The New Zealand

Journal of Agriculture.

Vol. XXVI.—No. 6.

WELLINGTON, 20th JUNE, 1923.

STUDIES IN NEW ZEALAND SOILS.

THE MICA-SCHIST SILTS.

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

WHEN the traveller through Central Otago alights from his coach his first action perhaps is to shake himself free from the millions of spangles of mica-schist which have settled on his clothing during the journey. He sees the mote in the sunbeam here glisten and flash with a new beauty of its own. These particles differ altogether from the dust of other journeys, being tabular or lamellar in form instead of irregular. This entirely novel experience impresses the observant visitor with the great difference between the type of soil over which he is travelling and that more weathered and mixed type near the east coast.

In the plains and river-terraces of this area there have been sorted out, from the harder portions of the metamorphic schists which comprise the country rock, the softer portions, and these have been deposited in the old lake-basins and river-terraces, as one would expect from the shape of the particles, in the form of a tightly packed soil. These soils respond to cultivation and irrigation in a marvellous manner.

The characters which this micaceous rock confers on the resultant soil are quite as important chemically as physically; for it would seem from the limited experience which one may derive from the few soils analysed that wherever such soils are found in the South Island they exhibit the same excellent chemical characters. When the mica-schist is carried away from the arid portion of Otago by rivers such as the Taieri and the Clutha, and deposited nearer the coast, forming plains and river-terraces under more favourable conditions as regards rainfall, the diluted soils are extremely fertile. Where the mica-schist soil is found in wet districts the soils are likewise extremely fertile, after the land has been stirred and the physical state due to the packed condition improved by liming and green or stable manuring. The fertility of mica-schist soils in New Zealand has been remarked by many, but the cause has been attributed to either the lime or the potash they contain. Thus Captain Hutton, F.R.S., in 1875 (" Report on the Geology and Goldfields of Otago," page 95), stated that " the soils of Otago taken as a whole are decidedly above the average in quality, and this appears to be owing to the great extent of mica-schist exposed at the surface, the decomposition of which has supplied more or less directly almost all the soil in the province. That this schist contains a considerable amount of lime is proved by the incrustation in nearly all the caves in it; and the good quality of the soil derived is well seen in the Dunstan district, which is remarkably fertile when irrigated."

The truth appears to be that the fertility of the mica-schist soils of Otago and Westland is due not to the lime or to the potash or to the total phosphoric acid they contain, but to the comparatively large amount of available phosphoric acid present, a point of great theoretical and practical importance. Available phosphoric acid has a very great influence on the growth of the young plant, stimulating the growth of the roots in a remarkable way, a property which is very valuable when utilized in raising plants whose root-systems it is desirable to develop, such as those of the turnip, potato, and mangold. Available phosphates also hasten the ripening of a plant, and for this reason are valuable as a dressing for all cereals. The fact that available phosphate is abundant in Otago soils but deficient in most New Zealand soils, especially those of the North Island and northern parts of the South Island, suggests that some day Central Otago, with its splendid summer climate and irrigation possibilities, may become the granary of New Zealand.

The proportion of readily available phosphoric acid present in mica-schist soils is about two or three times and sometimes even as much as four times the quantity that one finds in an ordinary fertile soil. Thus, assuming that an ordinary soil yields from 0·015 to 0·02 per cent. of phosphoric acid when it is agitated with a 1-per-cent. solution of citric acid for twenty hours (B. Dyer's method, Hall's modification), a micaceous soil may contain 0·04 to 0·08 per cent. This amount would be equal to a dressing of 8 cwt. to 16 cwt. of phosphoric acid per acre, which it would take from 2½ to 5 tons of ordinary superphosphate to supply. This will give some idea of the potentiality which lies hidden in the glittering dust of these micaceous lands.

It must not be supposed that this type of soil is exceptionally rich in phosphate only when it occurs in arid districts. It is as rich when it occurs on the very wet western coasts of the South

Island. Neither must it be thought that the percentage of total phosphoric acid which occurs in the parent rock is exceptionally high, for it is not. There is either something in the lamellar method of weathering which enables the phosphate to become available, or, alternatively, the metamorphism—the pressure and heating—to which the rock has been subjected has made the phosphate available, acting perhaps as the furnace acts in smelting the iron-ore in the Bessemer process, when the slag of the ore becomes converted into a fertilizer in which 80 per cent. of the phosphate is available. It would seem, therefore, that while the proportion of available to total phosphoric acid in ordinary soil is about 10 per cent., in a mica-schist soil it would amount to from 25 to 30 per cent. of the total present.

The experience of the mica-schist type of rock in other countries is rather contradictory. Primrose McConnell (England) in "Agricultural Geology" (1902), states that mica-schist crumbles down with comparative ease and gives a soft friable deep layer of rich soil. On the Breadalbane chain of hills (Ben Lawers) this is exemplified by the intensive flora of alpine and Scandinavian character, rich and well developed in contrast to the poor appearance on the granite of Braemar and Ben Nevis. The pines and larches are magnificent on the decomposed mica-schists of the Highlands generally, but are poor stunted sticks on their cold clays of granite. On the Kingsbridge estuary, in Devon, there is a flourishing vegetation on this rock, including orange and lemon growing in the open air where sheltered from the south and south-west winds. In Ireland the rich green pasture and good "heath" land on the same formation near Knocklayd and Ballycastle, County Antrim, may be noted.

Hilgard, the great American soil chemist, in "Soils" (1906), states that mica-schist, being a mixture of quartz and mica only, not only weathers slowly, but also supplies but little of any importance to plants in soils formed from it. Such soils would be mostly absolutely barren but for the frequent occurrence in this rock of accessory minerals that yield some substance to the soil. Yet it remains true that as gneiss and mica-schist are among rocks in which mineral veins most commonly occur, the proverbial barrenness of mining districts is frequently traceable to these rocks. The difference between American and British opinion regarding the value of mica-schist as a soil-former is remarkable, but probably has some simple explanation, such as the amount of phosphate which is present. There are, moreover, several distinct kinds of mica, which vary greatly in the rate at which they break down or weather in the soil. It is not to be inferred from this that the phosphate is necessarily included in the mica; but wherever mica occurs in South Island soils it appears to be an indication of the presence of available phosphate in good quantity.

H. W. Wiley, in "Principles and Practice of Agricultural Analysis" (1906), points out that the schists include an extremely variable class of rocks of which quartz is the prevailing constituent, and which as rocks are deficient in potash and other important ingredients of plant-food.

Rastall, in "Agricultural Geology" (1916), suggests that such rocks yield soils of all kinds, their character being dependent largely on the climatic conditions. Where these are favourable the soils yielded by the rocks are often very fertile. He attributed the comparative barrenness of these formations in Britain, which occur among the Highlands of Scotland, to the climate and elevation of those parts. In many tropical regions where conditions favourable to the weathering of such rocks exist great fertility results.

In the accompanying Table 1 are given some analyses of mica-schist soils made in this Department's chemical laboratory from time to time. They comprise details of the composition of soils

TABLE 1.—CHEMICAL ANALYSES OF MICACEOUS SOILS.

Results, except *, are percentages on soil dried at 100° C.

Laboratory No.	Locality.	Volatile Matter.		Total Nitrogen.	1-per-cent. Citric-acid Extract, Dyer's Method, Hall's Modification (Available Plant-food).				Hydrochloric-acid Extract (Total Plant-food).			
		*At 100° C.	On Ignition.		Lime, CaO.	Magnesia, MgO.	Potash, K_2O.	Phosphoric Acid, P_2O_5.	Lime, CaO.	Magnesia, MgO.	Potash K_2O.	Phosphoric Acid, P_2O_5.
L 295	Earnscleugh, Clyde	2·48	4·60	0·140	..	..	0·014	0·052	0·35	0·38	0·20	0·10
B 944	Cromwell ..	0·64	0·34	0·080	..	..	0·011	0·069	0·41	1·01	0·16	0·24
B 1037	Kurow	1·70	5·51	0·250	..	..	0·018	0·058	0·90	0·85	0·16	0·27
J 11	Alexandra ..	32·00	1·12	0·056	..	..	0·008	0·064	..	..	..	..
J 77	Maniototo ..	4·52	5·95	0·189	..	..	0·031	0·041	..	..	..	..
P 278	Composite, Central Otago	1·92	6·05	0·254	0·197	0·055	0·037	0·031	1·23	1·02	0·66	0·09
B 848	Stirling	0·74	2·82	0·100	..	..	0·015	0·072	0·74	0·80	0·10	0·19
E 1233	Maruia Plains, Murchison	1·58	4·62	0·152	..	..	0·014	0·050	1·02	1·26	0·58	0·20
H 570	Kokatahi ..	..	4·70	0·182	..	..	0·013	0·056	..	..	..	..
H 572	Hokitika ..	..	1·48	0·084	..	..	0·006	0·080	..	..	..	..
J 306	Koiterangi ..	2·00	4·02	0·150	..	..	0·016	0·056	..	..	..	..
J 307	,, ..	0·54	1·45	0·056	..	..	0·012	0·087	..	..	..	..

NOTE.—In H 572 potash by hydrochloric acid is 0·24 per cent, and potash by hydrofluoric acid 3·09 per cent.

TABLE 2.—ANALYSES OF MICA-SCHIST ROCKS IN THE KOKATAHI WATERSHED, WESTLAND.

(1.) Schist from Jumbletop watershed of Toaroha River. (2.) Quartz-mica-schist from Toaroha Gorge. (3.) Mica-quartz-schist from Mikonui River. (8.) Schistose rock from Mikonui River. "C" and "D," American analyses quoted by Clarke in "Data of Geo-Chemistry" (1908).

Constituents.	(1.)	(2.)	(3.)	(8.)	C.	D.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Silica (SiO_2)	68·09	70·18	71·93	70·18	70·76	64·71
Alumina (Al_2O_3)	14·34	14·15	13·39	16·26	14·83	16·43
Ferric oxide (Fe_2O_3)	0·16	0·28	0·12	0·46	1·46	1·83
Ferrous oxide (FeO)	4·39	3·53	3·31	2·84	3·09	3·84
Manganous oxide (MnO)	0·26	0·32	0·36	0·27	..	Trace.
Lime (CaO)	1·48	1·21	2·45	2·87	0·36	0·08
Magnesia (MgO)	1·57	1·01	0·91	2·58	1·99	2·97
Potash (K_2O)	3·23	2·48	2·20	0·78	3·50	5·63
Soda (Na_2O)	2·90	4·95	4·09	0·43	0·47	0·11
Titanium oxide (TiO_2)	0·66	0·46	0·49	0·70	0·33	0·72
Carbonic anhydride (CO_2)	..	0·60	..	0·08	..	..
Loss on ignition (excluding CO_2) ..	2·09	1·09	0·80	1·84	2·79	3·10
Phosphoric anhydride (P_2O_5) ..	0·28	0·17	0·18	0·32	0·26	0·02
Total	99·45	100·43	100·23	99·61	99·84	99·44

(Nos. 1, 2, 3, and 8 from Dominion Laboratory reports.)

from the wet Westland and the arid central district of Otago. Included also are the results yielded by a remarkably fertile soil from Maruia Plains, near Murchison, in the south Nelson district. Dr. Henderson, of the Geological Survey, who collected this sample of soil, informs me that it is derived from a mica-schist rock. A composite made up of samples of soil from Roxburgh (two), Beaumont, Naseby, Sutton, Manuherikia, Maniototo, St. Bathans, and Frankton, all in Central Otago, is given under No. P/278. The analysis of this composite sample bears out the opinion expressed by Professor Park in Bulletin No. 2 of the Geological Survey, that " the soil possesses a latent richness that the casual observer would hardly suspect. By the application of water the wilderness is transformed into fruitful gardens and prosperous farms. The conservation and distribution of water for irrigation purposes will in time convert the plains and valleys of Central Otago into one of the most prosperous agricultural districts in New Zealand."

Some analyses of unweathered mica-schist rocks are given in Table 2, from the Geological Survey Bulletin No. 6, and accompanying them are two samples, " C " and " D," of American mica-schist rocks from Clarke's " Data of Geo-Chemistry." Analyses of other schist rocks from Central Otago unfortunately lack the requisite information and are therefore not given.

These mica-schist soils often show a deficiency in nitrogen, and are all deficient in organic matter. In the wet districts the available potash is often deficient, although present in very great quantity in an unavailable state. The treatment of such soils with quick or caustic lime has been suggested by the writer as a remedy, in the bulletin " The Wire-basket Method of Testing Soils " (1907). The available phosphoric acid is, as has been stated, present in great excess, but the total is sometimes present in quite moderate amounts. The happy position of Otago in the matter of available phosphate in the soil, compared with other parts of New Zealand, is summarized in the New Zealand Official Year-book for 1913, page 549, and in this Department's Bulletin No. 48, " Phosphates," by the writer. Only 3 per cent. of the soils from Otago analysed were found to be deficient in available phosphate, whereas the percentage deficient in Wellington was 33 and in Auckland 65.

New Rabbit District.—The Patea-Waitotara Rabbit District has been constituted for the purposes of Part II of the Rabbit Nuisance Act, 1908.

Rabbit Control and Trapping.—Regulations under the Rabbit Nuisance Amendment Act, 1920, relating to the destruction of rabbits in the Mangapiko and Kawa West Rabbit Districts, have been gazetted. These provide that every owner of land who is served with a notice to destroy rabbits in terms of the Rabbit Nuisance Act, 1908, must do so either by laying poison or by the fumigation or filling-in of burrows. Where it is desired to substitute other means of destroying the pest, application for permission to do so must first be made to the Rabbit Board, whose decision is final. Further, within seven days of service of the notice, all trapping on the land must cease for a period of six months. The penalty for a breach of the regulations is a fine not exceeding £10. The full text of similar regulations governing the Hurunui Rabbit District was published in the *Journal* for November last (page 315).

THE GRASSLANDS OF NEW ZEALAND.

PRINCIPLES OF PASTURE-ESTABLISHMENT.

(Concluded.)

E. BRUCE LEVY, Biological Laboratory, Wellington.

QUALITY OF SEED AND METHOD OF SOWING.

WITH regard to agricultural seeds there should be only one quality sown—namely, the best. It may be laid down as an axiom that "cheap" poor seed is always expensive. Many samples of reputedly cheap seeds have been analysed at the seed-testing station of this Department, and never in one instance could the individual living seeds of the sample be called cheap. In connection with the accompanying photograph of 5 grams of a typical "cheap" mixture (Fig. 111), it was worked out that the real value of this mixture was approximately 4¾d. per pound, and unless a farmer could buy such a mixture for considerably less than 4¾d. he could not in any way congratulate himself on his deal. It is true he will not get a pound of a good mixture for 4¾d., but he will get more living desirable plants in 4¾d. worth of a good viable clean line of seed, and it is the living desirable plants that the farmer requires and which he pays to get. The price asked for this mixture was in the neighbourhood of 6½d. per pound, which makes it quite an expensive seed as far as the viable seeds in it are concerned.* There may, of course, be times when the farmer can strike a bargain in buying seeds, but the selection of cheap mixtures demands great judgment on the part of the buyer to ensure that the bargain is not on the side of the vendor.

It is admitted that there are certain types of country which demand cheapness of sowing. A cheap sowing, however, does not imply that the seed used should be a cheap, low-grade seed of any particular variety, but that the amount of money spent per acre must be low. Just how to ensure this cheapness and also secure satisfactory results is a problem, with our present knowledge, difficult of solution. It is an extremely unfortunate thing for farmers located on poor rough country that the seeds of plants fitted for such country are expensive, owing no doubt to the cost and difficulty of harvesting them. Cheapness per acre of seeding can be secured (1) by limiting the amount sown—by putting in a certain amount of the desirable elements, and then, by spelling, allowing a certain amount of reseeding; (2) by sowing seeds of inexpensive varieties—but unfortunately rye-grass, Yorkshire fog, and suckling-clover are about the only inexpensive ones that could be used, and rye-grass is of no use as a permanent element on such country; (3) by using "cheap" mixtures, dressings, seconds, &c., which are usually sold

* The same mixture is shown semi-diagrammatically, in greater detail, on page 166 of the *Journal* for September, 1918.

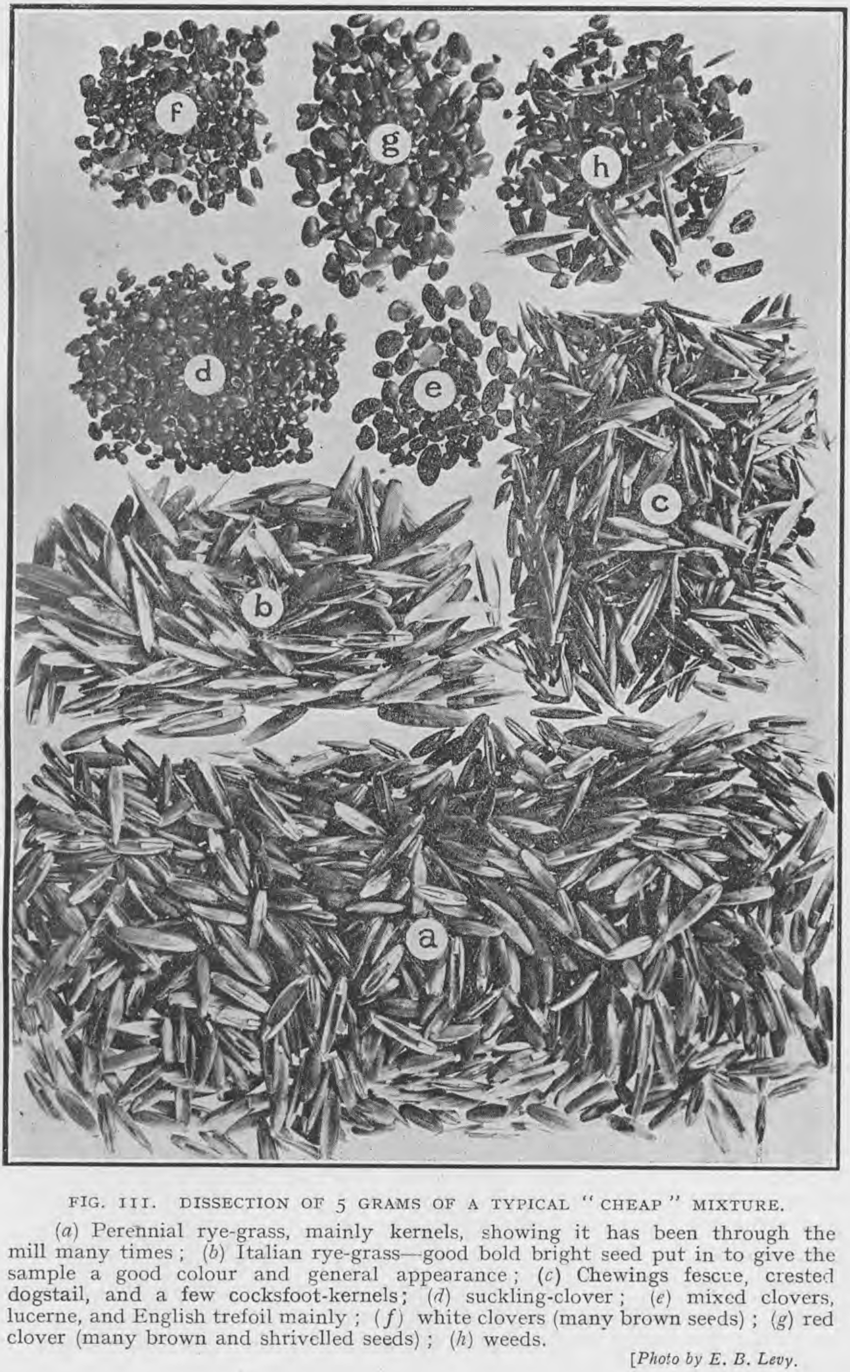

FIG. III. DISSECTION OF 5 GRAMS OF A TYPICAL "CHEAP" MIXTURE.

(*a*) Perennial rye-grass, mainly kernels, showing it has been through the mill many times; (*b*) Italian rye-grass—good bold bright seed put in to give the sample a good colour and general appearance; (*c*) Chewings fescue, crested dogstail, and a few cocksfoot-kernels; (*d*) suckling-clover; (*e*) mixed clovers, lucerne, and English trefoil mainly; (*f*) white clovers (many brown seeds); (*g*) red clover (many brown and shrivelled seeds); (*h*) weeds.

[*Photo by E. B. Levy.*

at so-much per pound. The mixture shown in the photograph is of this class, and farmers undoubtedly will be wise to leave such lines alone. At certain times rye-grass and cocksfoot seconds may be bought fairly satisfactorily, but these so-called cheap mixtures as a whole represent little better than seed-cleanings to which a small quantity of good-coloured seed—generally of Italian rye-grass—has been added for the purpose of giving the sample a good general appearance. There is a fourth alternative—namely, for the farmer to grow his own seed. This last method scarcely comes within the scope of the present article, but there is no doubt that where a farmer has difficult country to grass the growing on some cultivated portion of his farm of small areas of those crops the seed of which he requires is well worth considering. Very rough threshing methods could be adopted, and often, too, the straw could be strewn about the burn. Expensive seeds like brown-top, Lotus major, yarrow, subterranean clover, &c., might well be secured in this manner.

In the buying of agricultural seeds in general there are three main considerations: (1) Germination of the seed; (2) purity of the seed; and (3) its place of origin.

GERMINATION.

