke's Bay..	Brown loose pumice soil	8·66	10·82	0·222	0·043	0·005	Light brown..	0·25	0·13	0·07	0·05	
963–2	,, ,, ..	Yellow loose pumice soil	4·88	5·82	0·097	0·031	0·003	Light brownish-grey	0·13	0·10	0·05	0·04	
963–3	,, ,, ..	Yellow coarse pumice soil	3·91	4·10	0·070	0·028	0·002	White ..	0·12	0·09	0·04	0·03	
967	Waitakaruru, Hauraki Plains	Greyish-brown stiff soil	18·23	32·12	0·854	0·066	0·034	Brown ..	0·58	0·33	0·10	0·26	
976–1	Rangitikei sand-dunes	Sand	0·08	0·35	..	0·014	0·031	Light brown ..	1·58	0·54	0·15	0·06	(*i*)
976–2	,,	,, ...	0·14	0·44	..	0·012	0·081	,, ..	1·52	0·49	0·19	0·06	(*j*)
1027	Waikato Heads ..	,, ...	0·20	0·33	..	0·013	0·012	Light greyish-brown	1·99	0·74	0·09	0·05	(*k*)
1085–1	Kaipara, North Auckland	Very stiff dark-grey clay soil	9·48	10·47	0·308	0·012	0·005	..	1·11	0·58	0·28	0·07	
1085–2	Ditto	Ditto	8·66	12·44	0·286	0·016	0·004	..	0·60	0·54	0·36	0·05	
1085–3	,, ...	Loose grey silty soil..	1·71	4·17	0·083	0·009	Trace	..	0·06	0·05	0·03	Trace	
1085–4	,, ...	Fairly friable grey loam	5·45	7·67	0·142	0·009	Trace	..	0·09	0·06	0·03	Trace	
1233	Maruia Plains, Murchison	Grey silt	1·58	4·62	0·152	0·014	0·050	Brown ..	1·02	1·26	0·58	0·20	
1268	Clarence Estate, Kaikoura	Friable brown loam	3·81	8·31	0·236	0·011	0·009	Brownish-grey	0·56	0·56	0·32	0·09	
1398	British East Africa ..	Light-brown soil ..	3·92	4·70	0·108	0·121	Trace	Dark greyish-brown	0·42	0·15	0·76	Trace	
1537	Wanganui	Sand	1·02	3·90	..	..	..	..	0·40	0·25	0·05	0·07	
F 159–1	Hastings, Hawke's Bay	Grey stiff clay soil ..	8·47	6·31	0·082	0·062	0·003	Light brown ..	1·21	0·38	1·32	0·09	
159–2	,, ,,	Yellow stiff clay soil..	7·03	6·91	0·060	0·148	0·040	,, ..	1·97	0·32	0·61	0·06	
G 394	Ruakura, Waikato ..	Swamp soil ..	24·17	34·74	0·726	0·024	0·074	..	0·189	0·069	0·041	0·132	
488	Ashhurst, Oroua ..	Waterproof soil ..	3·55	13·24	0·367	0·019	0·027	..	0·749	0·308	0·212	0·072	
499	Turanganui, Lower Wairarapa	..	14·47	7·45	0·184	0·028	0·006	..	0·335	0·400	0·371	0·053	
686	Ward, Marlborough ..	..	2·94	8·88	0·248	0·038	0·024	..	2·527	0·461	0·502	0·038	(*l*)
C1026	British East Africa ..	Light reddish-brown soil	5·50	6·26	0·109	0·121	Slight trace	..	0·47	0·25	0·61	0·02	

(*a*) Reaction to litmus faintly acid. (*b*) Citric-acid extract, iron 0·11 per cent. Reaction to litmus faintly acid. (*c*) Citric-acid extract, iron 0·107 per cent. Acid reaction to litmus. (*d*) Citric-acid extract, iron 0·13 per cent. Reaction to litmus slightly acid. (*e*) Citric-acid extract, iron 0·085 per cent. Reaction to litmus faintly acid. (*f*) Citric-acid extract—lime 0·253 per cent., magnesia 0·067 per cent. (*g*) Contains 0·03 per cent. sodium chloride. (*h*) Contains 0·53 per cent. sodium chloride. (*i*) Specific gravity, 2·95. (*j*) Specific gravity, 2·80. (*k*) Specific gravity, 3·16. (*l*) Citric-acid extract, lime 1·73 per cent.

Dune-sands from Rangitikei, Wellington, and Waikato Heads, Auckland (E976/1–2 and E1027), were analysed for the Lands Department in connection with the problem of foresting the dunes. Organic matter, and therefore nitrogen and humus, is lacking, but the mineral plant-food, both available and total, is present in remarkably good quantities.

Kaipara, North Auckland (E1080/1–4), are various soils on which it is desired to plant orchards. They are generally deficient in total and available phosphoric acid, and sometimes in available potash. No. 1 is from limestone country originally growing kauri-trees; No. 2 is on limestone growing heavy manuka and cabbage-trees but not kauri, and is not considered so suitable for fruit-growing; No. 3 supported light manuka and tauhinu (*Pomaderris phylicaefolia*); No. 4 was originally heavy manuka and cabbage-trees.

Maruia Plains, Nelson (E1233). — A soil collected by the Geological Survey at the foot of the Spenser Mountains. These are micaceous soils, rich in available and total phosphoric acid and in total potash, lime, and magnesia, the ratio of the latter two being slightly unbalanced. They are similar to the grey mica-schist silts of the West Coast (see my 1908 Annual Report, p. 246, and Wire-basket Bulletin, No. 2, p. 8).

Clarence River, Kaikoura, soil (E1268).—This is a country of which very little is known. The lime and magnesia ratio is 1–1, and the amount of total and available phosphoric acid is low.

Wanganui garden soil or sand (E1537).—A soil which refused to grow anything, and probably owes its sterility to want of humus and consequent parching. Analysed for the Horticulture Division.

Hastings, Hawke's Bay (F159/1–2).—These are soils analysed for the Fields Division. No. 1 is deficient in available phosphoric acid and low in total phosphoric acid; well supplied with available potash. No. 2 is low in total phosphoric acid.

Ruakura Experimental Farm, Hamilton, soil (G394). — This is a remarkable swamp soil which in patches refuses to take the moisture and remains permanently dry, no crops growing on it. Analysis shows that all plant-food is present in good and even (in some cases) high amounts. The peculiar physical conditions which make it permanently dry have yet to be determined.

Ashhurst, Wellington (G488).—This is another example of water-proof soil—*i.e.*, a soil which will not wet. The ordinary chemical analysis shows nothing unusual.

Lower Wairarapa soil (G499) from Turanganui, near the outlet of the Wairarapa Lake. This shows a deficiency in phosphoric acid, total and available, and slightly unbalanced lime-magnesia ratio.

Ward, Marlborough, soil (G686).—This is an example of a fertile soil resting on Amuri limestone debris at the foot of limestone hills near Ward. The available mineral plant-food is high, but the total phosphoric acid is low, so low, indeed, that in a soil with less lime it would be deemed deficient. The remarkable fact that highly productive soils with much lime may contain very little total phosphoric acid, even lower than the above sample, has been pointed out by Hilgard in his classic work on American soils.

British East Africa soils (C1026 and E1398)—the latter from the Kedong Valley Escarpment—were analysed at the request of the Fields Division for a gentleman in East Africa who had rendered service to the Department. The analyses show great deficiency of available and total phosphoric acid, coupled with extremely high total and available potash, and are comparable with no soils in New Zealand.

WHEAT-RUST.

A NEW ZEALAND OBSERVATION.

R. WATERS, Biological Assistant.

THE occurrence of wheat-rust (*Puccinia graminis*) in New Zealand is by no means uncommon; in fact, its presence may be detected more or less every season. The severity with which it attacks and the extent of country that it seriously affects is, however, often so limited that farmers either regard its effects as trivial or even fail to note its presence at all. Under conditions favourable to its development wheat-rust occasionally assumes the form of an epidemic in which a large acreage in wheat-growing areas may be seriously affected. Such was the case during the past season in the vicinity of Greenfield, Bruce County, South Otago. There the yields over a wide area were reduced from 30 down to about 10 bushels per acre, while several hundred acres of crop had to be merely gathered up and burnt, the grain being so shrivelled as to be unmarketable.

CAUSE OF THE DISEASE.

An investigation of a large portion of the affected area, made at the instance of the Greenfield Farmers' Union, showed that while a certain amount of damage may have been caused by

frost, yet in the main the wheat crops had suffered from the effects of rust. *Puccinia graminis* is a form of plant-life which is classed with the ordinary field mushroom as a fungus. Like the mushroom, it is unable to derive its sustenance direct from the soil. While the mushroom is large in size and lives upon decaying animal and vegetable matter deposited in the soil, *Puccinia* is so small as to be seen in detail only with the aid of a microscope. It nourishes itself upon the food substances on their way from the roots to the seed-heads of wheat-plants. This misappropriation by

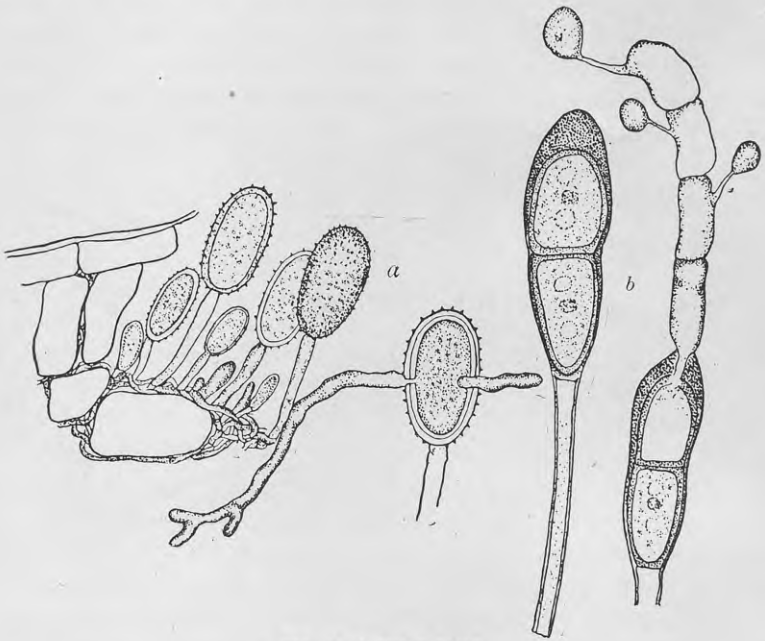


FIG. 1. WHEAT-RUST.

(*a*) Summer spores (uredospores), one of which has germinated; (*b*) winter spores (teleutospores), one of which has germinated and has produced three basidiospores. Very highly magnified. [*After Duggar.*

the fungus of the food materials intended for the development of wheat-grains readily accounts for the undeveloped and shrunken appearance of the grains of affected plants.

To the naked eye one of the first signs that a crop is affected is the appearance on the stems of a fine reddish powder which comes off and sticks to the clothes or blows about in the wind. Under the microscope this reddish powder is seen to consist of innumerable red globes borne in very narrow slits or crack-like ruptures (sori) in the skin or epidermis of wheat stems and leaves.

These slits may be seen with the naked eye if examined closely. They arise in the following manner: The fungus having penetrated the outer skin (epidermis) of wheat-plants, then develops minute root-like fibres (hyphæ), which ramify amongst the inner tissues of the plant. These "roots" draw upon the plant-juices, increase in length and number, and finally burst through the outer skin of the stems, leaves, and bracts, forming slits therein. Here they produce abundantly those red globes which are the so-called summer spores (uredospores) of the fungus — that is, the reproductive bodies by which wheat-rust spreads in the summer from one wheat-plant to another and from one crop to another. Highly magnified, their appearance is similar to Fig. 1 (*a*). The name "wheat-rust" is given to the disease on account of the rusty-red appearance lent to affected crops by these spores, particularly in the summer months. Later on there arises from the same slits a black powder—the so-called winter spores (teleutospores) of the fungus. Fig. 1 (*b*) shows two winter spores highly magnified. The presence of this black-spore form in the slit-like ruptures was greatly in evidence at the time the investigation was made (end of March last).

Both the summer and the winter spores are the reproductive bodies of the same fungus — *Puccinia graminis*. The especial function of the summer spores is to propagate the fungus in the summer, while that of the winter spores is (1) to withstand severe winter conditions; (2) to germinate the following spring and themselves produce another special kind of spore known as the basidiospore (Fig. 1 (*b*)). The function of the basidiospore is to infect the barberry (*Berberis vulgaris*) as a host-plant. The fungus resulting from the basidiospore creates a fungus disease of the barberry, and ultimately produces a spore-form distinct from any of the three previously mentioned — namely, the acidiospore. The acidiospores are dispersed by the wind and infect wheat-plants with *Puccinia graminis*, which fungus then proceeds to produce the summer spores, and so on as before.

In New Zealand the occurrence of barberry is so rare in many parts that it would appear impossible for it to bear the fungus producing the acidiospores which originate the wheat-rust; moreover, so far the occurrence of affected barberry shrubs has not been recorded in New Zealand. The usual means by which wheat-rust survives during the winter is therefore apparently not resorted to in New Zealand, and the question as to how it winters here is still obscure. The summer spores, which are believed to perish in countries with hard winters, are, it is asserted, capable of maintaining their viability in certain countries with

milder winters, and of carrying the disease over from season to season. The most satisfactory explanation at present of the means by which the fungus continues from season to season in this country is that the summer spores infect the aftermath of a wheat crop (the self-sown plants from a previous crop) and autumn-sown crops, and thereon again produce summer spores, which later disperse and infect the spring-sown crops. As will be seen later, there is strong evidence of the Greenfield outbreak having spread more especially from an autumn-sown crop.

THE RELATION OF WEATHER TO DEVELOPMENT OF THE FUNGUS.

