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CONTROL OF WEEDS BY SODIUM AND CALCIUM CHLORATES.

FURTHER INFORMATION AND ADVICE.

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AN article by the writer on the use of chlorates in weed control, especially in regard to ragwort, was published in the May issue of the *Journal*. Considerable interest in the subject has been created, and various statements and claims are being made in reference to the discovery and use of these chlorates for weed destruction. The position is that most of the chlorates have been under test for several years as agents for weed-control, and the general results, particularly in France and America, go to show that the most effective work is being done by sodium and calcium chlorates.

The attention of the Fields Division was particularly directed to the use of these chlorates some eighteen months ago by reports of experiments carried out in the United States for the control of bind-weed (convolvulus) by means of spraying with sodium chlorate. This suggested the possibilities of chlorates for the control of some New Zealand weeds, particularly ragwort and similar plants. We also learned that calcium chlorate was being tested in Australia by the Victorian Railway Department for the control of weeds on the railways. Inquiry was made from the authorities in Melbourne, and their report was so favourable that we decided to give both chlorates a trial. Half a ton of the sodium and a small drum of the calcium was secured, and experiments were started as related in the previous article.

Ragwort being a weed that was causing farmers great trouble received most attention, although small experiments with other weeds were carried out, with the result that we found that most soft weeds were destroyed by one application, while the harder weeds, such as Californian thistle, blackberry, &c., were greatly weakened. At the present time there are indications that three sprayings have killed patches of Californian thistle; but we shall require next season's experience before making a definite statement regarding this weed. The same remarks apply to blackberry. Quite a number of experiments are under way this year with various weeds, and so soon as anything definite in regard to any particular weed is available the

information will be given due publicity. It may be mentioned here that Scotch thistle, which does a great deal of harm in good pastures by spreading out and smothering the grass, and which is costly to grub, is easily controlled when in the rosette stage by a spraying of sodium chlorate.

We do not look upon sodium chlorate as a " kill-all," but apparently there are many people who have got the idea that if it will kill ragwort it will kill most things, and we have had inquiries from all over New Zealand asking if the chlorate will kill couch, rushes, gorse, piripiri, &c. Up to the present we have not been able to thoroughly test the material on these plants, and cannot give any reliable information just now. We are carrying out tests, but it is suggested that farmers might also conduct small trials themselves. We shall always be pleased to hear of results obtained by farmers.

In the last article the writer recommended the spraying of ragwort from early October onwards. Now, with the extra two or three months' experience since the article was written, there can be no hesitation in advising farmers to start spraying so soon as the second growth appears in the autumn and to go right on throughout the winter so long as the plants are appearing. This has the great advantage that the spraying may be done when the grass is short and the ragwort easily seen, and when more time is available for this class of work. Solutions of 2 to 2½ per cent. are quite strong enough for winter work on ragwort. As already advised, a fine day should be chosen for the spraying.

In the previous notes it was pointed out that both sodium and calcium chlorate had been tested by the Fields Division and that both appeared efficient, but that we considered sodium the better. At the present time there are indications that ample supplies of sodium will be available at about 5d. per pound for drums of 2 cwt., at 6d. to 7d. per pound for smaller parcels, and with special quotations for ½-ton lots.

Representations have been made to the Department of Agriculture that we should import the chlorates and sell to farmers at cost price, but it has been decided that so long as merchants import sufficient and sell at a reasonable profit over cost the Department will not interfere. Should any attempt be made to impose an undue profit the Department certainly would reconsider the position. From the great interest merchants are showing in the matter this is not likely to happen, however.

Considerable discussion has taken place on the merits of calcium chlorate as against sodium chlorate, particularly in regard to the fire risk. The advantages of sodium chlorate are that it appears to do better work, is cheaper, better to handle, and ample supplies of it are available. Supplies of calcium chlorate, on the other hand, are not so plentiful, and, as already mentioned, it is at present more costly; also, as it readily absorbs moisture it is not so easy to handle. It does not, however, present the same risk from fire. We have just landed a further half-ton of calcium chlorate, and its advantages and disadvantages will be thoroughly tested this year.

There does not appear to be much risk with the dry sodium chlorate so long as it is not mixed with any other dry material, such as dry

earth; but if mixed with the latter or similar material it is supposed to burn readily if it comes in contact with fire. The greatest danger appears to be when clothes become saturated with the liquid spraying material and are allowed to get dry. They then burn rapidly if allowed to come in contact with fire. Persons using sodium chlorate as a spray should endeavour to keep their clothes dry, and if by chance the clothes get wet they should be rinsed with water—hot or cold—before drying. As a precaution, users are advised to wear oilskin leggings or gum boots when working with this spray. One of the Fields Division officers wore gum boots for several months when spraying with this material, and so far as can be seen it has not had any detrimental effect on the boots or his clothing.

Dealing with Blackberry.

At a recent field-day gathering in Taranaki the writer mentioned in reply to a question that there were indications that sodium chlorate would kill blackberry, but that we would not be in a position to give definite advice as to the proportion of kills or best method of application until experiments which were under way had been going long enough to give conclusive results. This was miscontrued by some of the newspapers into statements that we were definitely recommending its use to kill blackberry. The position is that our trials show with blackberry, sprayed last December when in full bloom, a large percentage of the plants killed, but some are still growing and will require further attention. This is in keeping with some of the experiments in Victoria, where the greater bulk of the blackberry was killed with a 15-per-cent. solution of sodium chlorate when sprayed in the summer, and a second spraying in the autumn cleaning up the remainder. There are also indications that applying the dry crystals round the roots of the blackberry might prove effective. However, as already indicated, we shall have reliable information on the subject later on. In the meantime farmers may test the matter for themselves.

Spraying Apparatus.

A knapsack sprayer will be found the most serviceable for general use, and it should always be fitted with a trigger spray, which gives the person using it good control and prevents waste of material. The spray nozzle should also be fine so as to nicely wet the plants without using a great deal of material. A very good type of sprayer is now being made at Christchurch, and is retailed by dealers at £4 2s. 6d. Where only small quantities of weeds are to be sprayed a garden syringe may be used. Again, where only very scattered plants are to be treated it will probably be best to carry a small quantity of the crystals, and after bruising the plant with the heel, put two or three crystals on its crown.

It may be mentioned here that the Live-stock Division of the Department, which carries out the inspection of noxious weeds under the Act, is equipping its field officers with spray pumps and material to give small demonstrations in their districts in order to encourage farmers to adopt this means of weed control. All who are interested would do well to get in touch with the Stock Inspector for their district.

FACTORS INFLUENCING THE ABORTION AND STERILITY RATES IN DAIRY HERDS.

BREEDING DATA FROM NORTH TARANAKI DISTRICT.

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IN order to form a comprehensive and reasonably accurate estimate of the prevalence of abortion and sterility in North Taranaki dairy herds, and also to ascertain to what extent the breeding-efficiency of a herd is influenced by the methods of management and maintenance adopted, practically every dairy-farmer in this district was circularized early in September, 1929.

Information was sought on the following points by means of a questionnaire to the following effect :—

(1) Acreage of farm.
(2) Number of dairy cows in herd.
(3) Whether (*a*) cows were hand-served—that is, bull kept separate and cows taken to him as required; or (*b*) bull was allowed to run with the herd.
(4) Date on which breeding operations commenced.
(5) (In case of 3*a*). Number of cows holding to first service.
(6) (In case of 3*b*). Number of cows calving to full time or before 31st August, 1929.
(7) Number of cows which failed to become pregnant.
(8) Number of "slips" or abortions during the winter.
(9) Method of herd-maintenance—(*a*) solely by home-reared heifers, (*b*) by outside purchases.
(10) Whether the cows were given to chewing bones, &c.

One thousand four hundred and eighty-nine copies of this questionnaire were posted and 644 replies were received; seventy-one of the latter were discarded, mainly owing to incomplete or approximate figures being entered, and the remainder have been systematically tabulated.

Twenty-three herds were picked out in which the owners reported considerable breeding difficulty. The returns showed only from 30 per cent. down to nil of the cows to have calved on or before 31st August and/or to have held to the first service. Sterility apparently existed in epidemic form in these herds, which will be dealt with later as a separate group.

The remaining 550 returns were regarded as normal, with 50 per cent. and upwards of the cows calving on or before 31st August.

The returns were tabulated to contrast the following points :—

(1) Herd-management—Hand service as opposed to allowing the bull a free run with the herd.

(2) Herd-maintenance—Home-reared heifers as opposed to outside purchases of cows and/or heifers.

In a number of returns it was stated that the bull was running with the herd, but full service records had been kept as for hand service. Such returns, however, were not classified as hand-served. Similarly in regard to maintenance, where it was stated that the herd was

chiefly maintained by home-reared heifers and only occasionally by outside purchases, it was nevertheless classified under the latter heading.

Table 1.

Column 1.	2.	3.	4.	5.	6.	7.	8.
Group.	Maintenance.	Number of Herds.	Number of Cows.	Average Number of Cows per Herd.	Number of Cows calving on or before 31st August and as Percentage of Total.	Number of Slips or Abortions and as Percentage of Total.	Number of Empty Cows and as Percentage of Total.
Group I— Hand-served ..	Home-reared heifers	141	5,555	39·4	4,108=73·9 per cent.	234=4·2 per cent.	215=3·9 per cent.
	Outside purchases	97	4,036	41·6	2,776=68·7 per cent.	260=6·4 per cent.	229=5·7 per cent.
Group II— Bull running with herd	Home-reared heifers	180	7,724	42·9	5,196=67·2 per cent.	360=4·7 per cent.	213=2·7 per cent.
	Outside purchases	132	6,488	49·1	4,013=61·8 per cent.	368=5·7 per cent.	288=4·4 per cent.
Totals ..	..	550	23,803	43·3	16,093=67·6 per cent.	1,222=5·13 per cent.	945=3·97 per cent.

General Discussion.

Table 1 shows the average results obtained by the four alternative combinations of herd management and maintenance. It should be stated here that in the "hand service" group the figures show as "calved on or before 31st August" were actually the numbers shown in the returns as "holding to first service." The reason for this was that in the wording of the questionnaire the former question was unfortunately made optional in the case of hand-served herds from which exact breeding records were available. Both questions were, however, answered in respect of eighty-five herds, in which 2,302 cows were returned as "held to first service" and 2,291 as "calved on or before 31st August." As a rule, where breeding commenced towards the end of October these returns showed more cows "held to first service" than "calved to 31st August," whereas when it was commenced early in October the reverse was the case. In the aggregate, however, these discrepancies almost exactly balanced—a difference of eleven in 2,302 records representing only 0·4 per cent. error. In view of this it may be safely assumed that the total for the whole group which "held to first service" was to all intents identical with the number "calved on or before 31st August."

Apart from this, the variations in the percentages in each column may be considered wholly significant, the probable margin of error in so large a cow population being extremely small.

The results indicate quite definitely that hand service increases the average breeding-efficiency of a herd, taking the numbers calving on or before 31st August as a basis. Group I (hand-served) gives an average of 71·8 per cent. as compared with 64·8 per cent. for Group II, a difference of 7 per cent. in favour of hand service.

Breeding-efficiency is also influenced by the method of herd-maintenance. In both groups there is a definite decrease in the breeding-efficiency of the subgroup shown as maintained by outside purchases compared with that maintained by home-reared heifers. In addition to this general decrease in breeding-efficiency in the "outside purchase" subgroups, there is an increase in the number of both "slips or abortions" and of "empty cows" to the extent of roughly 2 per cent. The relative figures for "slips or abortions" in the subdivisions of each group show little or no significant variation, but those for "empty cows," although the relative variation between the subdivisions of either group is approximately the same, are definitely less in Group II than in Group I. The explanation of this probably lies in the fact that breeding operations are carried on to a later date in those herds in which the bull is running. In quite a number of instances the date at which breeding ceased for the season was given in the space left for "Remarks" in the questionnaire. These replies showed that it was often the practice to give up attempts to breed about the end of January and to carry through any cows empty at that date in hand-served herds, whereas the bull was frequently allowed to run with the herd until the end of February or later. This would undoubtedly result in a few cows holding to service very late in the season and so lower the percentage for this group.

The Breeding Season.

The date on which breeding operations commenced for the season varied to some extent with the district. Coastal districts had a tendency to begin early in October, while colder and more backward inland districts, as a rule, were two or three weeks later.

Replies were not furnished in every instance regarding this question, but in 334 returns a definite date was given, the results being as follows:—

September 24–30 ..	24 herds.	October 15–21	101 herds.
October 1–7	44 ,,	October 21–28	59 ,,
October 8–14	53 ,,	October 29 to November 4	53 ,,

In a few instances the date was later still, but such returns were included in the group of seventy-one discards mentioned earlier and not used in the general analysis.

These figures show that there is a very definite peak in the third week in October. Cows bred from this date will calve from 1st August onwards.

In the case of hand-served herds it has already been shown that "holding to first service" and "calving on or before 31st August" were in the aggregate practically synonymous terms, and it is a safe assumption that this statement holds good over the whole series of returns, since the great majority of cows which fail to hold to their first service must, obviously, calve subsequently to 31st August. It follows, therefore, that any decrease in the percentage of cows calving on or before 31st August represents an increasing percentage which failed to hold to the first service.

An analysis of some 700 individual breeding records has shown that, while a few cows return to the bull at a shorter interval than the

normal three-weekly period a considerable number exceed this time, and the average interval over the whole series was twenty-five days.

As a concrete example of the significance of the figures already quoted, the breeding-efficiency (number of cows holding to first service) of a herd of one hundred cows on the hand service and home-reared heifers system is, according to Table 1, column 6, 73·9 per cent., while a similar herd run with the bull and maintained by outside purchases shows only 61·8 per cent. efficiency, a difference of 12·1 per cent., or a loss of the production of twelve cows for a period of twenty-five days—a considerable item.

Factors influencing System of Herd Management and Maintenance.

Herd management and maintenance are both influenced to some extent by the size of the herd. Table 2 shows that 238 hand-served herds average 40·3 cows per herd, while 312 herds with which the bull runs average 45·5 cows per herd.

Table 2.

——	Herds.	Cows.	Cows per Herd.	Acres per Farm.	Acres per Cow.
Group I ..	238	9,591	40·3	117·7	2·92
Group II ..	312	14,212	45·5	133·3	2·93

Reference to Table 1, column 5, shows that of the 238 hand-served herds 141 are maintained solely by home-reared heifers and average 39·4 cows per herd, while 97 maintained by outside purchases average 41·6. The 312 herds with which the bull runs show 180 maintained by home-reared heifers and averaging 42·9 cows per head, while the remaining 132 maintained by outside purchases average 49·1 cows per herd.

Contrary to expectations, however, closer subdivision, leading to a better utilization of the land, is apparently not a factor influencing the system of herd-management adopted. Table 2 shows that the average size of the farms comprising Group I (hand-service) is 117·7 acres, while that of Group II is 133·3 acres. However, the area required to support each cow in Group I is 2·92, and in Group II 2·93 acres—practically a constant. The increased acreage per farm in Group II (15·6 acres) compared with Group I is exactly accounted for by the increased average size of the herd in the former group (5·2 cows).

The Significance of Bone-chewing.

The importance of adequate mineral supplies in the diet of stock is universally admitted at the present time. The mineral requirements of various classes of stock vary to some extent. Those of the modern dairy cow are particularly high, especially as regards phosphorus. This is becoming more and more universally appreciated, as evidenced by the annually increasing application of phosphatic manure to dairy pastures. The significance of bone-chewing lies in the fact that about 84 per cent. of the mineral matter of bone consists of calcium phosphate, and when cattle are grazing on minerally deficient pasture they

instinctively endeavour to satisfy their craving for further phosphorus by eagerly chewing any bone which they can find.

It is a well-known scientific fact that an extreme phosphate deficiency may reduce the breeding efficiency by bringing about a total inhibition of any sexual desire (heat periods). Such an extreme deficiency on dairy pasture is rare and was not reported in any instance.

However, bone-chewing is a safe indication of some degree of phosphatic deficiency, and the last query in the questionnaire was designed to ascertain to what extent a slight deficiency influenced the breeding efficiency.

Table 3.

—	Reported Bone-chewing.	Bone-chewing non-existent.
Number of herds	72*	478
Number of cows	2,986	20,817
Number of cows calving on or before 31st August	1,903=63·7 per cent.	14,190=68·2 per cent.
Number of slips or abortions ..	179=5·96 per cent.	1,043=5·01 per cent.
Number of empty cows ..	124=4·15 per cent.	821=3.94 per cent.

*Hand-served and home-reared heifers, 16 herds; hand-served and outside purchases, 13 herds bull running and home-reared heifers, 24 herds; bull running and outside purchases, 19 herds.

Table 3 shows that seventy-two herds which reported bone-chewing gave a decrease of 4·5 per cent. in their breeding-efficiency (number calving normally on or before 31st August) compared with the remainder of the returns which reported no bone-chewing. The figures for "abortions" and "empty cows" are both higher, although only slightly. The differences are probably wholly significant, as the numbers of herds under each of the alternative methods of management and maintenance (as shown in the footnote to Table 3) are proportionally almost identical with those of the complete series (see Table 1, column 3).

The increases of "abortions" and "empties," though slight, are interesting in view of the fact that the United States Department of Agriculture has reported an increase of abortion and sterility on mineral-deficient pasture.

In addition to the seventy-two herds whose owners reported bone-chewing, a further forty-eight farmers stated under "Remarks" that this habit was formerly in evidence in their herds, but had ceased of recent years as a result of regular phosphatic top-dressing.

Apparent Epidemic Sterility.

As stated earlier, returns from twenty-three herds revealed evidence of the existence of what appeared to be an epidemic form of sterility. These herds totalled 1,289 cows, with 226 or 17·5 per cent. calving on or before 31st August, 72 or 5·6 per cent. "slips or abortions," and 129 or 10 per cent. "empty cows." A discussion of the specific cause of such outbreaks of sterility is outside the scope of the present article. It will suffice to state that it appears to be a definitely infectious disease and not directly related to contagious abortion, since the percentages of abortions (5·6 per cent.) is similar to the normal average (5·1 per cent.).

Herd-management does not appear to affect the incidence of such outbreaks, since approximately equal numbers were "hand served"

and "run with the bull." Herd-maintenance, on the other hand, appears decidedly significant. Whereas in the 550 herds considered "normal" 321 were maintained by home-reared heifers and 229 by outside purchases—a ratio of 1 : 0·7—in this group the numbers are 8 and 15 respectively, a ratio of 1 : 1·87. Purchases in the open market would therefore appear to greatly increase the risk of introducing an epidemic form of sterility into a herd.

CONCLUSIONS.

(1) In North Taranaki the proportions of cows calving on or before 31st August, aborting, or failing to become pregnant are approximately 68 per cent., 5 per cent., and 4 per cent. respectively, calculated on returns totalling 23,803 cows.

(2) Hand service combined with herd-maintenance by means of home-reared heifers results in the highest average breeding-efficiency, while the practice of allowing the bull to run with the herd coupled with maintenance by means of saleyard purchases gives the worst results.

(3) Irrespective of the method of herd-management, maintenance by outside purchase results in decreased breeding-efficiency, together with increased numbers of abortions and empty cows.

(4) The methods of herd management and maintenance adopted are influenced by the size of the herd; the smaller the herd the greater the tendency to hand service and maintenance by home-reared stock, and *vice versa*.

(5) The size of the farm is not a factor influencing the system of management and maintenance.

(6) Bone-chewing is a sign of mineral deficiency, and is reflected in a decreased general breeding-efficiency, and possibly in increased abortion and empty cow rates.

(7) Epidemic sterility apparently exists in about 3·5 per cent. of herds, and its incidence seems to be markedly influenced by the system of herd-maintenance, being nearly twice as prevalent in herds kept up by outside purchases (see also No. 3 above).