Germination, or the capacity of the seed to grow, is the prime consideration in the buying of all seeds. High germination means high vitality: high vitality means success in the competition that will follow in the pasture. No amount of cultivation of the land and no amount of manure applied can make a dead seed grow. The farmer, at present, has no actual guarantee that the seed he buys will grow, but that the seed-merchants of New Zealand can be relied on very largely in this prime matter of germination is reflected in the statistics of our seed-testing station, where out of ten thousand samples tested last year only eighty samples were sent in by farmers. The farmer can always have resource to the official seed-testing free of charge, both for germination and purity, but so far as his ordinary seed-buying is concerned he is advised rather to demand from his merchant seed bearing a high germination percentage shown by the official test. "Government-tested" seeds are often displayed by vendors, but it does not suffice to buy merely on the strength of this label, for the test may show the seed to be of high or of low germination. The seed should have a high germination as shown by the official test. The foregoing course is recommended because the farmer, as a rule, does not buy his seed until he is practically ready to sow, and it would take fully a week to secure a germination test even with the quicker-germinating seeds. Further, if the test proved the seed of low germination the line would have to be returned to the vendor and a fresh stock secured, meaning another week's delay. The farmer, of course, could get samples preparatory to buying, but then he has no guarantee that the seed ultimately delivered would be of the same line as that from which the sample was originally drawn.

Practically all seed-merchants at the present day know the germination of the seed they have in stock, and while they may charge a little more for their high-germinating lines, yet these are undoubtedly the best ones to buy. High germination means great vitality;

high-vitality seeds come through the ground often several days before low-vitality ones, and the weakening influence of unfavourable conditions on the establishment of the former is not nearly so marked as it is on the lower-vitality seeds.*

It must be remembered that all seeds deteriorate in vitality on being stored. Some species are more susceptible to deterioration than others. Chewings fescue may lose its vitality in two years after harvesting, and this is a very important point to be considered in the buying of that seed ; current season's seed should always be demanded. Meadow-fescue, in common with Chewings fescue, is also a short-lived seed, and frequently seed arrives in New Zealand from America with a very low germination. Meadow-foxtail and Poa trivialis, two expensive seeds, demand attention in the buying, as there is at times low-germinating seed on the market. In purchasing paspalum, also, the safest plan when buying without a knowledge of the germination is to stipulate Australian-grown seed, for the New-Zealand-grown seed is often extremely low, and may, in fact, germinate nil or only as little as 3 or 4 per cent. Many failures to secure a strike of paspalum are due to sowing this locally grown seed.

As far as the other pasture seeds are concerned, with reasonable care in buying only high-grade seed there should be little danger of failure through poor germination.†

PURITY OF SEEDS.

As far as the purity of the seeds is concerned there is no doubt that the general well-machine-dressed lines of merchants are quite satisfactory for sowing. There are, however, one or two noteworthy exceptions. Southern crested dogstail and imported alsike are likely to contain Californian thistle (Fig. 112). Auckland-grown Lotus major is likely to contain dodder and Lotus hispidus. This latter may have been purposely added as an adulterant, but frequently the crops harvested are very mixed. Brown-top may contain red-top, the seed of which is almost identical and distinguishable only with quite a high magnification of the microscope.

Owing to the resemblance of certain kinds of seeds to one another the practice of adulteration is not unknown, and while in certain cases substitution of one seed for another may occur accidentally, one finds that in the case of mixed seeds resembling one another the mixture is usually sold at the figure of the higher-priced seed, indicating that there might have been something of method in the mixing. It must be said, however, for the seed-merchants of New Zealand that wilful adulteration is now seldom practised, and having regard to the fact that it is so easy of accomplishment this certainly is to their credit. It still remains a fact, however, that all merchants are not so scrupulous as one might wish regarding the sale of seeds. As this article is written a sample of white clover offered to a farmer by a North Island merchant has been received into the Laboratory here from the farmer concerned, and it contains 60 per cent. of suckling-clover. The price

* See photograph of turnip-seed on page 96 of *Journal* for August, 1918.

† For germination of agricultural seeds in 1921 and 1922, see tabulation by Nelson R. Foy in *Journal* for April, 1923, page 250.

asked for the line is 2s. per pound, and in view of the fact that suckling-clover may be bought for 6d. per pound the line is extremely expensive. The real value of this line is 1s. 2½d. per pound, whereas the merchant was charging only 3d. per pound less than the present ruling market rate for white clover.

The following seeds may be readily adulterated in the manner indicated, and care should be exercised in buying them: White clover with suckling-clover, clustered clover, or haresfoot trefoil; Lotus major with Lotus hispidus; Poa trivialis with Poa pratensis; brown-top with American red-top; Western Wolths rye-grass with

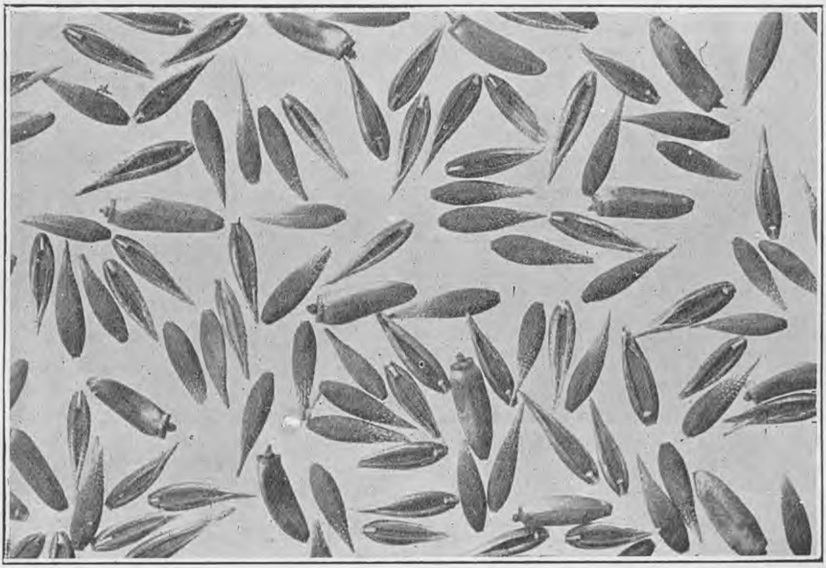

FIG. 112. CALIFORNIAN THISTLE IN SAMPLE OF SOUTHERN CRESTED DOGSTAIL. ENLARGED 6 DIAMETERS.

The thistle-seeds are readily seen in the photo by their rimmed end with small projection.

[*Photo by E. B. Levy.*

Italian rye-grass; meadow-fescue with perennial rye-grass; lucerne with English trefoil. All these adulterations, with the exception of Western Wolths and Italian rye-grass, can be detected by the seed expert, and there is no doubt that our seed-testing station, with its ready diagnostic methods, has played a very important part in reducing wilful adulteration. It would appear, however, from numerous analyses made in the laboratory that just so long as the farmer is prepared to use only well-machine-dressed seeds and to pay the ruling market rate the question of the purity of seeds need scarcely cause him any worry; but just so soon as he strives to strike a bargain, then should his movements be very cautious.

In undressed seeds there is likely to be a whole host of impurities. Danish cocksfoot as it lands in New Zealand is frequently infested with ox-eye daisy; imported timothy and alsike may contain Californian thistle; while imported red and white clover frequently contain dodder.

This recommendation to sow only machine-dressed seed may seem unsound to many farmers on old arable land, where undoubtedly the weed-seed content of the soil is often enormous—so much so that a few more added by way of the grass-seed mixture seems to be insignificant. In the *Journal* for January last, page 20, the writer records that in one single strike over fifteen million weed-seeds germinated per acre, representing a seeding of about 100 lb. The really great danger of sowing impure seeds, however, lies in the fact that new extremely troublesome weeds may be introduced. Here, again, the merchant often gets blamed for supplying clients with impure seeds, when the root of the trouble lies in the seed or plants already in the farmer's field. A very common complaint in many districts is the rapid appearance of Californian thistle in fields that have been ploughed out of grass and then resown. The merchant almost invariably gets blamed for the thistles, whereas really in 99 cases out of 100 they are young shoots from old worn-out plants regenerated by the cultivation.

From another aspect, however, the machine-dressed seeds are the ones to use, for, apart from any misgivings one who takes a pride in his farming might have in knowingly applying weed-seeds to the land, there is that one important attribute usually associated with machine-dressed seeds—namely, their capacity to grow. With machine-dressed seed one is more certain of getting seeds that will grow than when buying undressed seeds. Nevertheless because seed is machine-dressed it does not necessarily mean that it is of high germination.

PLACE OF ORIGIN AND STRAIN OR TRUENESS TO TYPE.

As far as our grasslands are concerned there has been virtually no selection work on the ordinary pasture plants, so that no definite strains have been worked up into marketable products. There is, however, a general consensus of opinion that the nationality or place of origin of our pasture seeds is very important, although not many definite tests made in New Zealand are available. A short consideration of some of the leading plants may serve to demonstrate this factor.

Perennial Rye-grass.—In those districts where perennial rye-grass remains permanent in the pasture over a long period the seed from crops grown there is looked upon as being superior to that grown in districts where, owing to the unsuitable soil conditions, rye-grass does not last for more than two or three years. Hawke's Bay and Sandon rye-grass, for instance, commands a price much in excess of that commanded by Canterbury or Southern rye-grass. In a price-list before me Hawke's Bay rye-grass is quoted at 7¾d., Sandon 6½d., Southern 4½d., and Canterbury 4¾d. per pound respectively. Whether or not the persistence of the Hawke's Bay and the Sandon rye-grass is due to some inherent quality of these strains, or whether the soil conditions alone are responsible, it is extremely difficult to say. If the plants of those soils have some inherent quality by which they can persist, then these strains are undoubtedly worth the extra money; but if soil conditions alone govern their persistence, then the Canterbury or Southern seed is a far better proposition at the price, provided always that the germination capacity of each is more or less the same. For all short-rotation pastures Canterbury or Southern rye-grass at the above prices should undoubtedly be used, but there are certain indications that for truly permanent pastures Sandon or Hawke's Bay rye-grass is preferable, although we have very little definite experimental work to support this recommendation.

In England the indigenous (Native) forms of perennial rye-grass are looked upon as being superior to any of the other nationalities. This indigenous form is a close dense one which bears, proportionately to seed-heads, a great number of barren shoots—*i.e.*, shoots that do not run up to form seed-heads. Practically all the other forms are not dense and tufted, and nearly all their shoots run up into seed-heads. Thus with these is produced a mass of seed-heads and virtually no "bottom." Whether or not the Hawke's Bay and Sandon rye-grass is after the style of the indigenous forms of England only research work can prove, but undoubtedly such is the type we require in New Zealand for our truly permanent pastures.

Cocksfoot.—There are four more or less distinct strains of cocksfoot available to the New Zealand farmer—Akaroa, Canterbury Plains, North Island, and Danish. The Akaroa cocksfoot is of old repute, and undoubtedly it is a good strain, but of later years the seed has been comparatively light, and the germination is often low for cocksfoot. The small seed, however, seems to be a definite character of this strain, for Stapleton* records from his harvest of cocksfoot grown from Akaroa seed that a thousand seeds of this strain weighed 0·95 grains, as against 1·30 grains for a thousand seeds from a crop of Danish origin. Stapleton's experiments on our Akaroa cocksfoot are extremely interesting and important. Akaroa cocksfoot agrees in nearly all details with the indigenous cocksfoot of England, which the English farmer looks upon as the best cocksfoot he can procure. Akaroa cocksfoot is like it in two essential respects—firstly in its dense bottom growth, and secondly in its resistance to frost injury. Danish cocksfoot in Stapleton's trials was more open in the bottom and was extremely subject to frost injury. This is extremely important to farmers in the South Island or in districts subject to heavy frosts. Danish cocksfoot, in view of its big seed, its usually high germination, and its comparative cheapness, is very tempting to use. With regard to the other cocksfoot strains in New Zealand the writer has no information to offer, except that when buying Canterbury Plains seed the purchaser should see that the proportion of perennial rye-grass in it is not unduly high.

Crested Dogstail.—There are two main districts in New Zealand producing crested dogstail—southern Otago and Southland, and Sandon. To any farmer who is afraid of introducing Californian thistle on to his place the use of Sandon seed is strongly recommended. The respective merits of the two strains have not been worked out.

* Preliminary Investigations with Herbage-plants, *Welsh Plant-breeding Station, University College of Wales, Aberystywth*, Series H No. 1, 1922.

Paspalum.—Having regard to the poor germination of the New-Zealand-grown paspalum, Australian seed should be used, unless the farmer is buying on a knowledge of the germination of the line. There is no doubt that good seed could be produced in New Zealand, but the methods of harvesting would have to be considerably modified. This low germination of the New Zealand seed is particularly disappointing, for it would appear that in almost all seeds there arises a certain strain of what may be looked upon as acclimatized plants, and the seed from these should be better fitted for conditions in that district or country. It would therefore seem reasonable to expect that in the course of time certain strains of paspalum could be produced in New Zealand by acclimatization that were much more resistant to frost injury. The introduction and sowing of Australian seed is certainly unsound from this point of view, but until better harvesting methods are adopted in the North the sowing of the better-germinating Australian seed must be recommended.

White Clover.—With regard to the seed of white clover, undoubtedly none other than the New-Zealand-grown seed should be used. The superiority of the New Zealand seed over the commercial imported is beyond question, particularly from a duration-of-life point of view. The imported white will produce well for the first year or so, and then it will go out. Plots laid down by the writer at the Central Development Farm, Weraroa, were sown with imported white clover, and within two years there was not a single plant left, whereas in the same area where only pure grass sowings were made white clover from seed already in the soil established itself and spread out over the plots, and lasted well until the plots were dug up several years later. Most of the white-clover seed harvested in New Zealand is either from old pastures or from land, like the wheat-stubbles of Canterbury, where the clover comes in naturally after the wheat crop has been harvested. Trials in Wales by Stapleton (*l.c.*) go to show that our New Zealand white clover is in very many important respects similar to the wild white clover of England, but at the time of writing they had not been going sufficiently long to prove the lasting-qualities of our seed compared with wild white.

Red Clover or Cow-grass.—There can be little doubt that so far as the New Zealand trade is concerned the seed of cow-grass and of red clover are one and the same. A large-seeded line is almost invariably well polished and sold as cow-grass, for which 2d. per pound more is charged. The smaller seed is usually not polished, and is sold as red clover. In every case it is probably best to buy the cow-grass even although the price is a little more, for a big robust seed of its kind nearly always indicates that a vigorous seedling will arise from it. The New-Zealand-grown seed is undoubtedly of very fine quality, and according to Stapleton's trials in Wales (*l.c.*) comes into the group known as the cow-grass or Broad Red type. From the point of view of persistence, however, these trials go to show that certain English strains, such as the English Late Flowering and Montgomery Red, are superior to our strain. In Denmark, also, our red-clover seed is not looked upon as being particularly hardy. There is no doubt that New Zealand can grow wonderfully fine red-clover seed, and it certainly does look as if our strain is capable of improvement for persistence and hardiness. With respect to all our pasture plants, however, the call for the plant-breeder is insistent, and unquestionably there is scope in our grasslands for an immense amount of selection work. Strains of seeds, also, from all over the world should be tried out and the best perpetuated by an efficient mother-seed-growing establishment. The plant-breeder alone is of comparatively little use; there must also be some seed-growing organization to carry the strain on from the nursery stage.

PREPARATION OF THE SEED-BED AND METHOD OF APPLYING THE SEED TO THE LAND.

It may be claimed almost without exception that our pasture plants prefer a well-consolidated seed-bed for their establishment, and as a rule they do not require to be deeply buried, particularly the clovers. It may be put down as a fairly general rule that the optimum depth for most seeds varies according to size, and as a rule the seeds should be buried some two and a half times their longest axis, neglecting the external appendages such as the husks and glumes of grasses and cereals. In the case of rye-grass and cocksfoot, &c., this would give a depth of between $\frac{3}{8}$ in. and $\frac{1}{2}$ in., and with oats, prairie-grass, &c., 1 in. to $1\frac{1}{4}$ in.; while with the finer grasses like crested dogstail and timothy approximately $\frac{1}{4}$ in. would suffice. In the case of the clovers, white clover and seeds of a similar size would be buried $\frac{1}{8}$ in. to $\frac{3}{16}$ in. deep, while red clover, lucerne, &c., would vary from $\frac{3}{16}$ in. to $\frac{3}{8}$ in. A good deal, however, depends on the soil. In heavy soil the depths specified should not be much exceeded, but on lighter sandy or loamy soils a greater depth can be approached with advantage. In a mixed sowing it is only possible to regulate the depth to suit in an average way the whole mixture, but the necessity of not burying the seed too deeply must here be stressed. In spring sowings on light land likely to dry out in the early summer fairly deep sowings should be made; up to $\frac{1}{2}$ in. or even $\frac{3}{4}$ in. is not too deep. The land should be well worked and a good tilth prepared, but this must be consolidated by the roller before the seed is applied.

There are several methods of applying the seed. The old-fashioned broadcasting by hand is still in vogue, and is about the only successful method for the sowing of bush-burns and the like. Undoubtedly the most efficient broadcasters on ploughable country are the specially constructed grass-seed distributors or the drill, the spouts having been removed and the seed dropping from the box on to the land. Special grass-seed boxes are attached to the better and more modern makes of drills. Whether the seed is broadcasted by hand or sown by the drill or distributor it should fall on a Cambridge-rolled surface, or else the roller should follow the drill. Often the seed sown is simply rolled in, but the hard-rolled bare surface is not good from a moisture-conservation point of view, and undoubtedly this surface should be roughened by the use of the chain harrow. If the seed is sown on a Cambridge-rolled surface the chain harrow should be used to cover, and is usually quite sufficient. The tine harrow is frequently used to cover the seed, but there can be little doubt that the tine harrow does bury a large proportion of the seeds too deeply.

On light land seed is usually drilled through the coulters, as by this means a greater cover can be secured for the seed. The disadvantage of this method, however, lies in the fact that the seeds are all crowded together in rows 7 in. apart, and very frequently the plants never meet between the drills; consequently a great deal of bare ground is frequently present in fields sown down in this way. This difficulty can be largely got over by drilling half the seed one way, and then drilling the other half of the seed across the first drills. By this means a very much better distribution of the seed is effected without any corresponding defect in the cover secured for the seed. The sowing, however, takes twice as long.

In the sowing of small seeds it is a frequent practice to mix the seed with the manure, and drill through the coulters or broadcast from the box. This practice is quite good provided the mixture of seed and manure is sown the same day they are mixed. If seed is mixed with manure, particularly superphosphate, some days before sowing the germination is very likely to be seriously damaged.

CONCLUSION.

In concluding this series of articles on pasture-establishment in New Zealand the writer feels that he has but touched on the fringe of the subject. More and more research work is needed before we can learn just exactly how our soils may be made to produce that wealth of grassland which is actually the chief support of this country. The writer will be content if the series has given the farmer some guidance for thought, for it is only by reflection and inquiry that the why and wherefore of things is made plain. Moreover, the reader should not be content to accept all that has been here written as incontrovertible fact, but should himself delve and probe into a subject which is of such prime utility and interest.

PROTECTION OF MARKS FOR AGRICULTURAL PRODUCTS.

A PROVISION which should assist producers in the protection of marks used by them on wool-bales and produce generally is embodied in the Patents, Designs, and Trade-marks Act, 1921–22. Formerly, many such marks actually in use were debarred from registration as not containing the constituents of a trade-mark within the meaning of the Act. In the 1921–22 Act, however, the Register of Trade-marks is divided into two sections: Part A consists of fully protected marks which comply with all the requirements of the Act as before, while Part B is open for entry of any trade-mark which for two years has been in *bona fide* use in New Zealand in connection with any goods for the purpose of indicating that they are the goods of the proprietor of the mark by virtue of manufacture, selection, certification, dealing with, or offering for sale. While not affording the full protection granted under Part A, registration of a trade-mark under Part B is *prima facie* evidence of the proprietor's right to the exclusive use of such mark, and any person charged with infringement must satisfy the Court that there was no intention to deceive or to lead to the belief that the goods marked were those of the owner of the trade-mark. Registration may be effected at the Patent Office, Wellington, or at any local Patent Office.

POWDERY MILDEW, PODOSPHAERA LEUCOTRICHA (E. AND E.) SALM.*

ITS APPEARANCE, CAUSE, AND CONTROL.

G. H. CUNNINGHAM, Biological Laboratory, Wellington.

POWDERY mildew although very frequently neglected by the orchardist is one of the most serious diseases with which he has to contend. It is prevalent throughout the fruitgrowing areas of New Zealand, and becomes especially troublesome during the late summer and the early autumn. It would appear that this disease originated in western North America, and from there it has spread to almost every country where apples are grown, for it has been recorded from Europe, Asia, and Australasia.

In New Zealand powdery mildew is confined to the apple, but in Japan it occurs on an additional host, *Pirus toringo*, and in North America has been recorded (though seldom) on the pear. So far as the writer is aware no apple varieties are immune, but certain varieties are more susceptible to attack than are others, Cox's Orange, Jonathan, Sturmer, Cleopatra, London Pippin, Gravenstein, and Northern Spy being usually severely infected.

ECONOMIC IMPORTANCE.

This disease causes the leaves to become much smaller in size, crinkled, brittle, and darker in colour. Infected leaves fall prematurely, so that about midsummer severely infected trees appear partially defoliated. Shoots, if infected early in the season, become stunted and often so weakened as to die at their tips, often losing their foliage, when they appear quite bare. Fruit-buds are damaged to such an extent that the resultant blossoms seldom set fruit. Fruits may be attacked while immature, with the result that at maturity they appear russeted and smaller than the normal. At the stem end they frequently become scabbed and cracked. In short, the effects of mildew infection are (1) the reduction of leafage and damage to the remaining foliage, (2) destruction of fruit-buds, (3) weakening and frequent killing of laterals, and (4) reduction of the marketable value of the fruit by russeting, cracking, and frequent deformation. Further, young nursery stock may be damaged to such an extent that wood-growth is entirely prevented ; consequently such stock becomes unsaleable.

APPEARANCE AND EFFECT ON THE HOST.

Trees infected with powdery mildew present a very sickly appearance ; they become partially defoliated, and carry about one-fourth of the leafage of a normal tree. The shoots are often bare at their tips (Fig. 2), and are partly covered with the glistening white masses of the fungus. The fruit is smaller than the normal, and usually disfigured.

* Synonyms : *Sphaerotheca leucotricha* Ell. and Ev. ; *S. mali* Burr. ; apple-mildew ; mildew.