While the spread of the disease in subsequent seasons is dependent upon the presence of spores, the extent to which they can infect and spread on future crops depends upon certain conditions, the chief of which undoubtedly is the weather. The exact temperature and degree of humidity favourable to the development of wheat-rust is unknown, but in general the moist, steaming, and hot conditions, similar to those of a hothouse, seem to favour the germination of the spores, their subsequent penetration of the epidermis, and the growth of the root-like fungus fibres amongst the tissues of the wheat-plant. Thus foggy weather seems to favour the fungus; also hot weather, especially following upon dewy nights; and also overheated soil (caused by a previous drought) with showers that cool the ground but little and themselves are largely given off in vapour. It will be seen that the presence of the rust-spores alone in a locality does not necessarily result in an outbreak, which is possible only when suitable atmospheric conditions prevail for a sufficient length of time. So also the affected districts of this season may or may not suffer materially next year, according to the extent to which the spores are present and the character of the weather next season. Hard winters, no doubt, are very important means by which the enormous numbers of the spores of wheat-rust are kept within bounds.

SUBORDINATE FACTORS AFFECTING THE YIELD OF WHEAT.

The effect of rust in the Greenfield district upon the yields per acre of grain varied considerably. In some cases an affected crop yielded over 40 bushels, others not more than 25. Again, there were crops that would return only 10 or 12, and a number that gave nothing at all. The reasons for this were carefully inquired into, and may be stated as follows:—

(1.) The atmospheric conditions certainly varied somewhat in the Greenfield district, rendering one part less favourable to an outbreak than another. Some parts were more subject to fogs

than others, and some held the rain that fell, while others lost it through natural drainage. The damper soils would be cooler, the constant but slower surface evaporation resulting in reduction of temperature, whilst the drier soils would be hotter and would disperse volumes of moisture as vapour after a shower. The superabundance of water-vapour in the atmosphere after the heavy thunder-showers just prior to the outbreak is one of the suspected contributory causes of the trouble, the hot sunshine about the same time being a necessary accompaniment.

(2.) The soil noticeably varied in different parts, some being reputed as much better wheat lands than others. The constitution of wheat-plants would undoubtedly vary according to the suitability of the land for this crop, and their susceptibility to damage by rust-infection would consequently be greater or less according to their weakness or vigour, their backwardness or precocity.

(3.) Rotations play an important part. Land out of lea is well recognized as inferior for wheat to land previously carrying turnips. Crops whose development was advanced by good rotations had produced better-filled grains by the time the fungus arrested their progress.

(4.) The date of sowing certainly seemed to have been directly connected with the amount of the yield of affected crops. Quite a number of instances were forthcoming: Early-sown crops gave comparatively good yields. Some growers who sowed in July or early in August got over 40 bushels from a rust-affected crop. Later sowings in general gave relatively smaller yields, while some who sowed in September found it quite unprofitable to thresh.

The explanation is very apparent. The outbreak in this district was very sudden. The fungus seized upon the stems and leaves of the wheat, intercepting the flow of plant-juices to the grain. This (with perhaps the exception of a certain crop sown in the autumn) happened practically simultaneously throughout the district, and the early-sown crops, having greater grain-development than the late-sown ones, were consequently able to ripen a better yield. The late-sown crops, being more milky when attacked, correspondingly produced a greater percentage of poorly filled or much-shrunken grains.

CENTRE OF INFECTION.

Throughout the district were one or two autumn-sown crops which, had they been affected at about the same time as those sown in the spring, and had other conditions been equal, should have yielded better than any of the spring-sown crops—the grain development of the former, theoretically, being greater than that

of the latter at the time of the attack. Strangely enough, however, one of these autumn crops in the affected area, instead of yielding comparatively well, had produced so poor a yield that it had been decided to burn off the lot. Inquiries elicited the fact, moreover, that this crop had not been attacked at the same time as the others—the presence of the rust having been reported upon it some time before the outbreak became general. The land upon which this crop was grown had two seasons before been occupied by a rust-affected crop, seed from which was used this season. While the outbreak is not considered as due to the use of seed from a rust-affected crop, yet it does seem very likely that this particular autumn crop became very early affected by spores emanating from self-sown plants from the crop of two seasons ago, and that the centre of infection for the remainder of the district in the season now dealt with was this early affected autumn-sown crop.

METHODS OF TREATMENT.

As already shown, it is advisable for the control of the rust to destroy quickly, as far as practicable, all the aftermath of wheat crops and self-sown wheat. The sowing of autumn crops is probably inadvisable, and early spring sowing is undoubtedly good. In the application of fertilizers it is well to remember that excessive nitrogen delays the early maturing of the grain, whilst phosphate fosters it and thus works to the end of getting as much grain-development before the rust appears. Any cultural or other measure which makes for early maturity and vigour is of value.

The so-called rust-proof varieties of other countries or places are more correctly rust-resistant; moreover, they are not necessarily even rust-resistant out of the environment in which they have been raised. It follows, therefore, that each rust-resistant variety will best be evolved in the district where it is eventually destined to be grown for a crop.

There is no satisfactory treatment known for a crop already affected, and the methods of preventing attack are at present still far from satisfactory.

PUCCINIA GRAMINIS AND OATS.

It is worthy of note that the odd oat-plants found here and there in some of the badly rusted wheatfields in the Greenfield district had practically no signs of rust, and had developed well-filled grains.

CERTIFICATE-OF-RECORD COWS.

W. M. SINGLETON, Assistant Director, Dairy Division.

DURING the first six months of the calendar year only a comparatively small number of cows on test complete their records. The appended list comprises those animals which qualified between 1st January and the end of June.

FRIESIANS.

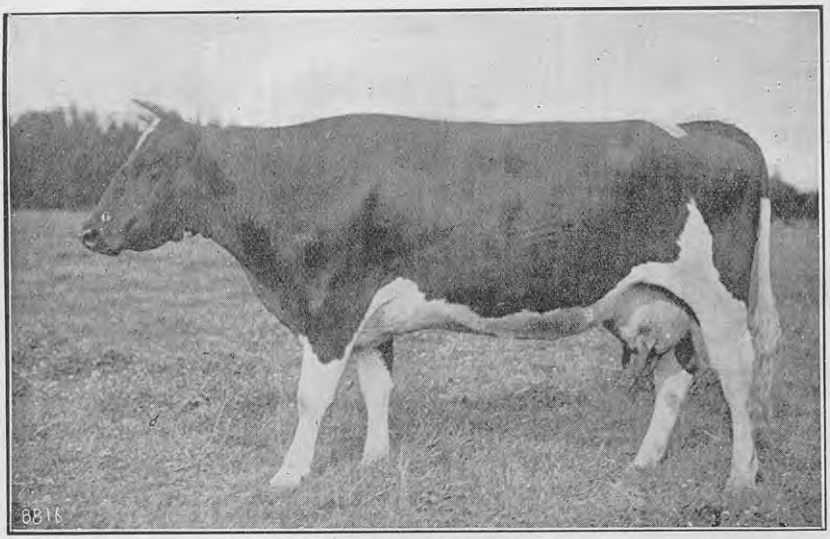
The two-year-old Friesians present some creditable records in the list. Domino's Friesland Belle, bred and tested by Mr. W. I. Lovelock, was a strong competitor for class leadership, being second only to the same breeder's Lady of Cliffside II, which produced 535·22 lb. butter-fat.

Friesland Alba, owned by Mr. W. McKenzie, all but touched the 500 lb. mark. She produced 247 lb. fat over her requirement for qualification. Belle of Friesland, belonging to Mr. Lovelock, exceeded her requirement by some 235 lb. fat.

The junior three-year-old class has few representatives, but the productions are high. Burkeyje Sylvia Posch, owned by Messrs. H. North and Sons, has again come to the fore, and lacked little for displacing the present leader of the class, Mr. G. Aitchison's Gladys II, which produced 614 lb. fat. During her first lactation period Burkeyje Sylvia Posch produced 505·27 lb. fat, and after an interval of forty-five days she commenced her second season's yield, as shown in the present list.

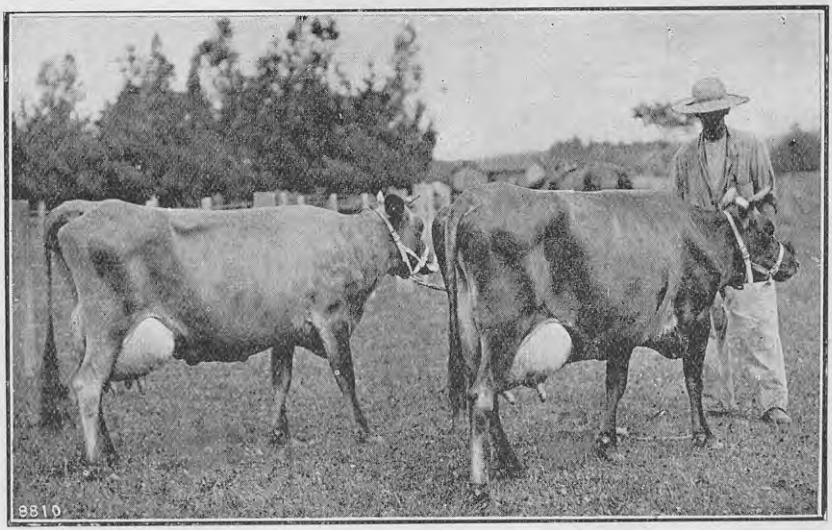
A new class leader appears in the junior four-year-olds. Salma Johanna Lyons, owned by Mr. W. Barton, has a credit of 560·47 lb. fat, or 245 lb. fat above her standard. She replaces Annette V of Brundee, which has a certificate of record for 545·30 lb. fat.

Salma Johanna Lyons, on both sides of her pedigree, traces to strains found in the pedigree of Finderne Pride Johanna Rue, a cow that made a yearly production of 1,176·47 lb. butter-fat. This stood as a world's record until eclipsed by that of Duchess Skylark Ormsby, with a yield of 1,205·09 lb. butter-fat.



SALMA JOHANNA LYONS.

Owned by Mr. W. Barton, Featherston. Leader of junior four-year-old Friesians. (See List of Records.)



EMINENT'S MAGGIE (ON LEFT) AND LENORA (ON RIGHT).

Owned by Mr. C. G. C. Dermer, Waipiko, Cheltenham. The record of Eminent's Maggie among the senior two-year-old Jerseys is 572·13 lb. fat. Lenora has a record of 685·18 lb. fat in the mature Jersey class.

The record of Virginia, owned by Mr. G. Aitchison, of Kaitangata, is one of special merit. This cow has produced over 300 lb. of butter-fat above her requirement. Such records as this should tend to popularize black-and-whites in the South.

JERSEYS.

Amongst the two-year-old Jerseys the record of Mr. S. R. Lancaster's Silver Fox stands out pre-eminent. Commencing at the age of 2 years 88 days, this heifer in 365 days produced 413·05 lb. butter-fat. She is a daughter of Mr. Lancaster's imported bull, Majesty's Fox, who has ten C.O.R. daughters to his credit.

In the three-year-old class the record of Eminent's Sherry is exceedingly good. She had been on test during her previous lactation season, when she produced 424·52 lb. butter-fat, commencing at the age of 2 years 20 days. After finishing this first record on 30th September, 1914, she commenced her second record on 7th November, 1914, when she gave a yield as shown in the table below. Eminent's Sherry is a daughter of Eminent's Fontaine (imp.). This bull has eleven C.O.R. daughters, and still heads the herd of Mr. C. G. C. Dermer, who bred Eminent's Sherry. This young cow is now owned by Mr. F. E. Hellyer, who has tested her for each of her certificates of record.

LIST OF RECORDS COMPLETED BETWEEN 1ST JANUARY AND 30TH JUNE, 1916.

Name of Cow and Class.	Name and Address of Owner.	Age at starting Test.	Fat req'd for Cert.	Yield for Season.		
				Days.	Milk.	Fat.
		FRIESIANS.				
Junior Two-year-olds.		Yrs. dys.	lb.		lb.	lb.
Friesland Alba ..	W. McKenzie, Palmerston North	2 114	251·9	365	13197·70	499·17
Friesian Countess Segis	W. I. Lovelock, Palmerston North	2 115	252·0	365	11771·50	396·69
Friesland Josina de Kol	Ditto	2 100	250·5	365	8048·60	307·37
Belle of Friesland ..	,, ...	2 83	248·8	365	13767·40	483·75
Domino's Friesland Belle	,, ...	2 99	250·4	365	14352·00	533·48
Lady Oak Piebe Pieterje de Kol	W. Remnant, Palmerston North	2 60	246·5	365	11833·00	376·21
Senior Two-year-olds.						
Gladi de Kol Burke	John Gould, Apiti ..	2 283	268·8	324	8671·2	366·79
JuniorThree-year-olds.						
Lady Tirania de Kol II	W. I. Lovelock, Palmerston North	3 4	277·4	365	16679·30	551·64
Burkeyje Sylvia Posch	H. North and Sons, Omimi, Seacliff	3 30	280·0	365	19024·70	610·42
Mutual Pontiac of Rock	W. Barton, Featherston	3 130	290·0	323	9924·10	313·66

LIST OF RECORDS COMPLETED—*continued.*

Name of Cow and Class.	Name and Address of Owner.	Age at starting Test.	Fat req'd for Cert.	Yield for Season.		
				Days.	Milk.	Fat.
		FRIESIANS—*continued.*				
Senior Three-year-olds.		Yrs. dys.	lb.		lb.	lb.
Mutual Belle of Rock	W. Barton, Featherston	3 185	295·5	342	12882·10	433·68
Junior Four-year-olds.						
Salma Johanna Lyons	W. Barton, Featherston	4 13	314·8	365	17406·40	560·47
Senior Four-year-olds.						
Mutual Dulcina Vale	W. Barton, Featherston	4 229	336·4	295	13031·10	429·67
Mature Class.						
Virginia	G. Aitchison, Kaitangata	5 36	350·0	365	18307·75	652·91
		JERSEYS.				
Junior Two-year-olds.						
Silver Fox ..	S. R. Lancaster, Palmerston North	2 88	249·3	365	7718·00	413·05
Aca	C. Stevens, Maungatapere, N'th Auckland	2 42	244·7	365	5130·30	246·02
Crown Pearl ..	E. O'Sullivan, Cardiff	1 349	240·5	206	5276·10	290·69
Seamaid of Bull's ..	Dr. F. J. Watson, Bull's	2 2	240·7	323	5135·30	286·95
Senior Two-year-olds.						
Una's Gloria ..	W. V. Harkness, Tariki, Taranaki	2 343	274·8	306	5398·30	323·94
Rozel's Marguerite II	Ditto	2 350	275·5	318	5086·90	276·90
JuniorThree-year-olds.						
Eminent's Sherry ..	F. E. Hellyer, North-east Harbour, Dunedin	3 57	282·7	365	10160·00	554·10
Cream Caramel of Sedgebrook	H. J. Lancaster, Glen Oroua	3 20	279 0	330	8187·40	376·71
Junior Four-year-olds.						
Eminent's Caif ..	C. G. C. Dermer, Waipiko, Cheltenham	4 30	316·5	356	7095·90	390·10
Senior Four-year-olds.						
Floria's Delight ..	J. F. Vosper, Matamata	4 200	333·5	365	7459·70	415·51
		AYRSHIRES.				
Two-year-olds.						
Newton Gipsy ..	N.Z. Government Experimental Farm, Moumahaki	2 241	264·6	365	7812·80	296·15
Mature Class.						
Molly Bawn ..	McPhail Bros., Clinton, Otago	5 118	350·0	337	9099·00	366·55
		SHORTHORNS.				
Two-year-olds.						
Beckfield Flora of 1912	W. Gibson, Kiwitea, Feilding	2 111	251·6	365	7189·85	264·14

OPEN-AIR STORAGE OF SEED POTATOES.