(8) Apparent epidemic sterility is not directly connected with contagious abortion, since the abortion rate in affected herds is similar to that for normals.

Siberian Cheese and Butter on London Market.—In a recent report Mr. W. Wright, Inspector of New Zealand Dairy-produce, London, remarks: "There has been a certain amount of cheese arriving in London recently from Siberia. When compared with pre-war days the cheese shows a marked improvement in make, but the flavours are very unclean—in fact, 'vile' would not be too strong a term to use. The shippers, however, take great care, not only with the cheese, but also with the butter exported. For instance, the individual cheeses are packed in crates, but first of all wrapped up in paper and then packed in wood shavings. In the case of butter, the quality of which is variable (but which does also show a certain amount of improvement in quality), the individual casks are wrapped up in a woven mat, after the style of some mats that are woven with New Zealand flax. On arrival of the shipment at Hay's Wharf, and before going into cold store, these wrappers are removed and the casks are then found to be in quite a clean condition, free from soiling of any kind, which makes the packages look very attractive to the trade."

MINERAL CONTENT OF PASTURES RESEARCH.

SOME NOTES ON THE WORK IN 1929-30.

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IN order to keep in view the aim of the Empire Marketing Board in granting a considerable sum of money annually for work on the mineral content of pastures in New Zealand for a term of years, it is desirable briefly to define the objective. Instructions remitted to the writer, as director of the grant made to the New Zealand Government, in February, 1928, explicitly stated that the money was granted by the Empire Marketing Board to test the application of the work of the Rowett Research Institute to New Zealand pasture. There was great need for testing, by feeding experiments or by grass-analysis, the value of mineral supplements in lime, phosphoric acid, and iodine deficient areas. If such deficiencies do occur in New Zealand, it is obvious that mineral supplement feeding will at once raise production. It will decrease mortality and improve wool. It was understood by the Imperial authorities that there were in New Zealand areas exhibiting evidence of mineral deficiency in the pasture, and therefore that a few experiments would demonstrate the importance of mineral supplements.

It will be noted that two kinds of evidence mentioned as necessary in determining the occurrence of deficiency of minerals are (1) that derived from feeding experiments, and (2) that derived from grass-analysis. There is no mention of blood-analysis or analysis of other portions of the animal. As the Rowett Institute is well supplied with physiologists and physiological chemists, blood-analysis would no doubt have been mentioned could any reliance be placed upon it as a method of detecting deficiencies in food.

It is evident that, without experiments on animals in the field, results of mere analyses are unconvincing. During the past year, therefore, endeavour has been made to push the animal experimental side of the investigation. Experiments with various licks, pellets, and other substances have been instituted with both sheep and cattle. Continued great and undoubted success has attended the use of the double citrate of iron and ammonium, so that the complete control of bush sickness in cattle at an early date may be confidently anticipated. The effective use of this compound with cattle has been recognized for several years by the Department of Agriculture and some settlers, but the idea of giving an additional food element is a novel one and takes years to establish as a practice.

A pleasing development of recent growth is the endeavour to use the remedy found so successful with cattle, to accomplish the continuous grazing and development of sheep on bush-sick lands. An experiment, begun in July, 1928, at Mamaku Demonstration Farm with a small flock of wethers was entirely successful in bringing the sheep back to health when they had started (in January, 1929) to become bush sick on unimproved paddocks heavily top-dressed with phosphates, and they were kept in good health for a year subsequently by the use of

iron pellets. Finally the wethers were sold fat. The difficulties in connection with the automatic administration of the extra food iron to sheep are, the writer is convinced, not insuperable, although difficulties have been encountered in the past year and losses sustained. Such are unavoidable in any original work where it is sought to impose an entirely new treatment of stock on the farmers.

In connection with this phase of the use of iron remedies, a recent report received states: "It is interesting to note that the five lambs and six ewes mentioned as having survived the hardships necessary to induce them to take the pellets are now in splendid condition and doing exceedingly well. These lambs are the first ever reared to the hogget stage on this farm. The future prospects of rearing one's own lambs to the breeding-ewe stage, which, incidentally, is the ideal aimed at in these experiments, is indeed bright, judging from the results of these few sheep under trial only three brief months."

PASTURE-ANALYSIS.

At the beginning of the working-year a scheme of work was laid down which would indicate roughly the effect of seasonal changes on the composition of typical pastures. The initial demand that the sampling of the pastures was a highly important work which required just as much skill lavished on it as on the analysis having been conceded, Mr. R. E. R. Grimmett, who has always been utilized as the officer in charge of the country work, was charged with the duty of supervising the collection of the pasture and soil samples in all cases except the Te Kuiti district.

The areas set down for intensive study were—

(1) The Te Kuiti district.
(2) The Wairarapa district.
(3) The Taranaki district.
(4) The Rotorua district.
(5) The Waikato district.
(6) The Poverty Bay back areas.
(7) Otago Central and Southland areas.

Various troubles in stock occurring in these districts led to their being chosen for work in this investigation, among which were—

(1) Temporary sterility
(2) Eclampsia } (in cows).
(3) Waihi disease
(4) Bush sickness or similar trouble (in cattle and sheep).
(5) Dopiness, or Mairoa malnutrition (in sheep).
(6) Iodine deficiency (in sheep).
(7) Pulpy kidney (in lambs).

Under the close supervision of the local or other veterinary officer of the Department of Agriculture, in all areas except Te Kuiti, farms were selected from which during the year under review periodic samples could be collected. It was not anticipated that work for one year would establish seasonal differences. The seasons in the North Island are notoriously fickle, the temperature and precipitation being extremely variable for the same season in different years. It was impressed on the samplers that they should exercise the greatest care in selecting the samples, and the Department obtained two assistants who were peculiarly fitted for this work.

SOIL-ANALYSIS.

In past years the examination of the country in the Rotorua district has yielded evidence of the greatest value in the mechanical analysis of the soil. It was found possible to classify the country more easily on the basis of soil-texture rather than on either geological or chemical considerations, and the texture (which can be expressed arithmetically) will be the guiding principle in determining the liability of bush sickness to occur on different lands. Whether this method will be found equally useful with malnutrition diseases other than bush sickness remains to be determined.

Te Kuiti District

The work in this area consisted chiefly of experiments in the field on animals, and the collection of samples for analysis. These experiments were under the control of Mr. C. M. Wright, Country Analyst. In January last Mr. Wright was promoted to the Native Department, and this rather upset the continuity of the field-work, as the results of a number of field experiments laid down and controlled entirely by him had yet to be adequately reported upon.*

The laboratory-work in this district has consisted largely in the analysis of soils and some pastures. During the last few months the taking of samples from Mairoa, which for various reasons offered difficulty to the samplers, has greatly been improved. Regular and good samples have now been received, and are being analysed as quickly as circumstances permit.

"MAIROA DOPINESS."

The investigation of any deficiency disease in domestic stock is best studied in three different directions with the object of ascertaining how (1) the soil, (2) the pasture, and (3) the animal differ from the normal; and each of these three factors in farming should be studied *separately* to determine how far each departs from the normal.

In the case of air-borne volcanic showers of *fine* material which form the typical soils of the Mairoa district and many other areas, an initial study of the mechanical and chemical composition of the soil brings out certain abnormalities wherein the soil differs from that of average hillside upland sheep-pastures of the North Island. These are (1) the very high "lime-requirement" by the Hutchison-McLellan method—roughly about 10 tons per acre; (2) the very high organic matter content—20 to 30 per cent; and (3) the exceptionally porous nature.

The soils belong to the class called "loams," which are universally recognized as fertile soils; hence it is probable that normal returns may again be expected under suitable treatment. In the three above particulars the Mairoa soils and probably all similar fine-grained volcanic soils with a similar history are an exception to the ordinary poor upland sheep-runs, and it may be in the study of these divergencies that a clue will be found for the failure of the herbage to sustain normal growth in the animals thereon depastured. That the soil exhibits in common with other soils put to a like purpose similar deficiency (*e.g.*, phosphoric acid) does not help much, seeing that similar deficiency occurs on all poor hilly country where disease does not develop.

* This report has not yet (June) been received by the writer.

There can be no doubt of the excessively high lime-requirement. In addition to the samples investigated by the officers of this Laboratory, Mr. J. K. Dixon, M.Sc., a research student, has spent several months at Te Kuiti carefully examining the lime status of the soils of the district, including pH value, replaceable lime and lime-requirement figures, and fully confirmed the immediate need for lime in the following unmistakable pronouncement :—

The application of the above methods to the district of which Mairoa is the centre shows that the country needs lime badly, and if the same figures were obtained for Southland soils one would not hesitate to recommend the application of 3 to 4 tons of limestone within the next few years. In view of the heavy leaching that goes on in the 100 in. rainfall district, it will be more economical to apply the lime in small quantities after a heavy initial dressing, rather than heavy top-dressings at long intervals.

The point that must be stressed is that although the lime required may vary from the typical light loam to the heavy mudstone-derived soil, yet wherever there is this light ash-derived browny sandy loam as a topsoil, either pure or mixed with the underlying formation, there is a pressing need for the immediate application of lime.

The writer, it will be remembered, has always emphasized the extreme need of lime for these soils (this *Journal* for September, 1928, p. 145) and the effect of leaching.*

* It is hardly likely that one of the elements leached out should be phosphorus. The Rotorua coarse pumice lands are subject to heavy leaching by a rainfall of 70 in. Cattle-farming is the type of grazing practised there, but no Waihi disease occurs on such pumice types, even on unmanured land. Such would undoubtedly occur were phosphoric acid leached out in any quantity. On the Mairoa loams, where dairy-farms are common, there is no history of Waihi disease occurring. This trouble is undoubtedly due to lack of phosporus in the pasture.

Regarding the high organic-matter content, it is difficult to assess the effect, but such soils are usually responsive to lime dressings.

The porous nature of the soil, making this subject to excessive leaching, is further evidence that lime is highly necessary, seeing that lime is a mineral substance lost by leaching from soils in very large amounts. Experience on many different types of soil in America, England, Scotland, India, and elsewhere gives unanimous evidence that phosphates are leached out only in very small quantity. In experiments at Rotorua with a very coarse pumice soil treated with superphosphate no phosphate could be detected in the drainage effluent from a lysimeter. Joachim ("Peradenya Drainage and Leaching Trials," *Tropical Agriculturist*, Vol. 73, No. 5, 1929, p. 271) states that "no phosphoric acid appears to be lost in the drainage waters of the Ceylon soils." Hendrick (*Trans. Highland and Agricultural Society*, Vol. 33, 1921, p. 76), "An Account of the Craibstone Drain Gauges") states: "Yet so well is the phosphate held by the soil that practically none of it is washed away in the drainage." Dyer found that no less than 83 per cent. of the phosphoric acid which six of the plots at Rothamsted should from calculation possess after fifty years' manuring was still present in the top 9 in. of the soil, whereas the subsoils from 9 in. to 18 in. and 18 in. to 27 in. showed no accumulation of phosphates (Hall, "The Soil," p. 221). Russell stresses the fact that, of all bases, calcium is the one most easily lost ("Soil Conditions and Plant Growth,"

1927). He states that P. W. Robinson considers calcium starvation the chief factor in North Wales soils subject to heavy rainfall.

It may be taken, therefore, that not only is there great deficiency of lime in the Mairoa soils, but that this deficiency is progressing both at Mairoa and on other soils more recently cleared and grassed; so that the experience at Mairoa may be expected to occur elsewhere in course of time. It must always be remembered that the initial history of Mairoa was highly favourable to the use of that type of country for sheep; that after some years of stocking the country did not improve as does the typical bush-sick pumice country, but after a time progressive deterioration set in and the utilization as sheep country became unprofitable. Something evidently was comparatively rapidly leached out of the soil, and that this something was lime there is much circumstantial evidence to prove. It may therefore be taken as proved that the crying need of this area in order to make the soil more normal is lime carbonate.

The analysis of the pasture provides the second class of criteria which must be examined in investigating deficiency diseases, and this is a more difficult direction to explore, owing to the fact that one is dealing entirely with living matter which is changing in chemical composition all the time with the climate and season, with the stage of growth, and with the botanical composition. Nevertheless, the analyses of the Mairoa pastures do show an abnormally low calcium content at all seasons of the year, and when these pastures are top-dressed with calcium carbonate they do, if the samples are properly taken, show an appreciable increase in the lime content. The entire absence of leguminous constituents in the untreated pastures upon which the malnutrition develops is further evidence of calcium deficiency, since legumes are the characteristic lime-winning plants in a pasture normally containing from two to three times as much calcium as the grasses contain even on unmanured land.

Finally, the composition of the animal may be studied, or, what is more to the point, the physiological symptoms. This is a very special department, and the technique is as yet poorly developed and very difficult to carry out. That this is realized by the authorities is shown by the importance attributed to the analysis of the pastures. Were it possible to determine from an analysis of blood, for instance, from what particular deficiency the animal is suffering, and any reliance could be placed on the result, the lengthy and laborious gathering and analyses of pasture samples could be largely discontinued

The proof of all the conclusions reached in the laboratory is, of course, the actual results on animals on a field test. The results of these will form the basis of a separate report, but an outstanding case may briefly be narrated.

A field experiment was carried out on a bleak hillside of 20 acres, 1,000 ft. above sea-level, where the pasture was brown-top, fog, and danthonia growing among the stumps of the old burn, the land not having been ploughed or top-dressed at any time. An application of 40 tons of very roughly ground limestone was made on the 20 acres in January, 1928. The history of this paddock of recent years has been that of high mortality experienced from malnutrition in sheep, and it was considered that parasites were not

responsible. Forty culled hoggets from a near-by farm, but one more sheltered and with a better pasture than the experimental paddock, were transferred to it in February, 1928. The hoggets did well. Unfortunately, dogs visited the paddock in March, 1929, and killed, injured, or drove into the creek a number of sheep. Nevertheless, when the experiment was concluded in March, 1930, thirty-two sheep were found on the limed paddock, and were seen by the two highest veterinary authorities in the Dominion, who reported them looking healthy and in very good condition. The owner of the sheep was so well satisfied with the results of lime in curing the malnutrition that he ordered 75 tons. Gypsum (land plaster or sulphate of lime) apparently has the same effect in curing the malnutrition.

The writer has from the first always contended and has publicly stated that the Mairoa type of country cannot be farmed without phosphates, but he entirely agrees with Mr. C. M. Wright that "lime is the limiting factor" in bringing the calcium-deficient area back to productive capacity (Annual Report of Department of Scientific and Industrial Research for 1928–29, pp. 23–26). Following excellent precedents, the land may be described as calcium-starved, and the trouble as "calcium starvation."

Some proved method of curing the malnutrition must be discovered before attempting to increase production by phosphate dressings. A mixture of lime carbonate and superphosphate known as the "5 : 2 mixture" (5 cwt. carbonate of lime to 2 cwt. of superphosphate per acre) has given great promise of being curative as well as of increasing the carrying-capacity. Full details of the animal experiments will doubtless be available for discussion later when the report on the field experiments is received.

Rotorua and Adjoining Counties.

The experiments in the coarse pumice area involved the usual treatment of animals with pellet, lick, and drench, the collection of pasture samples, the treatment of the soil by manuring and by top-dressing with fertilizers, and the collection and analysing of drainage-water. Mr. C. R. Taylor, a Country Analyst's skilled assistant, has been stationed at Rotorua in order to further these experiments. It is satisfactory to note that no evidence can be obtained of any leaching of phosphates from the soil when they are applied as superphosphate in the area of coarse soil and heavy rainfall (60 in. to 70 in.). Mr. Taylor also supervised experiments with various chemical compounds (including sodium chlorate) and mixtures on the eradication of ragwort by chemical means, and these provide evidence that ragwort, which is considered locally a great danger and cumulative with bush sickness in preventing the settlement of the pumice lands, need no longer be feared.

The writer of these notes has previously remarked on the fact that soils formed from volcanic air-borne showers of material when coarse in texture give rise to malnutrition or deficiency diseases in ruminants, whereas adjacent or near-by sedimentary soils, even though principally derived from similar materials as the air-borne showers, are free from such diseases. There has been the inevitable tendency to confuse

similar deficiency diseases, and the hypothesis has been advanced that the "Mairoa dopiness" in sheep is the same as "bush sickness," in spite of veterinary advice to the contrary. The exact definition of these two diseases is, of course, work for an animal pathologist, but it may be remarked that a typical bush-sick animal, even at death, has healthy well-developed bones, whereas in Mairoa dopiness animals have light bones. It does not seem possible that a bush-sick animal should be suffering from a deficiency of phosphates and lime when at all stages of its growth it is able to develop such good bones as do the animals on typical bush-sick country. Further, there is the experience acquired at the Mamaku Demonstration Farm and elsewhere by several direct experiments that top-dressing the pasture with phosphates or with lime does not eliminate bush sickness. At Mairoa, on the contrary, there is gradually accumulating evidence that phosphates and lime, and even lime or gypsum alone, are curative when applied to the soil. Veterinary authorities assert, moreover, that the symptoms of these diseases are sufficiently distinct for them to be separated.

Bush Sickness.

The year has witnessed many suggestions from various experts as to the cause of the progressive anæmia in ruminants known as "bush sickness" or iron-starvation. The new hypotheses (for they can hardly be dignified by the name of theories, as they are put forward without any evidence to support them) are: (1) That bush sickness is due to deficiency of available calcium in the soil; (2) that it is due to deficiency of available phosphoric acid in the soil; (3) that it is due to both calcium and phosphoric acid being deficient; (4) that it is due to a poisonous mineral element in the soil; (5) that it is due to a poisonous organic compound in the pasture.

Nos. (1), (2), and (3) are disposed of from the fact that there is ample lime and phosphoric acid in much of the pastures upon which stock become bush sick, so that no amount of top-dressing with phosphates will cure the trouble in a season or so, although top-dressing undoubtedly enables the stock to be kept longer in health on the top-dressed compared with the non-treated paddocks. Neither does administration of phosphates to an animal enable it to recover when affected with sickness, nor prevent it from being sick. That the bones of an animal dying of bush sickness are always normal in composition and texture is also significant, the bones being the repository or bank of phosphates and lime in the animal.

Those seeking a poisonous element have the difficult task of finding one in such diverse soil-formers as the pumice lands of Rotorua, the dune sands of New Zealand generally, the calcareous dune sands of Tasmania (King Island), the granitic gravel wash of Nelson, the volcanic ash of Mount Kenya (Africa), and the Cheviot Hills of Scotland on a coarse sandy silt—on all of which the bush-sickness condition occurs.

Those seeking poisonous organic compounds must search in such diverse fodder-plants as grasses on the one hand and clovers on the other. It is hardly possible that two such widely separated botanical families as the Gramineæ and the Leguminosæ could elaborate within their tissues the same organic poison.

One feels certain of the fact that these soils, which are undoubtedly bush sick, and which continue to be so for a number of years after they have been cultivated and top-dressed or laid down in pasture, are always found to be coarse-textured soils. That texture will therefore prove to be a deciding factor, and not geological origin, is highly probable. Coarse texture is probably responsible for excessive drainage conditions of soil in spite of seemingly abundant rainfall.

The only economic way of arresting the soil-moisture in its downward path is by ploughing in green manure, and this is probably the method of treatment best calculated to change the state to that of a healthy soil.

It has been suggested that the soil survey of Rotorua County (this *Journal*, 1926 and 1927) should have been made according to geological origin. Putting aside the impossibility of doing so in the absence of any existing geological survey at the time the soil survey was required, the evidence afforded by the textural survey was so satisfying in differentiating the land into sick and healthy areas that it would have been foolish to ignore the advantages of texture as a basis of the survey. (See *Journal*, June, 1926, p. 374.)

In referring to the Mamaku deposits as the Rotorua shower, the writer is following Professor A. P. W. Thomas, who originally called the shower by that name and supposed that it had its origin in the vicinity of the Blue and Green Lakes.