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FIG. 1. TIP OF A STURMER APPLE LATERAL ATTACKED BY THE POWDERY MILDEW FUNGUS. HALF NATURAL SIZE.

Further growth is prevented, and the subsequently formed leaves remain small and strongly curled.

FIG. 2. INFECTED APPLE LATERAL FROM WHICH THE MATURE LEAVES HAVE FALLEN. SLIGHTLY REDUCED.

Note the stunted leaves, and especially the white mycelial mass covering the upper portion.

FIG. 4. DUNN'S FAVOURITE APPLE RUSSETED AS THE RESULT OF EARLY INFECTION. NATURAL SIZE.

Although not noticeable, the near side is much deformed.

[*Photos by G. H. Cunningham.*

Powdery mildew attacks leaves, shoots, blossom-buds, and fruits. On the leaves it first becomes noticeable in the form of small, irregular, white or greyish cobwebby patches. These make their appearance first on the under-surface of the leaf, and gradually spread until both surfaces may become entirely covered, when the leaf appears as if covered with flour. Leaf-infection first occurs as soon as the leaves emerge from the bud, and the fungus spreads progressively from these to subsequently formed leaves. Infected leaves become narrower and rather longer than the normal. At first they appear somewhat blistered, then the edges gradually curl inwards until they appear markedly distorted (Fig. 1). Later they become brittle and have a scorched appearance. Finally they change to a bronze colour and ultimately fall away.

FIG. 3. APPLE-SHOOT INFECTED THE PREVIOUS SEASON. SLIGHTLY REDUCED.

Note the bunchiness of the laterals, their small size, and the closeness and small size of the buds. Normal buds indicated by arrows.

[*Photo by G. H. Cunningham.*

Laterals are infected shortly after the leaves have emerged from the buds and immediately after they have begun to increase in length. Infection occurs from the leaves, the hyphæ growing down the leaf-stalk (petioles) to the young shoots. As a result of infection growth is somewhat checked, consequently the buds are more closely set together (Fig. 3). When infection is severe the tips of the shoots are killed, and the following season several small shoots spring from below the killed area, the resultant shoots presenting a "bushy" appearance (Fig. 3). The fungus continues to develop on the shoots until they become covered with a white felt-like mass, more abundant near the tip, which consists of the mycelium or vegetative portion of the fungus (Fig. 2).

Infected blossom-buds are somewhat smaller than the normal, and are conspicuous by reason of their covering of white mycelium. When the buds expand and the blossoms appear, the calices and stalks are seen to be somewhat deformed and altered in colour. Infected blossoms rarely set fruit, and are invariably later in appearing than the normal blossoms.

The fruits are infected shortly after blossoming, and at this stage may be seen to be partially covered by the fungus. At this stage the delicate epidermis becomes damaged, so that later, when the fruits approach maturity, the epidermis is seen to be decidedly russeted, the markings appearing either as a delicate brown or yellowish tracery over the surface (Fig. 4), or as scabbed and deformed areas on one side, but more frequently on the stalk end of the fruit. This may be followed later by the appearance of concentric cracks which usually extend some distance into the flesh and afford opportunity for the entry of spores of soft-rot fungi; consequently fruit from trees infected with mildew rarely keeps well for any time. The writer has not observed the hyphæ of the fungus on other than very small fruits. The fruits of all varieties do not appear to be attacked, as russeting has not been observed on fruits of Cleopatra, although the leaves and shoots of this variety suffer severely.

LIFE-HISTORY OF THE CAUSATIVE ORGANISM.

Powdery mildew is caused by *Podosphaera leucotricha*, a fungus having two spore stages in its life-cycle. The first or conidial stage is produced throughout the growing season on the felt-like masses of mycelium which cover the surfaces of infected leaves and shoots; the second or perithecial stage in New Zealand appears about the middle of March (although it would appear to be common in midsummer in North America) in the form of small black bodies (perithecia) partially embedded in the mycelial masses. The conidial stage is the more important one, as apparently the perithecia play little if any part in the perpetuation of the organism.

If a small portion of the felt-like mass of mycelium is examined under a microscope it is seen to consist of very numerous, colourless, closely woven threads (hyphæ) closely applied to the surface of the host (Fig. 5, *m*). From these at intervals arise upright stalks (conidiophores) (Fig. 5, *con*) bearing on their free ends chains of colourless oblong conidia (Fig. 5, *c*). These are produced in such enormous numbers as to give the leaves and shoots upon which they may happen to be growing the appearance of being covered with flour. Should one of these conidia be carried by wind or other agency to the surface of a growing leaf or shoot, and conditions prove favourable, it germinates and produces a slender germ-tube (hypha), which grows over the surface of the substratum, branching repeatedly to form a mycelium. This consists of very numerous interwoven hyphæ, and derives its nourishment from the epidermal cells, into which small branches (haustoria) penetrate (Fig. 5, *h*) to absorb therefrom the necessary food substances. It is thus seen that with the exception of these small haustoria all the fungus is superficial. The hyphæ continue to spread over leaves and shoots during the whole of the growing season.

About the middle of March the perithecia make their appearance on the shoots, leaves, and petioles, appearing as small, globose, black objects densely crowded together, and partially embedded in the mycelium (Fig. 7). Each perithecium has on its free surface several bristle-like structures, which serve to characterize the species* (Fig. 7). Within the perithecium is a single large ascus containing eight one-celled, colourless ascospores (Fig. 7, III). Under humid conditions the perithecia absorb moisture and swell, and their walls become ruptured, allowing the ascospores to escape. Experiments carried out in North America (1914-18) would tend to show that the perithecia play little or no part in the perpetuation of the disease, as attempts made to infect young developing leaves with ascospores invariably failed.

The fungus is carried over from year to year by the felt-like masses of mycelium, which cover the buds, spurs, and tips of laterals, and by hyphæ which are enclosed within the scales of infected buds. This mycelium remains more or less dormant until the spring, when conidia are produced from the hyphæ, and these infect the leaves as they emerge from the buds, thus starting the disease afresh. Doubtless in many instances infection occurs from the hyphæ within the bud-scales, before the leaves emerge. It thus becomes apparent that the persistent mycelium is the source from which the fungus is spread in the spring; therefore in combating the disease the elimination of this mycelium should be attempted before any spray is applied.

CONSIDERATIONS REGARDING CONTROL.

As has just been shown, powdery mildew is perpetuated by the persistent mycelium (Fig. 2); therefore where systematic attempts are being made at control attention should be given to the removal of this source of infection. If all infected shoots and buds were removed, then the disease would be entirely eliminated and spraying unnecessary. Unfortunately, this cannot be accomplished in a commercial orchard, partly because the time required would be too great and the labour involved too costly, but principally because the disease is in part carried over in infected buds, which in many instances are not apparent from a casual inspection. Furthermore, infection would still be liable to occur from wind-borne spores from neglected orchards in the vicinity. Nevertheless, cutting out would minimize infection, especially spring infection, to such an extent that control by spraying would be rendered comparatively simple.

The crop would not be in any way lessened by the removal of infected shoots and fruit-buds, for, as has been shown earlier, infected buds are incapable of setting fruit. Therefore systematic control of powdery mildew must commence with the cutting-out of visibly infected material. This may be readily accomplished during the winter pruning, especially in New Zealand, where the system of pruning is such that practically every shoot is dealt with. If the disease were much in evidence during the late summer a further cutting-out could be undertaken.

From time to time numerous sprays have been recommended for mildew-control. Bordeaux, lime-sulphur, "iron-sulphide solution," atomic sulphur, and several variants of these have all been tried. Undoubtedly atomic sulphur has given the most satisfactory results.

* Recently the writer has obtained abundant perithecia from shoots of Sturmer collected at Ettrick, Otago. From the accompanying drawings it will be seen that the species in question is *Podosphaera leucotricha* (E. and E.) Salm. It is believed that the perithecia have not previously been recorded for Australasia.

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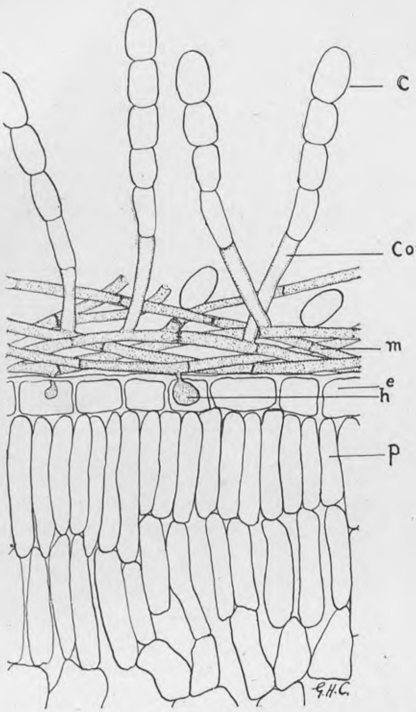

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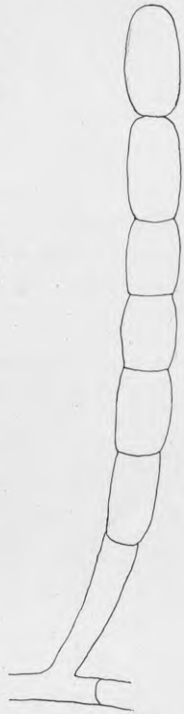
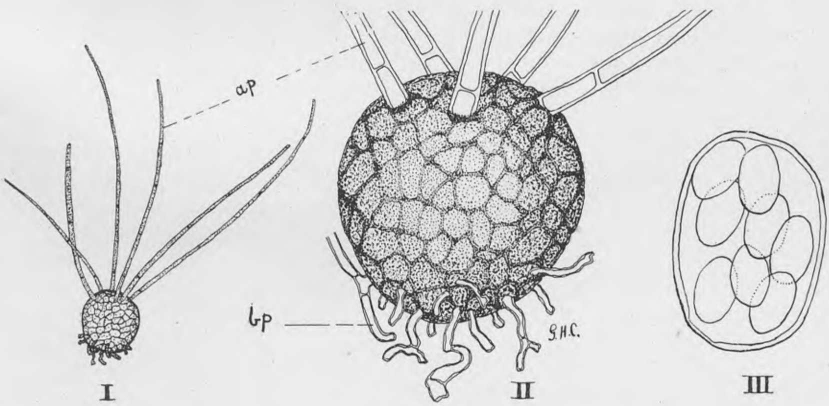


FIG. 5. SECTION THROUGH LEAF INFECTED WITH POWDERY MILDEW.

(*c*) Conidia; (*con*) conidiophores; (*e*) epidermis of the leaf; (*h*) haustorium; (*m*) hyphæ (collectively forming the mycelium); (*p*) palisade cells of the leaf, × 325.

FIG. 6. CONIDIOPHORE AND CHAIN OF CONIDIA, SHOWING METHOD OF SPORE PRODUCTION, × 600.

[*Original.*



I II III

FIG. 7.

I. Perithecium of the fungus, × 85. II. Perithecium, × 330. Note the apical (*ap*) and basal (*bp*) appendages. III. Ascus and ascospores, × 330.

[*Original.*

The iron sulphide solution has been favoured by numerous growers (this is a solution of lime-sulphur to which iron sulphate ($FeSO_4$) has been added), but consideration will show that this is merely a solution of atomic sulphur and iron sulphide (FeS), the latter compound possessing little if any value as a fungicide.

CONTROL.

(J. A. Campbell, Director of the Horticulture Division, Wellington.)

As powdery mildew is carried over the winter months by the patches of fungus which remain on the shoots and in the bud-scales, it is necessary that as many of these as are seen be removed during the winter pruning. This should be followed by spray applications according to the following schedule :—

No.	Time of Application.	Spray.
1	Between open-cluster and pink stage	*3–4–50 bordeaux, or preferably 1–30 lime-sulphur.
2†	Calyx (petal-fall, or when the majority of the petals have fallen)	1–100 to 1–120 lime-sulphur, or preferably 10–100 atomic sulphur.
3	Beginning of January	10–100 atomic sulphur, or 1–120 lime-sulphur.
4	Middle of February	10–100 atomic sulphur, or 1–100 lime-sulphur.

* Bordeaux is not as efficient a spray for mildew as any of the sulphur preparations, so that where black-spot is absent (as in Central Otago) it is better to use lime-sulphur, 1–30, at this stage.

† With this and subsequent sprays arsenate of lead, 3 lb. paste or 1½ lb. powder to 100 gallons, may be added for the control of codlin-moth and leaf-roller caterpillar.

Where a regular spray formula for black-spot control is being followed it will be found that mildew is held in check somewhat, but not entirely, as lime-sulphur is not altogether satisfactory as a controllant of mildew owing to the very weak strength (1–120) at which it is applied. A dual spray—lime-sulphur 1–120 + atomic sulphur, 10–100—is therefore recommended in place of lime-sulphur alone. The second black-spot spray would be lime-sulphur, 1–30, in preference to bordeaux, 3–4–50, as the latter is not as efficient a mildew controllant as the former.

The first two sprays in the schedule prevent leaf-infection from mycelium overwintering in the buds, No. 2 especially preventing russeting of fruits. The third and fourth sprays prevent infection from outside sources. It should be realized, however, that spraying is effective only where cutting-out has been practised in the winter. No. 3 spray should be followed by cutting-out, especially where the disease is prevalent.

SUMMARY.

(1.) Powdery mildew is a fungous disease attacking leaves, shoots, buds, and fruits. It occurs on apple, pear, and (in Japan) *Pirus toringo.*

(2.) The name of the fungus is *Podosphaeria leucotricha*, as has been definitely established by the recent finding of abundant perithecia.

(3.) The disease overwinters by means of resting mycelium on the shoots and in the bud-scales. It is spread in summer by means of conidia produced from mycelium covering leaves and shoots.

(4.) It may be controlled by the systematic cutting-out of infected shoots and buds during the winter pruning, and by spraying according to the foregoing schedule.

(5.) Atomic sulphur, 10 lb. to 100 gallons of water, is the most efficient fungicide to use as a controllant.

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HERD-TESTING.

WHY AGGREGATE ASSOCIATION RECORDS ARE HIGHER THAN FACTORY RETURNS.

W. G. BATT, Farm Dairy Instructor, Taumarunui.

HERD-TESTING association members often ask why association records, as a rule, show a greater aggregate amount of butterfat than the actual factory returns, and in this article an endeavour is made to outline some of the chief causes of the difference. In the first place it may be pointed out that the comparison in question is totally unfair, and rather tends to show a lack of understanding of the working of the system on the part of the farmer concerned. When one considers that the association records are the result of an average taken from two days' production in every thirty, and that conditions are all in favour of this being on the high side, it is no surprise that the figures recorded are often greater than the actual return. It must be understood, however, that this can make no difference to the value of such figures in culling, as they must be taken on a comparative basis, which, providing each cow receives the same treatment, is of value even if the records are considerably higher than the amount of butterfat actually produced. This has been amply demonstrated, and I have no hesitation in asserting that the association figures provide a safe and reliable basis for culling.

CAUSES OF DISCREPANCY.

Some of the causes of the discrepancy referred to are as follows :—

Milk fed to calves and used by household : In the early part of the season this is fairly considerable, and takes a material amount of fat away from the factory returns while being credited to the association records. There is in this way a difference set up between the two returns more or less throughout the season.

Loss of fat in separation: In some cases this loss is considerable, and in all cases there is some. I would suggest to all farmers the advisability of having separated milk tested at intervals during the year.

Loss of fat in transit of cream: In some cases this also is considerable, especially where the cream supplied is of a thin consistency and churns in transit to the factory.

Cream used for buttermaking on the farm: Where this is the practice a considerable difference is made between the two returns—to the credit of the association and debit of the factory return.

Carelessness in sampling: Care in this direction is very important if the work is to be well done, and the milk must be thoroughly stirred before sampling. Discrepancies also occur in connection with damage received by samples in transit to the factory. Occasionally farmers check or think they are checking this class of testing by placing the milk from one cow in two or more bottles, again showing how little farmers in general know of the damage samples may receive in transit, the necessity for careful sampling, and the consistency of milk and its relation to testing. The butterfat in milk is suspended in the serum in the shape of small globules, and this suspension is often broken by the shaking samples receive in transit, especially in hot weather, when milk expands. Once this happens the fat floats on the top of the serum as an oil, and usually it is difficult to make a correct test. Other variations in the test of two samples of the same milk may occur in the leakage of fat in transit, the absorption of fat in corks, the churning of samples on their way to the factory, and irregular and careless sampling on the farm.

Variations in general conditions: Factory returns embody all variations in weather conditions, feeding-conditions, and weights of milk and tests, while the association records as a rule are not so handicapped. This is usually the main cause of the difference between the two returns. The factory has to take all these variations as they come, while, generally speaking, the association records are affected by only a comparatively small proportion, owing to the latter samples being taken on only two days in the month, as compared with thirty in the case of the factory. It is well known that cows (especially those of a nervous temperament) will rise and fall in their tests from day to day to a very great extent. This also applies to the milk-flow—in some cases a change of milker or feed or weather conditions being sufficient to cause a large variation in production. This being the case, it is not surprising that in some periods the figures may be very much in favour of the association. This is the more likely seeing that most farmers appear to wait for good weather and feeding conditions before taking their two days' samples for the association.

Sampling not representative: A fully representative sample can only be obtained when the weights of milk are the same for each sampling, unless the size of the sample is varied according to the variation in the weight of milk. This, again, is usually in favour of the association. The milking-hours on most farms are so arranged that cows produce more milk at the morning than at the evening milking, and most cows show a greater percentage of butterfat at the evening milking than in the morning. This means that where the same amount of milk is sampled from each milking, and the weight of milk differs, the test received will usually be higher than it should be, owing to a proportionately greater amount being taken from the higher-testing evening milk.

Variations from normal in the milk: Allowance must, of course, be made for these variations, especially when the tests are rising. They are usually in favour of the association returns.

Retrospective records: Providing the cow has been in milk less than one hundred days of the end of the period in which she was first tested, the association record is made retrospective to calving-date. This means that a cow calving in the late winter and being tested for the first time in the spring, when there was a good flush of milk, would get more fat to her credit for that period than she had actually produced. This can be overcome by commencing the test of each cow as soon as possible after she calves, and it is important that this should be done.

THE SOUND BASIS FOR CULLING.

When judging the merits of individual cows for factory dairying, it is necessary to do so on their butterfat production for the season, not on the quantity of milk produced, and not on the test. The latter is only the percentage of fat in a given quantity of milk, and is likely to fluctuate considerably. Farmers very often make the mistake of judging cows on their tests, and as this is usually misleading good cows have sometimes been culled while poor ones were retained in the herd. A sound basis and an accurate conclusion on which to cull can only be obtained by taking the amount of butterfat produced by the cow for the season, in conjunction with her age and the number of days she has been in milk. When this is done, and the causes of discrepancy just enumerated are appreciated, farmers will realize that if they do their part of the work conscientiously the association will do its part towards providing a safe and reliable basis for culling.

THE FIELDS DIVISION.

The Fields Division of the Department has been reconstituted as from 1st May, with Mr. A. H. Cockayne as Director. The Division incorporates the following branches: The Biological Laboratory (including the seed-testing station); the Agricultural Instruction Service; experimental and demonstrational areas (not including at present the Ruakura, Weraroa, and Moumahaki Farms); the Hemp-grading Service; and the Grain-grading Service. Under the Director, Mr. R. Waters has been appointed Officer in Charge of the Biological Laboratory.

Importation of Game Birds.—An application by the Auckland Acclimatization Society for permission to import Virginian quail was further considered by the Board of Agriculture last month. The Board decided that it could not support the request in view of the many complaints which had reached it as to the damage now being done by quail in the Auckland District. A further application by the same society to import from England a small number of Mongolian pheasants and black-necked pheasants was recommended for favourable consideration, as was also the request of the Southland Acclimatization Society for permission to capture quail in the Lakes Acclimatization District for liberation in the Southland District.

THE BEST STAGE FOR CUTTING WHEAT.

EXPERIMENT UNDER THE STATISTICAL METHOD AT LINCOLN.*

F. W. HILGENDORF, D.Sc., and J. W. CALDER, B.Agr., Canterbury Agricultural College, Lincoln.

IF wheat is cut too early it shrivels, and if cut too late there is a risk that grain will be lost by shaking. The question that has to be answered many times each harvest, therefore, is, "How soon can the wheat be cut without losing weight by shrivelling?"

To answer this question by a definite experiment had long been in mind, but it seemed difficult to arrange. If one were to take the yields of adjacent plots cut early and late, the mere removal of its neighbour would give the late-cut plot an advantage; and if the plots were taken large enough to obviate this difficulty they might run into different soils, and so would need numerous repetitions to correct the variations due to this cause. So the question was left as requiring more time than was then available.

Some time before last harvest, however, it occurred to one of us that it may confidently be taken for granted that no new grains of wheat can be formed during the last fortnight before maturity, and consequently that the weight of, say, 100 grains of the early and late-cut crops would be an accurate reflex of their final yields. An experiment was therefore arranged on these lines. An even crop of Solid-straw Tuscan was taken, and a block 14 yards by 11 yards was marked out therein. Strings were run lengthwise and across the block at each yard, so that 154 plots, each 1 yard square, were marked out. Since it was designed to cut the wheat at five different stages, the plots were named A1, B1, C1, D1, E1; A2, B2, C2, &c., so that there were thirty or thirty-one plots bearing each naming letter, and each letter was distributed evenly over the block.

When it was judged that the crop was about a fortnight from maturity cutting commenced, twelve straws being cut from the middle of each of the square yards named A1, A2, A3, &c. The straws cut were always adjacent, they were cut without looking at their heads to see if large or small, and were all cut at ground-level. Just before cutting elaborate notes were taken as to the stage of ripeness that the crop had reached, and after cutting each bundle of twelve straws was tied and labelled and hung up indoors to harden and dry.