Two methods of storing seed potatoes are practised at Moumahaki. One is to store the seed in sprouting-boxes placed in a well-ventilated shed; the other is to spread the potatoes on wire netting raised on frames about 3 ft. from the ground, without

THE OPEN-AIR SEED POTATO BENCHES AT MOUMAHAKI.

any covering except that afforded by pine-trees growing overhead, as shown in the accompanying photograph. During the past season better results have been obtained from seed stored under the pine-trees than from seed kept unde cover during the winter. Of course, the former method is suitable only in a mild climate.—*T. W. Lonsdale, Manager, Moumahaki Experimental Farm.*

THE LIME-SULPHUR SPRAYING COMPOUND.

J. A. CAMPBELL, Assistant Director, Horticulture Division.

COMMERCIAL lime-sulphur solution has now been in fairly general use by New Zealand fruitgrowers for three seasons, and it is safe to say that it has gained in favour each year.

As an insecticide lime-sulphur is not equal to oil emulsion for winter use, nor is it equal to some of the other special sprays for summer use; nevertheless, it is very useful in summer for the control of red mite, scab, &c.

As a winter fungicide it does not equal either bluestone solution or Bordeaux mixture, but when used sufficiently strong it is not to be despised for this purpose. The same may be said of the solution as a summer fungicide. It is not equal to Bordeaux mixture for the control of black-spot, particularly after the disease has made its appearance; but it is infinitely preferable to Bordeaux for summer use, being far less liable to damage the fruit. In addition, lime-sulphur has a direct advantage over Bordeaux mixture in the control of powdery mildew. Bordeaux is of little or no use against this disease, while lime-sulphur (apart from atomic sulphur, which, although so far satisfactory, has had only one season's trial) is the best remedy for mildew we have.

The fact that emulsified oil and other solutions are recognized to be superior insecticides, and that Bordeaux is a more effective fungicide than lime-sulphur, should on the face of it leave the latter spray at a disadvantage. But this is compensated for, particularly for summer use, by the fact that lime-sulphur possesses both insecticidal and fungicidal qualities, and, when properly applied, covers both these purposes quite satisfactorily, thereby doing away with the extra amount of labour required in spraying with separate solutions for the different purposes. Lime-sulphur can be safely combined with arsenate of lead; in fact, the general opinion is that the good effect of lime-sulphur is increased by the combination.

Lime-sulphur when used at too great a strength is liable to damage foliage badly, and the action of the material in this way appears to be somewhat inconsistent. A diluted mixture which

can be safely used one season may, at the same strength, scorch the foliage more or less the next season. Similar inconsistencies may be experienced at different times during the same season or in different orchards in the same district. Again, the strength 1–100, which has been found to give general satisfaction in the North Island, will at times severely scorch the foliage when used in the South Island. In the southern districts 1 in 120 is considered to be the greatest strength at which the mixture can be safely used as a general summer spray. This peculiarity, however, although calling for careful attention, is not sufficient to greatly affect the popularity of the lime-sulphur spray.

In combining lime-sulphur with arsenate of lead there are two matters worthy of attention. Either the full quantity of arsenate of lead to which the lime-sulphur is to be added should be first prepared, or the ingredients should be prepared separately and poured simultaneously into a third vessel, as in preparing Bordeaux mixture. When combined the mixture should not be allowed to stand longer than can be avoided before using, otherwise the danger of scorching is increased.

Lime-sulphur as a late winter or spring fungicide is of particular interest at present owing to the greatly increased price of bluestone. This fact will, no doubt, mean a large increase in the use of lime-sulphur.

HOME-MADE LIME-SULPHUR SOLUTION.

When used at winter strength and even when somewhat reduced, commercial lime-sulphur becomes a fairly expensive spray. This cost can, however, be reduced considerably by the orchardist preparing his own solution. If good materials are available, this can be done satisfactorily according to the following formula:—

Sulphur	100 lb.
Roche-lime (95 per cent. pure)	50 lb.
Water	50 gallons.

Slake the lime with hot water, mix the sulphur to a paste and add it to the lime, also sufficient water to make up to 50 gallons. Boil vigorously in an iron boiler of sufficient capacity to prevent waste from boiling over, and add water to replace waste from boiling, so that there will be about 50 gallons when cooked. Solutions made in this way usually register 27° to 28° Beaume. In order to secure a standard strength corresponding with the commercial solution — that is, 33° — it is essential to ascertain the specific gravity of the mixture before dilution. For

this purpose a Beaume hydrometer is recommended. Test the mixture, compare with the accompanying table compiled by Mr. A. B. Mansfield, Orchard Instructor, Auckland, and dilute accordingly.

Referring to the chart, it may be explained that the top line of figures represents spray mixtures, varying in strength from 1 in 10 to 1 in 125. The column of figures on the left represents lime-sulphur solution, varying in density from 25° to 35° Beaume.

To prepare a spray of any standard strength first find the specific gravity of the solution by means of a Beaume hydrometer. Mark the figures in the column on the left of the chart corresponding with the reading of the hydrometer. Next select the figures in the top line representing the strength of the spray required. The figures where this column and the cross-line denoting the specific gravity of the solution intersect represent the quantity of water required to make a spray mixture of equal strength to that given at the top of the column.

For instance, suppose the specific gravity to be 28° Beaume, and the strength of spray required is 1 in 80 standard. The figures at the intersection are 67·9. This means that one part of the 28° Beaume solution with 67·9 (say, 68) parts of water added is of equal strength to 1 part of a 33° Beaume solution with 80 parts of water added.

STRENGTH OF SOLUTION RECOMMENDED.

The various strengths at which lime-sulphur based on a 33° Beaume test is recommended for use is as follows:—

Winter.—Sucking-insects and Fungoid Diseases.

Pip-fruits: 1–10, applied preferably just as the buds begin to swell.

Stone-fruits: 1–15, applied in autumn and as the buds begin to swell.

Spring.—Fungoid Diseases.

Pears: 1–15 to 1–20.

Apples: 1–25 to 1–30.

Applied as the buds show colour or as the most advanced burst into bloom.

Summer.—Sucking-insects and Fungoid Diseases.

Pip-fruits: 1–100 to 1–120 throughout the season, combined with arsenate of lead.

REFERENCE CHART FOR STANDARDIZING HOME-MADE LIME-SULPHUR SOLUTION BASED ON A 33° BEAUME STANDARD.

Beaume.	1–10.	1–15.	1–20.	1–25.	1–30.	1–40.	1–50.	1–60.	1–70.	1–80.	1–90.	1–100.	1–110.	1–120.	1–125.
25° ..	7·6	11·4	15·2	19·0	22·7	30·3	37·9	45·5	53·0	60·6	68·2	75·8	83·3	90·9	94·7
26° ..	7·9	11·8	15·8	19·7	23·6	31·5	39·4	47·3	55·2	63·0	70·9	78·8	86·7	94·5	98·5
27° ..	8·2	12·3	16·4	20·5	24·5	32·7	40·9	49·1	57·3	65·5	73·6	81·8	90·0	98·2	102·3
28° ..	8·5	12·7	17·0	21·2	25·5	33·9	42·4	50·9	59·4	67·9	76·4	84·8	93·3	101·8	106·1
29° ..	8·8	13·2	17·6	22·0	26·4	35·2	43·9	52·7	61·5	70·3	79·1	87·9	96·7	105·5	109·8
30° ..	9·1	13·6	18·2	22·7	27·3	36·4	45·5	54·5	63·6	72·7	81·8	90·9	100·0	109·1	113·6
31° ..	9·4	14·1	18·8	23·5	28·2	37·6	47·0	56·4	65·8	75·2	84·5	93·9	103·3	112·7	117·4
32° ..	9·7	14·5	19·4	24·2	29·1	38·8	48·5	58·2	67·9	77·6	87·3	97·0	106·7	116·4	121·2
33° ..	10·0	15·0	20·0	25·0	30·0	40·0	50·0	60·0	70·0	80·0	90·0	100·0	110·0	120·0	125·0
34° ..	10·3	15·4	20·6	25·8	30·9	41·2	51·5	61·8	72·1	82·4	92·7	103·0	113·3	123·6	128·8
35° ..	10·6	15·9	21·2	26·5	31·8	42·4	53·0	63·6	74·2	84·8	95·5	106·1	116·7	127·3	132·6

MARKETING POULTRY FOR THE TABLE.

A STRIKING TEST OF THE PRIMING PROCESS.

F. C. BROWN, Chief Poultry Instructor.

THE marketing of poultry, especially cockerels, in a proper table condition is an adjunct to egg-production the value of which is not appreciated in New Zealand as it should be. The great bulk of our poultry is marketed in merely store condition, and thus sold at merely store prices. Yet were cockerels marketed at a right age—four to five months old—and properly primed, they would bring highly profitable prices, and the table-poultry trade would be a valuable source of income to the producer.

In order to give some idea of the money now being lost to the industry by the marketing of poultry for table purposes in poor and practically unsaleable condition, and incidentally to demonstrate the cost entailed by feeding birds from month to month (vast numbers of cockerels are fed up to eight to twelve months, when they should have been sold at half that age), the Department recently conducted a feeding-test for determining the actual cost of converting the ordinary store birds seen at city auction-rooms into a prime table condition.

A number of cockerels were purchased under competition at one of the weekly auctions at Christchurch. They were taken to the Department's reserve at Quail Island, and there fed on ordinary well-balanced fattening-diet. After twenty-four to thirty-one days' treatment the birds were again offered for sale at the same auction-mart, and returned, after deducting cost of feeding, a profit of 92 per cent. The result affords a striking illustration of the value of priming poultry before marketing, and also of the money lost to the poultry-keepers of this country by failure to treat their birds for market in an intelligent manner.

Thirty-one cockerels took part in the test, divided into two pens, No. 1 containing fifteen birds and No. 2 having sixteen.

The following tables give particulars of the results:—

Ring No. of Bird.	Weights during Test. 4th April (Date purchased).	11th April.	17th April.	28th April.	5th May.	Date sold.	Weight gained.
			Pen No. 1.				
	lb.	lb.	lb.	lb.	lb.		lb.
10	3½	4½	5¼	6¼	..	29th April ..	2¾
12	3½	4½	5½	6¼	..	29th April ..	2¾
23	3	4	5	5½	5½	6th May ..	2½
19	4	4½	5½	6	..	29th April ..	2
20	4	4¾	6	6½	..	29th April ..	2½
21	4	5	5½	6	..	29th April ..	2
22	3¾	4	5	6¼	6½	6th May ..	2¾
24	3¾	4½	5	6½	6½	6th May ..	2¾
36	3½	4	4½	5	..	29th April ..	1½
1	3	3½	4	4¾	..	29th April ..	1¾
2	2½	3	3½	4	..	29th April ..	1½
3	3	3½	4	5	6	29th April ..	3
4	3½	4½	5	5½	5½	29th April ..	2
7	2¾	3½	4	4¾	..	29th April ..	2
41	1¾	2	2½	3	..	29th April ..	1¼
Totals	49½	59¾	70¼	81¼	..	..	33
			Pen No. 2.				
1	3½	4	4¾	5¼	..	29th April ..	1¾
2	3	3½	3¾	4¼	4¾	6th May ..	1¾
3	3½	4	4½	5	..	29th April ..	1½
4	3	4	4½	5	..	29th April ..	2
11	4	5	6	6½	..	29th April ..	2½
13	2	2½	3	3½	4	6th May ..	2
16	3	4	5	5¾	5¾	6th May ..	2¾
17	3½	3½	4½	5	5½	6th May ..	2
18	3	3½	4¼	4¾	5	6th May ..	2
5	2	3	3¾	4¼	..	29th April ..	2¼
6	2½	2¾	4	4½	4½	6th May ..	2
8	3	3½	4	4½	..	29th April ..	1½
9	2½	3	3	4	4	6th May ..	1½
10	2	2½	3	3½	..	29th April ..	1½
14	2	2½	3	3½	4	6th May ..	2
15	3½	3½	3¾	4½	4½	6th May ..	1
Totals	46	54¾	64¾	73¾	..	..	30

The results of the operations are summarized as follows:—

Number of birds bought	31
Average weight when bought	3·08 lb.
Average weight when sold	5·11 lb.
Aggregate purchase-price	£2 7s. 4d.
Aggregate selling-price	£5 12s. 7d.
Gain in value	£3 5s. 3d.
Cost of feed	£1 1s. 8d.
Profit	£2 3s. 7d.

PRELIMINARY TREATMENT OF BIRDS.

Before fattening was attempted — and this point should be emphasized — the birds were put into a healthy condition. Epsom salts and sulphur were employed to clear the intestines, and thereby bring the birds into such condition that they could make the best use of the fattening-diet. One packet of salts dissolved in the water with which the mash was mixed was allowed for every twelve birds. The sulphur (about the same amount as of salts) was also added to the mash, and was well mixed with the ingredients before they were moistened. The birds were also carefully treated for vermin, being dusted with carbolic powder before the test commenced, and again a week later. Everything, in fact, was done to ensure that the effect of the neglect to which the birds had previously been subjected should be overcome, and that the priming treatment would have every chance of success.