That bush sickness has a simple cause, and one for which it is not necessary to postulate poisonous elements in soil or pasture or poisonous organic compounds in the herbage, is the conviction of the writer.

Under certain conditions of rainfall bush sickness will probably occur on all very coarse-grained soils with an almost entire absence of fine particles, no matter what the origin, where *these soils exist in large uninterrupted areas* and are utilized by growing as the main fodder for ruminants what is known in New Zealand as English pasture.

That bush sickness occurs only on soils of coarse texture, even when of the most diverse geological origin, is significant, and discounts the possibility of any poison being present. That the pasture does not affect horses is another reason for dismissing the possibility of any poison being present in the pasture, since it is highly improbable that a poison could exist that would poison ruminants and not horses.

Definite knowledge as to the amount of iron daily required by ruminants as compared with other grazing animals (Herbivoræ) would be the most satisfactory way to a correct understanding of bush sickness. It seems to the writer that it will ultimately be found that ruminants, owing to their much quicker growth, require very much more iron in comparison to the slower-growing non-ruminating horse.

(To be continued.)

National Mark Eggs in Britain.—Under this system, which became effective last year, the marked eggs have but one quality where freshness is concerned and three weight grades. The minimum weights of Special (blue label), Standard (red label), and Pullet or Ducklet Standard (yellow label) are 2¼ oz., 2 oz., and 1¾ oz. in the case of hen-eggs, and 2¾ oz., 2½ oz., and 2¼ oz. in the case of duck-eggs.

ASHBURTON EXPERIMENTAL FARM.

NOTES ON OPERATIONS, SEASON 1929–30.

R. McGILLIVRAY, Fields Superintendent, Christchurch, and J. G. McKAY, Farm Manager, Ashburton.

THE season of 1929–30 was a somewhat trying one in the Ashburton district. The spring was very dry, followed by an unusual amount of rain during December and January. From that period onward dry conditions again prevailed.

The Experimental Farm was again visited by large numbers of farmers and others. Special interest was shown in the potato-certification work, and in the growth of lines of potatoes imported by the Department of Agriculture from Scotland, Ireland, and Canada.

WHEAT-SELECTION WORK.

The wheat work carried out was chiefly an extension of the preceding season's operations. Of the varieties under observation, Solid-straw Tuscan, Dreadnought, Velvet Chaff, Solid-straw Velvet, and Major were the most promising of some fifty-seven of the 1928–29 strains. Selections were sown in plots consisting of three rows 50 ft. long, and each trial was replicated eight times.

Increase plots were also sown. The seed in all cases was hot-water treated, and all lines were free from smut. The small plots were harvested by hand and threshed with the small peg-tooth mill. The larger areas were harvested with the binder and threshed with a Settlers' mill. The area of land selected was considered fairly uniform, but the long period of dry weather experienced in the spring showed up marked variations in depth and general condition of soil, and the variations in growth nullified data in connection with the yielding-power of various lines.

A disturbing factor in connection with the raising of pure wheat lines under local conditions is the amount of natural crossing that evidently takes place. Of the different strains of the varieties under trial not one has retained its purity. The location of certain plots indicates that crossing may occur where varieties are quite 10 ft. apart. The condition of several lines has necessitated further selections from all varieties. Some seed of the following varieties is available for distribution: Dreadnought, Velvet Chaff, Solid-straw Velvet, and Major. All seed of Solid-straw Tuscan was sold for milling, as its purity did not reach expectations.

Ear-to-row trials from selected Marquis 10B, Marquis 4, Sensation, and Garnet, and yield trials of these wheats were also conducted in small plots. A buffer of mixed grain was sown round the trial plots as a protection from small birds, but despite this precaution, plus shooting, great damage was done. Garnet was completely stripped, and the Pearl under yield trial was so attacked as to make results valueless.

BARLEY TRIALS.

Four acres were under barley variety trials. Four strains each of the malting varieties, Plumage, Plumage Archer, Archer Spratt,

Goldthorpe Spratt, and Chevallier were sown for observational purposes, and also to obtain sufficient seed for further work and yield trials which will be carried out next season. The seed used was one season removed from the hot-water treatment, and the crops were absolutely free from smut. The long dry period experienced in the spring and early summer resulted in slow growth on the part of the barley, with the result that fathen became a strong competitor, and the amount of seed available for next season's work is not so great as was expected.

Potato Certification.

The number of lines of potatoes grown on the Farm for certification purposes was 323. A more comprehensive method of planting was adopted this season. Each line of one hundred tubers was planted diagonally across the field in short rows of ten tubers. As a yield

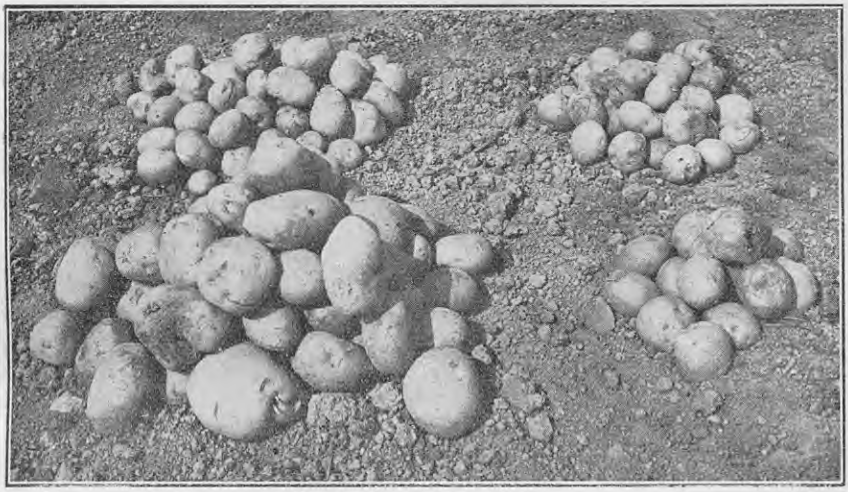


FIG. 1. TWO LINES OF ARRAN CHIEF POTATOES GROWN AT ASHBURTON.

On left, produce of ten shaws fairly free from mosaic disease; on right, produce of ten shaws badly infected with mosaic.

check every third row was planted with a certified line of Bresee's Prolific. The manurial treatment was 3 cwt. of super per acre applied prior to planting, and a further 1½ cwt. broadcast after completion of planting. No fertilizers were applied in the drill in contact with the seed.

There was a considerable amount of moisture in the soil at time of planting, and growth was rapid, but the lengthy period of dry weather later interfered with development and yields were not as good as was originally expected. The difference between the yields of lines of high cropping-power and those of low cropping-power was very marked, however. Of the 323 lines entered for certification, only eighty-seven passed the second field inspection, and it was probable that some further rejections would take place when the final tuber inspections were carried out.

The principal cause of rejection can be attributed to the presence of virus diseases—in fact, half of all the rejections can be put down to that cause. Some promising lines, however, in so far as cropping-power is concerned had to be rejected owing to a high percentage of rogues in the crop. The aim and object of the certification scheme is to eliminate weak, low-producing lines of potatoes, irrespective of variety. The difference in cropping-power of different lines of the same variety when all are grown under similar soil conditions and with the same manurial treatment is quite remarkable. Those who have been in close contact with the trial plots on the Experimental Farm have been deeply impressed by what has been demonstrated regarding differences in cropping-power and in the incidence of various diseases in the same varieties.

Farmers often seek advice as to what variety of potato they should grow. The Ashburton trials have clearly proved the importance of strain rather than of variety. For example, the Dakota variety may be quoted as regards the main crop and Epicure among the early varieties. The yield of table potatoes in the case of Dakota ranged from 11·6 down to 1·7 tons per acre, and that of Epicure from 9·7 down to 0·5 tons.

Following are details of lines entered for certification and grown at the Farm :—

Table 1.

Variety.	Number of Lines.	Total Area entered.	Area rejected in Field.	Area passed in Field.
		Acres.	Acres.	Acres.
Dakota	107	476¾	351¼	125½
Aucklander Short-top	62	202	116	86
Arran Chief	35	201¾	198¾	3
Aucklander Tall-top	25	132	66	66
Bresee's Prolific	17	110	32	78
Up-to-date	14	24	22	2
Epicure	13	39½	10½	29
Majestic	9	22	12	10
Iron Duke	6	6	6	..
Endurance	4	8	5	3
Early Regent	3	6	½	5½
Great Scot	3	6½	3	3½
Field Marshal	3	7	2	5
Robin Adair	2	2½	½	2
Sharpe's Express	2	2	2	..
Golden Wonder	2	2	1	1
Brownell's Beauty	2	4	..	4
Other varieties	14	29½	25½	4
Totals	323	1,281½	854	427½

CERTIFIED VERSUS NON-CERTIFIED SEED.

A trial to test the relative cropping-power of lines of certified versus non-certified potatoes of the following varieties was carried out: Aucklander Short-top, Epicure, Up-to-date, Dakota. There were ten replications of each in rows ½ chain in length. Considerable difference was discernible in growth and vigour during the growing-period, and results are as follows :—

Table 2.

Kind of Seed.	Up-to-date.		Dakota.		Aucklander Short-top.		Epicure.	
	Table.	Seed.	Table.	Seed.	Table.	Seed.	Table.	Seed.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
Certified	4·8	3·6	6·5	2·8	4·5	2·3	1·1	1·6
Non-certified ..	1·7	1·7	3·8	2·8	4·4	2·2	0·4	0·7
Differences in favour of certified	3·1	1·9	2·7	..	0·1	0·1	0·7	0·8

Other Work on Potatoes.

Origin of Seed Trial.—The trial of Ashburton versus Southland-grown Arran Chief potatoes was carried a stage further. The trials were planted with the following lines: (A) Ashburton seed, (B) Ashburton seed once grown in Southland, and (C) Ashburton seed twice grown in Southland. The results of the trials were as follows:—

Table 3.

Seed.	Table Potatoes.		Seed Potatoes.	
	Yield.	Increase over Ashburton.	Yield.	Increase over Ashburton.
	Tons.		Tons.	
A	2·3	..	2·2	..
B	2·9	0·6	2·6	0·4
C	3·3	1·0	2·5	0·3

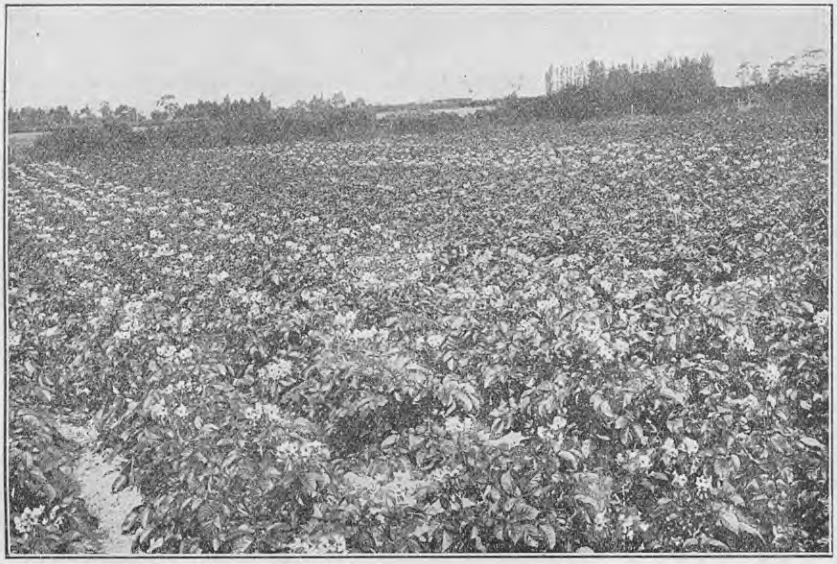


FIG. 2. GENERAL VIEW OF THE IMPORTED SCOTTISH POTATOES IN FULL GROWTH AT ASHBURTON.

Pure Seed Lines.—These trials were planted with selections of potatoes some of which were imported in 1927–28. An area of approximately 7 acres was utilized for this purpose. Roguing for virus disease was commenced early in December and continued throughout the growing-period. Some selections were discarded entirely, while others proved to be of considerable merit both in cropping-power and freedom from disease, and these are being retained for further extensive trials.

Imported Seed.—About 3½ acres was required for the Scottish and Irish seed potatoes imported during the season. One hundredweight of fifteen varieties were received from Scotland, and fifteen varieties were later in the season received from Ireland. The Scottish lines made very rapid growth, and a considerable quantity of seed is assured. The Irish lines opened up in anything but a satisfactory condition, and as they were planted late it was doubtful if much seed would be secured.

Several varieties were also received from Canada. These lines only amounted to a few sets of each of the following: Irish Cobbler, Burbank, Green Mountain, Dooley. Burbank showed the most vigorous growth and proved the best yielder. These potatoes were very free from virus disease and will be put under trial again next season.

Field and Garden Peas.

About 370 selections from thirty-six varieties of field and garden peas were planted out in September in ¼-chain rows, seeds being spaced 6 in. apart. Germination was exceptionally good in all cases, and although the plants did not make good growth, owing to dry weather, they podded well, and the most promising strains have been retained for further trial.

Onion Selections.

A quantity of bulbs from nine varieties was planted out in isolated positions on the farm for seed-production purposes. These varieties were grown from seed imported by the Department in 1928, and the purpose of the trial was to endeavour to obtain commercial quantities of seed of varieties possessing long-keeping qualities. The varieties grown were Danvers Yellow Globe, Golden Globe, Southport Yellow Globe, Ebenezer, Sutton's A.L., Australian Brown, Sutton's Improved Reading, Sutton's Globe. A small quantity of seed of each variety has been obtained for future work, but supplies for trial on growers' farms will not be available for some time yet.

Linseed.

Twenty lines selected from the Bull Moose variety were sown for comparison with a commercial line. A number of varieties from Australia and also various selections made last year were under observation. Considerable variation was present in the Bull Moose selections, and it seems quite possible to evolve a taller-growing strain of this favourite variety. Work will be continued along these lines next season.

Acknowledgments are made to Mr. R. Thomson, Assistant in Agronomy, who throughout the season conducted the plant-selection work organized by Mr. J. W. Hadfield, Agronomist.

SUBDIVISION OF DAIRY-FARMS FOR MODERN GRASS-FARMING.

R. P. CONNELL, M.A., Fields Division, Department of Agriculture, Palmerston North.

THE benefits to be obtained from proper control of pasture growth, especially during the late spring and summer seasons, are rightly receiving ever-increasing attention. This is because efficient utilization of pastures comes only from control of grass growth, more particularly during the periods when the rate of growth is rapid, and it is being more fully realized what a close connection there is between efficient utilization and economic production. This connection was well illustrated in a recent survey of dairy-farms in the Manawatu district, all of very similar soil-type. The survey involved examination of the operations of twenty-five farms. The following table summarizes the results obtained on the sixteen most productive farms :—

Production Group.	Butterfat per Acre.	Butterfat per Cow.	Rate of Stocking per 100 Acres.	Manure per Acre.	Average Size of Farms.
	lb.	lb.		Cwt.	Acres.
Averaging over 130 lb. butterfat per acre—three farms	136	297	47	1·7	82
Averaging 100 to 130 lb. butterfat per acre—thirteen farms	109	279	39	1·8	77

These two groups of farms did not differ materially in respect to size, soil, top-dressing, and average production of herds. But they did differ in production per acre to the extent of 25 per cent., and as they were all dependent essentially on grass-farming this difference must be due to variations in the degree of efficiency secured in the utilization of the grass growth. On farms of the type considered the higher efficiency brought an increased annual return of approximately £130 per farm.

Another striking instance of what can be accomplished by efficient pasture-utilization is the production of a farm of 75 acres, all of which was in grass. On this farm in February, 1929, the daily production of butterfat was 87 per cent. of the December daily production. The true significance of this performance becomes clear from the fact that often the February daily production in the same district is from 70 to 75 per cent. of the December production. In this case good pasture-utilization resulted in a lesser seasonal falling-off in the production of stock fed on grass alone than that which often occurs in the production of stock which have the benefit of supplies of special annual forage crops such as soft turnips, maize, millet, &c. This instance is cited not as an indication that producing cows necessarily should be fed on grass alone during February, but as a

partial indication of what can be achieved by efficient pasture-utilization. Farm practice has shown that there is a definite connection between efficiency in pasture-utilization and the number and arrangement of the fields constituting a farm.

On many farms, in the interests of better grassland-utilization, there is need for additions or alterations to the fencing already erected. Adequate subdivision is one of the essentials of efficient grass-management. However, it is well to bear in mind that it is only one of the essential requirements; while adequate fencing does not necessarily mean efficient pasture-utilization, efficient pasture-utilization means adequate fencing. It cannot be hoped to practice efficient pasture-utilization on many farms until the fencing provision has been much increased. Further, it is fortunate that on many other farms quite substantial improvement in pasture-utilization can be brought about without any great expenditure in fencing, minor additions only being necessary; while in certain other cases greatly improved utilization could be effected by changes in grazing methods, using only the fencing already provided.

From this it will be clear that while subdivision of the farm is important it is not generally of such vital importance as sometimes seems to be thought. The advice occasionally tendered farmers in regard to improved pasture-utilization is of a kind which tends to discourage many from even considering the details of methods of improved utilization—it implies that almost invariably a considerable outlay, which many are not prepared to face, is imperative in respect to such matters as fencing and water-supply. Against this the true position is that the present fencing and water-supply arrangements are sufficient in many instances, particularly if supplemented by minor additions, to admit of much improved pasture-utilization even though they do not permit of the attainment of an ideal standard of efficiency.

In brief, in many instances the greatest need is not for heavy expenditure on the part of the farmer, but for a thorough understanding of the principles and practices involved in effective utilization of pasture-growth. Indeed, until it is certain that these principles and practices are understood a heavy expenditure on subdivision may be not only ineffective but actually harmful. This arises from the fact that what is called "extensive" grazing—that which is ordinarily practised on relatively large paddocks—is preferable to a badly managed attempt to graze small paddocks on the intensive or rotational system. The reason for this is that a series of small paddocks which are intermittently spelled and grazed in an inefficient manner will all fairly rapidly during the spring and summer become completely covered with long, mature grass-growth. The result is that no portion of the land being grazed will be producing the desirable short fresh growth. On the other hand, in "extensive" grazing on larger paddocks the stock will allow certain portions of the paddocks to become long and woody and productive of flowering stalks, but at the same time will graze other portions short so that parts at least of the fields will be productive of the desirable fresh leafy well-balanced growth. And these parts will supply feed to meet the milk requirements of the cow and the ewe much better than would a series of small paddocks wholly overrun with long growth in the manner already mentioned.

Another aspect of the subdivision of dairy-farms that is of some importance lies in the fact that it is not always necessary or even

desirable to erect permanent standard fences. Actual field trials have shown that in many instances fences consisting of three barbed wires and four posts to the chain are reasonably effective. Such fences are likely to prove all that is necessary, especially in the initial stages when the suitability of the position of new fences may be more or less under trial.

Because the contrary view is at times expressed, it may fittingly be pointed out that quite effective intensive grazing can be secured without subdividing into an exceptionally large number of unusually small paddocks. In support of this the case may be cited of a farmer, holding 75 acres and milking forty-eight cows last season, whose pasture-utilization was outstandingly effective. His farm was subdivided as follows: one paddock of 4 acres, one of 6 acres, six of 7 acres, one of 8 acres, and one of 15 acres, a total of ten paddocks. The pasture-utilization on this farm was markedly better than that on several adjoining similar farms which relatively were better subdivided. This past season (1929–30) the farm has produced 216 lb. of butterfat an acre, while similar farms in the district average about 160 lb. an acre. Such farm experience illustrates the fact that ample subdivision alone will not give effective pasture-utilization. It is to be admitted that on this farm of ten paddocks better utilization could possibly be obtained if further subdivision were carried out. For instance, cutting in half of the fields of 15 acres and of 8 acres suggest themselves as desirable. But the important point is that quite effective utilization was secured without the extra cost that this would involve. Hence it would seem that it is not always necessary to wait until expensive fencing has been carried out before attempting to obtain better utilization by systematic grazing; it is often profitable to proceed with the facilities that are on hand.