After three days new observations were taken, and twelve straws were similarly cut and tied from each of the thirty-one plots marked B; and so on at three-day intervals until plots E were cut, twelve days after the cutting of plots A. The first cutting was made while the

* This article is of note as recording what is probably the first application of the "method of statistics" and the "theory of probability" to an agricultural experiment in New Zealand. The system has been increasingly adopted of late in experimental work in Britain.—EDITOR.

general aspect of the crop was still decidedly green, and the last one when about half a bushel of grain per acre had been shaken on to the ground, so that the various cuttings embraced the whole period during which any one would be likely to harvest a crop on a farming scale. Complications possibly arising from differences in weather after cutting were reckoned with in a subsidiary experiment. The actual stage of maturity at which each cutting was made will be described later.

Before proceeding to state the weights of the 100 grains cut at the various stages, it is perhaps necessary to explain why so large a number as thirty plots were taken from which to cut representative straws at each stage. It was because of the generally unsatisfactory nature of averages as commonly determined in agricultural experiments. An average alone gives a scanty amount of information. "An average of 20" may mean that there were 100 observations between 19 and 21, with a mean of 20; or it may mean that there were two observations of 1 and 39. Again, in tossing 20 coins 20 times we may find that an average of 9 heads will turn up—a result that is obviously not strictly reliable. Therefore mathematicians have invented a device to indicate the reliability of any average. They add to the figure indicating the mean another figure indicating what is called the "probable error." Thus, if an average is stated to be 20 ± 1 the 1 is called the probable error, meaning that if another average were computed with equal care the chances would be even that the new average would be between 19 and 21, or outside these limits. Not the clearest of indications, one might think, but one that becomes quite easily understandable with use. It is clear that the smaller the probable error the more reliable the average.

Returning to the Lincoln experiment, the twelve heads of each of the thirty A plots and the twelve from each of the thirty B plots, &c., were hung up for a couple of months until they were all dry, and assumed to have the same water content—an assumption that was checked and found correct later on. They were all threshed on the one day, and from each of the 154 lots 100 grains were counted and weighed within two days. The averages with their probable errors were as follows:—

Average Weight (from thirty or thirty-one Plots) of 100 Grains of Solid-straw Tuscan Wheat cut at Three-day Intervals.

Stage A (the earliest)	4·047 ± 0·024 grammes.
„ B cut three days later ..	4·060 ± 0·026 „
„ C „ ..	4·299 ± 0·028 „
„ D „ ..	4·269 ± 0·032 „
„ E „ ..	4·299 ± 0·045 „

These figures are of considerable interest. The smallness of the probable errors (0·5 to 1·0 per cent. of the averages) is satisfactory proof that the weighings were accurate and their number sufficient, but no explanation occurs to us of their gradual increase with the advance in the date of cutting. There is a general similarity between the A and B cuttings, then a distinct break between B and C, and then a similarity between C, D, and E. The variations between the last three—*i.e.*, the falling-away at D to less than C or E—might occasion some concern at first, until the meaning of "probable error" is recalled. The weight of C is 4·299 ± 0·028 grammes—*i.e.*, it is equally likely to be between 4·271 grammes and 4·327 grammes or outside these limits. At the same time the weight of D is 4·269 ± 0·032 grammes—*i.e.*, it is equally likely to be between 4·238 grammes and 4·301 grammes or outside these limits. Thus the lower limit of C (4·271 grammes) is much lower than the upper limit of D (4·301)—that is, the two overlap—so that there is no real difference between C and D, but only a difference caused by the special set of samples here used to compute the means. Such a difference is said to be "non-significant"—*i.e.*, it does not signify any real difference.

Mathematicians have computed from their study of probability that any difference less than three times the probable error of that difference has only a 20-to-1 chance of being a real difference—that is, one not caused by mere fluctuations of sampling. Thus, on comparing averages, the probable errors of the differences are of great importance. They have been calculated for the present set of figures as follows :—

Difference between	A and B	= 0·023 ± 0·035	grammes.
,,	B and C	= 0·239 ± 0·038	,,
,,	C and D	= 0·030 ± 0·042	,,
,,	D and E	= 0·030 ± 0·055	,,

Thus, the differences between A and B, C and D, and D and E are less than the probable errors of these differences, and so are non-significant. Therefore we cannot say that there is any difference in weight between grain cut at stages A and B and between those cut at stages C, D, and E. On the other hand, the difference between B and C (0·239 grammes) is 6·3 times the probable error of the difference, 0·038. This is the outstanding fact of the investigation, and consultation of tables of probabilities shows that the chances are 25,000 to 1 that such a difference is significant—odds that most of us would be willing to accept as certainty. Thus we conclude that if we cut at stage C there are 25,000 chances to 1 that we will get a higher yield than cutting at stage B, but that if we wait longer no increased weight need be anticipated.

Two more points must be mentioned. Firstly, a further calculation will enable us to estimate the gain obtained by waiting from stage B to stage C as 2·5 bushels per cent., or exactly 1 bushel per acre on a 40-bushel crop—the probability of at least this gain occurring being 40 to 1, which may be taken as practical certainty. Secondly, we may now define the degree of maturity to which the crops had attained at the critical stage C, cutting before which results in a loss of weight, and cutting after which results in no gain. The stage will be more closely defined by describing those before and after it as follows :—

Stage B, second cutting : General aspect of crop—nearly ripe-coloured, in some patches nearly all green has disappeared. Straw—practically all straws now yellow, but a few still green just below the head and just above top knot. Heads—one-third still green and two-thirds white or turning white. Grain—that in white heads when squeezed between the fingers produced a dry dough. (This stage proved too early to cut profitably).

Stage C, third cutting, three days after B: General aspect of crop—ripe-coloured, but close scrutiny showed green tinge. Straw—all yellow except about 1 per cent., which showed 3 in. of green above the top knot; all knots green. Heads—ripe-coloured except about 1 per cent. still green. Grain—that in ripe heads would not squeeze out any kind of dough, but cut easily with thumb-nail. (This proved the earliest stage at which cutting meant no loss of weight.)

Stage D, fourth cutting, three days after C: General aspect—quite ready to cut, a slightly green head and stalk being found only after close search. Straw—nearly all ripe to the head, but about 5 per cent. still yellow below head. Knots—most knots still green, but about 25 per cent. half brown and a few quite brown. Heads—all ripe. Grain—will not squeeze but will still cut with thumb-nail. (No gain in weight resulted from leaving the crop till this stage.)

SUMMARY AND CONCLUSION.

A crop of wheat was cut at five different stages of ripeness at three-day intervals, and thirty plots were cut at each stage so as to reduce the experimental error of the average. The relative crops at various cuttings were computed by weighing 100 grains of each of the thirty plots cut at each stage. A calculation of probabilities showed 25,000 chances to 1 that an increased weight was securable by waiting till stage C, and that there was no further gain but only risk of loss by waiting longer. There is a 40-to-1 chance—*i.e.*, a practical certainty—that the gain from waiting till stage C is 1 bushel per acre on a 40-bushel crop.

Stage C is thus shortly defined: The green has been replaced by yellow in the top internode of 99 per cent. of the straws; all knots are still green; no dough can be squeezed out from the grain, but the grain is still soft enough to cut with the thumb-nail.

Raising Cherry-plum and Olearia Forsteri *for Hedge Purposes.*—Both these plants root quite freely from cuttings if properly inserted in suitable soil. It would be in nearly all cases useless to plant the cuttings in a hedge-row, as conditions suitable for rooting are rarely obtainable. For the cuttings select a plot of good friable soil where the drainage is good. Dig or deeply plough the soil, throwing aside any bulky weeds there may be, as these will not have time to rot down before the cuttings are put in. When planting the cuttings dig with a spade till there is room for a row; then stretch a line where the first row is to go. Make a trench in front of the line by inserting the spade, held quite upright, against the line and dragging the soil forward. The trench will require to be of a depth to suit the length of the cuttings, which may be placed with about two-thirds of their length in the ground. Place a row of cuttings in position, and then push some soil against them and tread it firm. Finish by digging to the row of cuttings, leaving the surface soil loose, until there is room for another row, then bring the line forward and continue as before. The plants will be ready for setting out in hedge-rows the following year.

Cherry-plum cuttings may be 12 in. to 15 in. long, and should be made from straight pieces of young wood, not thin spray. Make and plant them as soon as possible after the leaves fall, placing them about 3 in. apart. For cuttings of *Olearia Forsteri* take the ends of branches cut about 12 in. long, trim the soft tops off, cut the base square across just under a joint, and trim off side growths so as to leave a head with two or more branches. Insert so that the heads just touch each other in the row. These cuttings may be put in at any time up to the middle of August. To facilitate rooting and after-growth, the space between the rows of cuttings should be kept free of weeds and the surface frequently loosened. —*Horticulture Division.*

REGRASSING EXPERIMENTS ON CANTERBURY BACK-COUNTRY.

F. E. WARD, Instructor in Agriculture, Christchurch.

SEVERAL factors have no doubt played a part in bringing about the condition of denudation which extends over thousands of acres of good sheep-country in the Mackenzie district. Among the chief causes of depletion are severe climatic conditions—hot north-west winds in summer with heavy and continuous frosts in winter; over-stocking with sheep and rabbits; and conditions of tenure which have not encouraged the occupiers to improve their holdings.

In the spring of 1921 the Agricultural Instruction Branch of the Department, in co-operation with Canterbury College, undertook experimental sowings to ascertain whether or not these areas could be regrassed by surface-sowing, or with the aid of such agricultural operations as could be applied in a practical manner over large areas. The Department already had two wire-netted areas on which experimental sowings of grass had been made a number of years previously. Numerous species had been tried, and the plots gave a useful guide as to what grasses were likely to establish if sowings were made on selected areas not protected by wire netting.

In planning the sowings now dealt with, three aspects were taken into consideration: (1) Flat ground exposed to wind, (2) sunny faces, and (3) dark faces. The sowings were made in the spring of 1921, autumn of 1922, and spring of 1922. The grasses used in the spring of 1921 were cocksfoot, heath mixture (Yorkshire fog, white clover, and rye-grass), yarrow, tall fescue, white clover, sheep's burnet, Grimm lucerne, tall oat-grass, Poa pratensis, and fiorin. The sowings made on the flat ground exposed to wind germinated and dried off, and resulted in no take of grass. Those made on sunny faces were also very poor and practically useless, except where soil conditions were favourable enough to support a weak strike.

The results on the dark faces were most encouraging. The first sowings (6th September, 1921) were inspected in March, 1922, when a satisfactory strike was noticed, but all plants were small and tender, and it was problematical whether or not they would be lifted out by frost during the advancing winter. When again inspected on 7th September, 1922, it was found that practically all the plants had wintered well, and quite a green tinge was noticeable on what had hitherto been a dark-brown face. The portion here referred to was Gallows Hill, on Haldon Station, the altitude of the latter being about 1,200 ft. The top of the hill, some 300 ft. above the surrounding flat country, is rocky, but it was among the rocks that the grass appeared to be doing particularly well. The hill was stocked with sheep from time to time, but not heavily in the early stages.

A further inspection was made on 23rd February, 1923, when it was found that the hill had been heavily stocked with both sheep and rabbits. The grass showed evidence of having been closely eaten, but not to any extent pulled out. Yorkshire fog had established strongly, and though despised in low-country pastures it is quite accepted in the country under notice. Cocksfoot, which had wintered well, was now showing signs of depreciation under the dry summer weather, and many plants secured at this time by a weak roothold were in grave danger of being pulled out by sheep. With due consideration to the amount of seed sown, the grasses present in order of abundance were: Very numerous—Yorkshire fog, cocksfoot, yarrow, rye-grass; Rarer—white clover, sheep's burnet, goose-grass, and Poa pratensis; rare—lucerne, tall oat-grass; practically none—fiorin and tall fescue. A few plants of fog, cocksfoot, rye-grass, and goose-grass in sheltered positions had seed-heads.

FIG. 1. SURFACE-SOWING ON GALLOWS HILL.

Showing good take of grass on rocky ground. Heavily stocked with sheep and rabbits. Sown 6/9/21; photo taken 23/2/23.

[*Photo by F. E. Ward.*

In a wire-netted area having a northerly aspect eight one-acre plots were sown, each plot having a different predominating constituent. There were two main objects in view with these sowings—firstly to ascertain if a quantitative sowing of the various constituents played any important part in regrassing such country, and secondly to note whether chain-harrowing had an advantage over surface-sowing without artificial means of covering the seed.

FIG. 2. VIEW ON FENCE-LINE DIVIDING THE HALDON NETTED AREA FROM EXPOSED GROUND, LOOKING WEST.

Note surface cover in netted area on right. Fence erected in 1910.

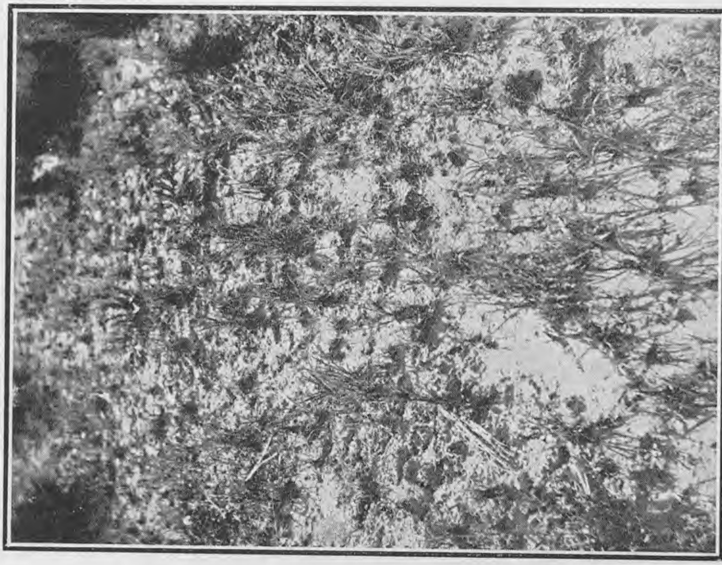


FIG. 3. VIEW OF PLOT IN NETTED AREA, HALDON.

Grasses, ungrazed, growing tall and straight. Sown 6/9/21, and seed covered with chain harrows. Photo taken 23/2/23.

[*Photos by F. E. Ward.*

At date of writing one cannot see any appreciable advantage in quantitative sowings. Owing to the very dry local conditions plants require a good deal of soil-space, and when the seed is thickly sown the death-rate is great and a thin strike results. It cannot yet be stated that any one plot excels the others, but the grasses most in evidence are the same species as those already mentioned as doing well on Gallows Hill. The same grasses were sown in the area as outside, with the addition of Chewings fescue and chicory. Owing to there being no stock in the netted area, the grasses when inspected in March, 1923 (sown 6th September, 1921), were tall and straight in habit of growth, but very little evidence was present of their seeding. Here cocksfoot, yarrow, tall fescue, and chicory were very noticeable, the

FIG. 4. GRASS-SEEDLINGS ON EXPOSED GROUND, MOUNT POSSESSION.
Sown 13/9/22; photo taken 31/1/23.

last-named having seeded fairly freely. The chain-harrowing to give cover to the seed seemed quite unnecessary—in fact, appeared to cover the seed too deeply in many places. The frost-cracked ground, with a shower of rain after spring sowing, gave the most satisfactory results.

Somewhat similar sowings were made on Mount Possession Station, Ashburton County, where the rainfall is somewhat heavier than at Haldon, but the land probably of poorer quality. Here flat and undulating country was selected (altitude approximately 2,000 ft.), and sowings made both in autumn and spring. The autumn sowings confirmed the Mackenzie country experience, and were quite useless. The spring-sown seed gave a fairly good strike, particularly on the southerly aspects or where protected from the north-west wind. As far as present observations go, bare ground proved a more acceptable seed-bed than that covered with vegetative growth, such as scab-weeds, *Triodia australis*, Strathmore weed, a yellow composite, New

Zealand bluebell, native willow-weed, &c. On the flat ground the tussocks (*Poa caespitosa* and *Festuca novae-zelandiae*) afforded shelter, and the seedlings were better and stronger than those in the open.

The general conclusions drawn so far are,—

(1.) Spring is the best time to sow.

(2.) Frost-cracked bare ground with a southerly aspect affords the best chance of a strike.

(3.) The regrassing of these positions should be attempted before the sunny faces or those positions exposed to the north-west winds.

(4.) The grass species mentioned are suitable for the purpose. The introduction of grasses from other countries having similar climatic conditions should have useful results.

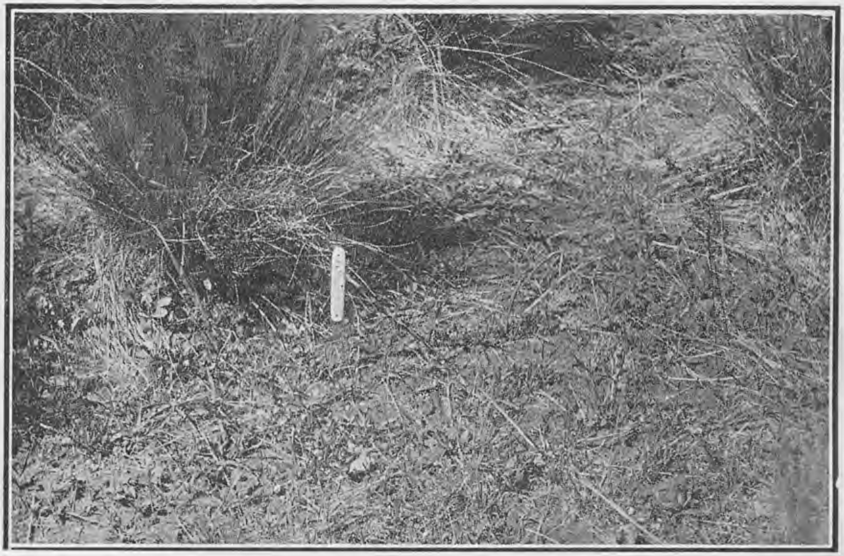


FIG. 5. SHOWING GRASS-SEEDLINGS GROWING IN SHELTER OF TUSSOCKS ON SORRELLY GROUND, MOUNT POSSESSION.

Sown 13/9/22; photo taken 31/1/23.

[*Photos by F. E. Ward.*

Four grasses have been introduced from South Africa and four from Queensland, and these will be sown next spring. The South African species are *Ischaemum glauchtachigum, Pennisetum cinroides, Panicum maximum,* and *Panicum laevifolium.* The Queensland grasses are *Eriochloa annulata, Setaria glauca,* and two samples of *Panicum* tussock-grasses. Australian spiked blue-grass (*Agropyron pectinatum*) was evidently introduced into the Mackenzie country by the wool of rams imported from Australia, and it is spreading rather rapidly, even on the sunny faces.

Thanks are due to Messrs. James Inness (Haldon Station) and James Grant (Gray's Hill Station) for their valuable assistance, which facilitated the carrying-out of this work. The co-operation and assistance of Mr. M. Dalziel, supervisor of the Canterbury College reserves, is also cordially acknowledged.

IMPROVEMENT OF PHORMIUM TENAX FOR THE FIBRE INDUSTRY.

INVESTIGATIONS AT MIRANUI.

G. SMERLE, Miranui, Shannon.

THE writer was appointed by the New Zealand Flax-millers' Association in November, 1921, to carry out investigations into the so-called yellow-leaf disease of *Phormium tenax*, with the object of discovering its cause and finding means of combating it. The scope of the work also included improvement of the existing poor condition generally of phormium,* and the breeding of plants immune to the disease. The investigation was centred at the Miranui mill and phormium areas of the Seifert Company, near Shannon.

When commencing the work I realized that to achieve some immediate result it would be necessary to concentrate on ascertaining the factors which give rise to the disease, rather than to discover its actual causal agent. By working on this line, I became of opinion that there are at least three factors which prepare the way for the disease—namely, (1) the common method of cutting the phormium-plant, (2) the grazing of cattle in the phormium areas, and (3) the presence of weed-growth among the plants. As the investigation has progressed, however, so has the field for research broadened, and we now realize that combating the yellow-leaf disease is but one of the ameliorative measures to be undertaken.

Work of prime importance for the future of the industry is the selection and breeding of the very best varieties of phormium—varieties which will produce the greatest quantity of fibre of the highest quality. We now know that there are great differences in the varieties of phormium, the fibre yield of some of the best being twice as valuable as that from the average. This comparison is based on the varieties already tested; there may be some even more valuable. It is therefore most important to test every variety.

FACTORS INDUCING YELLOW-LEAF DISEASE.

Faulty Cutting of the Plant.—Examining the four factors which induce yellow-leaf disease, it is found that the present ordinary method of cutting the plant is the most important. That method consists in chopping down all the fans 5 in. to 10 in. above the ground. As the cutters are paid by the weight they cut, and the butts of the leaves are the heaviest part, they naturally try to cut as low as possible, the only restraint being that the butts must not show too much of what is colloquially termed "rhubarb." The butt ends of the leaves are of a rhubarb colour, and if there are long ends

* The term "phormium" instead of "flax" is used throughout this article, in conformity with recent practice in the *Journal*.

with that colour it discolours the fibre when stripping: discoloured fibre is graded lower than a good white fibre.

The present method of cutting was adopted owing to its cheapness. The effect upon the plant was never considered. Why the present method of cutting is so detrimental to the plant's growth is because cutting all the leaf low to the root causes a large injured surface—a severe wound shock—and deprives the plant of all its green leaves, without which it cannot assimilate carbonic-acid gas and convert it into starch-sugar When the growth of such a low-cut plant is observed one notices a creamy white centre leaf coming up in the stump of the fan. After a day or two the first day's growth becomes greenish and subsequently quite green, but for a considerable time after cutting one can count by the day's growth (which is green) and the night's growth (which is white) how long a time the phormium has been cut. The markings are quite distinct, and I have by this means counted as many as twenty-six days' growth in summer-time. The plant can produce the green colouring-matter called "chlorophyll" in light only, and hence the green and white markings in the new leaves. As the plant has to obtain from the root-system all the nourishment necessary for its growth until sufficient green leaves have grown to obtain adequate nourishment from the air, the root-system is weakened, and yellow-leaf being a root-disease this method of cutting encourages it greatly.