THE PRIMING DIET AND MANAGEMENT.

Pen No. 1.—The mash formula used in feeding pen No. 1 was as follows: 100 lb. ground hulled oats, 50 lb. ground wheat, 10 lb. ground maizemeal, 7 lb. meatmeal, 1 lb. salt.

The fifteen birds consumed 113 lb. of this mixture, costing 10s. 3¾d. In addition they were given 8 lb. of whole wheat, costing 7½d., and charcoal, sulphur, and insect-powder, costing 6d. — a total approximate cost of food of 11s. 5¼d.

The mash was mixed into a crumbly mass with sour skim-milk. The birds were given this twice each day—as much as they could eat without waste. During the last eight days of the test whole wheat and some of the dry ground-grain mixture was always left before the birds in separate receptacles.

Pen No. 2.—The following mash formula was used in feeding pen No. 2: 50 lb. ground hulled oats, 50 lb. ground wheat, 6 lb. meatmeal, 1 lb. salt.

The sixteen birds consumed 71¼ lb. of this mixture, costing 6s. 8½d., and in addition 74¼ lb. potatoes, costing 1s. 5d., 16½ lb. whole wheat, costing 1s. 5¾d., and charcoal, sulphur, and insect-powder, costing 7¾d., the total approximate cost of food being 10s. 3d.

For the first week the mash was mixed with boiled potatoes and sour skim-milk, as near as possible 2 parts of potatoes to 1 of meal. From the commencement of the second week to the end of the test the mash was made of equal parts by weight of

potatoes and ground-grain mixture. During the last week whole wheat and some of the dry grain-mixture were left always before the birds in separate receptacles.

All birds were given sour skim-milk to drink, as well as clean water in a separate receptacle, while grit and charcoal were always before them. In addition raw mangels were always left before the birds to pick at. No account was kept of the amount of skim-milk or mangels that was consumed.

The pens in which the birds were running were about 20 ft. wide by 40 ft. long.

It will be noted from the tables that the birds that were fed till 6th May made little or no gain in weight during the last week of the test, indicating that in most cases three weeks of proper priming should be sufficient for well-grown birds.

The success of this trial is due in a large measure to the efficient supervision of Mr. C. Cussen, Poultry Instructor, Christchurch, and to the close attention given to the birds by Mr. R. M. Henderson, Caretaker of the Quail Island Quarantine-station.

POTATO VARIETY TESTS: SEASON 1915–16.

MOUMAHAKI.

In past years a large number of varieties of potatoes have been tested at the Moumahaki Experimental Farm. Each year numerous sorts were discarded, with the result that during the past season, although an increased area was grown, the number of varieties was considerably reduced.

As in the previous season, the land devoted to potatoes was a portion of an old lucerne-field, and the lucerne having enriched the soil in nitrogenous matter it was not necessary to supply any to the crop artificially. The following fertilizers were applied at the rate of 5 cwt. per acre: Superphosphate 5 parts, sulphate of potash 1 part.

Planting took place from the 22nd to 27th September, 1915. The crop was sprayed with Vermorite on 23rd November and again on 15th December, and the tubers were lifted during the last week in March, 1916. A normal growing season was experienced.

Following are the results as regards the principal varieties tested :—

Variety.	Marketable Tubers. Tons per Acre.	Small Tubers. Tons per Acre.	Total Yield. Tons per Acre.
Gamekeeper	20·00	3·00	23·00
Maori Chief (ordinary seed) ..	15·25	1·75	17·00
Maori Chief (small seed) ..	9·75	1·50	11·25
Vitality	20·00	2·00	22·00
King Edward	7·50	2·00	9·50
Red Rock	8·25	1·75	10·00
Up-to-Date	8·50	1·00	9·50
Patea Gem	8·75	2·25	11·00
Commercial	11·75	1·25	13·00
Palmer's Prolific	11·50	1·00	12·50
Queen Mary	9·00	1·50	10·50
Skerry Blue	6·25	1·50	7·75
Star of New Zealand ..	10·25	1·25	11·50
Sir J. G. Wilson	12·50	6·75	19·25
Arran Chief	8·75	2·00	10·75

—T. W. Lonsdale, Manager, Moumahaki Experimental Farm.

RUAKURA.

The following is the Experimentalist's report on potato-variety tests at the Ruakura Farm of Instruction for the season 1915–16 :—

The potato crop was grown in No. 6 paddock. The previous year this paddock grew a crop of cereals which received 1½ cwt. superphosphate and 1½ cwt. bonedust per acre. After the cereals were harvested the land was ploughed and sown down with white mustard at the rate of 10 lb. per acre, intended for green-manuring. The mustard was ploughed in on 20th September, 1915, the land being again ploughed, disked, and harrowed on 1st November. It was then ridged and the manure sown between the ridges. The manure used was the following mixture per acre : 4 cwt. basic superphosphate, 3 cwt. bonedust, 1 cwt. Seychelles guano.

The sets, being previously sprouted in boxes, were then planted 14 in. apart in the drills on 12th November. On 13th December horse-hoeing was done between the rows to eradicate weeds, and hand-hoeing between the plants. The crop was again horse-hoed on 23rd December, and received the first spraying on the following days. The Bordeaux mixture used for the first spraying was as follows : 4 lb. copper sulphate, 5 lb. quicklime, 50 gallons water.

The crop was again horse-hoed on 28th December, and for the last time on 10th January, 1916, followed up by a second spraying on 11th, 12th, and 13th January. The mixture used for this spraying was slightly different, as ordinary washing-soda was substituted for the quicklime used in the mixture for the first sprayings. The spray consisted of 5 lb. copper sulphate, 7½ lb. washing-soda, 50 gallons water. After being sprayed, the potatoes were ridged up.

It may be mentioned here that spraying experiments were carried out, testing Bordeaux mixture, lime-sulphur (strength 1 in 80), and "Tuber-tonic" (strength 3 lb. to 50 gallons water). As there was no sign of disease during the season the only effect seen was that the potatoes sprayed with the Bordeaux mixture did not ripen off so quickly as those sprayed with the Tuber-tonic and lime-sulphur.

The crop was dug between the 20th and 28th April, but owing to the very dry season after the New Year some of the varieties gave a light yield; also, one half of the paddock being a heavier soil, the varieties grown on that soil gave a heavier yield.

Following are particulars of the yields :—

Variety.	Weight per Acre.															
	Table.				Seed.				Pigs.				Total.			
	Tns.	cwt.	qr.	lb.	Tns.	cwt.	qr.	lb.	Tns.	cwt.	qr.	lb.	Tns.	cwt.	qr.	lb.
Abbey Craig	4	0	1	1	2	18	0	11	6	15	1	25	13	13	3	9
Breeze's Prolific ..	3	15	2	6	2	8	0	0	6	4	0	7	12	7	2	13
Commonwealth ..	6	12	2	12	1	11	2	16	2	16	2	22	11	0	3	22
Alpha	4	15	2	2	1	14	1	12	3	11	1	12	10	4	0	26
Coronation	6	1	3	13	2	2	2	5	2	6	2	15	10	11	0	5
Bismarck	6	2	0	0	1	6	2	16	2	16	1	18	10	5	0	6
Blue Derwent	4	8	0	0	2	8	0	19	3	4	3	8	10	0	3	27
Celt Scottish Seedling ..	5	10	1	12	3	10	0	6	0	13	1	5	9	13	2	23
Daniel's Sensation ..	4	6	3	1	2	11	3	12	2	14	3	17	9	13	2	2
Sutton's Bountiful ..	4	14	0	8	1	16	2	7	2	16	0	14	9	6	3	1
Conquest (White) ..	4	13	0	9	1	15	1	23	2	8	1	7	8	16	3	11
North Pole	4	11	0	25	2	0	1	9	1	1	0	14	7	12	2	20
Up-to-Date	2	15	2	18	2	8	0	26	2	5	2	4	7	9	1	20
Runciman's Purple ..	3	3	0	26	2	8	2	3	1	8	1	23	7	0	0	24
Findlay's Rosebelle ..	3	6	0	12	1	19	0	24	1	5	1	1	6	10	2	9
Duchess of Buccleugh ..	4	13	0	14	1	5	3	10	0	7	3	11	6	6	3	7
Brownell's Beauty ..	2	19	3	15	3	12	1	24	0	19	0	0	7	11	1	11
Britannia	2	15	2	1	1	15	2	25	1	13	3	17	6	5	0	15
Acme..	3	16	1	23	0	19	1	3	1	15	0	1	6	10	2	27
Findlay's Aurora ..	2	16	2	1	1	17	0	25	1	6	0	0	5	19	2	26
Radium	3	6	0	12	1	16	0	20	0	17	0	20	5	19	1	24
Factor	3	5	0	11	1	14	3	17	0	19	0	2	5	19	0	2
Excelsior	3	3	0	18	1	8	2	9	1	5	2	0	5	17	0	27
Dalmeny Beauty ..	3	3	0	18	1	3	3	0	1	3	3	0	5	10	2	18
Dakoto Red	3	3	2	21	1	6	3	12	0	18	2	8	5	9	0	13
Duke of Albany ..	3	14	2	23	0	19	3	23	1	6	3	19	6	1	2	9
Dalmeny Hero.. ..	2	19	3	9	1	0	3	22	1	3	0	23	5	3	3	26
British Queen ..	2	6	0	6	1	13	0	27	1	6	2	10	5	5	3	15
Conquest (Purple) ..	4	15	2	26	1	4	2	11	1	8	3	12	7	9	0	21
Late Rose	1	11	3	18	2	2	3	7	0	17	0	1	4	11	2	26
Findlay's Challenge ..	1	17	3	16	1	5	1	1	1	7	3	19	4	11	0	8
Northern Star	1	5	1	26	1	13	0	27	1	9	1	0	4	7	3	25

It will be noted that although Commonwealth did not give the highest total yield, it gives the highest yield of table potatoes. Next to it are Bismarck, Coronation, and Celt. Bismarck, however, having very deep eyes, is not so useful a variety as either Coronation or Celt.—*A. W. Green, Manager, Ruakura Farm of Instruction.*

LUCERNE-CULTURE.

CENTRAL OTAGO EXPERIENCE.

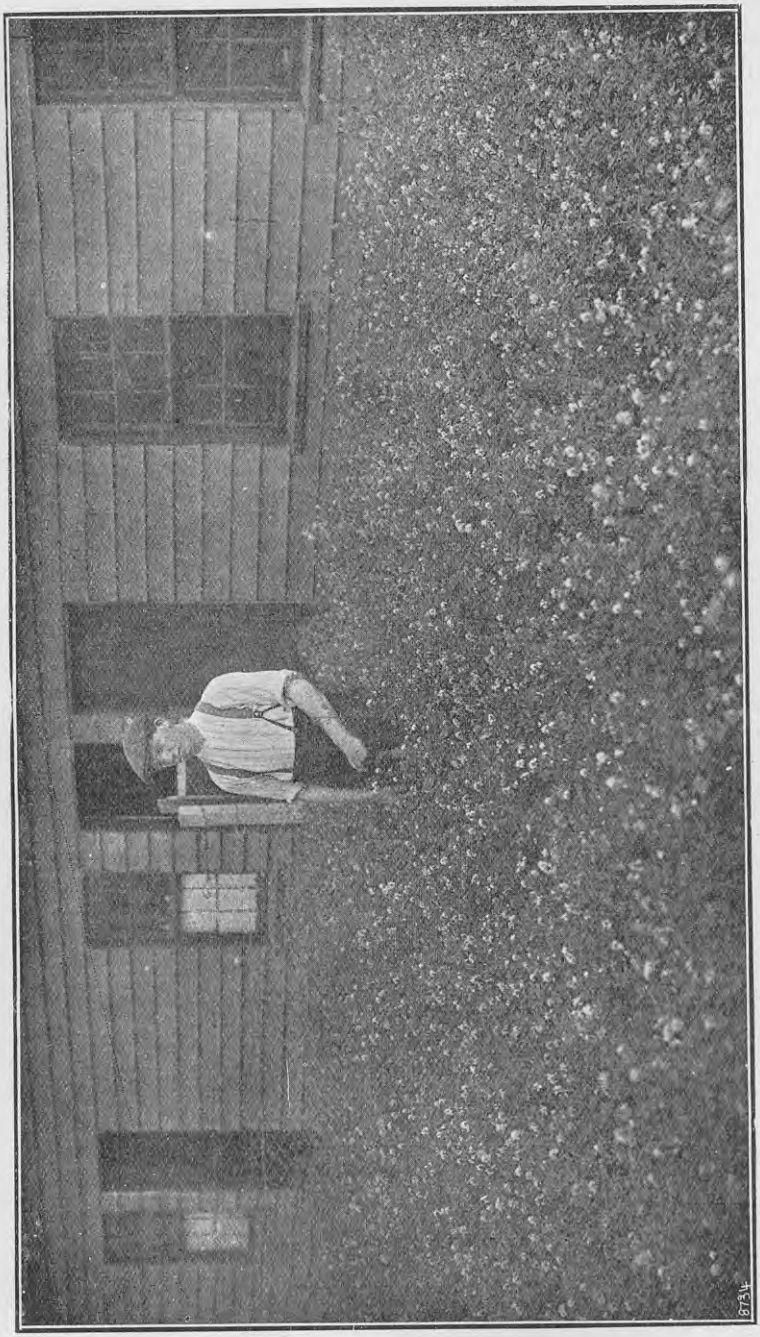
AMONG the lucerne hay shown in the Department's winter-show exhibit this year were samples grown by Mr. J. M. Love, of Galloway, Central Otago. A stand of 25 acres of lucerne has been established by Mr. Love at his farm on the Manuherikia River, concerning which Mr. A. Macpherson, Fields Instructor for the South Island, supplies the following note:—

The area was sown broadcast in the spring of 1914, the seeding being 14 lb. per acre. The first year the crop was cut and left as mulch; the second year two cuts of hay were obtained, and the lucerne was afterwards grazed with sheep, 950 being carried on the area for four months and a half (August to middle of December, 1915). A crop and a half-crop of hay was afterwards secured, the last cut being ob ained in March, 1916. A mob of sheep was then put on to fatten (middle of March to middle of May). The soil is a light sandy loam, with a free subsoil, and is eminently suitable for lucerne-growing. Mr. Love has secured eight stacks of excellently cured lucerne hay, and estimates that he will have about 60 tons of hay, for which a ready sale is assured in Dunedin. Besides this he will have sufficient hay left to keep an increased number of cattle and sheep in abundance of feed until next spring. Mr. Love is of opinion that lucerne alone is too laxative for feeding ewes with lamb. He had no trouble, however, in grazing other sheep, and had no bloat. The feeding-off with sheep in this case, however, has allowed the grasses and weeds to come away, which will be a source of trouble in the future.