Two Useful Systems of Farm Subdivision.

When additional fences are to be erected, the decision where they should be placed generally calls for a good deal of thought and raises the important question of what system of subdivision should be adopted. A well-known system of proven merit, due to its convenience and simplicity, is that which involves the use of a narrow roadway or race running practically from back to front of the typical farm which has a relatively short road frontage and therefore is much deeper than it is broad. The orthodox narrow race or roadway is not always as desirable or economical as is sometimes assumed.

It is well to remember in this connection that the narrow race as a basis of farm subdivision did not originate under conditions similar to those obtaining on many farms to-day. Indeed, the conditions were often vitally different. This becomes clear from the fact that to-day we have many farms that pre-eminently consist of permanent grassland, a position which promises to become more rather than less marked in the future. On these pre-eminently grassland farms the passage of drays and cultivation implements, &c., becomes reduced materially. This correspondingly reduces the necessity for a solid and therefore costly roadway. These conditions which are now so frequently present are almost the opposite of those under which the narrow race won favour. To-day, when the narrow race has been

fenced off, the real roadway, on account of considerations of expenditure, is often omitted. Two markedly undesirable conditions attach to such a narrow race. In the first place, mud and slush to an unpleasant depth frequently are present. In the second place, when large herds of cattle have to pass along the narrow race injury by horning, &c., is apt to be incurred—a result which would be present whether the roadway is provided or not.

These considerations lead one to ask whether at times a long narrow paddock, rather than a narrow race, should not be utilized as a basis of farm subdivision. This idea is incorporated effectively in the subdivision of one of the most successful dairy-farms in the Dominion. This farm is 14 chains wide, and 55 acres in area. If on it a narrow race were utilized there would be a series of paddocks opening off the race, each of a depth of about 7 chains. Actually along each side of the farm there are paddocks 5 chains deep, and these are separated by a central series 4 chains wide. Along these central paddocks the cows usually pass from the back to the front of the farm as occasion demands. This arrangement is not perfect, but it has two distinct advantages. In the first place, muddy tracks are practically unknown; and in the second place, with the same length of internal fencing, three paddocks are obtained for every two that would be given by the central-race system of subdivision. This matter of the number of paddocks is specially worthy of note, because at times it is one of the prime considerations in subdivision which aims at better utilization. On this farm fifteen paddocks are utilized in the grazing of the dairy cows.

To some the number of paddocks provided may seem large, but actually it is in keeping with what was the practice of good farmers even before so much attention was being directed to the value of proper grazing-control. This is well shown by a farm survey made recently in which the following instances are typical of the subdivision provided by farmers who have been obtaining good results. The instances are as follows:—

Area of Farm in Acres.	Number of Paddocks.	Area of Farm in Acres.	Number of Paddocks.
92	16	200	22
48	13	23	13
90	15	55	14
40	13		

Cases of similar subdivision are far less rare than are cases in which full advantage is taken of the possibilities of efficient pasture-utilization which such subdivision gives.

Factors determining the Size of Fields.

No farm layout can suitably serve as a model for general adoption in a detailed manner. The great range of variation in important respects that occurs on farms prevents this. All that the study of farm plans can serve to do is to stimulate thought and suggest ideas that may prove useful if incorporated into the working of other farms. The individual farmer must plan for himself the system of farm subdivision which best suits his circumstances.

The impossibility of drafting any fixed scheme of farm subdivision which would be of value for general use becomes obvious when consideration is given to the size of paddocks necessary in order to be able

to effect properly controlled grazing. In this connection the suitable size for paddocks will be determined by two main circumstances, both of which are likely to vary from farm to farm. These are the size of the herd and the fertility of the land. Of two farms carrying herds of the same size, one may consist of land so much more productive than that of the other that 4 acres of it will produce as much feed as 6 acres of the other. In such a case if on the farm of superior quality 4-acre fields are necessary in order to be able to effect properly controlled grazing, then 6-acre fields will suffice on the other farm. The size of paddocks that will admit of properly controlled grazing is also affected by a number of other factors, some of which are the density of the pasture, the rate of growth, the amount of grass harrowing which is carried out, and the number of store stock carried in conjunction with wet stock. With such a number of factors to be considered it becomes impossible to lay down any hard-and-fast rules in respect to the number of stock to the acre which should be carried, and with this undetermined it follows that hard-and-fast rules in respect to size of paddocks are out of the question.

From the inter-relation between the control of grazing, size of fields, and other varying circumstances, such as rate of pasture-growth, it may be correctly inferred that uniformity in the size of fields on the same farm is not likely to be either necessary or desirable. An example of this fact is provided by a Horowhenua district farm of 200 acres, on which highly efficient pasture-utilization is achieved. On this farm the range of paddocks is as follows: One of 20 acres, three of 12 acres, one of 9 acres, one of 7 acres, two of 4 acres, one of 14 acres, four of 10 acres, two of 8 acres, three of 6 acres, and three of 2 acres. On this farm there were kept, in addition to 110 cows in milk, a considerable number of dry cattle and of sheep, but the farm is essentially devoted to butterfat-production.

Another example is provided by a Manawatu farm of 100 acres, which consists of the following fields: Two of 20 acres, three of 10 acres, one of 6 acres, one of 2 acres, one of 3 acres, and one of 1 acre, together with 1 acre of homestead. This farm wintered in 1929 a flock of 300 breeding-ewes, a herd of thirty-four dairy cows, and the normal quota of dry stock. It is likely that advantage would be gained by slight further subdivision in the case of both these farms, but quite good utilization has been possible without such subdivision.

From the instances cited it may be gathered that good results can be obtained in pasture-utilization on farms divided into about ten or twelve paddocks, but it should be kept in mind that further subdivision would probably give still better results. On a farm of ten to twelve paddocks of fairly even size often it may be possible to close up three or four paddocks for the production of hay and ensilage, leaving six to nine available for special crop production or grazing during the period of maximum pasture-growth.

How to determine Frequency of Grazing-periods.

If the fields under intermittent spelling and grazing are utilized when they carry enough growth to meet the requirements of the milking stock for about two days, then on a farm of ten to twelve paddocks it will be found that there will be suitable intervals of

spelling between successive grazing periods to allow of adequate development of pasture-growth. Although two days has just been mentioned as a suitable duration of grazing periods, it is not to be assumed that this is the most suitable duration under all circumstances.

Carefully recorded and supervised farm experience has shown that grazing periods of two days' duration have given excellent results. For instance, in connection with pasture-management investigations conducted by the Fields Division, records of the butterfat returns and of the duration of the grazing periods were kept for a complete season in respect to seventy good farms distributed in the Auckland, Wellington, and Taranaki districts. Seven of these farms were characterized by specially good grazing returns. On six of these seven specially good farms the great majority of the grazing periods were short—that is, of a duration of two days or less. But good results have also been obtained by the use of grazing periods both of longer and of shorter duration. The best stage of growth at which grazing-down of a pasture should be undertaken is decided not so much by the total amount of feed on a paddock as by the length and maturity of the growth of herbage. Hence an open pasture might call for stocking in the autumn, when it provided only one day's grazing, while a dense pasture would call for stocking when in the spring it provided two days' stocking at the same carrying-capacity.

It is of importance in deciding at what stage to graze a pasture to study not so much the average length of the growth as the length of growth on the richer patches of the field, which mark the vicinity of where animal manure has been deposited. If the growth of these richer areas is left untouched until the growth on the remainder of the field has reached the maximum length at which it may well be grazed, then difficulty will be experienced in dealing with the ranker growth on the specially enriched patches. Hence it is often well to take as a criterion for the commencement of grazing the state of the growth on the ranker portions of the field. As greater knowledge and greater proficiency in respect to grazing management is obtained, it is possible that opinions will be modified in regard to such matters as the best stage of growth at which to commence grazing.

The proper provision of an ample water-supply and of shelter are matters which call for more general attention than they receive. They are of such vital importance that they should rank as essential features of any scheme of dairy-farm subdivision, and they should not be sacrificed in order to secure merely convenient and orderly arrangement of paddocks.

To sum up: While successful pasture-utilization will often call for additional farm-fencing, yet often better utilization than is being obtained could be secured by employing to the best advantage the fencing already provided. The road to better pasture-utilization is not so much increased farm outlay as improved grasp of the principles and practice of properly controlled grazing. The vital feature of properly controlled grazing is the prevention as far as possible of the growth becoming so mature as to have reached the flowering stage. Proper water-supply and shelter for the stock also call for careful attention.

WHEAT-MANURING EXPERIMENTS IN THE SOUTH ISLAND, SEASON 1929–30.

Fields Division, Department of Agriculture.

THE programme of wheat-manuring experiments for 1929–30 comprised thirty-three trials located at different points from Marlborough to Central Otago. Thirty-two of these experiments are reported on in this article; the other one, which was a detailed study of the effect of applying different forms of soluble nitrogen at different times of application, will be reported on in a subsequent issue of the *Journal*.

The *Journal* for April, 1929, contained a summary of six years' wheat-manuring experiments. This report indicated that the investigation of certain problems had been carried to a definite conclusion. Consequently a slight modification was made in the 1929–30 programme.

The method of conducting the experiments has been described in the *Journal* for July, 1926, page 6.

Manures used in 1929–30: Two types of experiment were laid down, Type A being a continuation of the investigation of potash and nitrogen as adjuncts to superphosphate. The treatments used were as follows, all amounts stated being per acre:—

Experiment Type A—

(1) No manure.	
(2) Superphosphate (44/46 per cent. tricalcic phosphate)	1 cwt.
(3) Super 1 cwt., plus muriate of potash 1 cwt.	2 cwt.
(4) Super 1 cwt., plus nitrate of soda 1 cwt.	2 cwt.
(5) Super 1 cwt., plus muriate of potash 1 cwt., and nitrate of soda 1 cwt.	3 cwt.

(Eighteen experiments of this type were carried out.)

Experiment Type B—

(1) No manure.	
(2) Super..	1 cwt.
(3) Super..	2 cwt.
(4) Super 1 cwt., plus nitrate of soda 1 cwt.	2 cwt.
(5) Super 2 cwt., plus nitrate of soda 1 cwt.	3 cwt.
(6) Super 1 cwt., plus carbonate of lime 2 cwt.*	3 cwt.

(Fourteen experiments carried out.)

NOTE.—The nitrate of soda was top-dressed in the spring in all cases.

* Carbonate of lime was included because of the general response to lime from grassland in Canterbury, and because a number of farmers are using small quantities of carbonate of lime and claiming good results.

Size of plot and number of replications: Each plot was 2 chains in length and seven coulter rows wide. Twelve replications of each treatment were sown in each case, so that a Type A experiment consisted of sixty plots and a Type B of seventy-two.

Interpretation of results: Statistical examination of results was made by "Student's" method. Where a difference between one treatment and another is stated in this report to be "significant," full confidence can be attached to the results. A difference which is not significant may be due to chance variation and cannot be viewed as really reliable. Each yield as expressed is the average of twelve plots.

Estimation of profits from manures: After allowing per-bushel costs such as threshing, hauling, &c., each bushel of wheat is worth 5s. in round figures. One hundredweight of super costs approximately 6s., so that a little over a bushel increase will meet the cost of 1 cwt. of super.

Nitrate of soda costs 16s. per hundredweight at the present time. If the profit from the use of nitrogen is based on the average increase from all trials and nitrate of soda as above quoted there would be a margin of only 6s. per acre. Nitrogen in the form of sulphate of ammonia is considerably cheaper, however, 1 cwt. costing 12s. 8d. Although the latter manure has not been used extensively in the Agriculture Department's trials, there is sufficient evidence to indicate that 1 cwt. of sulphate of ammonia (20·6 per cent. nitrogen) will give better results than 1 cwt. of nitrate of soda (15·5 per cent. nitrogen). Consequently the Department recommends farmers to use sulphate of ammonia at the present time. An increase of just over 2½ bushels will pay for 1 cwt. per acre.

Muriate of potash costs about 14s. 6d. per hundredweight. Consequently just under 3 bushels of wheat are required to pay for 1 cwt. Potash as used has given increases in very few cases, and in no experiment has the increase in yield been sufficient to more than meet the cost of the manure.

RESULTS OF TYPE A EXPERIMENTS.

1. Co-operating Farmers: Smith Bros., Tua Marina, Marlborough.

Experiment No. 16/3/337. Variety of wheat: Solid-straw Tuscan, 105 lb. per acre. Date sown: 28th August, 1929. Nitrate of Soda applied: 10th October, 1929. Date harvested: 12th February, 1930. Date threshed: 7th March, 1930. Previous crops: 1928–29, wheat; prior to this the field was in grass. Soil: Alluvial silt tending to be peaty.

Table 1.—Results of Smith Bros.' Experiment.

Treatment per Acre.	Bushels per Acre.		Remarks.	Profit per Acre.
	Yields.	Increase over No Manure.		
(1) No manure ..	35·1	..	..	..
(2) Super 1 cwt. ..	40·8	5·7	Significant increase ..	22s. 6d.
(3) Super 1 cwt., plus muriate of potash 1 cwt.	42·8	7·7	Significant increase over super	18s.
(4) Super 1 cwt., plus nitrate of soda 1 cwt.	45·6	10·5	Significant increase over super	30s. 6d.
(5) Super 1 cwt., plus potash 1 cwt., plus nitrate of soda 1 cwt.	44·0	8·9	Significantly lower yield than super plus nitrate of soda	8s.

Comment on Table 1: The increase due to super is highly paying. The addition of potash to super has further increased the yield by 2 bushels per acre. The increase from potash is not a paying one. Nitrate of soda as an adjunct to super has caused an increase of 4·8 bushels over the yield from super; its use has been profitable. The

complete manure (treatment 5) shows a significantly lower yield than super plus nitrogen. This effect of reduced yield when muriate of potash has been combined with super and nitrate of soda has occurred on several occasions previously. (See *Journal* for April, 1929, page 227.)

2. H. D. Burt, Hawarden, North Canterbury.

Experiment No. 16/3/340. Variety of wheat: Solid-straw Tuscan, 90 lb. per acre. Date sown: 18th June, 1929. Nitrate of soda applied: 13th September, 1929. Date harvested: 22nd February, 1930. Date threshed: 27th February, 1930. Previous crops: In grass for three years. Soil: Clay loam overlaying shingle.

Table 2.—Result of H. D. Burt's Experiment.

Treatment per Acre.	Bushels per Acre.		Remarks.	Profit or Loss per Acre.
	Yields.	Increase over No Manure.		
(1) No manure ..	19·9	..	..	..
(2) Super 1 cwt. ..	23·5	3·6	Significant increase ..	12s. profit.
(3) Super 1 cwt., plus muriate of potash 1 cwt.	23·9	4·0	Not significantly better than super	6d. loss.
(4) Super 1 cwt., plus nitrate of soda 1 cwt.	21·8	1·9	Not significantly different from super	12s. 6d. loss.
(5) Super 1 cwt., plus potash 1 cwt., plus nitrate of soda 1 cwt.	24·7	4·8	Significantly better than super plus nitrate, but not better than super plus potash	12s. 6d. loss.

Comments on Table 2: The increase due to super is paying. Potash as an addition to super has not affected yield materially. The addition of nitrate of soda to super has not been beneficial. The complete manure has given the best yield, but shows a monetary loss.

NOTE.—Unusual circumstances were experienced in connection with this experiment. Mr. Burt reports that an unusually severe frost at the end of October cut back the wheat on the manured plots, which showed better growth than the no-manure plots. The no-manure plots were only slightly affected. The crop was still in the leaf stage at the time. It is very unusual for wheat to be badly affected by frost at this stage. The yield was extraordinarily low for this class of land. It is usually in the vicinity of 50 to 60 bushels per acre.

3. J. Wyllie, Omihi, North Canterbury.

Experiment No. 16/3/297. Variety of wheat: Solid-straw Tuscan, 95 lb. per acre. Date sown: 5th July, 1929. Nitrate of soda applied: 13th September, 1929. Date harvested: 24th January, 1930. Date threshed: 17th February, 1930. Previous crop: Grass. Soil: Silty loam.

The results are shown in Table 3 (next page).

Comments on Table 3: The increase from super is a paying one. None of the additional manures has had an appreciable effect on yield.

Table 3.—Results of J. Wyllie's Experiment.

Treatment per Acre.	Bushels per Acre.		Remarks.	Profit or Loss per Acre.
	Yields.	Increase over No Manure.		
(1) No manure ..	49·4	..	..	..
(2) Super 1 cwt. ..	52·9	3·5	Significant increase ..	11s. 6d. profit.
(3) Super 1 cwt., plus muriate of potash 1 cwt.	51·9	2·5	Not significantly different from super	8s. loss.
(4) Super 1 cwt., plus nitrate of soda 1 cwt.	53·9	4·5	Not significantly different from super	6d. profit.
(5) Super 1 cwt., plus potash 1 cwt., plus nitrate of soda 1 cwt.	52·6	3·2	Not significantly different from other manurial treatments	20s. 6d. loss.

4. H. Heinsch, Cust, North Canterbury.

Experiment No. 16/3/300. Variety of wheat: Solid-straw Tuscan, 120 lb. per acre. Date sown: 1st June, 1929. Nitrate of soda applied: 4th September, 1929. Date harvested: 3rd February, 1930. Date threshed: 19th February, 1930. Previous crop: Rape. Soil: Light silt loam.

Table 4.—Results of H. Heinsch's Experiment.

Treatment per Acre.	Bushels per Acre.		Remarks.	Profit or Loss per Acre.
	Yields.	Increase over No Manure.		
(1) No manure ..	22·2	..	..	..
(2) Super 1 cwt. ..	25·5	3·3	Significant increase ..	10s. 6d. profit.
(3) Super 1 cwt., plus muriate of potash 1 cwt.	25·7	3·5	Not significantly different from super	3s. loss.
(4) Super 1 cwt., plus nitrate of soda 1 cwt.	33·1	10·9	Significant increase over super	32s. 6d. profit.
(5) Super 1 cwt., plus potash 1 cwt., plus nitrate of soda	32·2	10·0	Significant increase over super plus potash. Significantly lower than super plus nitrate	13s. 6d. profit.

Comments on Table 4: Super has caused a paying increase. The addition of potash to super has had no appreciable effect on yield. Super plus nitrate of soda is 7·6 bushels better than super. The use of potash with super plus nitrate of soda has caused the yield to be depressed below that from super plus nitrate of soda by nearly 1 bushel. (See Table 1.)

5. G. H. Cross, Oxford, North Canterbury.

Experiment No. 16/3/301. Variety of wheat: Solid-straw Tuscan, 90 lb. per acre. Date sown: 31st May, 1929. Nitrate of soda applied: 5th September, 1929. Date harvested: 7th February, 1930. Date threshed: 21st February, 1930. Previous crop: Rape. Soil: Silty loam.

Table 5.—Results of G. H. Cross's Experiment.

Treatment per Acre.	Bushels per Acre.		Remarks.	Profit per Acre.
	Yields.	Increase over No Manure.		
(1) No manure ..	23·0	..	..	..
(2) Super 1 cwt. ..	29·7	6·7	Significant increase ..	27s. 6d.
(3) Super 1 cwt., plus muriate of potash 1 cwt.	28·0	5·0	Not significantly different from super	4s. 6d.
(4) Super 1 cwt., plus nitrate of soda 1 cwt.	32·8	9·8	Significantly better than super	27s. 6d.
(5) Super 1 cwt., plus potash 1 cwt., plus nitrate of soda 1 cwt	33·1	10·1	Significant increase over super plus potash	14s.