Cutting away all the leaf not only makes the root-system subject to disease, but also encourages all possible leaf-diseases on the new pale-green leaves. These have no bloom (the waxy matter on the epidermis) to protect them, as old leaves have. Altogether the present method of cutting is very detrimental to the growth of the plant, and the sooner it is abolished the better it will be for the fibre industry.

Grazing of Cattle.—The grazing of cattle among phormium is also detrimental to the plant's growth, because the cattle chew the leaves and pull out the centre leaf, which delays the growth of new leaves from three to four months. The constant jerking of the leaf while the animal is chewing tends to injure the tips of the embryo fans in the sheath, and in consequence they become affected by diseases and never come up. The function of the gum in the plant is to lubricate the sheath, but that does not protect all the embryo fans from being wounded by the constant jerking. It is known to all experienced workers that phormium does not thicken up where cattle are grazed, although they usually are not aware of the cause of this.

Weed-growth.—A growth of weeds among phormium crowds the plant and absorbs the light and air which it would utilize for its better development. I have compared the fibre-content of plants grown close to a fly-line* in the open with that of plants of the same variety grown in the shade of willow-trees. The plants which grew in the open produced over 16 per cent. of finished fibre, while those which grew in the shade produced only 12 per cent. Moreover, weeds interfere with the cutting of the leaf, and so increase the cost of that operation, and they also occupy land where phormium could grow.

* Fly-lines are 6-ft.-wide cleared tracks through the phormium, upon which tram-lines are laid to carry out the cut leaf.

SELECTION AND BREEDING-WORK.

Besides studying the factors which are detrimental to the growth of the phormium-plant I also selected in the Miranui and Whitaunui Swamps over eight hundred apparently healthy plants for the purpose of observing their growth and disease-resistance, also to obtain seed from the healthiest-looking individuals in the most diseased areas. For this work a nursery area of about 4 acres was measured and fenced off. About an acre of this is on a fairly high terrace; the remainder of the area comprises the terrace slope and a low-lying swampy area. The nursery is situated close to the main road between Palmerston North and Wellington, about two miles north of Shannon. The portion on the top of the terrace is subdivided into twenty plots. Some of the plots were manured with different fertilizers or a mixture of fertilizers, and some were left without any manure, as checks.

The phormium-seed was sown at intervals of a month, in order to ascertain the best time for sowing. As the land was not ready

FIG. 1. THE NURSERY AREA AT MIRANUI.

[*Photo by H. A. Seifert.*

in March a small plot was sown below the Miranui mill. In the nursery, plots 1 to 4 inclusive were sown on 9th June; plots 5 to 8 on 10th and 21st July; plots 9 to 12 in September; plots 13 and 16 early in October; and plots 17 to 20 on 19th October.

I selected seventeen varieties of phormium in the Miranui and Whitaunui Swamps. As these varieties are not yet thoroughly studied and compared, they have been given tentatively numbers for distinguishing purposes. I also obtained from Mr. Pickett, Whitaunui, a variety of mountain-phormium; from Mr. P. Rikihana, Otaki, two varieties—*aho* and *whenu;* from Mrs. John Field, Paraparaumu, one variety—*tihore;* and from Mrs. W. Simcox, Otaki, seed from a "bronze" variety, and plants from three different varieties, which are not yet compared and identified. As the plants were not seen, examined, and compared when in flower, the identification and description are not complete, and there may be two or three similar varieties.

Most of the varieties were tested for their fibre quantity and quality. A series of six to eight tests for each variety were made, from 12 lb. to 25 lb. being used in each test. Following are the results :—

Variety.	Yield of Unscutched Fibre.	Yield of Finished Fibre.	Grade.	Disease-resistance.
	Per Cent.	Per Cent.	Points.	
1	16·0	12·2	70	Good.
2	16·1	12·2	73	Good.
3	14·8	11·2	69	Good.
4	13·8	10·7	72	Poor.
5	15·2	13·0	69	Medium.
6	17·1	13·6	70	Medium.
7	16·4	13·0	72	Medium.
8	19·0	14·2	69	Good.
9	14·9	12·1	70	Medium.
10	5·2	2·5	Reject	Good.
12	19·8	16·8	68	Good.
13	18·5	14·5	72	Good.
14	17·6	12·5	70	Good.
15	19·8	16·3	70	Good.
16	18·9	15·3	69	Medium.
17	18·0	13·3	69	Good.
Aho	16·2	11·2	70	Medium.
Whenu	20·5	16·8	72	Good.
Tihore	19·4	15·4	78	..
Bronze	22·0	18·8	69	..
Chocolate margin ..	17·8	15·3	71	Medium.
Waikanae	22·4	17·9	68	..

NOTE.—Disease-resistance is not recorded in the case of "*tihore*," "bronze," and "Waikanae," these plants not having been under observation while growing.

A number of plants selected for disease-resistance by Messrs. R. Waters and E. H. Atkinson, of the Biological Laboratory, Wellington, were also received, but are not yet large enough for the various tests. They will be reported on later.

A considerable proportion of the seed sown in the nursery was selected with a view to ascertaining (1) to what extent cross-pollination takes place between the different varieties ; (2) whether seedling plants are more vigorous growers than plants grown by vegetative reproduction ; (3) whether the seedling plants keep as healthy or healthier than the parent plants. The parent plants are all marked and kept under observation. A few of them are planted in the nursery on the slope of the terrace.

There are also planted two rows of badly diseased plants. The plants in one row were sterilized for half an hour in a corrosive sublimate solution of 1 in 800. In two rows the seed was gathered from diseased plants to ascertain if there is any difference between seed from healthy and from sick parents. An aggregate of about half an acre was sown with seed. The chief reason for sowing so much was that it is easier to find plants with the desired characters in a multitude than among a few.

IMPROVED METHODS OF CUTTING.

Being convinced that the common method of cutting is very bad for the phormium-plant's growth I sought to discover a better practice. To be able to demonstrate to the millers the best way of cutting for the plant's future growth I selected in the mill block at Miranui four plants of the same variety, size, and amount of fans, and cut them on 28th March, 1922. The first one was cut in the manner favoured by the working cutters; the second in the way the swamp-manager likes to cut (at Miranui the phormium has not been cut so low as at most other mills); the third 4 in. higher than the second and 8 in. higher than the first plant; and in the fourth the side or mature leaves only were cut.

At present, after a year's growth, the difference is so striking that one can see it from a distance. In the first-cut plant three fans have died, and in the remaining fans the leaves are small, spindly, affected by disease, and of a sickly yellowish-green appearance. The second plant has not lost any fans, but the leaves are very small and much affected by different leaf-diseases. The third is much bigger than the two first plants, and is very vigorous and healthy looking. The fourth plant, with the side leaves cut, is the best, although the side leaves were cut again in August, 1922.

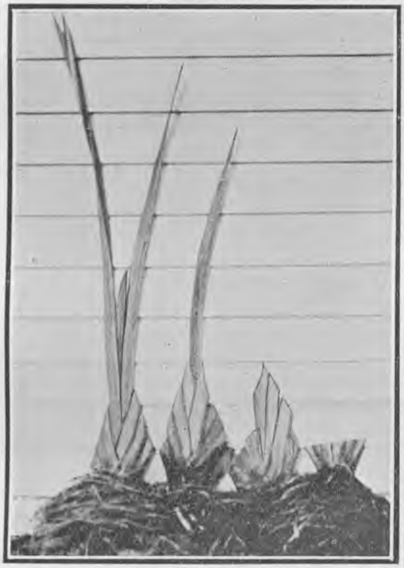


FIG. 2. SHOWING METHODS OF CUTTING PHORMIUM-PLANT.

From left to right—(1) Side leaves cut, with two middle leaves and centre shoot left intact; (2) fan cut diamond-shape, with centre leaf left; (3) cut diamond-shape; (4) common method —whole fan cut level.

[*Photo by H. A. Seifert.*

It may be mentioned here that when I showed Mr. Alfred Seifert these plants, after they had grown for about three months and the difference in the growth could be plainly noticed, he informed me that he had tried (but not followed up) the side-leaf or mature-leaf method of cutting on a quarter of an acre at Piaka, in the Moutoa Swamp, some twenty years ago. Later he showed me a fifty-year-old volume of parliamentary papers in which was given in full the report of the first Commission on the phormium-fibre industry, in 1871. In the report it is recorded that a Mr. Nelson, of Napier, advised cutting the mature or side leaves, but no reason is given for such method.

In order to obtain more evidence against the existing bad method of cutting I counted the dead leaves in four-year-old and five-year-old blocks of phormium, and found by a series of twenty-seven counts that where 100 tons of leaf is cut there is about 120 tons lost in dead leaves. It is easy to understand this if one is aware that the fan produces nearly every month a new leaf (there is an exception of one

FIG. 3. SHOWING (ON LEFT) AREA CUT BY SIDE-LEAF METHOD AND (ON RIGHT) AREA CUT BY COMMON METHOD.

Cutting was carried out on same date (12/10/22) in each case.

FIG. 4. AREA CUT DIAMOND-SHAPE, WITH CENTRE LEAF LEFT INTACT.

Cut 17/1/22; photo taken 25/5/23.

[*Photo by G. W. Haycock.*

to three months in the year, depending on the variety). The life of a leaf is about one year and nine months at the most.

In order to demonstrate on a more practical scale the importance of the method of cutting I measured off in the swamp, where the cutters were cutting for the mill, plots of $\frac{1}{20}$ acre each for diamond-shape cutting and for side-leaf cutting respectively. These plots were cut on the same day as the cutters cut adjoining phormium. The leaves in the plants cut diamond-shape were cut just where they start to separate from the sheath. In the side-leaf cutting the leaves were cut at the same place as in the diamond-shape cutting, except that the two middle leaves and the centre shoot between them were left intact. At date of writing (May) there are on the side-leaf-cut plant four to five full-grown leaves, which have grown since the cut was made in October, 1922. I also, in November, 1922, cut an area diamond-shape with the centre leaf or shoot leaf intact, at the time when the cutters cut the adjoining phormium.

Mr. Alfred Seifert is the first miller in New Zealand to definitely adopt the side-leaf method of cutting. He started to cut in this way (for the Miranui mill) on 4th January this year, has kept two strippers running continuously, and will continue cutting all the year round. Mr. Seifert's opinion is that, taking into account the increased yield obtained by side-leaf cutting, it is commercially advantageous to adopt this method. By side-leaf cutting it is possible to harvest three times more phormium in four years from a given area than by the old whole-sale-chopping method. There are also other advantages of side-leaf cutting which may be dealt with later.

FUTURE WORK AND POTENTIAL RESULTS.

There have been tested at the Miranui mill twenty-two varieties of phormium, among which the fibre-content varied from 2·5 per cent. in No. 10 to 16·8 per cent. in No. 12 in those from Miranui and Whitaunui Swamps, and up to 18·8 per cent. recorded for the "bronze" variety (see preceding table).

Dr. B. D. Cross has identified forty-two varieties of phormium, and the Maoris about sixty, so there are from twenty to forty varieties to be tested yet. There may be varieties which greatly exceed even the above-mentioned 18·8 per cent. Numbers 1, 2, 12, 13, 14, and 15 seem to resist the yellow-leaf disease, but there may exist absolutely disease-resistant varieties. The next most important step in the investigation is therefore to obtain as far as possible plants of all the existing varieties in New Zealand, also in Norfolk Island.

In order to make the breeding and selection branch of the investigation self-supporting it will be necessary to plant from 10 to 20 acres of phormium—one-half of that area to seedling plants and the other to selected plants from the swamp. The land has to be well prepared before planting, and after planting cultivated as long as the growth of the plant permits. This work will have to be done on proper farming lines on a strictly commercial basis to ascertain the profitableness of phormium when grown as other farm crops. Once it is practically demonstrated that good profit can be derived from phormium-growing people will start to cultivate it, and there will be a demand for good plants. The growing and selling of plants should thus defray the cost of this part of the work.

Luther Burbank says that no one can estimate the great possibilities of a wild plant before it is taken into cultivation. Our *Phormium tenax* is claimed to yield more fibre from a given area than any other known fibre-plant. So far these investigations show that there are great possibilities if the plant is cultivated like other farm crops. The estimates are based on its wild state in the swamp and give striking indications. Assuming that a certain area yields 100 tons of fibre every four years under the present ordinary cutting method and the present average state of phormium swamps, I estimate that similar areas under improved conditions are capable of yielding as follows :—

Condition of Area.	Yield by Present Method of Cutting.	Yield by Side-leaf Cutting.
	Tons.	Tons.
Average phormium area	100	300
Area freed of weeds	120	360
Area planted wholly in best varieties and kept clean of weeds	180	540

The highest average yield of phormium-leaf from 1,000 acres in the Makerua Swamp was 28 tons per acre in four years, or 7,000 tons per annum. It takes slightly over 8 tons of leaf to produce 1 ton of fibre, consequently the fibre-production of 1,000 acres under the old methods would be 870 tons yearly. By cleaning the weed-growth out of the swamp the fibre percentage of the phormium would be increased to the extent that the yield of this same area would be 1,064 tons of fibre. By planting the same area in the best selected varieties only the yield would be 1,219 tons. But by employing the side-leaf cutting method the yield in each case would be trebled. Then 1,000 acres in the present state would give 2,610 tons of fibre ; if cleaned of weed-growth 3,192 tons ; and if the best varieties only were planted on that area the production would reach the remarkable total of 3,657 tons of fibre per year. By selecting and growing the present best varieties on a 1,000-acre area, and keeping the plants clean of weeds, when the phormium was fully developed it would yield, by cutting side leaves every year, in ten years, according to the foregoing estimate, $3,657 \times 10 = 36,570$ tons of fibre. A similar area of the present average phormium cut by the old method would not yield as much in forty years. While, of course, there is an element of theory in these calculations, there is strong evidence that such yields may be readily attained in practice.

CONCLUSION.

In concluding this account I have to express my thanks to all those who have so kindly given plants and seed for experimental purposes ; also to Messrs. M. Campbell, Carkeek, Greedy, and H. A. Seifert, of the Miranui mill, and especially to Mr. Alfred Seifert, for their kind help and co-operation in the work of investigation. If the phormium-fibre industry is put on a really profitable basis it will be greatly due to Mr. A. Seifert's efforts to ascertain the commercial possibilities of the side-leaf-cutting method, this being a matter of prime importance.

TESTING OF PUREBRED DAIRY COWS.

HILDA MINTO DE KOL'S 1,000 LB. CERTIFICATE-OF-RECORD.

THE Friesian cow Hilda Minto de Kol, owned by Mr. C. H. Steadman, of Kamo, Whangarei, qualified for certificate by calving on 2nd June, subsequent to her year on C.O.R. test. Commencing her lactation period and test on 23rd March, 1922, she milked the full year—giving, in fact, for the 365th day no less than 46·5 lb. of milk. Her total production was 27,773·8 lb. of milk, containing 1,046·31 lb. of butterfat, which represents an average test of 3·76 per cent. Her highest production of butterfat for a full calendar month was 110·03 lb., and her lowest 63·06 lb. This is a remarkable achievement, and its significance is considerably enhanced when it is recognized that Hilda Minto de Kol commenced her test at the age of 12 years 56 days.

HILDA MINTO DE KOL.

Hilda Minto de Kol has been granted certificates-of-record on two previous performances. She was first placed on test in 1918, at the age of 8 years 179 days, when she yielded 12,644·8 lb. milk and 402·78 lb. butterfat. Two seasons later she gave 738·07 lb. butterfat from 22,922 lb. milk. She has now increased this creditable performance by no less than 308·24 lb. of butterfat, bringing her record to the 1,046·31 lb. stated above. Thus in three alternate seasons under test she has returned her owner an aggregate of 2,187·16 lb. butterfat, or an average of 729·05 lb. in 346 days.

Hilda Minto de Kol was imported from Canada in 1913, and her ancestors figure in the pedigrees of several high-producing Canadian Friesians. The accompanying photograph shows her to be a good stamp of Friesian of the more robust type, her roomy body, well-sprung rib, and general appearance indicating her as an animal which with good handling might be expected to give a good account of herself. Mr. Steadman is to be congratulated on his ownership and management of an outstanding cow.

—*W. M. Singleton, Director of the Dairy Division.*

MANURES AND MANURING FOR GARDEN CROPS.

W. H. TAYLOR, Horticulturist, Wellington.

THE purpose in this article is to refer in a brief manner to the fertilizers and manures most commonly used, and to give some indication of the requirements of ordinary garden crops. It is understood that a number of elements are required by plants in addition to those usually applied in manuring. These are found in most soils in sufficient quantities, or are supplied from the atmosphere. Deep tillage and draining, where necessary, by warming the soil and admitting air assist nature in making available the natural constituents of soil and of the atmosphere. Most cultivated soils throughout the world are deficient in phosphoric acid, potash, nitrogen, and in some cases lime. All plants take out varying amounts of these elements, and manuring is designed to maintain the supply. New Zealand soils are generally very deficient in phosphoric acid ; it is for this reason that phosphatic fertilizers are of such great importance in this country, and that they must be liberally employed.

The practice of crop rotation is based on the fact that crops that are unlike each other take up different amounts of the various elements. By rotating the crops a fuller use is made of the fertilizers, one crop taking what another has left. There also appears to be some other influence at work, as it is generally admitted that crops do not give the best results if grown repeatedly in the same soil, even though the proper fertilizers be applied for each crop. A notable exception is onions ; these succeed for an indefinite number of years in the same soil. Probably this is because onions require a fairly well-balanced fertilizer, and take most of it out of the soil. An extra amount of nitrogen should be applied to crops that are required to make strong vegetative growth and are not grown for their fruit, such as the cabbage tribe, onions, leeks, spinach, and celery.

Theoretically at least large amounts of nitrogen would be wrong for tomatoes, which are naturally inclined to be gross in growth, and which are grown for the fruit. It is well known that plants making soft growth are those most liable to attack by fungus diseases, tomatoes and potatoes being noteworthy examples. Yet blood manure, which is almost solely nitrogenous, is the fertilizer most commonly used by tomato-growers. In some cases blood-and-bone is used; this should be much safer, as bone is a phosphate, though it does contain a modicum of nitrogen, and the blood-content is considered to be in a milder form than in pure blood.

The position as it appears to the writer is as follows: Blood manure is used because it is thought to be a quick-acting fertilizer that will push young plants into rapid growth and bring the crops along early. This is a mistake: blood has to undergo a change in the soil before it is available, and it is comparatively slow in action. The opinion is expressed that if it were quickly available it would induce a soft growth that might result in harm, because during the early part of the season there is usually a fair amount of rain. Every one knows that blight is most prevalent after a spell of wet weather; the weather is blamed, but the part the fertilizer may have had in the trouble is not considered. The fact seems to be that during the early part of the season the blood is not available, not having undergone the necessary change. After that time there is seldom a great amount of rain, and as a fertilizer can be taken up only in solution and in a dissolved state the plants get only a moderate amount of it. If, however, a period of wet weather occurs the plants will get all they can absorb of the blood, which will then be in an available condition. The case may be summed up in this way: If the fertilizer were available a little at a time and all the time it might do no harm. When a dry season is experienced it does no harm, because most of the blood remains in the soil. If the season is a wet one, or if a spell of wet weather occurs, the blood is taken up and damage is caused. Similar results follow the use of fresh stable manure, but the effect is felt early in the season, as its elements are more readily available. It appears logical that the bulk of the fertilizer for tomatoes should be of a phosphatic description, particularly as phosphates tend to promote early maturity, and the lateness of the open-air crop is its chief drawback.

The practice of manuring for garden crops is different from that of the farm. In the latter case all that usually is wanted is sufficient fertilizer to give the young plants a start, as the period of cropping the land is comparatively short, and fertility is maintained by means other than the application of fertilizers. On the other hand, garden-soil is subject to continuous and intensive cropping, and the crops are mainly dependent on the fertilizers applied, consequently much larger quantities must be used, and they must be of a fairly complete character. Amounts much beyond the requirements of the current crop should not, however, be used. The effect of an overdose would in some cases be immediately harmful, while in others the effect, though in the direction sought, might be altogether too pronounced. For example, nitrate of soda has so powerful an influence on growth that quite small amounts produce the effect desired, while large amounts would set up such strong growth as to seriously delay maturity, prevent such plants as lettuces from hearting, and render a plant, by reason of its soft texture, particularly liable to disease. Authorities state that an oversupply of potash can stop growth altogether. The case of stable or farmyard manures is different. These are largely composed of organic matter, which rarely can do harm, while the fertilizing properties are of a different character from those in artificials.

PHOSPHATE.

Phosphoric acid promotes root-formation, causing young plants to root freely, and lays the foundation of a thrifty plant. It builds the framework of a plant, promotes fruiting, and hastens maturity while also increasing the nutritive value of the crops. It is supplied by the following phosphatic fertilizers :—

Superphosphate.—On most soils superphosphate is the most effective phosphatic fertilizer when equal amounts of phosphoric acid are compared, but for the full benefit to be received from this fertilizer the soil should contain an abundance of lime. Where sufficient lime is not present the free phosphoric acid combines with iron or alumina, forming more or less insoluble phosphates, and therefore much of the phosphoric acid is lost to the plants it is proposed to benefit. The soils in which applications of superphosphate do not have full beneficial effect are light sands and gravelly soils deficient in lime, peaty soils containing sour humus, and sour soils generally. The effectiveness of this form of phosphatic fertilizer seems to be due to the fact that owing to its solubility when put in the soil, even though it reverts quickly, it is deposited in a very fine state of division throughout the soil in the neighbourhood of the roots of plants. It has a wonderful effect in promoting rapid root-development, and thus is specially valuable to shallow-rooted plants and to short-lived crops that have to develop rapidly. In order to secure a more lasting effect for crops that have a long season of growth it is customary to use a phosphatic mixture of superphosphate and bonedust, two of the former to one of bonedust.

Basic Superphosphate.—This is ordinary superphosphate with which has been mixed caustic lime in the proportion of about 15 lb. to 85 lb. of superphosphate. Therefore 100 lb. of basic superphosphate has only the same amount of phosphoric acid as is contained in 85 lb. of ordinary superphosphate. It would consequently be cheaper to apply lime to the soil in autumn and use ordinary superphosphate in spring. Basic superphosphate is useful where liming has been neglected.