LUCERNE AND CALIFORNIAN THISTLE.

The Department is conducting several tests for determining the power of lucerne to smother out Californian thistle. A brief interim report on two of these trials now proceeding in Taranaki under the co-operative experiment system is furnished by Mr. A. F. Wilson, Fields Inspector, Stratford, as follows:—

Mr. P. J. Groshinski's Area, Te Wera.—This land was limed and ploughed on the 16th November, 1915, but it was too wet to sow until 29th December, 1915. Before sowing the ground was well worked. The lucerne took well, and was cut twice, when 12 in. and 18 in. high respectively. After the last cutting it got away from the thistle. On 17th April, 1916, the owner put his weakly lambs on the lucerne, and they did very well on it; it stopped their scouring, and they did much better than other sheep on rape and pasture. Since Mr. Groshinski



PART OF THE LUCERNE PLOT AT THE MILTON POULTRY-STATION.
(See next page.)

established his first acre of lucerne as a co-operative experiment two years and a half ago he has put in 18 acres, mostly on hill country, and he is so well satisfied that he intends going on with it.

Mr. R. Mounsey, Bird Road, Stratford, ploughed and limed his land on 20th November, 1915, but on account of wet weather it was not fit to sow until 7th January, 1916. The lucerne was cut on 16th March, 1916, when about 2 ft. high, and let lie on the ground. I inspected the area on 27th April, and found that the lucerne had come away well again, and had beaten the thistle in growth. Mr. Mounsey will give it a top-dressing this winter, and he considers that by cutting it early in the spring it will get away from the thistle.

LUCERNE FOR POULTRY.

All poultry-keepers who have ground available should establish a patch of lucerne for green-feeding purposes, while some of the commercial plants might well grow larger areas in order to secure lucerne-hay chaff for feeding in the mash. How readily a plot can be established has been demonstrated during the past season at the Department's Poultry-station, Milton, South Otago. The ground was given no special treatment beyond a liberal liming after a crop of peas. The seed was sown early in the spring of 1915; the lucerne came away well and made splendid growth throughout the summer and autumn, a number of cuts being taken—in fact, it was reported as still growing in June. The yield from this plot was used for green feed only, the lucerne hay for chaffing used in the recent feeding-test being supplied from outside sources. The illustration on the preceding page shows part of the Milton plot.

LUCERNE-GROWING IN MARLBOROUGH.

The extent to which lucerne is grown in the Marlborough district is not always realized by farmers in other parts of the Dominion. Mr. F. H. Brittain, Fields Inspector, Blenheim, writes: "There are at least 2,000 acres of lucerne round Blenheim alone, and in the whole district, including Seddon, I should think there would be fully 4,000 acres, if not more."

It is notified that the Administrator of the British militarily occupied territory of Western Samoa has by Proclamation ordered that all plants, fruit, potatoes, or vegetables imported or brought into the Islands of Western Samoa must be accompanied by a certificate issued by a Fruit Inspector of the Department of Agriculture, Industries, and Commerce at the port from which such plants, fruit, potatoes, or vegetables are shipped.

WORK FOR THE COMING MONTH.

THE ORCHARD.

J. A. CAMPBELL, Assistant Director, Horticulture Division.

PRACTICALLY the earliest signs of life in the fruit-tree after its winter rest appear with the month of August. The swelling of the buds heralds the approach of spring, and before the month expires the profusion of pink and white blossom of the peach, nectarine, and plum will have changed the orchard from its barren winter state to a thing of beauty. But the beauty of the scene is apt to appeal more strongly to the orchardist who has his work well in hand than it will to the man who has more or less back work to make up. To the orchardist in this position the blossoming season is more a source of worry than admiration, as he well knows that in a comparatively short time the full burst of spring will be at hand. This stage not only means that important work must be immediately attended to, but it precludes all possibility of satisfactorily carrying out incompleted work of the dormant season.

Apart from work unduly carried over, that normally required in an established orchard for the month is not heavy. It is too early, and the soil is too wet in most instances for spring ploughing. Pruning and winter spraying has already been completed, with the exception possibly of finishing off the pruning of pip-fruits. This and the application of the late winter fungoid sprays in respect to stone-fruits, and the second oil application for the control of woolly aphis in cases where this plan is being adopted, should comprise the main work for the month. At the same time there will be many instances where much additional work is required to be done. Where necessary, all forms of dormant-season work can still be carried on. These include pruning generally, spraying for the control of the various sucking-insects and fungoid diseases, the selection and preservation of scions for grafting, &c. With regard to the planting of fruit-trees, shelter-belts, &c., August is, of course, in respect to many districts, about the best time the work can be undertaken.

PRUNING.

With regard to pruning, I wish to again point out the great importance of this work in relation to the future welfare of the tree and the fruit crop, more particularly in respect to young trees and those which have reached maturity and are languishing through overbearing or other causes. Other conditions, such as shelter, cultivation, moisture, &c., being satisfactory, many of the disabilities of the growth of a tree can be overcome by judicious pruning. Hard winter pruning encourages strong wood growth. This state is required in the formation of a young tree; therefore do not be afraid of cutting a young tree back hard or of removing wrongly placed branches, as the vigour of the tree will very soon replace those removed by others, which, if the work is properly done, will be more satisfactorily placed. Shape and vigour is required in a young tree. When this is secured the possibilities of building up a tree worth having are greatly increased, while the subsequent pruning problems are considerably lessened.

With the mature tree stunted through overbearing, underpruning, &c., the same principle of hard pruning applies. The leaders should be cut back, if necessary into the older wood. In the latter case select, where possible, a vertical lateral of the previous season's growth to form the leader; reduce the number of fruit-spurs in order to lighten the crop, and thereby provide additional sap for the formation of wood. By this means the vigour of the tree will be renewed and an all-round improvement in the crop will be effected.

SPRAYING.

Sucking-insects.

Mussel scale: Pip-fruits—emulsified oil, 1 in 12; stone-fruits—emulsified oil, 1 in 15.

San Jose and other scales: Pip and stone fruits—emulsified oil, 1 in 15; citrus fruits—emulsified oil, 1 in 20 to 1 in 25.

Red mite and mealy bug: Pip-fruits, 1 in 12 to 1 in 15; stone-fruits, 1 in 15 to 1 in 17.

Woolly aphis: Emulsified oil, 1 in 12, if for one application only, or 1 in 15 in the event of a previous oil-spraying having been given.

Peach-aphis: Emulsified oil, 1 in 15 to 1 in 17.

Fungoid Diseases.

Black-spot, apple and pear: This is not considered to be the most suitable month for undertaking preventive measures in regard to black-spot other than the application of bluestone solution, which may be applied either in July or early in August. For this purpose the strength of the solution used should be in the

ratio of 1 lb. bluestone to 12 or 15 gallons water. Bluestone solution is rather soluble, and is easily washed off by rain. To guard against this the oil spray, if oil is being used, should be applied within a day or two of the bluestone application. While on the subject of black-spot it may be as well to mention that this disease is more particularly destructive during damp, misty weather, which often prevails in the spring and early summer. Where such conditions obtain extreme care is necessary in spraying operations to prevent an outbreak of the disease without at the same time damaging the fruit or foliage of the tree. Whether such conditions are to be experienced, however, cannot be judged until after the fruit and foliage have developed to that stage when the application of a strong spray would be dangerous. Therefore preventive measures in the form of a stronger spray applied earlier in the season are necessary. Undoubtedly the most favourable time for this work to be done is just after the buds burst and show colour, or as the most advanced come into full bloom. This state can be looked for during the months of September and October. The mixtures recommended for this spraying are Bordeaux mixture or lime-sulphur at the following strengths: Pear: Bordeaux, 6-4-40; lime-sulphur, 1 in 15. Apple: Bordeaux, 6-4-50; lime-sulphur, 1 in 25 to 1 in 30.

THE POULTRY-RUN.

F. C. BROWN, Chief Poultry Instructor.

BREEDING OPERATIONS.

Now that the breeding season is at hand provision should be made to have everything on the plant in connection with breeding operations in perfect order, so that this important work may be carried out to the best advantage. The first essential is to see that the breeding-stock are in the very pink of condition, for unless these are in a healthy thriving state it can only be expected that trouble will be met with both in the hatching and rearing of the young stock. In order that they may produce strong healthy chicks the breeding-birds should have a variety of foods. A common mistake made in this respect is to feed the one class of grain at all times. It should be remembered that a chicken is made up of many elements, and that the mother hen must be supplied with different foods that contain these if her offspring is to grow and develop to the best advantage. While sound and liberal feeding is imperative, no attempt should be made to produce a heavy egg-yield. Meat or its substitutes should be

fed sparingly. A good range and a liberal supply of green stuff should, if possible, be provided. The greater the range the higher will be the percentage of fertile eggs and the number of strong chickens produced. Exercise is of great importance to breeding-birds. Where a good range is not available the house should be deeply littered with straw or other suitable scratching-material, in which the grain foods should be scattered, so as to induce the birds to exercise.

A careful watch should at all times be kept on the male bird. It frequently happens that a good cock who is too attentive to the hens in allowing them to have all the feed will decline in health, with the result that a high percentage of infertile eggs will be produced as well as others containing weak germs. When it is observed that the male is not in his very best form he should be fed by himself or replaced by another. It is next to useless having the females in the right nick if the male bird is in a low condition. When a male has to be taken out of the breeding-pen through going off it is a mistake to put him by himself. He will eat better and be more contented if given the company of one or two hens.

SUBSTITUTE FOR POLLARD.

A correspondent asks whether, in view of the high prices ruling for pollard and the inferior quality of a great deal of that which is offered for sale, there is any other meal which can be used to take its place in the mash. I cannot do better than recommend the use of wheatmeal (whole wheat finely ground) as a good substitute for pollard. When it is considered that out of a bushel (60 lb.) of wheat that is milled about 42 lb. becomes flour, leaving only 18 lb. for both bran and pollard, it will readily be seen how much greater must be the feeding-value of ground wheat than pollard. In place of the usual mixture of 2 parts pollard and 1 part bran for making a mash I would advise using equal parts of bran and wheatmeal. Though not suitable for feeding alone, bran is a very valuable food for poultry. Care should be taken to see that a good sample of wheat is obtained for grinding purposes, otherwise the door will be left open for inferior wheat to be passed off to the poultryman in the form of wheatmeal. Of course, a good grade of short, plump oats, ground finely, also ground maize, make a valuable addition to the morning mash.

TUBERCULOSIS.

Several inquiries have recently been received regarding fowls going lame in one leg, followed by a wasted condition and finally

death. Where these outward symptoms are present it may generally be taken for granted that the birds are affected with tuberculosis. As is well known, this is a contagious disease caused by the micro-organism tubercle bacillus. It is sometimes known as "consumption," and another name for it is "spotty liver," owing to the fact that this organ is frequently affected, and the disease can easily be seen on post-mortem examination —the liver presenting a spotted appearance. The spots, which are white or yellow in colour, vary in size from a pin's head to a large pea. In some cases the liver may be greatly enlarged, even to twice its normal size. The symptoms generally shown are a listless appearance and a gradual wasting, the latter condition being especially seen in the shrinking of the muscles of the breast, leaving the breast-bone practically devoid of flesh and standing out as a sharp ridge. The wings and tail droop, and the face and wattles become pale and flaccid. Towards the later stages of the disease a yellow or greenish diarrhœa is frequently present, accompanied by lameness, generally on the right leg. In some cases the disease runs a rapid course, and the fowl may die in a few days from the first appearance of the symptoms, while in others the bird may linger for weeks and even months, becoming more emaciated as the disease progresses.

Tuberculosis is one of the most serious diseases affecting poultry, as, in addition to its fatal nature, it can be so easily conveyed from one bird to another. The droppings of a diseased bird contain enormous numbers of tubercle bacilli, and it is easy to understand how food, &c., may become contaminated and a healthy bird become infected. There is no cure for this disease, and the only way of checking it is to prevent it. The first essential in its prevention is to breed birds with the desired constitutional vigour, so that they may have the power of resistance should they come in contact with the infection. Once this disease make its appearance, and the flock is not a large one, the quickest and best course is to kill off all the birds in the affected pen. Where the flock is a large one, and it is not practicable to destroy them all, drastic measures of suppression are most necessary. All suspicious cases should be isolated at once, and any showing definite symptoms should be killed and burnt. No sentiment should be allowed to enter into this matter. The healthy-looking birds should be at once removed to fresh quarters which have been thoroughly cleaned out and disinfected. The houses where the infected birds have been kept should be well cleaned out (all litter and loose material removed) and sprayed with a strong solution of sheep-dip, while the runs should also be turned up, heavily limed, sown down

in grass, and given a rest. All the droppings in the isolated pen should be raked up daily and burnt or deeply buried with lime, while the floor under the perches should be given a dressing of lime after each cleaning. The food-troughs and drinking-vessels should be frequently cleaned with disinfectant.

The fact cannot be emphasized too strongly that prevention is the one thing to aim at in keeping this disease at bay. Too much stress cannot be placed upon the value of cleanliness, and plenty of sunlight and fresh air in the houses, while ample food of a nourishing nature should be supplied at all times. This disease is most common when the birds are preparing for or are undergoing the moulting process. The appearance of any infectious disease should at once be reported to the Director of the Live-stock Division, Department of Agriculture, Wellington.

THINGS TO REMEMBER.

To secure the best results from poultry-keeping both eggs and table birds must be marketed to the best advantage.

Turning a store cockerel into a table delicacy by good feeding doubles the weight of the bird and the profit to the poultry-keeper.