Comments on Table 5 : The increase due to super is highly paying. Potash has no appreciable effect on yield. The addition of nitrate of soda to super has increased yield by 3·1 bushels and to super plus potash by 5·1 bushels per acre.

6. T. Pearson, Hororata, Canterbury.

Experiment No. 16/3/302. Variety of wheat : Solid-straw Tuscan, 100 lb. per acre. Date sown : 7th June, 1929. Nitrate of soda applied : 6th September, 1929. Date harvested : 18th February, 1930. Date threshed : 26th February, 1930. Previous crop : Wheat. Soil : Clay loam.

Table 6.—Results of T. Pearson's Experiment.

Treatment per Acre.	Bushels per Acre.		Remarks.	Profit or Loss per Acre.
	Yields.	Increase over No Manure.		
(1) No manure.. ..	18·6	..	..	..
(2) Super	20·0	1·4	Significant increase	1s. profit.
(3) Super 1 cwt., plus muriate of potash 1 cwt.	18·7	0·1	Significantly lower than super	20s. loss.
(4) Super 1 cwt., plus nitrate of soda, 1 cwt.	23·6	5·0	Significant increase over super	3s. profit.
(5) Super 1 cwt., plus potash 1 cwt., plus nitrate of soda 1 cwt.	23·2	4·6	Significant increase over super plus potash	13s. 6d. loss.

Comments on Table 6 : The use of super has caused a small but paying increase. The addition of potash to super has caused the yield to be depressed below that from super. Nitrate of soda has been responsible for an increase of 3·6 bushels when used with super and an increase of 4·5 bushels when used with super plus potash.

7. J. D. Penny, Halkett, Canterbury.

Experiment No. 16/3/303. Variety of wheat : Solid-straw Tuscan, 100 lb. per acre. Date sown : 8th June, 1929. Nitrate of soda

applied: 6th September, 1929. Date harvested: 14th February, 1930. Date threshed: 25th February, 1930. Previous crops: Brown-top pasture for six years. Soil: Sandy loam.

Table 7.—Results of J. D. Penny's Experiment.

Treatment per Acre.	Bushels per Acre.		Remarks.	Profit or Loss per Acre.
	Yields.	Increase over No Manure.		
(1) No manure.. ..	23·0	..	..	..
(2) Super 1 cwt. ..	26·4	3·4	Significant increase ..	11s. profit.
(3) Super 1 cwt., plus muriate of potash 1 cwt.	25·7	2·7	Not significantly different than super	7s. loss.
(4) Super 1 cwt., plus nitrate of potash 1 cwt.	31·2	8·2	Significant increase over super	19s. profit.
(5) Super 1 cwt., plus potash 1 cwt., plus nitrate of soda 1 cwt.	30·5	7·5	Significant increase over super plus potash	1s. profit.

Comments on Table 7: The applications of both super and nitrate of soda have been paying. Potash has had no beneficial effect on yield.

8. H. E. Evans, Fernside, North Canterbury.

Experiment No. 16/3/297. Variety of wheat: Solid-straw Tuscan, 100 lb per acre. Date sown: 4th July, 1929. Nitrate of soda applied: 4th September, 1929. Date harvested: 1st February, 1930. Date threshed: 18th February, 1930. Previous crop: Turnips. Soil: Light stony loam.

Table 8.—Results of H. E. Evans's Experiment.

Treatment per Acre.	Bushels per Acre.		Remarks.	Profit or Loss per Acre.
	Yields.	Increase over No Manure.		
(1) No manure.. ..	24·5	..	..	..
(2) Super 1 cwt. ..	27·0	2·5	Significant increase ..	6s 6d. profit.
(3) Super 1 cwt., plus muriate of potash 1 cwt.	25·7	1·2	Significantly lower than super	14s. 6d. loss.
(4) Super 1 cwt., plus nitrate of soda 1 cwt.	27·1	2·6	Non-significant increase over super	9s. loss.
(5) Super 1 cwt., plus potash 1 cwt., plus nitrate of soda 1 cwt.	27·4	2·9	Significant increase over super plus potash	22s. loss.

Comments on Table 8: Super alone is the only treatment which shows a profit from its use. Potash added to super has depressed yield.

NOTE.—The nitrogen plots ripened earlier than the other plots, and a certain amount of grain was shaken before cutting.

9. H. R. Wilkinson, Chertsey, Mid-Canterbury.

Experiment No. 16/3/258. Variety of wheat: Solid-straw Tuscan, 93 lb. per acre. Date sown: 29th May, 1929. Nitrate of soda applied: 6th September, 1929. Date harvested: 7th February, 1930. Date threshed: 1st March, 1930. Previous crops: 1928–29, wheat; 1927–28, Italian rye-grass, clovers, and kale. Soil: Light silty loam.

Table 9.—Results of H. R. Wilkinson's Experiment.

Treatment per Acre.	Bushels per Acre.		Remarks.	Profit or Loss per Acre.
	Yields.	Increase over No Manure.		
(1) No manure.. ..	23·0	..	..	..
(2) Super 1 cwt. ..	23·8	0·8	Increase not significant	2s. loss.
(3) Super 1 cwt., plus muriate of potash 1 cwt.	24·4	1·4	Increase over super not significant	13s. 6d. loss.
(4) Super 1 cwt., plus nitrate of soda, 1 cwt.	31·7	8·7	Significant increase over super	21s. 6d. profit.
(5) Super 1 cwt., plus potash 1 cwt., plus nitrate of soda 1 cwt.	30·9	7·9	Significant increase over super plus potash	3s. profit.

Comments on Table 9: Super and super plus potash have been unprofitable in use. Nitrate of soda has given excellent results on yield with both super and super plus potash. Without super it is highly probable that the nitrogen would have had very little effect.

10. W. and A. Campion, Highbank, Methven, Mid-Canterbury.

Experiment No. 16/3/260. Variety of wheat: Solid-straw Tuscan, 105 lb. per acre. Date sown: 5th June, 1929: Nitrate of soda applied: 17th September, 1929. Date harvested: 19th February, 1930. Date threshed: 12th March, 1930. Previous crops: 1928–29, wheat. Soil: Medium silty loam.

Table 10.—Results of W. and A. Campion's Experiment.

Treatment per Acre.	Bushels per Acre.		Remarks.	Profit or Loss per Acre.
	Yields.	Increase over No Manure.		
(1) No manure.. ..	23·8	..	..	..
(2) Super 1 cwt. ..	26·3	2·5	Significant increase over no manure	6s. 6d. profit.
(3) Super 1 cwt., plus muriate of potash 1 cwt.	26·3	2·5	Not significantly better than super	8s. loss.
(4) Super 1 cwt., plus nitrate of soda 1 cwt.	33·3	9·5	Significant increase over super	25s. 6d. profit.
(5) Super 1 cwt., plus potash 1 cwt., plus nitrate of soda 1 cwt.	33·7	9·9	Significant increase over super plus potash	13s. profit.

Comments on Table 10: Both super and nitrate of soda have given paying increases. Potash has had no appreciable effect on yield.

11. J. Bland, Winchmore, Mid-Canterbury.

Experiment No. 16/3/154. Variety of wheat: Solid-straw Tuscan, 93 lb. per acre. Date sown: 21st May, 1929. Nitrate of soda applied: 17th September, 1929. Date harvested: 13th February, 1930. Date threshed: 10th March, 1930. Previous crop: 1928–29, wheat; 1927–28, turnips; 1926, grass. Soil: Silty loam.

Table 11.—Results of J. Bland's Experiment.

Treatment per Acre.	Bushels per Acre.		Remarks.	Profit or Loss per Acre.
	Yields.	Increase over No Manure.		
(1) No manure.. ..	33·6	..	..	..
(2) Super 1 cwt. ..	35·3	1·7	Significant increase over no manure	2s. profit.
(3) Super 1 cwt., plus muriate of potash 1 cwt.	35·0	1·4	Not significantly different from super	13s. 6d. loss.
(4) Super 1 cwt., plus nitrate of soda 1 cwt.	42·8	9·2	Significant increase over super	24s. profit.
(5) Super 1 cwt., plus potash 1 cwt., plus nitrate of soda 1 cwt.	42·0	8·4	Significant increase over super plus potash	5s. 6d. profit.

Comments on Table 11: Both super and nitrate of soda have proved profitable in use. Potash has had no appreciable effect on yield.

12. G. Edgar, Rangitata, South Canterbury.

Experiment No. 16/3/375. Variety of wheat: Solid-straw Tuscan, 120 lb. per acre. Date sown: 6th August, 1929. Nitrate of soda applied: 9th October, 1929. Date harvested: 13th February, 1930. Date threshed: 13th March, 1930. Previous crops: 1928–29, rape; 1927–28, wheat; 1926, grass. Soil: Good sandy oam.

Table 12.—Results of G. Edgar's Experiment.

Treatment per Acre.	Bushels per Acre.		Remarks.	Profit or Loss per Acre.
	Yields.	Increase over No Manure.		
(1) No manure.. ..	48·8	..	..	..
(2) Super 1 cwt. ..	54·4	5·6	Significant increase ..	22s. profit.
(3) Super 1 cwt., plus muriate of potash 1 cwt.	51·8	3·0	Significantly lower than super	5s. 6d. loss.
(4) Super 1 cwt., plus nitrate of soda 1 cwt.	60·7	11·9	Significant increase over super	37s. 6d. profit.
(5) Super 1 cwt., plus potash 1 cwt., plus nitrate of soda 1 cwt.	62·3	13·5	Significant increase over super plus potash, and super plus nitrate of soda	31s. profit.

Comments on Table 12: Super and nitrate of soda have both proved highly paying. Potash added to super has depressed yield, but when used in conjunction with super and nitrate of soda, has increased the yield by 1·6 bushels per acre. The increase is not a paying one (compare this with Table 1).

13. Boys' High School, Timaru, South Canterbury.

Experiment No. 16/3/259. Variety of wheat: Solid-straw Tuscan, 120 lb. per acre. Date sown: 30th May, 1929. Nitrate of soda applied: 25th September, 1929. Date harvested: 10th February, 1930. Date threshed: 15th March 1930. Previous crop: Grass for several years. Soil: Cold clay flat.

Table 13.—Results of Experiment at Boys' High School, Timaru.

Treatment per Acre.	Bushels per Acre.		Remarks.	Loss per Acre.
	Yields.	Increase over No Manure.		
(1) No manure.. ..	26·8	..	..	..
(2) Super 1 cwt. ..	27·2	0·4	Non-significant increase	4s.
(3) Super 1 cwt., plus muriate of potash	24·9	—1·9	Not significant, different from no manure and super	Dead loss.
(4) Super 1 cwt., plus nitrate of soda 1 cwt.	28·7	1·9	Not significantly better than super	13s. 6d.
(5) Super 1 cwt., plus potash 1 cwt., plus nitrate of soda 1 cwt.	29·0	2·2	Increase not significant	25s. 6d.

Comments on Table 13: None of the manures has affected yield to a significant extent. NOTE.—A good deal of this experiment was flooded in the winter and rust was bad in places.

14. F. Saunders, Studholme Junction, South Canterbury.

Experiment No. 16/3/113. Variety of wheat: Hunter's, 103 lb. per acre. Date sown: 15th May, 1929. Nitrate of soda applied: 26th September, 1929. Date harvested: 11th March, 1930. Date threshed: 17th March, 1930. Previous crops: 1928–29, potatoes; 1927–28, wheat; 1926, grass. Soil: Clay loam.

Table 14.—Results of F. Saunders's Experiment.

Treatment per Acre.	Bushels per Acre.		Remarks.	Profit or Loss per Acre.
	Yields.	Increase over No Manure.		
(1) No manure.. ..	44·7	..	..	..
(2) Super 1 cwt. ..	50·4	5·7	Significant increase ..	22s. 6d. profit.
(3) Super 1 cwt., plus muriate of potash 1 cwt.	48·0	3·3	Significantly lower than super	4s. loss.
(4) Super 1 cwt., plus nitrate of soda 1 cwt.	53·6	8·9	Significantly better than super	22s. 6d. profit.
(5) Super 1 cwt., plus potash 1 cwt., plus nitrate of soda 1 cwt.	52·8	8·1	Significant increase over super plus potash	4s. profit.

Comments on Table 14: Super has been highly paying in effect. The addition of potash to super has depressed the yield. Nitrate of soda has increased yield when used with super just sufficiently to pay for its cost.

15. D. M. Borrie, Papakaio, North Otago.

Experiment No. 16/4/157. Variety of wheat: Solid-straw Tuscan, 120 lb. per acre. Date sown: 10th September, 1929. Nitrate of soda applied: 15th November, 1929. Date harvested: 26th February, 1930. Date threshed: 19th March, 1930. Previous crops: Turnips, rape, and wheat. Soil: Clay loam with clay subsoil.

Table 15.—Results of D. M. Borrie's Experiment.

Treatment per Acre.	Bushels per Acre.		Remarks.	Profit or Loss per Acre.
	Yields.	Increase over No Manure.		
(1) No manure.. ..	59·0	..	..	..
(2) Super 1 cwt. ..	62·8	3·8	Significant increase	13s. profit.
(3) Super 1 cwt., plus muriate of potash 1 cwt.	59·5	0·5	Not significantly different from super	18s. loss.
(4) Super 1 cwt., plus nitrate of soda 1 cwt.	62·4	3·4	Not significantly different from super	5s. loss.
(5) Super 1 cwt., plus potash 1 cwt., plus nitrate of soda 1 cwt.	60·0	1·0	Not significantly different from super plus potash	31s. 6d. loss.

Comments on Table 15: Super alone is the only treatment which shows a paying return. The depression due to potash is not statistically significant, but it is highly probable that an actual depression has occurred. Nitrate of soda has had no effect.

16. J. Grant, Awamoa, North Otago.

Experiment No. 16/4/155. Variety of wheat: Solid-straw Tuscan, 120 lb. per acre. Date sown: 9th September, 1929. Nitrate of soda applied: 16th November, 1929. Date harvested: 25th February, 1930. Date threshed: 19th March, 1930. Previous crops: 1927–28, turnips; 1928–29, wheat. Soil: Stiff soil described locally as "tarry."

Table 16.—Results of J. Grant's Experiment.

Treatment per Acre.	Bushels per Acre.		Remarks.	Profit or Loss per Acre.
	Yields.	Increase over No Manure.		
(1) No manure.. ..	15·6	..	..	..
(2) Super 1 cwt. ..	21·1	5·5	Significant increase ..	21s. 6d. profit.
(3) Super 1 cwt., plus muriate of potash 1 cwt.	19·0	3·4	Significantly lower than super	3s. 6d. loss.
(4) Super 1 cwt., plus nitrate of soda 1 cwt.	23·4	7·8	Significant increase over super	17s. profit.
(5) Super 1 cwt., plus potash 1 cwt., plus nitrate of soda 1 cwt.	21·4	5·8	Significant increase over super, plus potash. Significantly lower than super plus nitrate of soda	7s. 6d. loss.

Comments on Table 16: Super has caused a highly paying increase. Potash has depressed yield. Nitrate of soda added to super has been responsible for an increase of 2·3 bushels over super alone. This increase does not meet the cost of nitrate of soda.

17. R. Kingan, Hawea, Central Otago.

Experiment No. 16/4/106. Variety of wheat: Solid-straw Tuscan, 120 lb. per acre. Date sown: 30th May, 1929. Nitrate of soda applied: 23rd September, 1929. Date harvested: 13th February, 1930. Date threshed: 25th March, 1930. Previous crops: Bare fallow and wheat alternating (with one crop of barley previous to last fallow) for last six years. Soil: Clay loam with clay subsoil.

Table 17.—Results of R. Kingan's Experiment.

Treatment per Acre.	Bushels per Acre.		Remarks.	Profit or Loss per Acre.
	Yields.	Increase over No Manure.		
(1) No manure ..	30·3	..	..	..
(2) Super 1 cwt. ..	32·9	2·6	Significant increase ..	7s. profit.
(3) Super 1 cwt., plus muriate of potash 1 cwt.	31·9	1·6	Not significantly different from super	12s. 6d. loss.
(4) Super 1 cwt., plus nitrate of soda 1 cwt.	42·1	11·8	Significant increase over super	32s. profit.
(5) Super 1 cwt., plus potash 1 cwt., plus nitrate of soda 1 cwt.	40·1	9·8	Significant increase over super plus potash	12s. 6s. profit.

Comments on Table 17: Both super and nitrate of soda have been profitable in use, the nitrate of soda having increased the yield when added to super by 9·2 bushels per acre. Potash has a depressing tendency, although the depressions are not significant.

18. L. Lee, Arrowtown, Central Otago.

Experiment No. 16/4/108. Variety of wheat: Hunter's, 120 lb. per acre. Date sown: 1st June, 1929. Nitrate of soda applied: 6th September, 1929. Date harvested: 25th February, 1930. Date threshed: 27th March, 1930. Previous crops: In grass for sixteen years; ploughed out of lea and sown in wheat for three successive years. Soil: Clay loam with clay subsoil.

Table 18.—Results of L. Lee's Experiment.

Treatment per Acre.	Bushels per Acre.		Remarks.	Profit or Loss per Acre.
	Yields.	Increase over No Manure.		
(1) No manure ..	34·6	..	..	..
(2) Super 1 cwt. ..	39·0	4·4	Significant increase ..	16s. profit.
(3) Super 1 cwt., plus muriate of potash 1 cwt.	36·8	2·2	Significantly lower than super	9s. 6d. loss.
(4) Super 1 cwt., plus nitrate of soda 1 cwt.	43·5	8·9	Significant increase over super	22s. 6d. profit.
(5) Super 1 cwt., plus potash 1 cwt., plus nitrate of soda 1 cwt.	45·5	10·9	Significant increase over super plus potash	18s. profit.

Comments on Table 18: Super and nitrate of soda have both been paying. Potash added to super depressed the yield by 2·2 bushels. When used with super and nitrate of soda the yield is increased by potash, although the increase is barely significant.

RESULTS OF TYPE B EXPERIMENTS.

19. Edgar Smith, Tuamarina, Marlborough.

Experiment No. 16/3/338. Variety of wheat: Solid-straw Tuscan, 90 lb. per acre. Date sown: 27th August, 1929. Nitrate of soda applied: 10th October, 1929. Date harvested: 7th February, 1930. Date threshed: 7th March, 1930. Previous crops: 1928–29, peas; 1927–28, rape; 1926, pasture. Soil: Alluvial silt.

Table 19.—Results of Edgar Smith's Experiment.

Treatment per Acre.	Bushels per Acre.		Remarks.	Profit per Acre.
	Yields.	Increase over No Manure.		
(1) No manure ..	26·7	..	..	..
(2) Super 1 cwt. ..	31·7	5·0	Significant increase over no manure	19s.
(3) Super 2 cwt. ..	34·2	7·5	Significant increase over super 1 cwt.	25s. 6d.
(4) Super 1 cwt., plus nitrate of soda 1 cwt.	37·7	11·0	Significant increase over super 1 cwt.	33s.
(5) Super 2 cwt., plus nitrate of soda 1 cwt.	39·8	13·1	Significant increase over super 2 cwt.	37s. 6d.
(6) Super 1 cwt., plus lime 2 cwt.*	31·5	4·8	Difference between this and super 1 cwt. is not significant	16s.

* The cost of carbonate of lime is reckoned as £1 per ton (1s. per cwt.).

Comments on Table 19: Both super 1 cwt. and super 2 cwt. have given paying increases, the latter giving a bigger profit than the former. The addition of 1 cwt. of nitrate of soda to each of the super dressings has caused substantial increases. Super 1 cwt., plus nitrate of soda 1 cwt., is 6 bushels better than super 1 cwt.; and super 2 cwt., plus nitrate of soda 1 cwt. is 5·6 bushels better than super 2 cwt. The addition of lime has not affected the yield.