Basic Slag.—The phosphoric acid in basic slag is not nearly so soluble as that in superphosphate, and slag is on that account not so serviceable in dry soil. It is particularly useful for heavy clay soils where there is a good rainfall or where irrigation water is used. It contains a high percentage of free lime in addition to that combined with the phosphoric acid, and is therefore useful where lime is deficient. It requires from 1¼ to 1½ cwt. of basic slag to supply the same amount of phosphoric acid as 1 cwt. of superphosphate.

Bonedust.—This consists of the bones of animals, and as the calcium phosphate in the bones is in an insoluble form, the fertilizer must be finely ground if the plants are to get much of the phosphoric acid in the year it is applied. Failing this fine state of subdivision the phosphate is but slowly available. It is usually safe to assume that the phosphate is not all used up the season it is applied, especially if the season is dry. Finely-ground steamed bones are good for use on light soils poor in lime, such as sands and gravel. Mixed with superphosphate it forms a lasting fertilizer, the superphosphate coming into use first.

Nauru Rock Phosphate.—This is the cheapest form of phosphoric acid, but fineness of grinding is essential for its efficiency.

NITROGEN.

Nitrate of Soda.—This salt is readily soluble in water, and is in a state that renders it immediately available to plants. It is of great value as a spur to lagging growth, and as an aid to the growth of most crops, especially those that require to make a large amount of green growth, such as the cabbage tribe, lettuces, onions, leeks, spinach, and asparagus. The effect of nitrate of soda is so pronounced that only quite moderate applications are necessary or safe. The effect of a proper amount is to promote a healthy state of growth. An overdose causes a rank and flabby growth. So potent a fertilizer is capable of doing a great amount of good, but it must in most cases be used in moderation. Being so readily soluble it should be applied only to growing crops, otherwise it is liable to be washed out of the soil before it can be used by the plants. Half an ounce per square yard, equal to $1\frac{1}{2}$ cwt. per acre, is a fair dressing for onions. Two applications should be made, one when thinning is completed, the other about a month later. There is no reason why this amount should not be doubled; it may be necessary in cases where growth is very poor.

Sulphate of Ammonia is another important nitrogenous fertilizer, differing from nitrate of soda in that it is more slowly available. This property renders it able to fill a part for which nitrate of soda is not adapted; all crops require some nitrogen, but not all are benefited by the pronounced effects of nitrate of soda. Again, plants that have special nitrogen-requirements need it all the time, and this requirement is supplied by sulphate of ammonia. The correct way to use it is to apply it in late winter or spring when other fertilizers are applied. Some amount of it is soon available, but a whole season is required for it to be all taken from the soil. In this way it has a double use; it is of itself sufficient for those plants whose nitrogen-requirements are low; and it gives a constant supply to plants that have a special nitrogen-requirement, any extra demand being very appropriately supplied by special applications of nitrate of soda.

Dried Blood.—Blood is essentially a nitrogenous fertilizer; it contains some amounts of other elements, but these are so small as not to be worth considering. It is not at first available as plant-food, but most of it can be taken up during the season it is applied. There is an amount of salt in blood sufficient to cause harm if used in excess.

Blood-and-bone.—Blood is more frequently used when combined with bone than separately. This combination forms a lasting nitrogenous and phosphatic fertilizer, useful as a change manure for all crops that require a considerable amount of nitrogen.

POTASH.

Potash forms starch and sugars, thus stiffening the tissues and making plants better able to withstand disease. It directly affects the fruit of plants, making them firmer. Potash has proved to be very beneficial to tomatoes, saving them from the destructive disease known as black-stripe, and improving the quality of the fruit. Pulse crops, such as peas and beans, are benefited by potash, and the period of bearing extended; root crops, such as potatoes, sweet potatoes, and artichokes, are improved in texture. Potash bears the same relation to the fruiting properties of crops as nitrate of soda does to the vegetative growth of plants. Potash is fairly abundant in most New Zealand soils, especially those of a clayey nature, but it is not always in a readily available state, and it is good practice, at least in the case of short-lived crops, to add a small amount in an available form.

Sulphate of Potash.—This, the most generally useful form of potash, is a purified potash salt. It grades usually 90 or 95 per cent., which is nearly four times as rich in potash as kainit.

Kainit contains sulphate of potash mixed with a good deal of common salt (chloride of sodium), Epsom salts (sulphate of magnesia), and chloride of magnesia. It will be evident that to get the same equivalent of potash as from sulphate of potash about four times the weight would have to be used. Kainit is often used for asparagus, for which the salt-content is useful. For other crops it should be applied during winter several weeks before sowing or planting, so that the salt may be washed out by rain. Potash is not readily leached from the soil, so that sufficient for the season can be applied in spring.

Muriate of Potash is the potash equivalent of common salt. It is highly irritating and injurious in contact with plant-roots. The way to apply it is as a top-dressing soon after the plants have started, taking care to keep it from actual contact with the plants. It should be scratched lightly into the soil.

Wood-ashes contain varying but always useful amounts of potash, which, being in the form of a carbonate, is immediately available to plants. The ashes should be protected from rain until they are applied to the soil, as the potash is highly soluble and is quickly washed out. Once in the soil, however, it is held till plants take it up, or, at any rate, it is only very slowly leached out. About 7 lb. per square rod is a fair dressing.

LIME.

Besides being a plant-food lime helps most soils by improving their physical condition—the structure of the grains. Clayey soil is made more open, and sandy soil closer. Lime sweetens the sôil—corrects acidity—thereby aiding the little organisms called bacteria. It liberates potash already in the soil, and its relation to potash is such that authorities state that it is useless to apply potash to soil deficient in lime. The disease of crucifers (cabbage, &c.) known as club-root has never been known to occur in the first place where a sufficiency of lime was present, the disease being promoted by an acid state of soil.

Lime is obtainable in two forms—burnt lime and ground limestone, known as carbonate lime. Burnt lime is also known as roche-lime and quicklime. It comes from the kiln in lumps, which break down to a very fine powder when water is taken up. Quicklime on exposure to air gradually takes up moisture from the atmosphere and breaks up; it is then known as air-slaked lime. It is in this form that it is useful for killing slugs and other garden pests. The caustic properties of quicklime cause it to burn up humus in the soil, therefore it should not be used on land poor in humus. It is the best form for use on swamp lands and other soils where a good deal of humus is present, also for clay soils. Air-slaked lime is, all things considered, the best form of lime for garden purposes, where success will certainly not be met with unless a good supply of humus is maintained. Moderate dressings of, say, half a ton per acre annually will on ordinary soil be better than heavier dressings at longer intervals, except in places wheie there is a special need for lime, where amounts up to 2 tons per acre may at first be necessary, or more in the case of swamp land and soils quite without lime.

ORGANIC MANURES.

Stable Manure.—All authorities agree that stable manure is the most valuable material of all for garden-work. This is chiefly because of the form of the humus, though it is fairly complete in plant-food; its weakness is in phosphates. Excellent crops have been produced continuously from the same ground with no other fertilizing than that obtained from stable manure and lime. For crops that require an extra amount of nitrogen or potash it will pay to use nitrate of soda or a form of potash, whichever may be required, as a supplement. Stable manure should not be directly applied for root crops, such as carrots, parsnips, and beet. These do well on land well manured the previous year for another crop, and with no addition of fertilizers. Moderate quantities of stable manure may be used for potatoes, but heavy dressings should be avoided, being liable to cause a great growth of haulm at the expense of the roots.

Farmyard Manure is in some cases quite different from stable manure, as it may contain cow-manure as well as horse-droppings. Such material should be well rotted before it is used; if not, much of it may be a long time decomposing, and that is bad. From 20 to 30 tons per acre is a good dressing of these manures.

Cow-manure is less rich in plant-foods than is stable manure. It is valuable for light and sandy soils, but its use on heavy or medium heavy soil should be avoided. It makes such soils unworkable.

Pig-manure is in manurial value intermediate between stable and cow manure. In other respects it is similar to cow-manure, being wet and heavy.

Sheep-manure is richer in plant-foods than stable manure, decomposes readily, and does not impair the working-quality of the soil. It has the objection of being full of grass and weed seeds, and if stored till these have germinated a large proportion of its fertilizing properties are apt to be lost. However, it still remains a valuable material.

Poultry-manure, when properly preserved, is worth in fertilizing properties eight times its weight of stable manure. The best way to preserve it is to collect the droppings frequently and mix them with dry soil, keeping the heap under cover and turning it over occasionally. The dry soil will hold the ammonia, the most valuable constituent. Lime or wood-ashes must not be brought in contact with the droppings, as either will drive off the ammonia.

In reply to a correspondent the Department's Chemist gave the following information: "The value of fowl-manure is very much enhanced by the addition of about half its weight of superphosphate. This should be mixed with the manure as it is collected from the roosts from time to time. This prevents the volatilization of any ammonia which would otherwise be liberated continuously from the manure. To improve the mechanical state of the final product it is advisable to intimately mix it with about one-third its weight of sawdust or peat. Such a mixture when sold as a garden manure should command a good price, and give good results where used with discrimination by vegetable-growers. For field-crops and fruit it should be used with extreme moderation, as, owing to the high availability of the nitrogen, it may unduly stimulate growth and produce a rank, weak plant which will be subject to attacks of disease organisms."

HUMUS.

Humus is an absolute necessity. Where even a moderate supply of stable or farmyard manure is available its judicious use will be sufficient for the purpose. Considerable quantities of waste vegetable matter in gardens can also be used. This, however, will not be sufficient, and, failing stable or farmyard manure, green crops must be grown for turning in. Nor are fertilizers alone sufficient; soil may be well supplied with these, yet in the absence of humus may be comparatively sterile.

SOIL-REQUIREMENTS.

It is a comparatively easy matter to state the chief requirements of various plants: it is a quite different thing to say what should be applied to any particular soil to obtain the desired result. Soils vary so greatly that it is impossible to lay down a rule that will apply to all alike. Nor does analysis of the soil help much, for this has been found to be very misleading. There are forces at work in the soil which analysis does not reveal, and, though it shows what is in the soil, analysis does not in all cases indicate whether or not the various elements are in a form available to the roots of plants. Scientists throughout the world now agree that soil-analysis by itself is of comparatively little use; experimental work must be done in each case before the best results can be secured. A knowledge of the chief requirements of plants and the effect of the various fertilizers is useful and important, because it teaches the direction in which we should move, what to avoid, and what to use. Within these limits the cultivator must judge by results as to what additions or omissions are required.

AMOUNTS OF FERTILIZERS TO USE.

Assuming that fertilizers are being used without organic manure a maximum and minimum may be stated with fair certainty as follows, the quantities being per acre: Superphosphate, maximum about 10 cwt., minimum 3 cwt.; bonedust (not all available the first year), maximum 12 cwt., minimum 4 cwt.; blood-and-bone, maximum 12 cwt., minimum 4 cwt.; sulphate or muriate of potash, maximum 2 cwt., minimum 1 cwt.; nitrate of soda (to be applied only to growing plants and in one or more applications according to judgment), 1½ cwt. to 2 cwt.; sulphate of ammonia, 3 cwt. (equal to 1 oz. per square yard). This latter form of nitrogen is suitable for use for crops that are stated to require a minimum amount of nitrogen.

The use of nitrate of soda to supplement this for plants that have a larger nitrogen-requirement has been previously referred to.

In cases where a partial supply of animal-manure is used, this should be supplemented by suitable fertilizers, using minimum amounts.

Crop-requirements may be stated as follows :—

Requiring principally phosphates, with a liberal supply of potash and a small supply of nitrogen : Turnips, carrots, beetroot, parsnips, radishes.

Principally potash, with a moderate supply of phosphate and a small amount of nitrogen : Potatoes, onions, leeks, artichokes, shallots. (This is not to be taken to mean that the potash should be largely increased in amount or be greater in amount than the phosphate. It means that the maximum of potash should be used and an amount of phosphate lower than the maximum stated.)

Principally nitrogen, with a liberal supply of phosphate and a small amount of potash : Cabbages, spinach, celery, asparagus, cauliflowers, rhubarb.

Phosphates and potash, with a small amount of nitrogen : Peas, beans, melons, marrows, pumpkins, cucumbers, tomatoes.

It seems necessary to add that onions and leeks are rightly placed with those plants that have special potash requirements, but they are benefited by a greater amount of nitrogen than are the other plants they are bracketed with, responding well to nitrate of soda, as stated earlier. Peas are usually regarded as having no need for applied nitrogen, but these are exceptional cases in which they do require it. Where they are lagging in growth for no apparent reason a dressing of nitrate of soda should be tried.

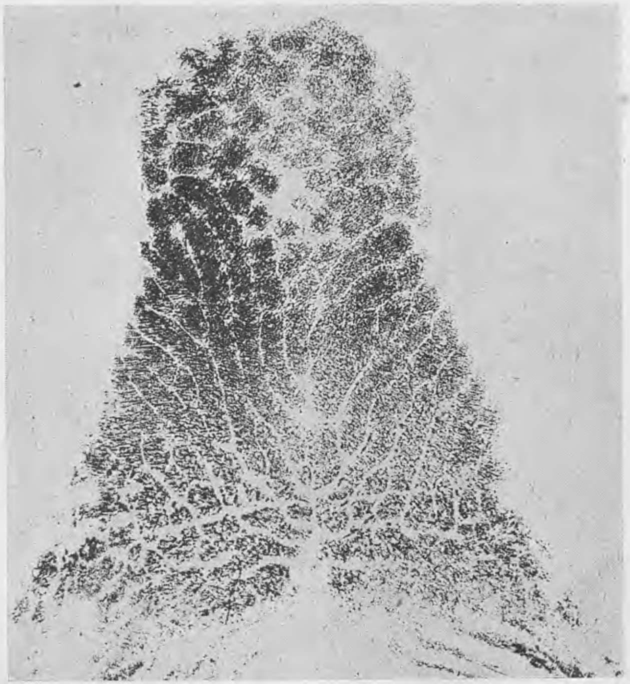
REGISTRATIONS OF FACTORIES, ETC., UNDER THE DAIRY INDUSTRY ACT: 30th April, 1923.

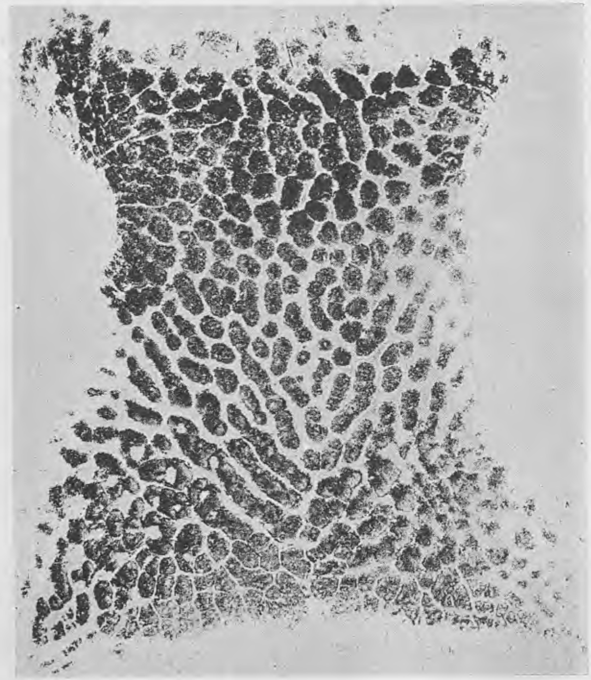
District.	Creameries (Butter).	Factories (Cheese).	Dual Plant (Butter and Cheese).	Private Dairies.		Packing-houses (Milled Butter).	Totals.
				Butter.	Cheese.		
Auckland ..	71	52	6	..	..	2	131
Taranaki ..	20	89	23	2	..	..	134
Wellington ..	17	60	7	..	..	7	91
Hawke's Bay ..	11	17	4	..	..	..	32
Nelson	6	4	1	..	..	7	18
Marlborough ..	4	6	1	..	..	..	11
Westland ..	7	3	..	..	..	..	10
Canterbury ..	12	15	2	..	3	..	32
Otago and Southland	17	80	..	..	..	..	97
Totals ..	165	326	44	2	3	16	556

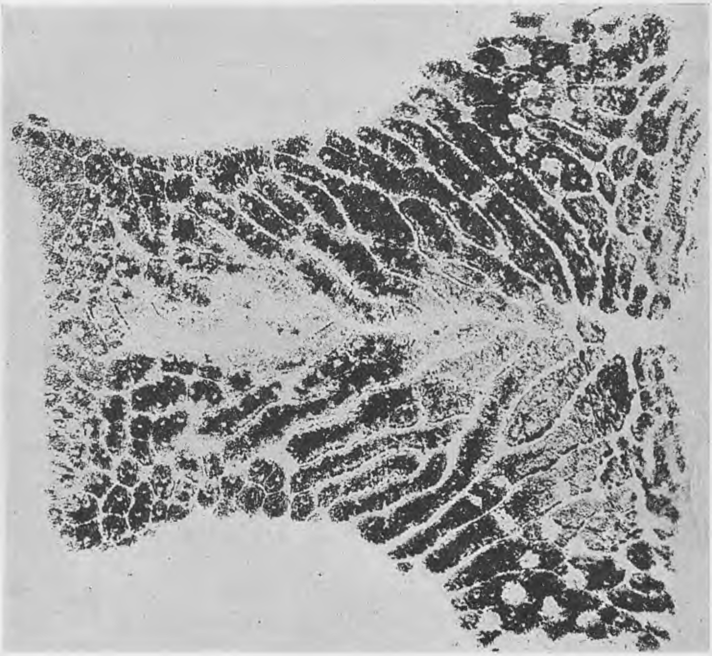
Seven milk-powder factories (four whole-milk and three skim-milk plants), one condensed-milk factory, and three casein-drying factories are also established in the Dominion.

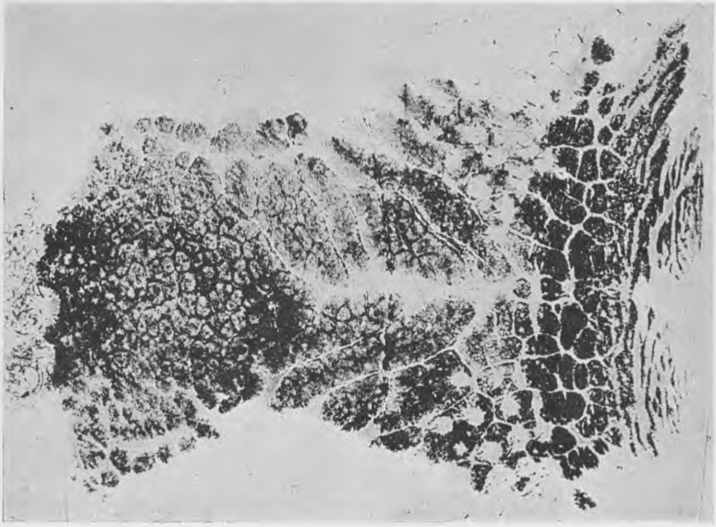
COW NOSE-PRINTS TAKEN AT THE WALLACEVILLE LABORATORY FARM.

The lately devised method of cattle nose-prints is being adopted for identification purposes in much the same way as the human finger-print system. The specimens here reproduced well indicate the practically limitless variations of which the surface of the bovine snout is capable.









SEASONAL NOTES.

THE FARM.

DRAINAGE.

As a rule, very little in the way of cultivation is practicable in July, and the month offers a good opportunity to finish any drainage-work that was commenced in the autumn. In many districts there are large areas of flat clay land that would be greatly benefited by tile draining. Drained land is not so badly poached or puddled by the tramping of stock in the winter-time, and in consequence it does not become so dry or liable to crack in summer. Drained land is earlier in the spring than undrained land and allows more latitude in time of cultivation. Draining of clay land is best done in the winter, as the soil can then be more easily worked and there is plenty of water in the drains to enable the drainer to judge the fall.

PASTURE-MANAGEMENT.

Where not already carried out, top-dressing should be pushed along. Suitable manures for this time of year are basic slag, basic super, and super and Nauru phosphate (half-and-half). In the earlier districts superphosphate alone will give good results; where lime has been applied earlier the super is best applied from the middle to the end of July. The harrows should be kept going to scatter stock-droppings. Now also is a good time to give a final harrowing to a top-dressed paddock and close it up for early calving cows or early-lambing ewes. There is no better tonic for a newly calved cow or lambed ewe than a piece of nice clean pasture. Pastures intended for haying next season will also greatly benefit from top-dressing and harrowing.

FEEDING OF FORAGE CROPS.

The feeding of roots will now be general, and where several kinds, such as swedes, carrots, and mangolds, are grown, the swedes are best used up for the dry cows, reserving the carrots for the cows as they come into profit, and the mangolds for August and September feeding. It may be well to repeat that mangolds should not be fed to dairy cows until they have been out of the ground for some weeks. In feeding out mangolds to cows it is advisable to see that the small roots are cut up. Cows are apt to swallow a small mangold whole and get choked in consequence. The roots can be most easily cut after they have been carted out to the field and scattered over the ground.

Cows feeding off swedes should be allowed a good ration of hay, or a run-off on to a field with rough feed. Allowing cows to gorge themselves on frosted turnips is a continual source of trouble; they should be kept off the field till well on in the day, and given a good feed of hay before being turned in.

In some districts Thousand-headed kale and similar crops are provided for August and September feeding. Great care should be taken to see that the ration is not too liberal, otherwise redwater and other stomach troubles may result. If this class of forage is cut and allowed to wilt for a day such danger is greatly reduced.

Dairy cows and springing heifers should have special attention from now on till calving-time. If feed is limited it is better to give it to the animals now rather than let them go back in condition with the idea of reserving the feed till they come into profit. If the dairy cow is to be pinched at all for feed she will stand it much better in the spring, when she has got rid of her calf, than in the winter when she is carrying it and has to find nourishment both for the calf and herself.