Feeding oats of inferior quality generally proves an expensive food when the egg-yield is taken into consideration.

Many failures in the work of rearing poultry stock are put down to incubators and brooders, whereas the fault is traceable to the breeding-birds.

THE APIARY.

E. A. EARP, Apiary Instructor.

EARLY SPRING WORK.

AUGUST is one of the most critical months in the year, as the bees have awakened from their semi-dormant condition, and the incessant demand of the young brood for food will deplete the stores in a way to astonish even the seasoned beekeeper.

Advantage may be taken of the mild weather occasionally obtaining in August to give the hives their first inspection of the season. This is very necessary where sufficient stores have not been left to carry the bees through the first stages of brood-rearing, which in the milder parts of the Dominion will have commenced in earnest. It is not wise to delay this work till breeding is well advanced, as it may lead to losses through a shortage of stores. The examination is made for the purpose of determining the amount of food in each colony, to note the

queenless hives, and to ensure that the bees are in a suitable condition to carry on brood-rearing until the appearance of the early spring flowers. In making the examination it is necessary to carry out the work expeditiously, choosing the warmest hours of the mildest days.

In cases where the supers have been left on the hives these should be removed, as advised previously. Have the smoker in readiness. After removing the mat, take out one of the end frames. This will facilitate the examination of the centre combs. Under normal conditions the centre combs will contain varying-sized patches of brood according to the strength of the colonies. This will at once denote whether the colony has a laying queen or not. However, it is not wise to conclude at once that the colony is queenless if brood is not visible, so much depending on the locality and the weather preceding the examination. If the colony is strong and contented it is as well to shelve the question of its queenlessness until a later date, when a further examination may be carried out.

If each hive is to be left for the next few weeks undisturbed it should contain at least 18 lb. to 20 lb. of honey; failing this amount, preparation should be made for feeding. For this the best feeder to use at this season of the year is the division-board feeder, which may be obtained at any of the hive-dealers, and advantage may be taken of this examination to put them in the hives. Feed only within the hives, for any other method will surely produce trouble. Place the feeders on the warm side of the hive and as close as possible to the cluster. It must be remembered that artificial feeding is invariably stimulating—*i.e.*, it induces an increase in brood-rearing, and once begun it must be continued until the natural flow from the field sets in. In feeding use only the best white sugar. On no account use honey, as it is impossible to be certain of its source. Many beekeepers, tempted by the cheap price of inferior honey, have in the past fed their bees with this in the spring, only to awaken later on in the season to the fact that they have infected all their colonies with foul-brood. A syrup compounded of 2 parts water to 1 of sugar, fed slightly warm, is the best artificial food for bees in the spring. Full particulars in regard to feeding are given in the Department's New Series Bulletin No. 39, which may be obtained free on application.

PREPARATIONS FOR THE SEASON.

By the end of August the beekeeper should have his preparations for the season's work well in hand. Hive and frame making, also the overhaul of all defective supers, roofs, and

bottom boards, should be undertaken in earnest. It is not wise to postpone the mechanical part of the work in the apiary until the bees themselves require the major portion of the beekeeper's time. If increase is desirable, and more especially where the apiary is being enlarged, make ample provision for it. Nothing is more tantalizing than to leave a swarm hanging on a tree while a hive has to be hastily put together.

Where the beekeeper does not make his own hives he should now order in sufficient stocks to see him through the coming season. In the majority of cases it does not pay the beekeeper to make his appliances. Hive-manufacturing in the Dominion has been brought to a high standard, and unless the beekeeper has ample capital to purchase machinery to turn out good hives he will find the home-made article too costly in the long-run. Whether the beekeeper is working on a small or large scale he should aim at uniformity, and in building up an apiary decide at the beginning on the style of hive and frame he is going to use, and continue on these lines. Non-fitting supers and frames mean extra labour, and lead to endless trouble in the long-run. The hives principally in use in the Dominion are the ten- and twelve-frame Langstroth, and experience of his district will enable the beekeeper to decide as to the the best one to adopt. Make careful inquiries from beekeepers of long standing in the district as to the best style of hive to use.

THE HIVE-CRAMP.

One of the most useful appliances in the apiary is the hive-cramp, and where many hives have to be made it is almost an absolute necessity. It enables the beekeeper to save much time and to carry out the work of hive-making quickly. In nailing hives together it is necessary that the parts should be held together firmly; moreover, hives which are subjected to rough handling will, when properly put together, be thereby prevented from getting out of the square. The jaws of the cramp hold the parts of the hive, while the platform of the cramp forms a good solid base to nail on. A good cramp will pay for itself the first season in the amount of time and labour saved. Hive-cramps may be purchased at a small cost from any of the dealers in bee appliances.

FRAME-MAKING AND WIRING.

Frame-making should receive every consideration, and proper nailing must be strictly attended to. There are no short-cut methods to the proper nailing of frames, and neglect in this direction will undoubtedly cause a great deal of worry when the

frames are in use, more especially in districts where the bees bring in a great deal of propolis. It is well to take every precaution that there is no danger of the top bar leaving the sides of the frame when manipulating heavy combs.

Strict attention must be given to wiring the frames. Many good combs are broken at the time of extracting through neglect to wire properly, and good wiring will allow the beekeeper to handle the combs freely without fear of the brood and honey falling out of the frame. The end bars usually contain three holes through which to thread wires. Cut the wire in lengths of about 60 in., and thread through the holes, draw tight, and fasten each end with a small tack. Some beekeepers advocate single wires in case the long wire gets broken, but if good wire is used the former method will prove satisfactory.

FITTING FOUNDATION IN FRAMES.

When fitting the foundation in the frames care must be taken to see that the sheets are properly sunk into the groove provided. Slip the sheet of foundation through the wires so that the centre one is on one side and the top and bottom one on the other. Put the foundation in the wide groove and the wedge, which should be broken in two pieces at least, in the narrow one. Sink the wedge, thus forcing over the tongue against the foundation, which will then be in the centre of the frame. This is a most important matter, as the correct position of the foundation alone ensures even combs. In order to make the foundation more secure a simple operation may be performed by the use of the spur-embedder. This small appliance forces the wires firmly into the foundation. It may be purchased for a few pence at any of the hive-dealers. A good method of securing the wires is to bring into use melted beeswax. The wax when molten may be applied to the wires by means of an ordinary paint-brush. The latter method is quicker, and prevents any danger of the wire cutting the foundation, as sometimes happens when the embedder is used with too much force.

THE FARM GARDEN.

W. H. TAYLOR, Manager, Arataki Horticultural Station.

VEGETABLE-CULTURE.

Onions.—Though onion-seed will have been sown in many places, there are other locations where it should not have been put in yet. In order to make a commercial success of onions the soil should be of the best, yet in the smaller operations of a domestic

garden any soil, with a little extra care, can be made to grow them well, provided it be properly drained and also not too dry. In many instances dry soil is improved by draining, and always by trenching. Light soil may well be treated to heavy, rich manure; heavy soil to drier, more strawy stuff. Wood-ashes, burnt soil, road-sand, or rubbish from the cleaning-up of the garden after decaying in a heap, are all good for lightening the soil; so also is quicklime. Lime should be applied some weeks before the soil is put in use, for its first effect on stiff soil is to make it pasty and stiffer; but after the ground is broken up again to let air into the soil the desired loosening effect is observed. Firm soil and an even surface are necessary—firm soil to prevent the seed sinking too low, and an even surface to enable the drawing of drills to an equal depth. The surface should be trodden firmly before drawing the drills, and a rake run over after treading. The seed may be put in with a Planet Jr. driller or by hand. In the latter case the drills are best closed up by using the heels of one's boots—an old plan that cannot be beaten, as it ensures perfect covering at the proper depth. After sowing, pass the rake lightly over the ground in a direction opposite to that in which the drills were drawn, so as to remove all footmarks. This will also have the effect of preventing rain settling in the drills. If rain should close the surface of the soil it must be loosened with a sharp rake. After the plants are up the soil must be kept open. They never thrive when the surface soil is allowed to set. Onions from seed sown in autumn should be transplanted. Giant kinds, such as Ailsa Craig, should be planted 12 in. apart; half that distance for such sorts as Brown Spanish. As a fertilizer soot is excellent; apply enough to slightly cover the ground without concealing it. Superphosphate and bonedust mixed should be given at the rate of about 3 oz. per square yard. Apply this before sowing or planting. Nitrate of soda may be applied when the plants are well up—2 oz. per square yard.

Other Vegetables.—With the advent of August periodical sowing of turnips should commence. Early Milan appears to be the quickest variety. It is not so good as most white kinds, so should be used only for the first crop. Sow a small area of carrot. Put in an early kind; Nantes Horn is good; leave the sowing of the main crop till later on. Plant and sow lettuce. Sow broad beans, also peas. Plant and sow cabbages and cauliflowers. Plant rhubarb of the summer kinds; Myatt's Linnæus is considered to be the best all-round variety. Plant divisions of old roots that have two or three good crowns; plant at least

30 in. apart, and work in plenty of manure. Asparagus-beds should be put in order. If planted on the flat lightly fork the surface and give a dressing of salt at the rate of 4 oz. per square yard; this will kill slugs and young weeds, and also act as a fertilizer. If in beds throw the soil removed earlier on to the top of the manure, then give salt as indicated above. Asparagus-planting was fully dealt with last month. Plant Jerusalem artichokes in rows 4 ft. apart, the sets about 15 in. apart. The sets should be of medium size—not large nor too small. The old red variety is better than the white kind. Sow parsley as a matter of course, and such other herbs as are wanted may be planted or raised from seed.

SMALL FRUITS.

Strawberries.—August is, in my opinion, the best time to plant strawberries, as the soil is in good condition, the temperature steadily rising, and continuous growth is assured—a great advantage with any crop, especially so with strawberries. Madam Melba appears to be the most reliable variety. It is certainly good, and is a very persistent fruiter even on young plants. There are many ways of planting strawberries. Planting in rows 30 in. apart, with the plants 15 in. apart in the row, answers well for ordinary purposes in the garden. As fertilizers, apply at once superphosphate 1½ oz., bonedust 1 oz., sulphate of potash 1 oz., nitrate of soda 1 oz., all per square yard. These quantities may seem small, but they work out at an aggregate of over 11 cwt. per acre.

Loganberries are now a deservedly popular fruit. They are best grown where the rods can be properly controlled. They may be trained to a wall or supported by wire trellises. For the latter method ordinary fence-posts serve the purpose, and the best manner of wiring is three wires on each side of the post. The rods are trained up between the wires. The plan of training is to renew the rods every year; that is to say, they are fruited once, then cut out, new ones being laid in each year. Where there are double sets of wires the fruiting-rods are tied to one side and the new ones to the other side. Thus the fruit is on opposite sides each year. The advantage of this method is that the new rods, being separate from those fruiting, are not crowded and can make better growth. There is also a great advantage in handling.

Other Small Fruits.—Planting of all other small fruits such as raspberries, currants, and gooseberries should be finished at once.

Cape gooseberry plants should be put out as soon as danger from frost is past.

THE FLOWER-GARDEN.

Planting trees and shrubs should be completed as soon as possible. Most things can be transplanted at this time. Seedlings from seed sown in the autumn should be got out, as these are usually hardy subjects. Half-hardy annuals should be sown at once. These include aster, ten-week stocks, salpiglossis, zinnias, and things of that class; also nemesias, which are not tender.

Lilies of all kinds may be transplanted. They should be planted deeply, as they tend to rise in the ground; 12 in. is deep enough for most sorts, but large bulbs of auratum should be planted deeper. The different families of herbaceous iris may be planted. The most important section is the Japanese. They do well in ordinary good soil which does not become too dry.

Many of the camellias will have done flowering, and now is the time to do any pruning they may require. Bushes that have become overgrown may be cut back to any extent desired, even to mere stumps; they usually break again quite freely. A lesser amount of pruning may be required to keep the bushes well furnished, or even thinning out to prevent crowding. As this is the period when camellias make their growth and perfect buds for next season's flowers, now is the time to manure them. It is not always necessary to give them stable manure, though this is never amiss if applied as a mulch, which, in fact, is the best way to give it at all times. Rain or the hose will wash it in, and the littery parts will serve to keep the sun out.

"THE FARM."

OWING to the wide variation in climate, soil and other conditions between the different parts of New Zealand, it has been found difficult to furnish under the heading of "Work for the Coming Month" satisfactory notes for general farm guidance—even though qualified as indicated. It is therefore intended to replace the notes by seasonable articles on chosen farming subjects, applied more closely to district requirements, and also of a more comprehensive character than the brief directions hitherto spread over a wide field. The monthly notes for the more specialized branches of fruitgrowing, poultry-keeping, bee-keeping, &c., will be continued as at present.—EDITOR.

ANSWERS TO CORRESPONDENTS.

IN every instance a question to which an answer is desired in these columns must be accompanied by the full name and the postal address of the inquirer, not necessarily for publication, but as a guarantee of good faith. The question should be written on one side of the paper only.

RED WATER IN COWS.

"SUBSCRIBER," Toko :—

Would you kindly give me some information as to the cause of red water in cows, also a cure for the same. I lost five cows last September from this complaint, about three weeks after calving. I also know and heard of other farmers who had serious losses from the same cause.

The Live-stock Division :—

This cattle complaint as met with in New Zealand is due to dietetic trouble, such as giving turnips (especially when frosted) to cows in calf. It is also apparent in certain districts in the spring of the year, when the grass is young and sappy. Treatment consists of a change to pasture containing less succulent herbage, and the animal should be given hay, chaff, &c. Any foods rich in albuminoids, such as eggs, have been proved beneficial. It is advisable to keep a rock-salt lick in the paddocks; in these cases it is particularly valuable. Although scouring is usually the first symptom noticed, an aperient drench should be given as follows: Mag. sulph. ¾ lb., powdered ginger ½ oz., mixed in a quart of gruel.

POTATO-SCAB.

"FARMER," Te Waiwai :—

Please state what would be the best way to treat seed potatoes to prevent scab on the ensuing crop.