20. C. G. Amyes, Springbank, North Canterbury.

Experiment No. 16/3/4. Variety of wheat: Solid-straw Tuscan, 100 lb. per acre. Date sown: 30th May, 1929. Nitrate of soda applied: 4th September, 1929. Date harvested: 31st January, 1930. Date threshed: 18th February, 1930. Previous crop: Wheat. Soil: Clay loam.

Comments on Table 20: Both super 1 cwt. and super 2 cwt. have given paying increases, the latter being more profitable than the former. Nitrate of soda has had no effect on yield. Carbonate of lime has had no effect on yield.

Table 20.—Results of C. G. Amyes's Experiment.

Treatment per Acre.	Bushels per Acre.		Remarks.	Profit per Acre.
	Yields.	Increase over No Manure.		
(1) No manure ..	22·5	..	..	..
(2) Super 1 cwt. ..	29·5	7·0	Significant increase ..	29s.
(3) Super 2 cwt. ..	31·8	9·3	Significant increase over super 1 cwt.	34s. 6d.
(4) Super 1 cwt., plus nitrate of soda 1 cwt.	28·7	6·2	Not significantly different from super 1 cwt.	9s.
(5) Super 2 cwt., plus nitrate of soda 1 cwt.	31·7	9·2	Not significantly different from super 2 cwt.	18s.
(6) Super 1 cwt., plus lime 2 cwt.	29·8	7·3	Not significantly different from super 1 cwt.	28s. 6d.

21. D. Mulholland, Darfield, Canterbury.

Experiment No. 16/3/6. Variety of wheat: Solid-straw Tuscan 100 lb. per acre. Date sown: 27th June, 1929. Nitrate of soda applied: 6th September, 1929. Date harvested: 10th February, 1930. Date threshed: 26th February, 1930. Previous crop: 1928–29, wheat. Soil: Silty loam.

Table 21.—Results of D. Mulholland's Experiment.

Treatment per Acre.	Bushels per Acre.		Remarks.	Profit per Acre.
	Yields.	Increase over No Manure.		
(1) No manure ..	33·8	..	..	..
(2) Super 1 cwt. ..	38·5	4·7	Significant increase ..	17s. 6d.
(3) Super 2 cwt. ..	37·1	3·3	Significantly lower than super 1 cwt.	4s. 6d.
(4) Super 1 cwt., plus nitrate of soda 1 cwt.	42·6	8·8	Significantly better than super 1 cwt.	22s.
(5) Super 2 cwt., plus nitrate of soda 1 cwt.	41·9	8·1	Significantly better than super 2 cwt.	12s. 6d.
(6) Super 1 cwt., plus lime 2 cwt.	39·7	5·9	Not significantly different from super 1 cwt.	21s. 6d.

Comments on Table 21: Super 1 cwt. has given a paying return. Increasing the super to 2 cwt. per acre has resulted in a depression in yield of 1·4 bushels. Nitrate of soda has increased the yield by 4·1 and 4·8 bushels when added to super 1 cwt. and super 2 cwt. respectively. Lime has had no significant effect on yield.

22. R. Letham, Lauriston, Mid-Canterbury.

Experiment No. 16/3/266. Variety of wheat: Solid-straw Tuscan, 80 lb. per acre. Date sown: 6th June, 1929. Nitrate of soda applied: 1st October, 1929. Date harvested: 6th February, 1930. Date threshed: 5th March, 1930. Previous crop: Grass for several years. Soil: Light silty loam.

Table 22.—Results of R. Letham's Experiment.

Treatment per Acre.	Bushels per Acre.		Remarks.	Profit per Acre.
	Yields.	Increase over No Manure.		
(1) No manure ..	16·5	..	..	..
(2) Super 1 cwt. ..	21·1	4·6	Significant increase ..	17s.
(3) Super 2 cwt. ..	22·3	5·8	Significantly better than super 1 cwt.	17s.
(4) Super 1 cwt., plus nitrate of soda 1 cwt.	28·4	11·9	Significantly better than super 1 cwt.	37s. 6d.
(5) Super 2 cwt., plus nitrate of soda	28·2	11·7	Significantly better than super 2 cwt.	30s. 6d.
(6) Super 1 cwt., plus lime 2 cwt.	23·1	6·6	Significantly better than super 1 cwt.	25s.

Comments on Table 22: Both super 1 cwt. and super 2 cwt. have given paying increases. The increase of super 2 cwt. over super 1 cwt. is just sufficient to meet the cost of the extra quantity of manure. The addition of nitrate of soda has increased the yield by 7·3 and 5·9 bushels over super 1 cwt. and super 2 cwt. respectively. Super plus lime has been responsible for an increase of 2 bushels per acre over super 1 cwt.

23. E. Body, Methven, Mid-Canterbury.

Experiment No. 16/3/158. Variety of wheat: Solid-straw Tuscan, 95 lb. per acre. Date sown: 22nd May, 1929. Nitrate of soda applied: 17th September, 1929. Date harvested: 12th February, 1930. Date threshed: 12th March, 1930. Previous crops: 1928–29, wheat; 1927–28, wheat following grass. Soil: Rich silty loam.

Table 23.—Results of E. Body's Experiment.

Treatment per Acre.	Bushels per Acre.		Remarks.	Profit per Acre.
	Yields.	Increase over No Manure.		
(1) No manure ..	42·4	..	..	..
(2) Super 1 cwt. ..	45·7	3·3	Significant increase ..	10s. 6d.
(3) Super 2 cwt. ..	45·5	3·1	Not significantly different from super 1 cwt.	3s. 6d.
(4) Super 1 cwt., plus nitrate of soda 1 cwt.	53·6	11·2	Significant increase over super 1 cwt.	34s.
(5) Super 2 cwt., plus nitrate of soda 1 cwt.	52·8	10·4	Significant increase over super 2 cwt.	23s.
(6) Super 1 cwt., plus lime 2 cwt.	45·7	3·3	Not different from super 1 cwt.	8s. 6d.

Comments on Table 23: Super 1 cwt. has been more profitable than super 2 cwt., as the increased phosphate had no effect on yield. The addition of nitrate of soda has increased the yield by 7·9 and 7·3 bushels over super 1 cwt. and 2 cwt. respectively. Lime has had no effect on yield.

24. S. Robinson, Methven, Mid-Canterbury.

Experiment No. 16/3/263. Variety of wheat: Marshall's, 105 lb. per acre. Date sown: 23rd May, 1929. Nitrate of soda applied: 17th September, 1929. Date harvested: 18th February, 1930. Date threshed: 11th March, 1930. Previous crops: 1928–29, wheat following grass. Soil: Silty loam.

Table 24.—Results of S. Robinson's Experiment.

Treatment per Acre.	Bushels per Acre.		Remarks.	Profit or Loss per Acre.
	Yields.	Increase over No Manure.		
(1) No manure ..	20·5	..	..	..
(2) Super 1 cwt. ..	21·5	1·0	Significant increase ..	1s. loss.
(3) Super 2 cwt. ..	21·7	1·2	Not significantly different from super 1 cwt.	6s. loss.
(4) Super 1 cwt., plus nitrate of soda 1 cwt.	29·8	9·3	Significant increase over super 1 cwt.	24s. 6d. profit.
(5) Super 2 cwt., plus nitrate of soda 1 cwt.	30·1	9·6	Significant increase over super 2 cwt.	20s. profit.
(6) Super plus lime 2 cwt.	21·5	1·0	Not significantly different from super 1 cwt.	3s. loss.

Comments on Table 24: Both super 1 cwt. and super 2 cwt. have increased the yield, but neither has proved paying. The addition of nitrate of soda has increased the yield by 8·3 and 8·4 bushels over super 1 cwt. and 2 cwt. respectively. Lime has had no effect on yield.

25. R. Campbell, Dromore, Mid-Canterbury.

Experiment No. 16/3/257. Variety of wheat: Solid-straw Tuscan, 90 lb. per acre. Date sown: 31st May, 1929. Nitrate of soda applied: 6th September, 1929. Date harvested: 3rd February, 1930. Date threshed: 28th February, 1930. Previous crops: 1928–29, oats; 1927–28, wheat following grass. Soil: Light loam with a few stones.

Table 25.—Results of R. Campbell's Experiment.

Treatment per Acre.	Bushels per Acre.		Remarks.	Profit per Acre.
	Yields.	Increase over No Manure.		
(1) No manure ..	19·2	..	..	..
(2) Super 1 cwt. ..	21·6	2·4	Significant increase ..	6s.
(3) Super 2 cwt. ..	22·1	2·9	Not significantly different from super 1 cwt.	2s. 6d.
(4) Super 1 cwt., plus nitrate of soda 1 cwt.	28·3	9·1	Significant increase over super 1 cwt.	23s. 6d.
(5) Super 2 cwt., plus nitrate of soda 1 cwt.	28·4	9·2	Significant increase over super 2 cwt.	18s.
(6) Super plus lime 2 cwt.	21·4	2·2	Not significantly different from super 1 cwt.	3s.

Comments on Table 25 : Super 1 cwt. has given a paying increase. Super 2 cwt. is not materially better than super 1 cwt., and the cost of the extra manure has reduced the profit. The addition of nitrate of soda has increased the yield by 6·7 and 6·3 bushels over super 1 cwt. and 2 cwt. respectively. Lime has not affected the yield.

26. J. F. Langley, Somerton, Mid-Canterbury.

Experiment No. 16/3/262. Variety of wheat : Solid-straw Tuscan, 90 lb. per acre. Date sown : 24th May, 1929. Nitrate of soda applied : 1st October, 1929. Date harvested : 6th February, 1930. Date threshed : 1st March, 1930. Previous crops : 1928–29, wheat following grass. Soil : Silty loam.

Table 26.—Results of J. F. Langley's Experiment.

Treatment per Acre.	Bushels per Acre.		Remarks.	Profit per Acre.
	Yields.	Increase over No Manure.		
(1) No manure ..	47·9	..	..	..
(2) Super 1 cwt. ..	53·2	5·3	Significant increase ..	20s. 6d.
(3) Super 2 cwt. ..	52·6	4·7	Not significantly different from super 1 cwt.	11s. 6d.
(4) Super 1 cwt., plus nitrate of soda 1 cwt.	57·2	9·3	Significant increase over super 1 cwt.	24s. 6d.
(5) Super 2 cwt., plus nitrate of soda 1 cwt.	59·3	11·4	Significant increase over super 1 cwt., and super 1 cwt. plus nitrate of soda 1 cwt.	29s.
(6) Super plus lime 2 cwt.	51·9	4·0	Not significantly different from super 1 cwt.	12s.

Comments on Table 26 : Super 1 cwt. and super 2 cwt. do not differ appreciably in their effect on yield. Both show a paying return. The addition of nitrate of soda to super 1 cwt. has increased yield by 4 bushels. When added to super 2 cwt. the increase is 6·7 bushels, thus enabling super 2 cwt. plus nitrate of soda 1 cwt. to show a greater profit. Lime has had no effect on yield.

27. J. W. Topham, Arowhenua, South Canterbury.

Experiment No. 16/3/111. Variety of wheat : Solid-straw Tuscan, 125 lb. per acre. Date sown : 9th July, 1929. Nitrate of soda applied : 10th October, 1929. Date harvested : 26th February, 1930. Date threshed : 14th March, 1930. Previous crops : 1928–29, peas ; 1927–28, wheat ; 1926, white clover ; 1925, wheat. Soil : Rich alluvial silt.

Comments on Table 27 : Both super 1 cwt. and super 2 cwt. have increased the yield, although super 2 cwt. has failed to give an appreciable increase over super 1 cwt. The addition of nitrate of soda has increased yields by 5·9 and 6·2 bushels over super 1 cwt. and 2 cwt. respectively. Lime has had no material effect on yield.

Table 27.—Results of J. W. Topham's Experiment.

Treatment per Acre.	Bushels per Acre.		Remarks.	Profit per Acre.
	Yields.	Increase over No Manure.		
(1) No manure ..	39·6	..	..	..
(2) Super 1 cwt. ..	42·4	2·8	Significant increase ..	8s.
(3) Super 2 cwt. ..	42·6	3·0	Not significantly different from super 1 cwt.	3s.
(4) Super 1 cwt., plus nitrate of soda 1 cwt.	48·3	8·7	Significant increase over super 1 cwt.	21s. 6d.
(5) Super 2 cwt., plus nitrate of soda 1 cwt.	48·8	9·2	Significant increase over super 2 cwt.	18s.
(6) Super 1 cwt., plus lime 2 cwt.	41·4	1·8	Not significantly better than super 1 cwt.	1s.

28. P. R. Talbot, Claremont, South Canterbury.

Experiment No. 16/3/112. Variety of wheat: Solid-straw Tuscan, 120 lb. per acre. Date sown: 22nd May, 1929. Nitrate of soda applied: 25th September, 1929. Date harvested: 12th February, 1930. Date threshed: 15th March, 1930. Previous crops: Grass for three years. Soil: Clay soil on downs.

Table 28.—Results of P. R. Talbot's Experiment.

Treatment per Acre.	Bushels per Acre.		Remarks.	Profit per Acre.
	Yields.	Increase over No Manure.		
(1) No manure ..	38·2	..	..	..
(2) Super 1 cwt. ..	43·1	4·9	Significant increase ..	18s. 6d.
(3) Super 2 cwt. ..	42·4	4·2	Not significantly different from super 1 cwt.	9s.
(4) Super 1 cwt., plus nitrate of soda 1 cwt.	48·8	10·6	Significant increase over super 1 cwt.	31s.
(5) Super 2 cwt., plus nitrate of soda 1 cwt.	48·1	9·9	Significant increase over super 2 cwt.	21s. 6d.
(6) Super 1 cwt., plus lime 2 cwt.	44·3	6·1	Significant increase over super 1 cwt.	22s. 6d.

Comments on Table 28: Super 1 cwt. and 2 cwt. do not differ appreciably in yield. The smaller quantity has proved more profitable. The addition of nitrate of soda has increased the yield by 5·7 bushels over super 1 cwt. and 2 cwt. respectively. The addition of lime to super has caused an increase of 1·2 bushels over super.

29. A. Davey, Waitohi, South Canterbury.

Experiment No. 16/3/360. Variety of wheat: Solid-straw Tuscan, 150 lb. per acre. Date sown: 15th August, 1929. Nitrate of soda applied: 22nd October, 1929. Date harvested: 14th February, 1930. Date threshed: 14th March, 1930. Previous crops: 1928–29, turnips; 1926–27, grass. Soil: Clay soil on downs.

Table 29.—Results of A. Davey's Experiment.

Treatment per Acre.	Bushels per Acre.		Remarks.	Profit per Acre.
	Yields.	Increase over No Manure.		
(1) No manure ..	14·1	..	..	..
(2) Super 1 cwt. ..	17·2	3·1	Significant increase ..	9s. 6d.
(3) Super 2 cwt. ..	17·8	3·7	Not significantly different from super 1 cwt.	6s. 6d.
(4) Super 1 cwt., plus nitrate of soda 1 cwt.	20·4	6·3	Significant increase over super 1 cwt.	9s. 6d.
(5) Super 2 cwt., plus nitrate of soda 1 cwt.	21·2	7·1	Significant increase over super 2 cwt. and super 1 cwt., plus nitrate of soda 1 cwt.	7s. 6d.
(6) Super plus lime 2 cwt.	16·7	2·6	Not significantly different from super 1 cwt.	5s

Comments on Table 29: Super 1 cwt. and super 2 cwt. have both given paying increases. Super 2 cwt. is not significantly better than super 1 cwt., and is less profitable. The addition of nitrate of soda has increased the yields by 3·2 and 3·4 bushels over super 1 cwt. and 2 cwt. respectively. The increases have just about met the cost of the manure. Lime has had no effect on yield.

30. D. Caird, Southburn, South Canterbury.

Experiment No. 16/3/110. Variety of wheat: Solid-straw Tuscan, 120 lb. per acre. Date sown: 24th May, 1929. Nitrate of soda applied: 24th September, 1929. Date harvested: 15th February, 1930. Date threshed: 17th March, 1930. Previous crops: 1928–29, rape; 1927–28, wheat and green feed; 1926, fallow; 1925, grass for five years. Soil: Clay soil on downs.

Table 30.—Results of D. Caird's Experiment.

Treatment per Acre.	Bushels per Acre.		Remarks.	Profit or Loss per Acre.
	Yields.	Increase over No Manure.		
(1) No manure ..	57·3	..	..	..
(2) Super 1 cwt. ..	61·7	4·4	Significant increase ..	16s. profit.
(3) Super 2 cwt. ..	59·4	2·1	Not significantly different from super 1 cwt.	1s. 6d. loss.
(4) Super 1 cwt., plus nitrate of soda 1 cwt.	61·2	3·9	Ditto	2s. 6d. loss.
(5) Super 2 cwt., plus nitrate of soda 1 cwt.	59·6	2·3	,,	16s. 6d. loss.
(6) Super 1 cwt., plus lime 2 cwt.	60·4	3·1	,, ...	7s. 6d. loss.

Comments on Table 30: Super 1 cwt. has given a paying increase. None of the additional treatments has affected the yield to a significant extent.

31. E. Haugh, Duntroon, North Otago.

Experiment No. 16/4/158. Variety of wheat: College Hunter's, 120 lb. per acre. Date sown: 29th May, 1929. Nitrate of soda applied: 16th November, 1929. Date harvested: 21st February, 1930. Date threshed: 18th March, 1930. Previous crops: 1928–29, wheat; 1927–28, oats for green feed; 1926–27, wheat. Soil: Clay loam with clay subsoil.

Table 31.—Results of E. Haugh's Experiment.

Treatment per Acre.	Bushels per Acre.		Remarks.	Profit per Acre.
	Yields.	Increase over No Manure.		
(1) No manure.. ..	24·4	..	..	..
(2) Super 1 cwt. ..	28·6	4·2	Significant increase ..	15s.
(3) Super 2 cwt. ..	30·0	5·6	Not significantly better than super 1 cwt.	16s.
(4) Super 1 cwt., plus nitrate of soda 1 cwt.	32·7	8·3	Significant increase over super 1 cwt.	19s. 6d.
(5) Super 2 cwt., plus nitrate of soda 1 cwt.	33·2	8·8	Significant increase over super 2 cwt.	16s.
(6) Super 1 cwt., plus lime 2 cwt.	27·7	3·3	Not significantly different from super 1 cwt.	8s. 6d.

Comments on Table 31: Super 1 cwt. and super 2 cwt. have given paying increases, although their yields do not differ significantly. The addition of nitrate of soda has increased yields by 4·1 and 3·2 bushels over super 1 cwt. and 2 cwt. respectively. Lime has not influenced yield.

32. R. Dick, Weston, North Otago.

Experiment No. 16/4/156. Variety of wheat: College Hunter's, 105 lb. per acre. Date sown: 10th July, 1929. Nitrate of soda applied: 25th November, 1929. Date harvested: 20th February, 1930. Date threshed: 20th March, 1930. Previous crops: 1928–29, wheat; 1927–28, rape; 1926–27, wheat. Soil: Clay loam with clay subsoil.

Table 32.—Results of R. Dick's Experiment.

Treatment per Acre.	Bushels per Acre.		Remarks.	Profit or Loss per Acre.
	Yields.	Increase over No Manure.		
(1) No manure.. ..	27·7	..	..	..
(2) Super 1 cwt. ..	32·6	4·9	Significant increase ..	18s. 6d. profit.
(3) Super 2 cwt. ..	32·4	4·7	Not significantly different from super 1 cwt.	11s. 6d. profit.
(4) Super 1 cwt., plus nitrate of soda 1 cwt.	38·6	10·9	Significant increase over super 1 cwt.	32s. 6d. profit.
(5) Super 2 cwt., plus nitrate of soda 1 cwt.	32·0	4·3	Not significantly different from super 2 cwt.	6s. 6d. loss.
(6) Super 1 cwt., plus lime 2 cwt.	30·7	3·0	Not significantly different from super 1 cwt.	7s. profit.