Early-sown fields of oats or wheat that are showing much growth should be fed down if the land is dry enough. This should be followed with a stroke or two of the tine harrows to open up the land.

PLOUGHING IN GREEN CROPS.

Where cover-crops are grown for green-manuring, care should be taken that the stuff is turned under sufficiently early to allow it to rot before the following crop is sown. Usually from four to six weeks will be sufficient, and, of course, the heavier the cover-crop the longer it will take to decay. If it is found that the crop cannot be turned under sufficiently early to allow the material to decay, it will be better to feed off the crop and turn under the manure from the stock.

THE NEXT DAIRYING SEASON.

In several dairying districts cows will be coming into profit towards the end of July, and all preparations for a busy season should be pushed along, especially repairs to milking-sheds and yards. The longer new concrete-work stands before being used the better. Where a milking plant is installed it should be well overhauled, and the engine put in good repair.

—*Fields Division.*

THE ORCHARD.

PRUNING.

APPLE-TREES on seedling stocks growing on rich heavy land in the orchards of the north-western States of America may require very little pruning after reaching maturity, but the dwarf tree on the prolific Northern Spy stock as we grow it in this Dominion requires more attention from the fruitgrower in this respect. The heavy-bearing properties and high-quality fruit from this type of tree can usually be maintained only by seasonable cultivation, manuring, and suitable annual pruning.

It is the custom now to grow the fruit on the laterals as well as on the spurs with which the framework of the tree is furnished. This furnishing in the best types covers the base as well as the upper parts of the tree; indeed, the base is a little more closely furnished and carries heavier laterals than the upper leaders. The base, being mechanically strong, is required to carry as much of the crop as possible; the heavier laterals there do no harm, as they shade only the ground. The pruner is recommended to keep this type in mind when carrying out his work, and gradually to modify the condition of that common class of tree which has bare forks at the base, brought about chiefly by the overfurnishing of the upper leaders with heavy laterals. The latter are not only detrimental in that they cast a heavy shade, but when loaded with fruit their top-heavy condition becomes a difficult problem.

Pruning is one of the main factors in the success of our orchards, and success can be secured only by giving careful consideration to the different varieties and sometimes to individual trees. How common are overfurnished Delicious and Cox's Orange trees; and, instead of the laterals being thinned, how often are they shortened to wood-buds, the congestion so accentuated resulting in little or no crop. Sturmers and Jonathans are naturally heavy-bearing varieties that soon lose their laterals unless they are invigorated and renewed by proper pruning. These can usually be pruned to wood-buds with advantage. But in all varieties overfurnishing the framework must be avoided, especially about the tops of the trees.

In the pear-tree we have rather a different problem: the seedling stock and vigorous habit have to be reckoned with. Commonly pear-trees are overpruned, and develop crowded leaders and laterals. Why prune the laterals of such a vigorous subject to wood-buds? Thin them out by all means, but shortening them makes a great amount of work at pruning-time and a very light harvest. By bringing a pear-tree into bearing early the growth is steadied, and a mature tree properly constituted should require comparatively little annual pruning.

GENERAL.

Remember to collect scions for grafting in spring if they should be required.

Fresh plantings should be pushed along when the ground is dry enough. See that trees are planted sufficiently deep and very firm. Many kinds of stonefruit may well be planted on good alluvial land where there is a local demand, also lemons where the soil is deep and well drained and the climate suitable. Such land is also suitable for walnuts. Sweet chestnuts of a good variety are becoming popular, and are suitably placed on hilly country. Filberts are also worth more consideration, and some plantations are returning very good crops. Good shelter-belts are beneficial in most localities, and in many they are indispensable.

Should the season be wet see that the water does not lie about the orchard; if it does so a good plough-furrow in the right place will often lead it off. On wet days overhaul motors, implements, and harness; a proper application of oil and paint will save depreciation and give smooth continuous working in the busy season.

The demand for fruit may now be expected to increase. Market the fruit from store in the right order of varieties, and pack to recognized standards. Waste fruit should not be allowed to lie around in buckets or other receptacles, but should be cleaned up daily and fed to stock or buried underground, and not tipped out to rot on adjacent land, as is so often done.

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

CITRUS FRUITS.

Delayed red-oil spray at 1–40 may yet be applied if found necessary, care being taken not to make the application in any area in which early frosts have affected the trees in the slightest degree, thus weakening their vitality for the time being.

FIREBLIGHT.

The attention of orchardists and others who have common white blossoming hawthorn (*Crataegus oxycantha*) growing on their properties is directed to clauses 2 and 3 of the Fireblight Act, 1922, as follows: "In the case of those districts and parts of districts included in the Second Schedule, all hawthorn shall, between the 1st day of June, 1923, and the 31st day of July, 1923, be cut down so as to prevent any part thereof from flowering, and thereafter shall be similarly cut down in the month of June or July in each year and at such other times as may be necessary to prevent any part thereof from flowering. In the case of the district and parts of districts included in the Third Schedule, wherein fireblight is known to exist, all hawthorn growing therein shall be completely destroyed before the 30th day of June, 1923, and any plants which may appear subsequently shall forthwith be completely destroyed."

—*J. W. Collard, Orchard Instructor, Auckland.*

POULTRY-KEEPING.

MATING THE BREEDING-BIRDS.

THE busiest season of the year and the most important one—that for hatching and rearing young stock—is now near at hand. This implies the necessity of getting the breeding-birds mated up at the earliest possible moment; it is a mistake to delay putting the birds together until just before eggs are required for hatching purposes. Every opportunity should be given them to become well settled down and in a proper breeding-condition before the work of incubation commences. This will not only ensure a greater proportion of fertile eggs, but in addition will tend greatly towards their containing stronger germs. When pens are first mated up it frequently happens that the male bird will exhaust himself, and it may be weeks before he regains a condition to produce even a fair percentage of fertile eggs. This does not apply to the same extent where all the hens are not in a laying-condition.

Wise poultrymen, and those who have acted in accordance with advice given previously in the *Journal*, will have selected and specially marked the best breeding specimens during the late autumn, or at some time before the birds moulted. It is at that period of the year that certain signs manifest themselves in a striking manner whereby the good layer can be distinguished from the poor one.

Where the choosing of the breeding females has been left till the flock has moulted, the accurate selection of the most desirable hens will be found a matter of great difficulty. Indeed, in most cases it will be found an impossible task. It is well known that when birds have been hatched at about the same time and have been fed and managed in a similar manner the late moulter is generally the one that has laid the best in the past and is likely to do so again in the following year. Obviously, when a flock has moulted and all birds are in a similar condition so far as their plumage is concerned it is impossible to distinguish between the early and late moulter, except, of course, where they have been specially marked to indicate this point. The poultry-keeper who has neglected to select his late moulters during the autumn may expect a high percentage of unprofitable stock as a consequence.

While lateness of moulting can generally be accepted as indicating good producing-power, this does not mean that all late moulters are suitable specimens for the breeding-pen. Something more is required. If a heavy-producing strain is to be built up or maintained it is imperative for the poultry-keeper to have pictured in his mind a definite type, and to aim for this at all times. Breeding from birds of mixed types merely because they happen to possess good laying-points, or even an ancestral high egg-yielding performance, will never tend towards reaching the desired end. Permanent results can only be secured by breeding from fixed types of purebred strains. Sometimes birds of inferior type will prove good layers, but in a general way such stock have not the power to transmit their laying-qualities to their progeny, and are thus undesirable for the breeding-pen.

In making the final selection, even where the late moulters are concerned, every bird should be carefully examined in order to ensure that it is healthy and possesses undoubted constitutional vigour. No matter what other good points the bird possesses, whether it be male or female, if there is the slightest constitutional taint it should be rejected from the breeding-pen. Health and vigour form the base of all successful breeding operations. Points indicative of these essential requirements are a clean face free from wrinkles and feathers; clear, bright, prominent eyes; short shanks, set wide apart; alert carriage; and tight, glossy plumage; while in the male bird of such breeds as Leghorns, Minorcas, &c., no bird should be bred from where the comb has insufficient base to enable it to stand erect. A folding-over comb usually indicates impaired vigour. The ideal breeding male should have a masculine appearance in every respect, but this does not imply coarseness.

The question of size is another important matter. All birds conspicuously under or over the weight clauses specified in the New Zealand Utility-poultry Standards should be rejected. It is, however, better to have a good big bird than a good small one. No matter how well they have laid, small diminutive specimens of their breed should not be used for breeding. Such stock usually produce weedy progeny which yield only second-grade eggs. In mating fowls the aim should be not only to breed from those birds which lay the most eggs, but also from those producing eggs of good marketable size—that is, of at least 2 oz. The production of small eggs is probably the greatest weakness in connection with present-day poultry-keeping. The size of the egg can be increased only by careful breeding, and by the selection for breeding of only those birds that lay large eggs.

Many specialist breeders secure the individual egg-records of their birds by means of single pens or trap nests. This is too troublesome for the average poultry-keeper to be bothered with, but with a little study and observation, and the annual selection of the late moulters and those birds with a broad back, well-developed crop, and deep abdomen, the egg-yield will be increased to a surprising degree. Never breed from a bird of either sex that has had a severe sickness, as it is rare that they thoroughly recover. Such birds may look well, eat well, and appear healthy, but as a general rule they fail to produce desirable progeny. In breeding to renew a laying flock pullets should not be used if it can possibly be avoided. Where they are used they should be mated with a second-season male bird.

I would again emphasize that in breeding profitable fowls the beginner in particular should aim at definite laying-types of purebred stock. The ideal types to strive for are contained in the New Zealand Utility-poultry Standards. Copies of this work may be had from the Publisher, Department of Agriculture, Wellington, at a cost of 3s., post free.

MANAGEMENT OF BREEDING-PENS.

The management of breeding-birds is of paramount importance. In the first place they should not be forced for eggs. The ration should consist chiefly of a variety of whole grains. The greater the variety in this respect the more fertile eggs will be produced, the stronger will be the germs, and the more easy will be the chickens to rear. It must be remembered that a chicken is built up of many constituents, and the food provided to the parent birds must contain those elements which are necessary for the formation of a properly developed chick. It is well known that the best hatchable eggs, and those which produce the strongest chicks, come from fowls which have a free range. If we could dissect a hen's crop after a day on free range we would not find any one particular class of food, but in most cases there would be a naturally balanced variety of different seeds, green-stuff, worms, and other kinds of insect-life.

On no account should breeding-stock be coddled. Strong, hardy chickens can only come from hardy parents. Where a good range or large run is available they should have access to it at all times, quite regardless of weather conditions. Of course, it must not be inferred that comfortably roomy houses, where the birds can exercise in comfort during extreme weather and when they prefer to remain indoors, are unnecessary. Indeed, the great bulk of the ration provided should be fed in deep litter to induce the birds to exercise, as a means of preventing fat-formation. Do not forget an abundance of green food; no bird can be maintained in a proper breeding-condition without it.

Care should be taken that the male bird does not get run down. He should be frequently dusted with a good insect-powder as a means of destroying parasitic life. If good dust-baths are provided the hens will usually keep themselves reasonably free from body-lice, but in the case of the male it is entirely different. He should be maintained at the top of his form at all times. When the bulk of the ration is fed in litter the male as a general rule will not scratch for his food to the same extent as the females, and as a result is apt to rapidly decline in weight. Where possible it is a good plan to remove the male from the hens and give him at least one good meal a day by himself.

THE TIME TO HATCH.

It should be the aim of every poultry-keeper to secure a fair supply of autumn and winter eggs. In order to secure these the pullets must be largely depended upon, and they must be hatched neither too early nor too late. In a general way, for the heavy breeds such as Orpingtons, Wyandottes, &c., July and August are the most suitable hatching-months, and for the lighter breeds August and September.

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

THE APIARY.

WINTER FOOD-SUPPLIES.

As advised last month, the bees should require no further attention until the spring. If, however, the beekeeper has any reason to fear that his bees are in danger of starving they should be given a block of sugar-candy, unless combs of honey or candied honey from colonies known to be free from disease are available. Instructions for making sugar-candy were published in the August, 1922, issue of the *Journal*.

RENDERING WAX.

If the season's accumulation of wax has not already been melted up this should be attended to without delay, and the wax sent to a manufacturer of comb-foundation to be made up. If there is any quantity of wax to be melted up a wax-press of some description should be obtained—there are several good makes stocked by dealers in beekeepers' requisites. The press is necessary in dealing with large quantities of wax owing to the retention otherwise of much of the wax by the slum-gum, which is made up very largely of the discarded cocoons of successive generations of larvæ. Wax obtained from cappings or combs that have not been used for brood-rearing will not contain much foreign matter.

In the absence of a better equipment, wax may be readily rendered in a kerosene-tin on the kitchen-stove. Place the pieces of comb or cappings to be reduced in the tin, and add sufficient water to cover them by a good margin; there is no danger of using too much water. When the wax is melted, remove the tin from the fire and place it in a sheltered place to cool. Do not hasten the cooling process by undue exposure, as slow cooling affords time for the heavier foreign matter to settle. When cool the wax should be taken out and as much as possible of the accumulated foreign matter scraped off. It should then be broken up and reduced to as small a compass as possible, placed in a bag of scrim or similar porous material, and melted again to remove the remaining particles of foreign matter. If the wax is not required for manufacture into foundation it will sell more readily if run into small moulds similar to patty-pans.

PLANTING FOR SHELTER AND BEE-FORAGE.

This being the planting season, any contemplated provision of additional shelter or forage for the bees should be attended to without delay. Tagasaste, commonly called "tree-lucerne," is a rapidly growing hedge-plant which can be recommended (if protected from cattle), as it yields an abundance of forage for the bees at a time when this is most valuable. As tagasaste does not transplant very readily the plants will require careful treatment when received from the nursery. If grown from seed the best results will be obtained by sowing in the early spring. To assist germination the seed should be first steeped in boiling water to which a little washing-soda has been added. Pour on the water and let it stand until quite cold; this will soften the seed, and, after straining, the addition of a little dry sand will separate it nicely for sowing. It is important that seeds treated in this manner be sown immediately.

The ground should be thoroughly worked (as for onions), and if, as is recommended, a double row is contemplated the width of the prepared bed should be not less than 4 ft. Sow the seeds three in a place, at a distance of 3 ft. apart and 1 ft. from the edge of the bed on either side, alternating the second row with the first—this gives 2 ft. between the rows. Thin out the plants when they have made sufficient growth to the strongest in each place.

Tagasaste is subject to the borer, and while it is an excellent temporary hedge-plant, it cannot be depended on to provide permanent shelter. The giant-growing privet (*Ligustrum sinense*) can be recommended for this purpose. It is a gross feeder, its roots extending in time several yards from the base on either side. For a single row a strip 3 ft. in width should be deeply dug, and if the ground is poor a liberal dressing of bonedust supplied. Select strong two- or three-year-old plants, and plant them 18 in. apart along the centre of the prepared ground. To secure a good bottom growth it will be necessary to clip the plants back fairly hard at the time of planting.

—*H. W. Gilling, Apiary Instructor.*

THE GARDEN.

VEGETABLE-CULTURE.

THE spring season, so far as seed-growing is concerned, may be said to begin with July in most places. Local conditions vary very considerably, and this must be allowed for; but in one respect all places are alike—the hours of daylight are beginning to lengthen at that period. Peas may be sown everywhere; for a start two kinds should be sown at the same time—an early kind for first use, and a second early to succeed them. After the first sowing one kind only should be sown at intervals of a fortnight, that being roughly the period of currency of each crop. Early potatoes may be planted in frost-free places.

Onions should be sown as early as possible, but not until a good seed-bed can be secured. The time when sowing is safe varies very considerably; those who can sow early in July have the best hope for a good crop. Varieties of keeping-types—Brown Spanish, Brown Globe, &c.—are the most valuable for spring sowing. Where early bulbs are desired sow White Queen. This variety will make good bulbs by the end of the year, but they are not good keepers, so only sufficient for summer and autumn use should be grown.

Carrots, lettuce, radish, parsley, cabbage, and cauliflower may be sown. Turnips should be left till August; if sown too early they bolt to seed without bulbing. All species of herbs may be planted, also cabbages and cauliflowers. Celery for early crops may be sown under glass. Henderson's White Plume is the best variety for early use.

Asparagus.

The quality of asparagus depends on the strength of its growth; stout heads grown quickly are the most succulent. Nitrogen being the element that promotes vegetative growth, it follows that nitrogen in some form is the element of the greatest importance in asparagus-culture. If stable or other animal manure is applied in large quantities it answers quite well, but moderate quantities are not effective. The method of planting also has a bearing on the matter. If the plants are set in rows far apart, in conformity with modern practice, much less manure per plant is required than is the case with the old-fashioned beds, where the plants are in close competition with each other. In either case some added nitrogen would be beneficial; in the latter it should be regarded as indispensable, and more especially as the nitrogen-content of animal-manure is practically an unknown quantity to the user, and may amount to very little.

Nitrate of soda is the best form of nitrogen for asparagus, because it is immediately available—it has an immediate effect on growth. Phosphates and potash are also required, but in smaller amount. A good dressing of wood-ashes or the remains of rubbish-fires will supply all the potash needed. Failing this material sulphate of potash may be applied, using 1 oz. per square yard. Blood-and-bone will supply phosphate from the bone, and slowly available nitrogen from the blood. About 4 oz. per square yard should be used. All except nitrate of soda may be applied at once. Nitrate of soda, being highly soluble in water, is quickly washed down beyond the reach of the roots, and therefore should not be applied till the roots are active. The roots being active some time before top growth is visible, about the middle of August is a good time to apply the nitrate. Comparatively large amounts can safely be used, up to 8 oz. per square yard for close-planted beds. This amount would kill slugs and most weeds, but would not injure the roots of asparagus.

SMALL-FRUITS.

Gooseberries.

Bushes should be trained up so as to secure a clean trunk between the surface of the soil and the first branch. The clean trunk should be at least 6 in. high, and a few inches more is better. To secure this all the buds on the cutting except three or four at the top should be cut out. If this has not been done it should be attended to before a young bush is planted. Bushes with branches coming from beneath the surface are a source of never-ending trouble. It is impossible to form a good bush, pruning is made difficult, and if weeds with perennial roots are present it is impossible to get them out. Besides these troubles, the work of cultivation around them is difficult and slow, causing waste of time and probably neglect.

Pruning: Young bushes should be started with three main branches evenly disposed around the trunk. These should, if they are strong, be reduced to about 10 in. If the shoots are feeble cut them down to near their base to induce strong growth. If three branches evenly disposed cannot be secured, and four can, keep the four and prune a few inches higher than advised for three branches. If only two strong branches can be secured cut these two down to about 6 in. In future years an endeavour should be made to duplicate the leading branches so as to work up an evenly formed bush. In dealing with an established bush it should be understood that although every young shoot and twig will bear fruit, as well as spurs on older wood, a good crop is not obtained by having a multiplicity of young twigs, but by securing a balance between root and top that will ensure proper development of the fruit. In other words, a multiplicity of shoots and twigs will result in a large number of berries. Judicious thinning of the wood will reduce the number, but the individual berries will be much finer, and the result a much more profitable crop. The object, then, is to prevent undue crowding. Thin the growths so that gathering can be easily done, and that will be about the proper balance. Strong young shoots that are left should be merely tipped. All other young twigs should be cut according to strength, the weakest being reduced to short spurs. All twigs on the lower part of the bush should be reduced to spurs, and all strong shoots on the inner part of a bush should be broken or cut right out so that they cannot break again.

Red Currants.

Red currants bear fruit on spurs on wood that is at least two years old, never on young wood. The correct method of training and pruning is to lead up main branches as described for gooseberries, and prune all young growth back to spurs about ¾ in. long. An open centre should be maintained, so that the sun may shine on every part, otherwise the spurs on the lower part will become barren. Of course, fruit will be produced if the bush is allowed to grow more or less wild with no systematic or correct pruning. The fruit, however, will soon be borne only on the upper and outward parts of the bush, and this will be neither satisfactory not profitable.

Black Currants.

The black currant bears fruit on the young wood and also on spurs on the old wood. In former times the training and pruning practised was the same as for red currants. The borer trouble has caused a revision of methods, and the present practice is to look to young wood to produce the greater bulk of the crop. When the cuttings are made all the buds are left on ; this causes shoots to break up from below the surface—gives the bush, in fact, what is termed a stooling habit. If a branch gets borers in it, it can be cut down, and a new one takes its place. Cutting down a branch causes the sending-up of new shoots, and so the stooling habit continues. The main branches are allowed to take any position they happen to come in, a hollow-centred bush not being wanted. Pruning consists in the removal of any kind of wood to prevent undue crowding, and just tipping the young shoots to remove the portion that is not thoroughly ripened.

—*W. H. Taylor, Horticulturist.*

LIST OF QUALIFIED VETERINARY SURGEONS.

THE following list of qualified veterinary surgeons known to be residing in New Zealand is published for the guidance of stockowners and for general information. In the event of the name of any properly qualified veterinarian being omitted it is requested that he communicate with the Editor, giving particulars of his qualification, in order that the necessary steps may be taken for the inclusion of his name in the next published list.