The Fields Division :—

Potato-scab is caused by a fungus known as *Oöspora scabies*. The spores may enter the soil through using for seed potatoes that are affected with scab, also through the manure from stock (particularly pigs) that have been fed with scabby potatoes. The disease spores may be in the soil and, owing to plenty of acidity in the ground, do not make much headway in attacking the tubers; but when lime is applied in quantity it greatly encourages the disease. This is particularly the case on stiffish clay soils. For this reason we usually recommend not planting potatoes within at least a year after liming. The treatment for potato-scab is as follows: On affected soils (1) adopt a rotation of crops, varying in length from three to five years; (2) plant potatoes after clover; (3) avoid alkali fertilizers, such as lime, wood-ashes, muriate of potash, &c. (use sulphate of potash in preference to muriate); (4) avoid manure from stock fed on scabby potatoes; (5) disinfect tubers with a solution of formalin, and plant only sound tubers. This may be done by soaking uncut tubers for two hours in formalin solution (1 pint formalin to 30 gallons water). Spread out the potatoes to dry on clean grass. Bags, &c, should also be disinfected. In the case of clean soils plant only sound tubers and disinfect them with formalin. When feeding scabby potatoes to pigs, boil the potatoes first.

Next year you had better grow your potatoes (treated with formalin) on new ground that has not been limed for some years, and on which farmyard manure from stock fed on scabby potatoes has not been used.

SAVING TOMATO-SEED.

A. B., Waimate :—

Kindly let me know the best way to save and separate tomato-seeds.

The Horticulture Division :—

When a small quantity of seed is required the best way is to spread the seeds with a knife on a sheet of newspaper ; sufficient pulp will go with the seed to cause them to stick. Pin the papers to a wall, and when dry they can be rolled up till sowing-time. The seed may then be scraped off, or the papers can be cut to the size of the box and seed sown as it is, in which case the paper should be just covered with soil. When the seeds come up the paper will be found to have disappeared. If larger quantities of seed are required they should be washed through a fine riddle and dried.

STARTING A PLANTATION OF EUCALYPTS.

H. A. NEVINS, Annedale, Tinui :—

Will you let me know where I can get gum-seed for sowing ; also how much seed would be required to sow an acre, as I intend to sow on ploughed ground where the trees are to remain ? What is the best time to sow ? We get frost in the winter.

The Horticulture Division :—

Seed of various gums can be procured on application to the Superintending Nurseryman of the State plantations, Whakarewarewa. The seed of the different varieties of eucalypts varies in weight. You do not state the variety you intend to grow. One ounce of blue-gum seed will produce approximately nine thousand plants. The number of trees required for an acre, at 5 ft. apart, is 1,742. For particulars of how and when to start a plantation see article on eucalypts in the April issue of the *Journal*, page 275.

FROST-PREVENTION METHODS.

J. F. WALCOTT, Clyde :—

I desire to take frost-preventing methods with a few early tomatoes and potatoes. Are alarm thermometers reliable, and, if so, where are they to be obtained, and their approximate cost ? I have heard that tomatoes, &c., if watered with a watering-can on a frosty morning before the sun strikes them are not likely to be frosted. Is that correct ? If so, what is the most suitable temperature for the water ? I intend to use smoke fires, but the watering method, if reliable, would be a further safeguard.

The Horticulture Division :—

Alarm thermometers are in general use and are considered quite reliable. They were procurable from G. W. Wilton and Co., Wellington, price 15s. 6d. each ; but at the present time there are none in stock, and it is doubtful if any are procurable in the country. Watering potatoes, tomatoes, &c., to prevent frost damage is a common practice ; but it is of little value, and applies only in cases of light frost. Water used for this purpose is not heated, and is applied before sunrise.

SAND-CRACK IN HORSES.

E. J. PEACH, Port Levy :—

Would you kindly tell me the best cure for quarter cracks in horses' feet. The horse that I am riding has one on each fore foot ; both are on the inside and are very bad. I have been putting mutton-fat on the cracks, but it is not a success.

The Live-stock Division :—

The following treatment can be adopted : Pressure must be taken off the shoe immediately below the crack by paring away the wall of the toe and the hoof. Get your blacksmith to fire the hoof by making an iron the same shape and size as a gouge-chisel, only fairly blunt. After making red-hot, apply to the hoof. The

impression should be about $\frac{1}{16}$ in. deep—that is, not deep enough to affect the sensitive structures underneath — and the tips of the iron should be $\frac{1}{4}$ in. from where the hoof starts to form. The hoof should have repeated applications of neat's-foot oil and tar. If the sand-crack is so far back as to allow movement of the quarter and an opening and closing of the crack, a clip should be applied to hold the crack together, and a bar shoe put on if necessary. Should the sand-crack extend to the coronet, an occasional painting of tinc. canthaniln to the skin above the crack will help to stimulate the growth of the horn.

GROWTH OF FRUIT-TREES.

V. P., Devonport :—

I have a number of peach and apple trees, five years old, that I have plentifully manured with fowl-droppings, hoed in at intervals, during the last twelve months. The trees have grown well with the treatment. Is there any danger that they will grow too much wood and too little fruit ? The ground is a foot of black loam over yellow clay.

The Horticulture Division :—

It is a very desirable thing to have five-year-old apple-trees growing well, as long as they are kept well open and the wood allowed to develop properly. To what extent this should be allowed to continue is difficult to say without seeing the trees ; but it is always advisable to give preference during the first five or six years to the building of the tree rather than to fruit-bearing. Peach-trees at five years of age should be fairly large, and therefore may require steadying up. If so, open up the trees well, but otherwise prune moderately this winter. It may be found necessary to further check the trees by pruning next summer.

BROWN-FLECK IN POTATOES.

C. E., New Plymouth :—

Some of my potatoes have brown glassy lumps in them when cooked, the white part being quite good for eating. Those affected were grown in ratstail sod after the second working, and manured with a small quantity of farm manure, superphosphate, sulphate of potash, and sulphate of ammonia. I thought perhaps the disease was due to the large amount of vegetable matter in the soil. I should be glad to know if my supposition is correct, or what is the probable cause.

The Fields Division :—

The name of the disease affecting your potatoes is brown-fleck or internal brown-spot. Various causes have been assigned for its appearance, but none of them is sufficient to account for it. The soil and the weather, and even the manure, have all been brought forward as probable causes, but none have been found to hold good in every case. It is certainly most prevalent in light loam or sandy soils, but it is observed here that it usually occurs in that portion of the field where water lodges. Rapid growth is said to favour the disease, since the smaller potatoes or " seconds " are seldom affected, such potatoes being produced late in the season when growth is slow. The disease is also attributed to a want of lime or potash in the soil, but here again it has occurred where these ingredients were not lacking. Dry weather, associated with poor growth, has also been mentioned ; but in Germany damp weather is said to favour it, although under such conditions it does not always appear. It has been observed that if stable manure is applied immediately before planting it does not occur, but if applied earlier, in the previous autumn, it is liable to appear. Some varieties are more liable than others, but, on the whole, it must be regarded as a physiological and not a pathological trouble. It is not a parasitic disease, for no organism of any kind has been found associated with it, and it cannot be transferred to a healthy tuber. Diseased pieces have been inserted into sound potatoes without producing any effect, and diseased tubers have been planted from which healthy ones were produced.

As regards preventive measures, it is certainly not advisable to use affected potatoes for seed, since, whether the disease is transmitted by the seed or not, its presence indicates that the potato is at least a susceptible variety. The use of a potash manure, such as kainit, has been found in Scotland and elsewhere to have a marked effect in decreasing the disease, and may therefore be recommended.

FALLING-OFF OF YOUNG GOURDS.—CURRANT-BORER.

MRS. F. E. A. GUNN, Takapuna :—

Would you kindly state (1) the cause of pumpkins and marrows withering and falling off when very small: (2) whether it is the borer that attacks black-currant trees and eats the pith out of the stems; if so, what remedy would you suggest?

The Horticulture Division :—

The dropping-off of the fruit of pumpkins and marrows while young is very common. There is nothing wrong necessarily with the plants. When the vines are growing very strong they leave no nourishment for the fruit. The proper course to adopt is to pinch out the tips of the runners. The trouble is not lack of pollination, as is often stated, but the strength of the plant going to the vine. To control currant-borer cut away all dead stubs, and encourage new wood by causing the bush to stool. Work old affected wood as soon as possible. Many currant-growers hold that spraying once or twice in the early summer with powdered white hellebore will assist in keeping down the borer.

TREES FOR GLENHOPE UPLANDS.

W. E. BURT, Station Creek, Glenhope :—

I should be glad if you could tell me what shelter and timber trees I could successfully grow here. The altitude is from 1,400 ft. up to 1,800 ft. The main valley runs practically east and west, with subsidiary valleys at right angles. Rainfall is about 50 in. Frosts commence about the middle of April, and I have seen 4 in. of snow, traces of which have remained for four days. On my own land I have only manuka and other scrub growing, but birch bush commences on the adjoining hillsides at about 1,600 ft. The land is a yellow clay on shingle.

The Horticulture Division :—

The following list of trees includes those suitable for the conditions mentioned: *Pinus insignis, Pinus austriaca, Abies excelsa, Abies Douglasii,* larch, *Picea Engelmanni, Eucalyptus viminalis, Eucalyptus sieberiana.*

LOOKING INTO THE POULTRY PLANT AT RUAKURA.

BOARD OF AGRICULTURE.

THE Board of Agriculture, at a meeting held on 15th June, dealt with a number of matters of a confidential nature that had been referred to it by the Minister.

The position arising out of the proposed commandeering by the Imperial Government of next season's output of cheese available for export was very fully discussed.

The Board had a long interview with Mr. D. E. Hutchins, F.R.G.S., with whom it discussed the various qualities and uses of the different varieties of trees which should be planted in New Zealand. Mr. Hutchins also furnished the Board with information concerning afforestation generally in Europe, Japan, and the various parts of the Empire.

Amongst other matters considered were the following: American meat trust; export of hides; supply of rock phosphate; exportation of stud sheep; Professor Bottomley's bacterized peat; sale of meat to the Imperial Government; noxious weeds; and proposed establishment of an experimental farm in the North Otago district.

A meeting of the Board was held on Thursday, 13th July, 1916.

The Board considered a number of questions that had been referred to it by the Council of Agriculture.

Amongst other matters, the Board had a lengthy conference with Mr. Morgan, Director of Geological Survey and Acting Under-Secretaty for Mines, with regard to making a careful search in various parts of New Zealand for deposits of limestone and phosphate rock for agricultural purposes. Mr. Morgan pointed out that owing to several members of the staff having enlisted the Department was rather short-handed; a sum of money had been allocated, however, for the purpose of locating limestone-deposits throughout the Dominion, and the Department was making arrangements to examine the most likely localities, and hoped to be able to furnish a comprehensive and exhaustive report on the subject during the coming year. He stated that he was afraid no large deposits of lime would be found in the Taranaki District, but that it was probable some might exist on the banks of the Mokau River, and he promised to ascertain whether such was the case, and, if so, to obtain samples of the limestone in that district.

The Board agreed to endorse the recommendation of the Council of Agriculture that the Government be asked to withdraw the embargo on the export of hides.

It was decided that the President and another member of the Board should wait upon the Prime Minister and ask him to take steps to ensure that at the conclusion of the existing agreement between the Imperial Government and New Zealand producers to purchase all the meat available for export, the whole of the stocks in the stores at the end of the war should be taken by the Imperial authorities, and not thrown back on the hands of the farmers.

A recommendation from the Council of Agriculture that the Government should be asked to bring in a Seeds Bill to provide for the redressing of imported seeds wherever necessary, with the power to prohibit the importation of seeds badly contaminated with noxious-weeds seeds, was also discussed, and arrangements were made to obtain further information on the subject, as a Seeds Bill will probably be introduced into Parliament during the next session.

The Board also dealt with a letter from the Dominion Secretary of the New Zealand Farmers' Union calling attention to the fact that there was a very large quantity of wool lying in Wellington which was damaged by bidibidi (hutewai) seed, and for which a reasonable figure could not be obtained in the Dominion. The Council of Agriculture thought the Government should be asked to provide for the shipment of such "seedy" and dirty wool to Japan or other allied countries where carbonizing machinery is available, and it was decided to urge the Minister to give effect to this proposal.

It was also agreed to write to the Minister of Education endorsing the proposal made by the Council of Agriculture that sections of land should be provided,

where practicable, near the various high schools, for experimental purposes, and that a science master should be attached to such schools to supervise the agricultural education of the scholars, and to work in conjunction with the experts of the Department of Agriculture, on similar lines to those that are being carried out at Ashburton High School.

The noxious-weeds question, and the commandeering of next season's cheese-output available for export, were also discussed.

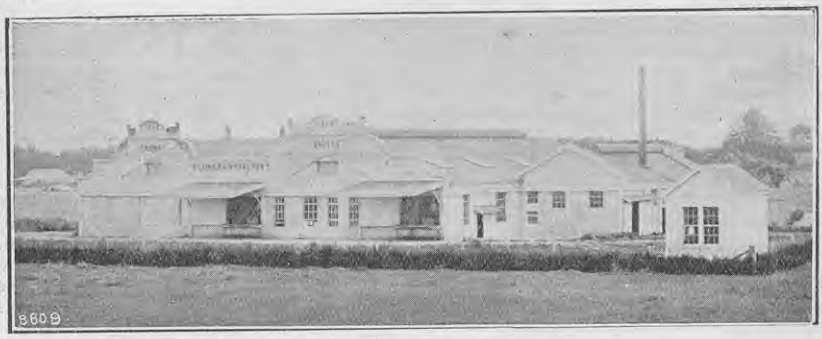
The following additional matters that had been referred to the Board by the Council of Agriculture were also dealt with: The various plans that had been suggested to assist and train returned soldiers desirous of taking up farming and fruitgrowing; the opening-up of fresh markets for New Zealand stud stock; reafforestation; and the inspection of sheep for export. The appointment of an Appeal Board to deal with anomalies arising out of the war taxation to be imposed under the new Finance Act was discussed, but no action was taken, as the Minister of Finance had already announced that a satisfactory Appeal Board would be provided in the Bill now before the House.

NURSERY REGULATIONS.