Comments on Table 32: Super 1 cwt. and super 2 cwt. both show paying increases, although the larger amount of super has not increased the yield over super 1 cwt. The addition of nitrate of soda to super 1 cwt. has increased yield by 6 bushels over super 1 cwt., although the addition of nitrate of soda to super 2 cwt. has not affected the yield. This result is entirely anomalous, and cannot be accounted for. Lime has not affected yield.

SUMMARY OF RESULTS.

Table 33.—Differences in Yields in Bushels per Acre between (a) *Super 1 cwt. and no Manure,* (b) *Super 1 cwt. plus Nitrate of Soda 1 cwt. and Super 1 cwt.,* (c) *Super 1 cwt. plus Nitrate of Soda 1 cwt. and no Manure. (Types A and B Experiments.)*

Experiment No. in Text.	Increase due to Manures.			Experiment No. in Text.	Increase due to Manures.		
	Increase of Super 1 cwt. over no Manure.	Increase of Super 1 cwt. plus Nitrate/Soda 1 cwt. over Super 1 cwt.	Increase of Super 1 cwt. plus Nitrate/Soda 1 cwt. over no Manure.		Increase of Super 1 cwt. over no Manure.	Increase of Super 1 cwt. plus Nitrate/Soda 1 cwt. over Super 1 cwt.	Increase of Super 1 cwt. plus Nitrate/Soda 1 cwt. over no Manure.
1	**5·7**	**4·8**	**10·5**	17	**2·6**	**9·2**	**11·8**
2	**3·6**	−1·7	1·9	18	**4·4**	**4·5**	**8·9**
3	**3·5**	1·0	**4·5**	19	**5·0**	**6·0**	**11·0**
4	**3·3**	**7·6**	**10·9**	20	**7·0**	−0·8	**6·2**
5	**6·7**	**3·2**	**9·9**	21	**4·7**	**4·1**	**8·8**
6	**1·4**	**3·6**	**5·0**	22	**4·6**	**7·3**	**11·9**
7	**3·4**	**4·8**	**8·2**	23	**3·3**	**7·9**	**11·2**
8	**2·5**	0·1	**2·6**	24	**1·0**	**8·3**	**9·3**
9	0·8	**7·9**	**8·7**	25	**2·4**	**6·7**	**9·1**
10	**2·5**	**7·0**	**9·5**	26	**5·3**	**4·0**	**9·3**
11	**1·7**	**7·5**	**9·2**	27	**2·8**	**5·9**	**8·7**
12	**5·6**	**6·3**	**11·9**	28	**4·9**	**5·7**	**10·6**
13	0·4	1·5	1·9	29	**3·1**	**3·2**	**6·3**
14	**5·7**	**3·2**	**8·9**	30	**4·4**	−0·5	**3·9**
15	**3·8**	0·4	**4·2**	31	**4·2**	**4·1**	**8·3**
16	**5·5**	**2·3**	**7·8**	32	**4·9**	**6·0**	**10·9**

NOTES.—Increases printed in heavy type are statistically significant. A minus sign preceding a figure indicates a decrease.

Comments on Table 33.

Super 1 cwt.—Average increase due to super 1 cwt. (thirty-two experiments) equals 3·8 bushels per acre. Average profit due to super 1 cwt. equals 13s. per acre.

Super has increased the yield to a significant extent in thirty out of thirty-two experiments. In the other two experiments and in one of the thirty the increases were too small to meet the cost of 1 cwt. of super.

Nitrate of Soda.—Average increase due to nitrate of soda 1 cwt. equals 4·4 bushels per acre. Average profit per acre due to nitrate of soda 1 cwt. equals 6s. per acre.

Average increase due to super 1 cwt. plus nitrate of soda 1 cwt. equals 8·2 bushels per acre. Average profit per acre due to super 1 cwt. plus nitrate of soda 1 cwt. equals 19s. per acre.

Nitrate of soda has given significant increases in twenty-seven out of thirty-two experiments. In six of these twenty-seven the increases have not been sufficient to pay for the nitrate of soda. (See comments on the use of sulphate of ammonia under "Recommendations to Farmers," page 51.)

Table 34.—Differences in Bushels per Acre (a) *when Super plus Potash is compared with Super,* (b) *when Super plus Potash plus Nitrate of Soda is compared with Super plus Nitrate of Soda,* (c) *when Super plus Potash plus Nitrate of Soda is compared with Super plus Potash. (Type A Experiments.)*

Experiment No. in Text.	Super plus Potash—Increase or Decrease in Relation to Super 1 cwt.	Super plus Potash plus Nitrate of Soda.		Experiment No. in Text.	Super plus Potash—Increase or Decrease in Relation to Super 1 cwt.	Super plus Potash plus Nitrate of Soda.	
		Increase or Decrease in Relation to Super plus Nitrate/Soda.	Increase or Decrease in Relation to Super plus Potash.			Increase or Decrease in Relation to Super plus Nitrate/Soda.	Increase or Decrease in Relation to Super plus Potash.
1	**2·0**	**—1·6**	**1·2**	10	0·0	0·4	**7·4**
2	0·4	**2·9**	0·8	11	—0·3	—0·8	**7·0**
3	—1·0	—1·3	0·7	12	**—2·6**	**1·6**	**10·5**
4	0·2	—0·9	**6·5**	13	—2·2	0·3	4·0
5	—1·7	0·3	**5·1**	14	**—2·4**	—0·8	**4·8**
6	**—1·3**	—0·4	**4·5**	15	—3·3	—2·4	0·5
7	—0·7	—0·7	**4·8**	16	**—2·1**	**—2·0**	**2·4**
8	**—1·3**	0·3	**1·7**	17	—1·0	—2·0	**8·2**
9	0·6	—0·8	**6·5**	18	**—2·2**	2·0	**8·7**

NOTES.—Figures printed in heavy type represent statistically significant differences. A minus sign preceding a figure indicates a decrease.

Comments on Table 34.

Potash.—Average decrease due to potash when used with super equals 0·9 bushels per acre. Average decrease due to potash when used with super and nitrate of soda equals 0·3 bushels per acre.

Potash used with super increased the yield significantly in one experiment only (No. 1). The increase was not a paying one. It depressed yield significantly in six experiments out of eighteen.

Potash used with super and nitrate of soda increased the yield significantly over that from super plus nitrate of soda in two experiments (Nos. 2 and 12). The increase of 2·9 bushels in Experiment 2 was just sufficient to meet the cost of the potash. It depressed yield definitely in two experiments.

In Experiment 1 potash used with super increased the yield by 2 bushels, but when used with super plus nitrate of soda the yield was depressed. (See reference to similar results in *Journal* for April, 1929, p. 227.) In Experiment 12 the reverse was the case.

Nitrate of Soda.—Average increase due to nitrate of soda when used with super and potash equals 4·7 bushels per acre.

Super plus potash plus nitrate of soda shows a superiority over super plus potash in all eighteen experiments. Although fourteen of these increases are significant, only eleven are paying. (See Table 33 for fuller details on nitrate of soda.)

Comparisons between Super 2 cwt. and Super 1 cwt.—Average increase of super 2 cwt. over super 1 cwt. equals 0·25 bushels per acre.

Super 2 cwt. was better than super 1 cwt. to a significant extent in two experiments (Nos. 19 and 20) out of fourteen. In Experiment 21 a definite depression in yield occurred as a result of using the larger quantity of super.

Comparison between Super 2 cwt. plus Nitrate of Soda 1 cwt. and Super 1 cwt. plus Nitrate of Soda 1 cwt.—Average decrease of super 2 cwt. plus nitrate of soda 1 cwt. below super 1 cwt. plus nitrate of soda 1 cwt. equals 0·1 bushel per acre. (Note.—If the decrease in Experiment 32 is disregarded there is a superiority of 0·4 bushel in favour of super 2 cwt. plus nitrate of soda 1 cwt.)

In three experiments (Nos. 19, 20, and 26) the treatment containing the greater quantity of super shows a significant superiority; in Experiment 32 a definite depression has resulted. (A comment is made regarding this under Table 32.)

Comparison between Super 1 cwt. plus Lime 2 cwt. and Super 1 cwt.—Average increase of super 1 cwt. plus lime 2 cwt. over super 1 cwt. equals 0·1 bushels per acre. In Experiments 22 and 28 the addition of lime has caused significant increases. The soils in the districts where these experiments were conducted respond markedly to lime, although some of the other experiments are on lime-response soils and do not show any appreciable effect from the use of 2 cwt. of lime.

Comparison between Responses from Super and Super plus Nitrate of Soda in 1928–29 Season and the same Manures in 1929–30.

On eight farms the following treatments were under trial in 1928–29 and again in 1929–30: (*a*) No manure, (*b*) super 1 cwt., (*c*) super 1 cwt. plus nitrate of soda 1 cwt.

Table 35.—Differences in Yield in Bushels per Acre between (a) *Super 2 cwt. and Super 1 cwt.*, (b) *Super 2 cwt. plus Nitrate of Soda 1 cwt. and Super 1 cwt. plus Nitrate of Soda 1 cwt.*, (c) *Super 1 cwt. plus Lime 2 cwt. and Super 1 cwt. (Type B Experiments.)*

Experiment No. in Text.	Super 2 cwt.—Increase or Decrease in Relation to Super 1 cwt.	Super 2 cwt. plus Nitrate/Soda 1 cwt.—Increase or Decrease in Relation to Super 1 cwt. plus Nitrate/Soda 1 cwt.	Super 1 cwt. plus Lime 2 cwt.—Increase or Decrease in Relation to Super 1 cwt.	Experiment No. in Text.	Super 2 cwt.—Increase or Decrease in Relation to Super 1 cwt.	Super 2 cwt. plus Nitrate/Soda 1 cwt.—Increase or Decrease in Relation to Super 1 cwt. plus Nitrate/Soda 1 cwt.	Super 1 cwt. plus Lime 2 cwt.—Increase or Decrease in Relation to Super 1 cwt.
19	**2·5**	**2·1**	−0·2	26	−0·6	**2·1**	−0·7
20	**2·3**	**3·0**	0·3	27	0·2	0·5	−1·0
21	**−1·4**	−0·7	1·2	28	−0·7	−0·7	**1·2**
22	1·2	−0·2	**2·0**	29	0·6	0·8	−0·5
23	−0·2	−0·8	0·0	30	−2·3	−1·6	−1·3
24	0·2	0·3	0·0	31	1·4	0·5	−0·9
25	0·5	0·1	−0·2	32	0·2	−6·6*	−1·9

* See comments on Table 32.

NOTES.—Figures printed in heavy type represent statistically significant differences. A minus sign preceding a figure indicates a decrease.

Table 36.—Response in Bushels per Acre to Super 1 cwt. and Super 1 cwt. plus Nitrate of Soda 1 cwt., 1928–29 and 1929–30.

Name of Farmer.	Experiment No. in Text.	Super 1 cwt.—Increase over no Manure.		Super 1 cwt. plus Nitrate/Soda 1 cwt.—Increase over Super 1 cwt.		Super 1 cwt. plus Nitrate/Soda 1 cwt.—Increase over no Manure.	
		1928–29.	1929–30.	1928–29.	1929–30.	1928–29.	1929–30.
C. G. Amyes ..	20	10·4	7·0	6·4	—0·8	16·4	6·2
D. Mulholland ..	21	7·9	4·7	6·2	4·1	14·1	8·8
E. Body ..	23	2·0	3·3	10·8	7·9	12·8	11·2
J. Bland ..	11	6·4	1·7	3·4	7·5	9·8	9·2
J. W. Topham ..	27	7·0	2·8	5·5	5·9	12·8	8·7
P. R. Talbot ..	28	10·3	4·9	5·5	5·7	15·8	10·6
D. Caird ..	30	6·3	4·4	0·0	—0·5	6·3	3·9
F. Saunders ..	14	3·8	5·7	2·0	3·2	5·8	8·9
Averages ..	..	**6·8**	**4·3**	**5·0**	**4·1**	**11·7**	**8·4**

Comments on Table 36.

Super Response.—On six of the eight farms the response to super was greater in 1928–29 than in 1929–30. The average for 1928–29 is 2·5 bushels greater than for 1929–30.

Nitrogen Response.—On one farm (No. 20) there was no response to nitrate of soda in 1929–30, although a good response occurred in 1928–29. On two farms the 1928–29 response was better and on four farms it was poorer than 1929–30.

Super plus Nitrate of Soda Response.—On seven farms the combined effect of super plus nitrate of soda was greater in 1928–29 than in 1929–30.

The number of farms under comparison is rather too small to draw definite conclusions from, but it would appear as though the 1928–29 season was the more favourable for manure responses. The 1929–30 season was a very dry one during the September to November period.

RECOMMENDATIONS TO FARMERS.

(1) Sow 1 cwt. of superphosphate with wheat at seeding. There is not sufficient evidence to warrant the recommendation of a greater quantity.

(2) Top-dress autumn- and winter-sown wheat, especially if it is inclined to be light in colour, with 1 cwt. of sulphate of ammonia per acre in late August or early September. Do not use nitrogen unless phosphate has already been used. Sulphate of ammonia is recommended because 1 cwt. costs about 12s. 8d., whereas 1 cwt. of nitrate of soda costs about 16s. Moreover, sulphate of ammonia contains 20·6 per cent. of nitrogen, whereas nitrate of soda contains 15·5 per cent. nitrogen. It is highly probable that 1 cwt. of sulphate of ammonia will give better results than 1 cwt. nitrate of soda (this point is being tested in the 1930–31 season), and the difference in profit should be greater than the difference in price between the two forms of nitrogen. A limited amount of evidence from experiments indicates that sulphate of ammonia should be applied two to four weeks earlier than nitrate of soda. If top-dressing with nitrogen is delayed until late September or early October it will be as well to use nitrate of soda.

(3) For spring-sown wheat mix equal parts of super and sulphate of ammonia, and sow at the rate of 2 cwt. per acre at sowing time; or sow 1 cwt. of super with the seed and top-dress with 1 cwt. sulphate of ammonia when the plants are about 3 in. high.

(4) Experiments conducted during the last five years indicate that the use of potash in Canterbury does not pay. Consequently its use is not recommended. Further work is required in Otago before a definite statement regarding potash can be made concerning that district.

The Department extends its thanks to the farmers who co-operated in the foregoing experiments.

The field work in connection with the experiments was carried out under the direction of Mr. R. McGillivray, Fields Superintendent, Christchurch, by Messrs. A. G. Elliott, Instructor in Agriculture, Marlborough, W. Stafford, Instructor in Agriculture, Christchurch (assisted by Instructors G. G. Calder and H. Chamberlain), E. M. Bates, Instructor in Agriculture, Ashburton, R. A. Calder, Instructor in Agriculture, Timaru, K. Montgomery, Fields Instructor, Timaru; and under the direction of Mr. R. B. Tennent, Fields Superintendent, Dunedin, by Messrs. T. Sellwood, Instructor in Agriculture, Oamaru, and A. S. Duff, Instructor in Agriculture, Alexandra.

—*A. W. Hudson, Crop Experimentalist, Plant Research Station, Department of Agriculture, Palmerston North.*

LEAF-SPOT DISEASE OF THE TOBACCO-PLANT.

TOBACCO leaves from Rotorua affected by a leaf-spot disease were submitted to the Plant Research Station during the past season for examination. The numerous leaf-spots are at first brown in colour, later changing to almost white. In a number of instances the affected part falls away, giving the leaf a perforated appearance. The spots vary very much in shape and size, the shape being round and angular, and sometimes elongated, and the size from mere specks to ¼ in. in diameter. Among growers the disease is sometimes known as "angular leaf-spot," a term that is often rather loosely applied.

After making cultures from these affected leaves, the Mycologist reports: "The specimens have now yielded an organism known as *Macrosporium tabacinum*, recorded in America and South Africa as the cause of a condition identical with that present on the specimens supplied. This disease is probably transmitted with the seed, as are most species of *Alternaria* and *Macrosporium*. Disinfection of the seed is advisable, and of the seed-bed prior to sowing. Seedlings showing signs of the disease should be removed, and the remainder of the bed sprayed with Bordeaux 5–4–50, which at this stage will not damage the leaf."

A disease-preventive treatment for tobacco-seed is being worked out by the Mycologist, and it is hoped that some definite information on this matter will be available before long.

—*Horticulture Division.*

INVESTIGATION OF TAINT IN PORK.

AN interim report by Mr. C. R. Barnicoat, of the Dominion Laboratory, on the current investigation into taint sometimes found of late in New Zealand frozen pork, is published in the June issue of the *N.Z. Journal of Science and Technology*. It will be recalled that the matter arose through complaints from British buyers, who described the taint as a "fishy" or "reasty" odour, which developed after thawing of the meat. The trouble was attributed here, in general, firstly to defective feeding of pigs, and secondly to faulty freezing and storage of carcasses. The report summarizes the indications of the experiments carried out as follows:—

(1) Certain meals which have been made by the rendering of certain animal or fish offals appear, when given with buttermilk, to exert a predisposing influence to taint upon the fat of pigs fed on them.

(2) It is doubtful whether the same meals fed with a concentrate (*e.g.*, barley) have this undesirable effect on the fat of those animals to which they have been fed.

(3) Sides of pork from pigs fed on various diets, when frozen for three months under somewhat fluctuating air-temperature conditions which would allow of slight variations in carcass-temperatures, were, on careful thawing, free of taint.

(4) These sides cured satisfactorily, and the freezing had in no way developed taint in the carcass.

(5) Carcasses submitted to very extreme fluctuating temperature conditions while in the frozen state rapidly became putrid-smelling in the flesh, rancid in the fat, and developed an unsightly, perished appearance.

Lord and Richter (Als. Milch-Fleich Hygeine, 1929, xl, 15 Oct.) point out that fat-rich fish-meals can be used fairly freely for feeding pigs for consumption as pork, but that a warning is necessary against the feeding of such meals to pigs intended for the manufacture of bacon.

The local experiments have in every way confirmed these observations in so far that the various experimental feeds have not produced any sign of tallowy taint at the pork stage (even after freezing). It has always been after curing that the trouble has become apparent, except when the carcasses were purposely submitted to fluctuating temperatures in order to produce defective fat and meat, as described in Part I of this report.

INTERIM RETURN OF SHEEP AT 30th APRIL, 1930.

Sheep District.	Number of Sheep.		Increase.
	Final Returns, 1929.	Interim Returns, 1930.	
Auckland	2,734,171	3,300,485	566,314
Gisborne - Hawke's Bay ..	6,795,339	6,941,284	145,945
Wellington – West Coast ..	6,058,934	6,222,883	163,949
North Island totals ..	15,588,444	16,464,652	876,208
Marlborough–Nelson–Westland..	1,456,952	1,509,010	52,058
Canterbury–Kaikoura ..	5,827,573	6,028,390	200,817
Otago	6,178,413	6,635,338	456,925
South Island totals ..	13,462,938	14,172,738	709,800
Dominion totals ..	29,051,382	**30,637,390**	**1,586,008**

SEASONAL NOTES.

THE FARM.

Pasture-management.

If necessary harrowing of pastures has not already been attended to it should be carried out during the next few weeks. If this is not done on fields in which animal manure is plentiful the spring pasture-growth will be very uneven, on account of the development of patches of rank herbage in the vicinity of where droppings have lain undisturbed for any considerable period. Such uneven growth presents a distinct hindrance to effective grazing-management during the months when the pastures are growing rapidly, unless special steps are taken to eliminate the patches of rank herbage. On farms carrying considerable numbers of dry stock which it is not desired to fatten immediately the objectionable rank patches can usually be removed by forcing the store dry stock to eat them out. But it is not at all easy to deal satisfactorily with rank patches of grass growth on farms supporting principally wet stock. Hence in practice it proves most desirable to obviate the appearance of such patches by opportunely using the harrows to distribute the droppings before their fertilizing ingredients have been washed into the soil beneath.