Aberdeen, C., L.V.Sc. (Melbourne), Wanganui.
*Ashe, G. G., M.R.C.V.S., Christchurch.
*Barnes, A. W., M.R.C.V.S., Hastings.
*Barry, W. C., M.R.C.V.S., Auckland.
Bayley, A., M.R.C.V.S., Hawera.
Begg, W. F., M.R.C.V.S., Te Awamutu.
*Blair, W. D., M.R.C.V.S., Invercargill.
*Blake, T. A., M.R.C.V.S., Masterton.
Brodie, A. M., M.R.C.V.S., Hastings.
*Broom, G., M.R.C.V.S., Gisborne.
Burton, S., M.R.C.V.S., Hamilton.
Carbury, H. W., M.R.C.V.S., Otorohanga.
Cockroft, J. E., M.R.C.V.S., Feilding.
*Collins, W. T., M.R.C.V.S., Wellington.
Crossley, F., M.R.C.V.S., Palmerston North.
Cunningham, T., M.R.C.V.S., Oamaru.
*Danskin, J., M.R.C.V.S., Dunedin.
*Elphick, E. E., M.R.C.V.S., D.V.H., Wellington.
Glover, F., M.R.C.V.S., Hamilton.
*Hickman, A. J., M.R.C.V.S., Auckland.
Hankin, T. H., M.R.C.V.S., Pukekohe.
*Haugh, P., M.R.C.V.S., Petone.
*Howard, E. C., M.R.C.V.S., Wanganui.
Johnson, A. A., F.R.C.V.S., Christchurch.
*Kerrigan, J., M.R.C.V.S., Christchurch.
Kyle, H. S. S., G.M.V.C. (Melb.), Templeton.
*Lawson, J. N., B.V.Sc. (Sydney), Wanganui.
*Lukey, E. J., B.V.Sc. (Melbourne), Christchurch.
*Lyons, J., M.R.C.V.S., Auckland.
*Mackenzie, A., D.V.S.M., M.R.C.V.S., Hamilton.
*Marsack, H. L., V.S. (Ontario), Auckland.
Marshall, D., M.R.C.V.S., Balclutha.
Martin, H. E., M.R.C.V.S., Christchurch.
McLeod, J., M.R.C.V.S., Christchurch.
*Meade, R. H., M.R.C.V.S., Palmerston North.
Miller, J., M.R.C.V.S., Invercargill.
*Paterson, A. M., M.R.C.V.S., Timaru.
Quinnell, W. C., M.R.C.V.S., Wellington.
*Reakes, C. J., M.R.C.V.S., D.V.Sc., Wellington.
*Reid, H. A., F.R.C.V.S., D.V.H., F.R.S.E., Wellington.
Ring, W. C., V.M.D. (Penn., U.S.A.), Ellerslie.
*Siddall, E. L., M.R.C.V.S., Opotiki.
Simpson, C. S., M.R.C.V.S., Auckland.
*Snowball, W. D., M.R.C.V.S., Dunedin.
*Stafford, J., M.R.C.V.S., Christchurch.
†Stapley, W., M.D., D.V.Sc., M.R.C.V.S., Cambridge.
Taylor, H. C., M.R.C.V.S., Dannevirke.
Taylor, J. B., M.R.C.V.S., Waverley.
Taylor, W. G., M.R.C.V.S., Wellington.
Ward, J., M.R.C.V.S., Katikati.
*Wood, R. B., M.R.C.V.S., Waitara.
*Young, A. R., M.R.C.V.S., Wellington.

* Officers of the Department of Agriculture. † Not practising as a veterinary surgeon.

ANSWERS TO INQUIRIES.

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

DRENCHES FOR YOUNG SHEEP.

T. DAVEY, Mahanga, Wairoa :—

In the *Journal* for April (page 215) is given a stock solution for drenching hoggets. As I have been using bluestone and carbonate of soda for some years now I would like to know if I am doing the right thing. I mix 9 oz. of bluestone and 9 oz. of soda in 4 gallons of water, and give each hogget 2 oz., commencing to dose them at weaning-time. The chief trouble in this district is stomach-worms—small white worms and tapeworms.

The Live-stock Division :—

Your solution works out at 13½ grains to the dose. For weaners we would say that this dose is excessive, though about right for hoggets (twelve months old). The United States Bureau of Animal Industry recommends a dose of 6 grains for lambs (three to twelve months). Without a change on to clean pasture and nourishing food, however, treatment is wasted.

EFFECT OF FEEDING ON BUTTERFAT TEST.

"CURIOUS," Te Hana :—

With regard to test of cows for butterfat, could you kindly tell me if feed makes any impression on the test, and does extra-good feed only affect the quantity? In other words, would, say, a four-test cow increase her test by special feeding?

The Dairy Division :—

If a cow is well fed for some time prior to calving, this feeding may influence the test for a limited period, and until the cow reduces her flesh to normal working-condition. Outside this our experience points in the direction of extra feeding having little if any influence on the test of the milk. The effect of liberal feeding on the quantity of milk given is, of course, widely recognized.

SCALDING OF PIG CARCASES.

"QUESTION," Kawhia :—

Could you advise me as to the best method, temperature, &c., for scalding pigs after slaughtering?

The Instructor in Swine Husbandry :—

First see that the carcase is well bled. In preparing the scald arrange for a temperature of 150° to 160° F. For a small pig use the former, and a large pig the latter. Above this temperature there is a danger of setting the hair. It is advisable to use a thermometer. Keep the carcase moving in the trough for one minute, and then try the hair on the feet and ears. If easily removed the scald is about right, but to be on the safe side try the hair on the flank, as this is the hardest to remove. If it comes away freely commence scudding at once. It is advisable when the process of scalding is done in the open air to raise the temperature two or three degrees higher than stated, so as to allow for the cold air, also for lowering of the temperature of the water when the carcase is submerged.

GROWING LUPINS FOR SEED.

C. JESSON, Rotorua :—

I intend growing about 2 acres of white lupins for seed purposes, and shall be glad of a little information as to sowing, manuring, and harvesting.

The Fields Division :—

Lupins for seed should be sown in the spring as soon as danger from frosts is over. Sow in 14 in. drills at the rate of 1¼ bushels per acre. Superphosphate, 1 cwt. per acre, drilled with the seed would be beneficial. The crop should be harvested with a mower fitted with a short knife, and the cut material should be forked back as it is cut to prevent the horses treading on it and knocking the seed out. When dry it should be stacked and then left in the stack about six or eight weeks before threshing. The average yield of seed is about 25 bushels per acre.

NON-BEARING PEAR-TREES.

H. WIGMORE, Mercury Bay :—

I have two pear-trees, a William Bon Chretien and a Packham's Triumph, and neither bears any fruit, although they have blossomed for several years. Would you tell me if those varieties are self-sterile, and, if so, what kinds would be required to fertilize them? I have twenty-seven hives of bees, so do not think there can be any fault in that way. The trees are six or seven years of age.

The Horticulture Division :—

Special pruning methods are necessary to bring pear-trees into bearing at an early age; they do not, as a rule, fruit so early as do apples. You give no indication as to what growth the trees have made, nor of the pruning done. It frequently happens that trees that make heavy growth may blossom but fail to set fruit, because the strong growth made diverts sap from the flowering portions of the tree and the blossoms are weakened. If the trees are making strong growth, do no pruning for a year or two. This will cause the cessation of strong growth and promote the development of fruit-buds. The Bon Chretien pear is self-fertile, therefore the want of cross-fertilization would not account for it not bearing. It is not known whether Packham's Triumph is self-fertile or not. Authorities who have investigated the matter state that any two varieties will pollinate each other if their flowering-period is practically the same, and that is the case with Bon Chretien and Packham's Triumph.

CONTROL OF RAGWORT.

J. B. T., Dunedin :—

Would you kindly inform me if it is worth while cutting down ragwort if it is in its yellow flower? I commenced to cut some on my place and was told by a neighbour that I was simply wasting my time, as the cut plants would ripen and seed.

The Live-stock Division (Noxious Weeds Inspection) :—

For effectively controlling ragwort, where it is not possible to well stock with sheep, when the plant is young frequent cutting must be resorted to before it flowers, thus preventing the growth of leaves. If flowering of the weed is permitted, and it is afterwards cut down, there is no doubt sufficient sap in the stem to mature a proportion of the seed. In such cases and where the weed is only on small areas much good might be done by either pulling up the roots or by cutting the plant beneath the surface, or by cutting down, gathering, and burning it. This, however, should be done at least in the early flowering stage, and not when the seed has matured and shed.

TUTU IN RELATION TO CATTLE.

H. A. ALDERSON, Christchurch :—

Is there any known treatment for poisoning by tutu, and what is the best way to eradicate the plant? Do cattle usually eat it when not particularly hungry?

The Live-stock Division :—

A comprehensive reply in regard to the treatment of animals poisoned by tutu was given on page 492 of the *Journal* for June, 1917. The eradication of tutu is often a very difficult matter. If the plants are cut the underground stems shoot up again rapidly. If there is only a small quantity to be dealt with the plants may be grubbed out, but if present in large quantities cutting and burning is the only method. After burning, grass-seed should be sown. It is very difficult to state definitely whether or not cattle generally will eat tutu when not particularly hungry. It is usually held that if there is an abundance of young grass available cattle generally will not eat tutu in large quantities, but some appear to be very partial to small quantities even when there is plenty of other feed, and these animals seem to gain some tolerance to the poison. The poison in tutu-plants is particularly dangerous when there are young shoots, and also when the plant is wet from rain or dew.

BLOOD-AND-BONE MANURE AFTER LIME.

L. McINNES, Marua :—

Will you please inform me if it is advisable to use blood-and-bone manure when sowing grass in a paddock that has recently been limed.

The Fields Division :—

Blood-and-bone may be used without being harmfully affected by the previous application of lime—especially raw ground limestone. If, however, quicklime is used, it is advisable to give the soil a good disking after the lime is applied; then, if the soil is moist, blood-and-bone may be applied with safety after a period of three to four days. You would be well advised to use 2 cwt. of superphosphate with 1 cwt. of blood-and-bone per acre when sowing grass in your district.

TARWEED IN HAY.

E. MULCARE, Ngatere :—

Is tarweed injurious to cows if chaffed with meadow hay and fed with molasses and concentrates? The hay contains a good deal of tarweed. Would it be advisable to feed out as hay, or would it be safe to chaff for winter feed?

The Live-stock Division :—

In the plant form stock will not eat tarweed (*Bartsia viscosa*), and there is therefore no danger in feeding stock with hay containing this weed. In the chaffed form, however, stock might eat it unnoticed; and while it is not definitely known that the plant is injurious to stock, there is a possibility of its being so, and we should not, on that account, recommend chaffing the hay containing it.

British Market for Peas and Beans.—The following information was cabled by the High Commissioner, London, on 2nd June :—

Peas.—Market firm for spot. Small sales reported of Maple at about 102s. 6d. per quarter. Limited demand for forward shipments. May–June shipments offered 81s., with buyers about 80s. For May shipments prices hardened recently to 77s. 6d. Tasmanian Maple scarce; May shipments offered 91s. 6d., buyers about 89s. Japanese Blue have declined further, spot selling at 21s. 6d. per cwt.; new crops August–September and September–October shipments 22s. to 23s. Limited demand for Tasmanian Blue at 19s. and New Zealand at 18s. *Beans.*—English supplies sufficient for requirements, and market quiet. New Zealand quoted spot, 50s. to 52s. per quarter.

WEATHER RECORDS: MAY, 1923.

Dominion Meteorological Office.

GENERAL SUMMARY.

FROM returns already to hand for the month of May rainfall was in excess in all parts of the Dominion except the towns of Auckland, Inglewood, and New Plymouth, as well as the Southland District. The north-east coast of the South Island registered what so far constitutes a maximum for those parts, and this was chiefly accounted for by the downpours which fell between the 5th and 8th inclusive. The average for the stations within this region runs between 3 in. and 4 in. for the whole month, while some typical records for the four days in question show the falls which accounted for very heavy floods and much damage, as follows:—

Station.	5th. Inches.	6th. Inches.	7th. Inches.	8th. Inches.
Picton	1·86	2·45	3·21	0·88
Spring Creek, Blenheim	0·73	4·00	2·50	0·05
Avondale	0·63	3·20	2·25	0·82
Hapuku, Kaikoura	2·00	13·57	10·31	0·82
Stag and Spey	3·60	19·69	10·83	2·67
Keinton Combe	2·28	14·40	10·17	1·88
Waiau	1·27	9·54	6·50	1·70
Highfield	1·50	9·55	7·78	2·26

The downpour was caused by a cyclone impinging on an anti-cyclone which passed in the south. The "edge" of the cyclone therefore accounted for these phenomenal rains. Hawke's Bay was threatened, but escaped damage.

Another disturbance passed in the north between the 18th and 21st, and an extensive westerly low-pressure followed, which accounted for very unsettled conditions, especially in and southward of Cook Strait.

The monthly temperatures recorded were above the average, and the general character of the month may therefore be described as dull, mild, and moist, the ground consequently being soft and muddy. Dairymen were glad that the season was practically over, and farmers and pastoralists had plenty to do in coping with damage and changes from the storm.

—*D. C. Bates, Director.*

RAINFALL FOR MAY, 1923, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average May Rainfall.
North Island.				
	Inches.		Inches.	Inches.
Kaitaia	7·98	20	1·90	5·06
Russell	8·75	18	2·36	3·53
Auckland	4·12	26	0·58	4·42
Hamilton	4·72	25	0·84	4·41
Kawhia	4·99	23	0·62	4·77
New Plymouth	6·08	23	1·02	6·16
Inglewood	8·32	27	1·44	10·31
Whangamomona	7·27	27	1·23	6·59
Tairua, Thames	6·46	15	1·20	6·11
Tauranga	5·84	24	1·01	5·02
Maraehako Station (Opotiki)	8·60	21	1·34	4·82
Gisborne	7·06	14	2·30	5·50
Taupo	5·06	19	0·92	3·60
Maraekakaho Station, Hastings	6·61	19	2·19	3·87
Taihape	5·73	24	1·08	3·75
Masterton	8·96	20	2·30	3·91

RAINFALL FOR MAY, 1923—*continued.*

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average May Rainfall
	North Island—continued.			
	Inches.		Inches.	Inches.
Patea	7·38	21	2·07	3·91
Wanganui	2·77	10	0·50	3·40
Foxton	4·31	17	0·94	2·38
Wellington	9·48	21	2·00	4·73
	South Island.			
Westport	6·65	20	0·92	6·58
Greymouth	7·88	18	1·35	8·39
Hokitika	11·20	17	1·84	9·90
Arthur's Pass	16·86	14	2·90	10·93
Okuru, Westland	12·40	18	2·16	11·60
Collingwood	10·80	22	1·28	10·18
Nelson	10·32	21	3·42	3·12
Spring Creek, Blenheim ..	11·42	19	4·00	2·49
Tophouse	7·89	20	1·20	5·46
Hanmer Springs	19·68	14	6·72	3·52
Waiau	23·36	13	9·54	3·12
Gore Bay	9·27	11	5·15	3·43
Christchurch	6·80	17	3·40	2·56
Timaru	4·64	15	2·36	1·27
Lambrook Station, Fairlie ..	5·28	12	1·80	1·28
Benmore Station, Omarama ..	4·40	16	1·73	1·75
Oamaru	3·03	12	0·54	1·58
Queenstown	4·05	11	0·80	2·71
Clyde..	2·07	11	0·60	0·97
Dunedin	4·48	10	1·26	3·22
Gore	1·96	14	0·35	2·84
Invercarglll	2·20	18	0·40	4·64

REGISTRATION UNDER THE FERTILIZERS ACT.

THE Fertilizers Act, 1908, requires every vendor of fertilizers to register his name and address before offering any fertilizer for sale, and thereafter on or before 1st July in each year. The Act defines a vendor as any person who, either on his own account or on behalf of any other person, sells in the ordinary course of his business any fertilizer. Storekeepers and others who act as agents for manufacturers and mixers of fertilizers are therefore "vendors." Vendors who carry on business at more than one address are required to register each address. It is sufficient if the addresses of all the branch establishments are stated on the head office registration forms.

It should be noted that, where a vendor has already registered a fertilizer during the current year, it is not necessary again to register the same particulars on 1st July. Many vendors are evidently under the impression that the registration year commences on 1st July, and that all fertilizers must then be registered afresh. This is not so. A second registration during any year (January to December) is necessary only where the previously registered particulars of a fertilizer require amendment.

On each sale of 5 cwt. or more the vendor must supply the purchaser with an invoice certificate showing the true particulars of the fertilizer as registered. All packages must be clearly and distinctly branded with the registered brand, provided that where any mixture is made up according to the written instructions of the purchaser it is sufficient to brand the packages "Special mixture."

Following are some of the more frequent errors made by vendors in completing the registration forms. Attention to these points will avoid a great deal of correspondence.

(1.) Omission or incomplete particulars of brands. The brand of each fertilizer must be clearly stated. Vendors frequently register fertilizsers as "Not branded." It is an offence under the Act to offer fertilizers (other than "Special mixtures" as above) in unbranded packages.

(2.) Entering the analytical figures in wrong column of the registration form. This is a frequent error on the part of agents and storekeepers, and is usually due to carelessness in copying the particulars from the manufacturer's invoice certificate. The Act provides for a penalty of £10 for failure to supply the correct particulars of any fertilizer.

Vendors are requested to fill in the columns "Name of Manufacturer or Firm from whom the Fertilizer was obtained," and "Price per Ton." This information is of great value to the Department, and it should be understood that the statement of selling-price does not commit the vendor in any way.

Every vendor of fertilizers should be conversant with the requirements of the Fertilizers Act, a copy of which, price 6d., may be obtained from the Government Printer, Wellington. Forms of registration will be supplied on application to the Chemist, Department of Agriculture, P.O. Box 40, Wellington, or to any office of the Department.

NEW ZEALAND MEAT-PRODUCERS BOARD.

REVISED SYSTEM OF ELECTION.

THE regulations of 8th June, 1922, under the Meat-export Control Act, governing the election of producers' representatives on the Meat-producers Board, have been revoked, and the following new regulations issued under date 7th June, 1923:—

1. In these regulations "the Board" means the New Zealand Meat-producers Board; "producers' representatives" means the persons to be elected pursuant to these regulations for appointment to the Board as representatives of the persons carrying on the business of the production of meat for export; "sheep-farmer" mean a person owning not less than 100 sheep, and includes a company or other corporation.

2. (1.) For the purposes of the election of producers' representatives a meeting of delegates (herein referred to as "the Electoral Committee"), elected as hereinafter provided, shall be held in the month of August, 1923, and in the same month in each year thereafter, on a day and at a place to be from time to time fixed by the Board. (2.) The Electoral Committee shall comprise twenty-five delegates to be elected by sheep-farmers.

3. (1.) For the purpose of the election of delegates the Board shall divide New Zealand into such number of electoral districts as it thinks fit. (2.) Each electoral district shall consist of one or more counties.

4. The Board shall prepare, or cause to be prepared, for each electoral district a list of sheep-farmers within the electoral district.

5. The number of delegates to be elected for each electoral district shall be determined by the Board, and shall, so far as practicable, bear to twenty-five the proportion that the number of sheep in the district bears to the total number of sheep in New Zealand.

6. (1.) No person shall be eligible for election as a delegate unless he has been nominated by a sheep-farmer and his nomination has been seconded by another sheep-farmer, and he has accepted nomination in writing. (2.) No person may accept nomination as a delegate for more than one electoral district. (3.) The form of nomination may be in the form No. 1 in the Schedule hereto. (4.) Nominations shall be received at such time and in such manner as the Board shall determine.

7. If no more persons are nominated as delegates in respect of any electoral district than are required for that electoral district they shall be deemed to have been duly elected.

8. (1.) If more persons are nominated as delegates for any electoral district than the number that has been determined by the Board for such district, then the electors of such district shall elect the required number of delegates by postal ballot to be conducted by the Board. (2.) If any question arises as to the validity of the election of any delegate it shall be determined by the Board, whose decision shall be final. The Board may in any case, if it thinks that the election of any delegates has been irregular, require a fresh election to be held.

9. (1.) The Electoral Committee shall meet in the month of August on a day and at a place to be fixed by the Board. (2.) At that meeting the Chairman of the Board shall preside. If the Chairman is also an elected delegate, but not otherwise, he shall have a deliberative vote on any question before the meeting. In the case of an equality of votes on any question he shall have a casting-vote, whether he is an elected delegate or not. (3.) The Chairman shall submit to the Electoral Committee for its consideration the report and balance-sheet of the Board's operations for the previous year.

10. (1.) No person shall be eligible for election as a producers' representative unless he has been nominated by a sheep-farmer and his nomination has been seconded by another sheep-farmer, and he has accepted nomination in writing. (2.) The form of nomination may be in the form No. 2 in the Schedule hereto. (3.) Nominations shall be received at such time and in such manner as the Board shall determine.

11. If no more persons are nominated as producers' representatives than are required to fill the vacant positions on the Board they shall be deemed to be duly elected.

12. (1.) If more persons are nominated than are required to fill the vacant positions on the Board, the delegates comprising the Electoral Committee shall proceed to elect by ballot from among the persons duly nominated the number of producers' representatives required. (2.) At such ballot no voting-paper shall be valid unless votes are recorded for the full number of persons required to be elected. (3.) If at such ballot two or more candidates have received the same number of votes, then, if it is necessary for the purposes of the election to determine their order of preference, and so often thereafter as it may be necessary to determine the order of preference of any candidates, a further ballot shall be taken of those candidates only: Provided that if no order of preference is indicated with respect to any candidates in two successive ballots the Chairman shall determine the order of preference by lot. (4.) Subject to the foregoing provisions, the number of candidates required to be elected who have received the greatest number of votes shall be declared elected.

13. The Secretary to the Board shall be the Returning Officer for the purposes of any ballot conducted for the purposes of these regulations.

14. The names of the persons who have been selected pursuant to these regulations as producers' representatives shall be forthwith forwarded to the Minister of Agriculture, and shall by him be submitted to the Governor-General for appointment.

SCHEDULE.

Form No. 1: Nomination of Delegate to the Electoral Committee.

............Electoral District.

Candidate [*Name in full, address, and occupation*]. Nominated by [*Name (signature), address, and occupation*]. Seconded by [*Name (signature), address, and occupation*]. Nomination accepted. [*Signature of candidate.*]

Form No. 2: Nomination of Producers' Representative on Meat-producers Board.
Candidate [*Name in full, address, and occupation*]. Nominated by [*Name (signature), address, and occupation*]. Seconded by [*Name (signature), address, and occupation*]. Nomination accepted. [*Signature of candidate.*]

Correction.—The Jersey cow shown on page 201 of the April *Journal* as St. Lambert's Bell is Lady Quickstep. Conversely the Jersey appearing on page 308 of the May issue as Lady Quickstep is St. Lambert's Bell.