REGULATIONS under the Orchard and Garden Diseases Act, introducing the registration of nurseries and governing the sale of specified trees and plants, were published in the *New Zealand Gazette* of 22nd June, and came into operation on 1st July. Growers, sellers, and buyers of the class of stock covered by the regulations —viz., fruit trees or plants, tomato-plants, timber or shelter trees or plants, hedge-plants, ornamental trees or shrubs or rose-plants—are closely concerned, and should familiarize themselves with the provisions.

Under the regulations "nursery" means any land which is used for growing any of the above-mentioned trees or plants if such are intended for sale for replanting. Any person engaged in raising for sale any of the trees or plants mentioned must first make application to the Director of the Horticulture Division of the Department of Agriculture for the registration of his premises as a nursery, such application to be accompanied by a fee of £1. Should the nursery stock prove on examination to be "free" or "nearly free" of the diseases specified in the Orchard and Garden Diseases Act, an unconditional certificate will be supplied which will continue in force until 30th April, 1917, unless suspended through an outbreak of disease. Should the stock on examination prove to be affected with disease, the £1 fee will be retained and a conditional certificate will be issued. "Conditional" means that the plants are subject to certain prescribed treatment, and it is only upon such conditions being complied with that sales are allowed from the nursery concerned of the particular stock prescribed for treatment. The method of procedure and inspection fees in respect to conditional registration are fixed.

Copies of the regulations may be obtained on application to the Director of the Horticulture Division, Department of Agriculture, Wellington.



ONE OF THE LATEST TARANAKI CHEESE-FACTORIES.

COMMERCIAL INTELLIGENCE.

LONDON WOOL-SALES.

FOLLOWING is the High Commissioner's cabled report, dated 11th July, 1916, regarding the opening of the fifth series of London wool-sales:—

The wool-sales commenced with buyers in large attendance. Home buyers prohibited from purchasing English wool are competing freely. The market is strong for all kinds of merinos, which are in small supply. Compared with the closing rates of the previous sales, prices for merinos have improved by 2d. per pound; fine crossbreds are ½d. per pound higher, and medium and coarse crossbreds have fallen ½d. per pound. The total net quantity of New Zealand wool available is 59,250 bales.

INTERIM RETURN OF SHEEP.

The Interim Return of Sheep in the Dominion as at 30th April, 1916, shows a total of 24,607,868 head. Compared with the complete returns for the previous year this is a decrease of 293,553. The following sheep districts show increases: Auckland, 155,920; Wellington – West Coast, 876,527; Marlborough–Nelson–Westland, 17,320. The decreases are: Napier–Gisborne, 661,661; Canterbury–Kaikoura, 620,066; Otago, 61,593. Calculating by islands, the North Island has an increase of 370,786 and the South Island a decrease of 664,339. It is expected that the full returns will largely, if not quite, wipe out the net aggregate shortage shown in the interim return.

REGISTRATIONS OF FACTORIES, ETC., UNDER THE DAIRY INDUSTRY ACT, 1908.

REGISTRATIONS AS AT 30TH APRIL, 1916.

District.	Creameries (Butter).	Factories (Cheese).	Private Dairies.		Packing-houses (Milled Butter).	Totals.
			Butter.	Cheese.		
Auckland	55	50	6	6	11	128
Taranaki	46	106	45	2	4	203
Wellington ..	26	57	5	2	24	114
Hawke's Bay ..	11	26	..	..	..	37
Nelson	7	5	2	1	14	29
Marlborough ..	4	7	..	..	..	11
Westland	7	3	..	..	..	10
Canterbury ..	12	15	1	11	8	47
Otago and Southland	5	112	..	2	4	123
Totals, 1916 ..	173	381	59	24	65	702
Totals, 1915 ..	167	330	64	24	63	648

LONDON MARKET VALUES.

COMPARATIVE STATEMENT COMPILED FROM THE HIGH COMMISSIONER'S CABLES FOR THE PAST THREE MONTHS.

London Date.	Wool. Bradford Quotations for Tops. 36's.	40's.	44's.	50's.	56's.	60's.	Mutton. Canterbury.	Mutton. North Island.	Lamb. Canterbury.	Lamb. Other than Canterbury.	Beef. New Zealand Hinds.	Beef. New Zealand Fores.	Butter. Danish.	Butter. New Zealand.	Cheese. New Zealand White.	Cheese. New Zealand Coloured.	Cheese. Canadian.	Hemp (Spot). New Zealand Good-fair.	Hemp (Spot). New Zealand Fair.	Hemp (Spot). Manila Fair (New Grade).	Hemp (Forward Shipment). New Zealand Good-fair.	Hemp (Forward Shipment). New Zealand Fair.	Hemp (Forward Shipment). Manila Fair (New Grade).	Wheat. N.Z. Short-berried.	Wheat. N.Z. Long-berried.	Oats. N.Z. Sparrowbills.	Oats. N.Z. Danish.
1916.							d.	d.	d.	d.	d.	d.															
April 8	..	..	..	..	..	..	7⅞	7⅞	8¾	8¾	7	6	174/0	163/0	103/6	103/6	107/0	49/0/0	47/0/0	54/0/0	47/10/0	45/10/0	53/0/0	..	..	..	..
„ 15	..	..	..	..	..	..	7⅞	7⅞	8¾	8¾	7	6	175/0	163/0	105/0	105/0	107/0	49/10/0	47/10/0	53/0/0	50/0/0	47/0/0	..	..	..	..	..
„ 20	..	..	..	..	..	..	7⅞	7⅞	8¾	8¾	..	..	173/0	163/0	105/0	105/0	108/0	49/10/0	..	55/0/0	48/10/0	46/15/0	51/10/0	..	..	..	..
„ 29	..	..	..	..	..	..	7⅞	7⅞	8¾	8¾	..	..	169/0	163/0	107/0	107/0	109/0	49/0/0	47/0/0	..	..	..	..	..	..	..	..
May 6	..	..	..	..	..	..	7⅞	7⅞	8¾	8¾	6½	6	170/0	164/0	110/0	110/0	112/0	50/0/0	48/0/0	..	48/10/0	46/10/0	54/10/0	..	..	..	..
„ 13	..	..	..	..	..	..	8⅛	8⅛	9	9	..	..	172/0	165/0	113/0	113/0	115/0	50/0/0	48/0/0	56/0/0	49/0/0	47/0/0	55/0/0	..	..	..	..
„ 20	..	..	..	..	..	..	8⅝	8⅝	9½	9½	..	..	172/0	169/0	114/6	113/6	115/9	49/10/0	47/10/0	55/0/0	48/0/0	46/0/0	54/0/0	..	..	..	..
„ 27	..	..	..	..	..	..	*8⅝	..	*8½	..	8	7¼	172/0	169/0	113/0	112/0	116/0	49/10/0	47/10/0	53/10/0	48/0/0	46/0/0	53/0/0	..	..	..	..
June 3	..	..	..	..	..	..	*8⅝	..	*9½	..	..	..	174/0	169/0	108/0	105/0	105/0	49/10/0	47/10/0	53/10/0	48/0/0	46/0/0	53/0/0	..	..	..	..
„ 10	..	..	..	..	..	..	*8⅝	..	*9½	..	7¾	6¾	176/0	170/0	110/0	106/0	105/0	49/10/0	47/10/0	53/0/0	48/0/0	46/0/0	51/0/0	..	..	..	..
„ 18	..	..	..	..	..	..	*8⅝	..	*9½	..	8	7½	175/0	169/0	109/0	105/0	105/0	48/10/0	47/0/0	50/5/0	47/10/0	46/0/0	48/10/0	..	..	..	..
„ 24	..	..	..	..	..	..	*8⅝	..	*9½	..	7½	7	176/0	169/0	104/0	101/6	100/0	48/10/0	47/0/0	50/0/0	47/10/0	46/0/0	48/0/0	..	..	..	..
July 1	..	..	..	..	..	..	*8⅝	..	*9½	..	7	6½	176/0	169/0	99/0	98/0	96/0	48/10/0	47/0/0	51/0/0	47/10/0	46/0/0	49/0/0	..	..	..	..
„ 8	..	..	..	..	..	..	*8⅝	..	*9½	..	6	5½	173/0	169/0	96/0	95/0	93/0	48/10/0	47/0/0	52/0/0	48/0/0	46/0/0	50/10/0	..	..	..	..

* Specified as "New Zealand."

NOTE.—All the above beef quotations are specified as "N.Z. bull-beef."

NEW ZEALAND EXPORTS TO BRITAIN.

COMPILED FROM MANIFESTS OF VESSELS SAILED DURING RESPECTIVE MONTHS OF CURRENT AND PRECEDING SEASONS.

Month.		Mutton, Carcases.	Lamb, Carcases.	Beef, Quarters.	Pork, Carcases.	Butter, Boxes.	Cheese, Crates.	Wool, Bales.	Wheat, Sacks.	Oats, Sacks.	Rabbits, Crates.	Hemp, Bales.	Tow, Bales.	Kauri-gum, Pkgs.
January,	1916	166,700	295,170	41,726	179	108,593	101,917	92,849	..	..	..	7,438	1,666	1,218
,,	*1915*	*137,816*	*296,439*	*45,622*	*339*	*138,081*	*85,123*	*87,393*	..	..	*2,860*	*683*	..	*1,209*
February,	1916	170,973	266,414	29,056	[illegible]	96,096	84,740	96,016	..	..	..	8,161	1,804	1,900
,,	*1915*	*433,585*	*517,581*	*77,421*	*311*	*119,371*	*96,090*	*159,347*	..	..	..	*13,111*	*6,619*	*2,763*
March,	1916	327,977	363,269	83,725	..	59,671	62,082	49,750	..	..	474	2,666	637	1,247
,,	*1915*	*80,439*	*203,480*	*30,176*	..	*55,280*	*51,811*	*49,809*	..	..	..	*8,410*	*185*	*274*
April,	1916	108,488	195,707	106,369	..	24,703	81,652	41,725	..	..	..	3,782	337	450
,,	*1915*	*286,155*	*328,779*	*45,340*	..	*6,703*	*38,561*	*41,371*	..	..	*1,011*	*9,328*	*1,474*	*3,461*
May,	1916	170,164	282,156	134,971	..	26,789	56,961	26,356	..	..	1,000	2,892	235	731
,,	*1915*	*257,953*	*433,831*	*34,780*	*655*	*148*	*17,065*	*21,615*	..	..	*2,923*	*4,968*	*808*	*2,636*
June,	1916	138,303	290,319	41,593	..	10,289	18,463	22,998	..	..	5,439	5,260	2,076	1,219
,,	*1915*	*99,080*	*154,785*	*19,316*	*932*	..	*26,869*	*11,946*	..	..	*9,800*	*5,027*	*1,320*	*1,229*
July,	1915	243,420	340,476	21,231	154	..	21,520	16,039	..	..	5,968	5,068	1,639	4,184
,,	*1914*	*225,411*	*239,143*	*38,170*	..	*1,355*	*2,003*	*15,868*	..	*1,425*	*1,000*	*5,810*	*2,584*	*8,053*
August,	1915	510,418	570,381	51,750	35	..	18,287	19,416	..	..	31,790	7,138	1,466	4,848
,,	*1914*	*84,251*	*63,111*	*19,094*	*516*	*1,979*	*50*	*4,845*	*600*	*38,220*	*10,403*	*367*	*245*	*3,705*
September,	1915	299,715	330,643	59,487	..	26,416	2,595	5,360	..	..	7,750	2,022	3,091	595
,,	*1914*	*53,386*	*49,200*	*2,353*	..	*15,885*	..	*3,337*	..	*5,896*	*7,288*	*1,143*	*57*	..
October,	1915	367,198	417,794	87,104	..	111,468	49,160	7,272	..	..	56,636	5,650	1,645	1,230
,,	*1914*	*291,432*	*128,016*	*49,104*	..	*81,842*	*30,487*	*8,938*	..	*68,660*	*38,121*	*2,042*	*1,650*	*1,683*
November,	1915	93,777	92,601	21,609	..	81,102	47,243	18,715	..	..	13,538	5,064	1,789	868
,,	*1914*	*136,346*	*27,577*	*48,302*	*27*	*98,729*	*70,048*	*37,604*	*15*	*24,289*	*35,783*	*885*	*110*	*1,377*
December,	1915	91,124	59,231	36,467	..	214,967	81,939	33,527	..	..	3,052	6,016	1,940	5,555
,,	*1914*	*192,952*	*149,835*	*44,876*	..	*172,990*	*80,144*	*86,317*	..	..	*9,306*	*1,136*	*116*	*2,157*

STOCK EXPORTED.

THE following table shows the numbers and descriptions of stock exported from the Dominion during the month of June, 1916:—

Port of Shipment.	Horses.		Sheep.			Cattle.		Pigs.
	To Australia.	To Eastern Pacific.	To Australia.	To Eastern Pacific.	To San Francisco.	To Australia.	To Eastern Pacific.	To Eastern Pacific.
Auckland ..	2	7	..	143	..	..	12	8
Gisborne ..	..	..	..	..	..	..	..	..
Napier ..	..	..	..	..	..	..	..	..
Wellington ..	3	..	..	..	115	..	..	..
Lyttelton ..	14	..	674	..	..	..	..	..
Dunedin ..	52	..	141	..	..	..	..	..
Bluff ..	..	..	47	..	..		..	..
Totals ..	71	7	862	143	115	..	12	8

Auckland also exported 3 crates of poultry to the eastern Pacific and 1 to Vancouver.

The following are particulars of horses shipped: Clydesdale, 27 colts, 24 mares; thoroughbred, 7 geldings, 3 mares, 1 stallion; draught, 5 stallions, 2 mares; 5 medium-draught geldings; 1 pony stallion and 1 mare; 1 hack gelding; 1 trotting gelding.

STOCK IN QUARANTINE.

THE following stock was received into quarantine during the month of June, 1916:—

No.	Description.	Sex.	Port of Origin.	Owner or Agent.	Address.
	MOTUIHI ISLAND (AUCKLAND).				
	Nil.				
	SOMES ISLAND (WELLINGTON).				
1	Border collie dog	Male ..	London ..	Harvey Isaac ..	Nelson.
1	,,	Female	,, ..	,, ..	,,
1	Irish setter dog	Male ..	Egypt ..	Major A. Samuels M.	Lower Hutt.
	QUAIL ISLAND (LYTTELTON).				
	Nil.				