Top-dressing of sod-bound and mossy pastures is almost certain to prove much more effective when accompanied by relatively severe harrowing. The harrowing should be severe enough to open up the turf, and thereby give a chance to young plants and to plants of better species, whose presence is made possible by the increased fertility to develop vigorously. This will bring about the process known as pasture-rejuvenation, which is so desirable on many old-established permanent pastures which have deteriorated and which it is not economically feasible to renew by putting the land under the plough.

At times, towards the end of winter, coarse growth which was developed in the summer and autumn is still left ungrazed. Such growth is specially apt to occur on fields which have been grazed by horses or sheep alone, both of which consume the finer and neglect the rougher herbage. Every effort should be made to remove such growth without delay, as it is a serious check on good herbage development in the spring. Its removal is particularly desirable where top-dressing is to be carried out, and most particularly so if nitrogenous manures are to be applied.

If top-dressing of grassland still remains to be done, superphosphate is the class of phosphate which should almost invariably be used at this season. Field trials have shown that it will make its influence felt substantially in four weeks from the date of application at this time of the year.

Young pastures, and particularly those it is intended to make permanent, should be treated with special care during the winter and early spring. The two extremes, undergrazing and overgrazing, should be equally avoided. Undergrazing, which is prone to occur in winter and early spring only when stock are being kept off young pastures specially to avoid "poaching" or "pugging" of the ground, will lead to suppression or weakening of valuable pasture species such as clovers and crested dogstail. Undergrazing is to be avoided by stocking sufficiently and, as far as possible, only in dry weather.

The damage from undergrazing is likely to be particularly heavy in the case of a young pasture which contains a large proportion of Italian ryegrass—a species which should never be allowed to become long in young

pastures. Overgrazing, which is much more likely to happen in August than undergrazing, will readily lead to a setback to valuable species before they have properly established themselves.

Sheep may very suitably be employed in the winter grazing of young pastures provided too close grazing, which will take place if not guarded against, is not allowed to occur. The grazing by sheep of young pastures, when not overdone, is valuable, because of the even, thorough consolidation of the soil which it brings about.

In late winter the greatest harm to pastures may be done if ground is stocked when it is so wet and soft that it is not fit to carry stock. Stocking wet ground is what at times leads to invasion by markedly objectionable weeds such as docks, daisies, and buttercups. Some of these weeds are occasionally cited as being indicative of want of drainage, but actually they often appear on land which is relatively well drained and which has been broken up by stocking when wet in the late winter.

General Tillage Work.

During August every day on which soil-moisture conditions are favourable for cultivation work should be devoted to the turning-over of as much as possible of the land intended for cropping. Areas which previously have been skim-ploughed should now be ploughed to the depth of the full furrow. The policy of speeding the plough at this season is especially advisable in respect to cereal crops, but it does not apply to cereal crops alone. Land intended for lucerne, root, and other forage crops should be ploughed in August if possible. When ploughing for these crops land which has been in grass it is often an advantage to fit to the plough the skimming-attachment, which assists in bringing about the complete burial of the turfy surface-layer. Without the use of the skimming-attachment twitches and other weeds are likely to make their appearance on the surface between the furrows.

Forage-crop Considerations.

The planning of the programme of forage-crop production for the coming season cannot safely be postponed much further. The experience of previous seasons may be useful as a guide for future work. For instance, it is well to keep in mind the occurrence of any crop disease. It is definitely known that it is merely courting failure to sow cruciferous crops such as turnips, swedes, and rape on land on which club-root has attacked recent crops. Onion-mildew and potato-blight are other instances to which the same principle applies. Dairy-farmers as a rule should aim to provide some fresh, young, or non-woody forage to supplement their pastures as soon after Christmas as possible. If the summer happens to be a dry one, or if pasture-grazing management has not really been efficient, then herds will begin to fall off in their production at an unduly rapid rate soon after Christmas unless they are fed some highly digestible non-woody forage. Young green lucerne following a first cut of the crop removed in good time, the fresh-grass aftermath on a paddock from which ensilage was obtained at a suitably early date, and soft turnips of a quickly maturing type sown early are three sources of forage which may be widely resorted to for relief in this connection. In planning the summer forage-crop provision it is well to remember that the season may be better than may reasonably be expected, and that when this is the case it is in the interest of convenience and economy to be able to convert any surplus into hay or ensilage. If the summer forages consist entirely of crops such as soft turnips and rape it will be impossible to do this—another instance of the weakness of having all the eggs in one basket.

The experience of the current winter will have emphasized to many the inadequacy of their winter-forage provision—a matter that should receive much attention from now onward for some time.

If it is possible, grazing of established lucerne during winter and early spring in particular should be avoided. Grazing causes consolidation, which favours the invasion of the lucerne by rye-grass and *Poa annua*, two of its worst invaders. Grazing also keeps the growth short, which favours white clover, at times a detrimental competitor with lucerne for vital requirements. Young stands of lucerne especially should now be easily treated. Harrowing of established weedy lucerne may be advisable at this season, but generally it is inadvisable unless the conditions allow one to lessen substantially the numbers of the invading weeds without unduly injuring the lucerne itself. Many seem inclined to cultivate lucerne as a matter of course and without due thought, and thus often do as much harm as good, or more so. It is well to remember always that the best way for lucerne to combat weeds is by virtue of its vigour obtained by good fertility, good drainage, and good utilization methods. The most profitable lucerne area is invariably that which combats weeds by its own aggressive vigour rather than by adventitious aids, such as surface-cultivation. A point of practical importance at this season is that lucerne which is heavily invaded by grass should not be top-dressed in the early spring. It is normally better to delay the top-dressing until the first cut has been removed. To top-dress in the early spring would lead to relatively greater stimulation of the grass than of the lucerne, and this would intensify the smothering effect of the grass, which is just what should be avoided.

In the liming of land under cultivation the ploughing-under of the lime should always be avoided. This is because normally lime is washed down through a soil more readily than is desirable, and it means that usually lime should be applied at about the time of sowing the seed, or later rather than earlier.

Italian rye-grass or Western Wolths, which often can be sown successfully at the end of August, may be looked upon as a special forage crop capable of providing hay or ensilage if necessary. Artichokes may be sown in mid-August or September. They thrive on land naturally suited to potatoes, but they will also produce well on somewhat poor light soils, providing they are freely manured. From 8 to 10 cwt. of seed per acre is required. The seed should be sown in rows about 3 ft. apart, with a space of about 2 ft. between the tubers in the rows. Generally a complete fertilizer may advantageously be used with artichokes. A mixture consisting of 2 cwt. super, 1 cwt. 30-per-cent. potash salts, and 1 cwt. blood-and-bone or sulphate of ammonia may be relied upon to give good results. The ground for artichokes requires to be well worked before the sowing of the crop.

The Cereal Crops.

The attention of every wheatgrower may well be given to the report on the 1929–30 season wheat-manurial experiments published elsewhere in this issue of the *Journal*.

The ploughing of land intended for cereals should now receive attention ahead of almost all other tillage work. Experience has led to the greater part of the spring wheat crop being sown in August and early September. In some districts good crops may be obtained from later sowings, but as a rule good yields are not so generally obtained. The sowing of oats should ordinarily follow the wheat as opportunity offers. It often proves advantageous to sow Black Skinless barley in August. A heavier amount of seed requires to be used with spring-sown cereals than would be used with the corresponding crops sown in the autumn. For instance, in the main South Island wheatgrowing districts, while 1½ to 1¾ bushels of Tuscan seed is accepted as suitable for autumn sowing.

2 bushels or more is used for spring sowing. Spring-sown cereals generally benefit from rolling of the ground after sowing, but, except in the case of light land, the rolling should not be done immediately after the drilling; rather it should be postponed until September or October.

When it is intended to produce a chaff or grain crop from autumn-sown cereals the final feeding-off should generally take place towards the end of August. An exception to this occurs in the case of crops on such rich ground that lodging may be expected. It is often well to arrange the final feeding-off of such crops in September as a means of obviating this. Ordinarily after the final feeding-off it is well worth while to give the ground a stroke or two of the tine harrows. This serves to open up the trampled soil and to scatter stock-droppings effectively. The spring feeding-off of cereals should be done by heavily stocking the ground for a short period at a time when it is not too wet. Light, prolonged stocking usually results in an uneven eating-down of the crop. Autumn-sown wheat which is somewhat thin may often with advantage be thickened out by tine-harrowing, even though it has not been eaten off.

Those who are proposing to carry out spring-sowing of cereals should specially keep in mind seed-treatment for disease-control. This matter was discussed in these Notes last March. The treatment of seed of oats and barley is rightly receiving much more attention than was accorded it some years ago, but there is still much room for desirable improvement in this respect. A point often overlooked is that smut in an oat crop grown only for chaff is distinctly detrimental; hence the seed used in the production of such a crop should be suitably treated in the way described in the March *Journal*.

All barley-growers should acquaint themselves with the work being done in regard to the hot-water treatment of seed barley for the purpose of eliminating smut. Full information may be obtained by applying to the Fields Division, Department of Agriculture. The value of the treatment is indicated by the fact that in the 1928–29 season the average yield of 4,331 acres of barley from treated seed was 53·5 bushels of firsts, while the average yield of 9,561 acres from untreated seed was 45·8 bushels, including seconds.

Miscellaneous.

August is one of the most critical months in the feeding of stock. The recovery of milking-cows and of ewes from a setback received in August because of underfeeding is often a very costly matter. The ravages of disease often originate from weakened vitality which arises at this stage. Yet farmers with stock unduly low in condition at this season often carry over reserves of forage. To say the least, the philosophy of their feeding-methods is difficult to understand.

The references to drainage in last month's Notes are equally relevant in respect to current farm-work. After wet weather the mole and tile drains should be inspected. Wet patches over drain-lines should be particularly watched for, as they may be indications of obstructions or breakages which affect the efficiency of a considerable portion of a drainage-system.

During wet weather attention may often well be given to the picking-over of stored potatoes and to the overhaul of implements in preparation for the busy season ahead.

In dry weather matters arising in connection with improved farm-subdivision, water-supply for stock, and the construction of ensilage-pits often may advantageously be given attention.

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

THE ORCHARD.

Pruning.

THE season for pruning is drawing to a close, and the work remaining to be done should be expedited in order that these operations may be completed before growth commences. The tendency during recent years to adopt a system of long pruning or light thinning, in place of the general cutting-out and shortening-back, requires careful consideration. Good results have been obtained under the newer system, but in any except the best land and under good growing-conditions there is a danger of growth decreasing to below the safety-point, with a detrimental effect upon the size of the fruit. Any additional strain placed upon the tree's resources must be offset by more generous treatment in the application of manures and in cultivation.

Not the least important work in connection with pruning is the collection and burning of all prunings. Many of the most destructive orchard diseases continue their development in dead wood, from which the infection is transferred to the young growth or fruit, and leaving heaps of prunings in the vicinity of the orchard is providing a breeding-place for diseases which may cause loss and expense later in the season. This applies particularly to silver-leaf, which is annually causing losses in stone-fruit trees. In the normal development of this disease the spore-producing parts are not developed until after the death of the infected portion, and it is not uncommon to find active fructifications on stumps which have been dead for several years. Under these conditions the spread of the disease must be expected, and only the complete destruction of all prunings or dead wood will remove the danger.

Grafting.

This operation is performed in the spring just after the sap has commenced to flow. Wood intended for use as scions should be gathered while the trees are dormant, and stored to retain its vitality and freshness. Good results are obtained by rolling the sticks in a damp sack, and completely burying them in a cool moist place until required. The object in removing the wood while dormant is to retard its development, so that when the grafting is performed the sap-flow is more active in the root than in the scion, thus providing immediate nutriment. Grafting before sap-movement commences may yield poor results owing to the scions drying out. Trees intended to be worked over may be headed back now to within about 1 ft. of where it is intended to graft, and further shortened to the desired height at the time of working, in order to have fresh plump bark which will quickly form a union. Some stone-fruits are unsatisfactory subjects for grafting, and will give better results if headed now with a view to budding into the young growth in the summer.

Cultivation.

Cultivation should be hurried on as opportunity permits. Delay in ploughing-in green crops may have a detrimental effect on growth in the spring, in as much as with the early cessation of wet weather the undecayed portion may keep the soil too open and produce conditions akin to drought. The manurial benefit of green manuring is required by the tree from the time that growth commences, and to obtain the full value decomposition or the conversion of the green matter into available plant-food should be well advanced by the time that the trees are in a suitable condition to utilize it.

As an adjunct to disease-control cultivation is an important item. Insect pests which hibernate during the winter in the ground or under the cover afforded by a growth of grass or weeds can be considerably reduced

in numbers if disturbed during their resting-period. Fungoid diseases overwintering on fallen fruit find conditions suitable to their development when provided with a covering of weeds. Under these conditions spore-discharge progresses, and with the aid of wind or any movement in the orchard the spores are carried to places suitable for their development, and fresh infection occurs. The cultivation programme should be so arranged that operations can be suspended from shortly before and through the blossoming-period. In the normal life-cycle of some of the worst diseases the spores are being discharged at that time, and any fruiting bodies which have been partly buried may be brought to the surface and the liberation facilitated.

Manuring.

The application of fertilizers will require early consideration. Orchards in districts which are subject to dry springs or where the rainfall is light should have their applications this month. Quantities will vary according to the nature of the soil and the condition of the trees, but for good average soils with bearing trees in fair condition up to about 6 cwt. per acre would be a good dressing. Poor and light soils may require heavier annual dressings until satisfactory growth is stimulated. Manuring alone cannot be expected to promote activity in badly stunted and stagnant trees. Generally this type is liberally covered with fruit-spurs, which during the winter season should be considerably reduced, and possibly a thinning of the fruit in following seasons will be beneficial.

Nitrogen in the form of nitrate of soda, sulphate of ammonia, dried blood, &c., acts as a stimulant to vegetation activity, and the quickly soluble forms should be applied just as growth is commencing. Excessive quantities may stimulate growth at the expense of fruit-production, and while the effects are being felt predispose the crop to bitter-pit. Phosphates promote fruitfulness, and annual applications are advisable for bearing-trees. Potash provides the colour and finish to fruit, and is especially needed for starch and sugar production. A generally satisfactory mixture comprises four parts of high-grade superphospahte, one and a half parts of sulphate of ammonia, and one part of sulphate of potash, mixed and applied evenly over the orchard during the late autumn or winter. Home-mixing of manures permits of slight variations being made in the proportions to suit individual requirements of varieties or locations, and a certain amount of experimental work is necessary to ascertain the soil-requirements. The lime content of the soil must be maintained to facilitate the action of manures.

Spraying.

Preparations for the spraying-season should be kept in view. An early overhaul of the spraying-plant and the completion of any repairs or renewals of doubtful parts may save costly delays when the season starts. The material required for the first sprays will be oil, and lime-sulphur or bordeaux, and stocks should be on hand. Oil is used as an insecticide, and has a beneficial effect on bark which has been hardened by the continued use of lime-sulphur or bordeaux. Lime-sulphur acts as a dual control of insects such as the various scales, red mite, &c., and as a fungicide; bordeaux is a straight-out fungicide and is in general use for the first foundation spray.

Planting.

Planting should be completed as early as possible, but only if the land is sufficiently dry to permit free working without producing a soggy mass under the necessary treading to compact the soil round the roots. Deep planting to withstand the wind in exposed situations is to be avoided, and, if necessary, stakes should be provided to keep the trees stationary. Shelter planting should be completed and any gaps in existing shelters made up.

Citrus Culture.

Harvesting sufficiently advanced lemons will now be routine work. While the demand is good every effort should be made to satisfy market requirements. To enable the trees to proceed with wood-production and the development of the next crop all fruit should be removed when it has attained a size of approximately 2½ in. diameter or when the colour is silver-green or pale-yellow, and stored until the curing process has advanced sufficiently. The demand for oversize, coarse, tree-ripened fruit does not warrant its production, and it can be avoided if harvesting is conducted at regular intervals. Care in handling cannot be overstressed, for the slightest skin-puncture will provide a home for some of the rot-producing fungi. The removal of mould-infected fruit from the storage-trays needs special care to prevent the spores being broadcast throughout the store-room. Sweet oranges improve in quality if allowed to remain on the trees until fully ripe, when the inner skin or rag separates readily from the flesh, resulting in a much more desirable article.

Spraying: Cases frequently come under notice where citrus-trees are oil-sprayed at the same time as deciduous fruit-trees, with unfavourable results. Unlike deciduous trees the young citrus growth is not injured by oil at 1–40, but if it is applied before growth commences defoliation will result. Spraying, therefore, should be delayed until the growing tips show several inches of soft young wood.

Planting: September is usually a favourable month for planting, but in localities subject to late frosts it can be delayed, though the preparation can be proceeded with. Thorough and deep cultivation with the fall of the land is desirable, and ample provision should be made for the rapid escape of excess surface-moisture.

Pruning: The removal of exhausted or unsatisfactory twigs and a general thinning of overcrowded places can be performed now, and will assist materially in eliminating low-grade fruit.

—G. H. McIndoe, Orchard Instructor, Dunedin.

POULTRY-KEEPING.

Management of the Breeding-birds.

AUGUST is a good period during which to hatch out chicks of any breed, hence next month the poultry-keeper's time will be chiefly devoted to the critical work of hatching and brooding the new flock. If success is to be achieved the necessity for maintaining the parent stock in proper breeding condition cannot be emphasized too strongly. This implies giving the birds a variety of grain foods such as wheat, oats, maize, &c., for it must be remembered that if properly developed chicks are to be produced the mated hen must be provided with the necessary elements to pass on desirable qualities to her offspring. No one class of food will fulfil all requirements in this respect, and the greater the variety of food supplied to breeding-birds the greater is the likelihood that good hatches and strong chicks will result. The dead-in-shell trouble during the various stages of the incubation process is invariably due to a weak germ, which may be traced back to the breeding-pen.

Breeding-birds should be induced to exercise as much as possible by such means as feeding the grain ration in deep litter. Nor should the liberal daily supply of green food be forgotten; a plentiful supply of succulent green material not only tends towards economic production, but in addition ensures the maintenance of healthy stock. With breeding-birds high egg-yields should not be aimed at, or trouble may be expected in the hatching

and rearing of the chicks, and for this reason meat, meat-meal, and other forcing-foods should be sparingly supplied, while condiments should never be included in the ration. The ideal condition for breeding-birds is a free range whereby natural food and exercise is available. I have seen eggs from birds kept in confinement and from those on free range placed in the same incubator. The eggs from the free-range bird could easily be picked out when testing during the incubation process by the strong embryo and the distinct contrast generally. It is not convenient for every one to give breeding-birds a natural run, but the aim should be to provide food and conditions as far as possible resembling those available on free range.

Selection of Eggs for Hatching.

It is well to reiterate that every care should be taken in selecting eggs for hatching purposes. However good a bird may be as a layer, if its eggs are on the small size it should not be bred from. If the proposed system for grading eggs on the local market is carried into effect (by which eggs will be disposed of according to their weight), and there is reason to believe it will be in the near future, the size of the egg will then be considered of almost as much importance as the number produced. No doubt the weight clauses adopted in the egg-laying competitions have done much to check the production of small eggs, but, generally speaking, much remains yet to be done in this direction by producers before it can be said that the bulk of the eggs that reach the market conform to the first-grade standard of 2 oz.

It must be admitted that under the present crude system of marketing the producer has little if any inducement to breed for large eggs, as these command no better price on the local market than do those of medium size. Eggs for export are sold according to their weight per long hundred (or ten dozen). The sooner this system is adopted on the local market the greater will be the tendency for the industry to become stabilized. At the present time egg-pulp is sold by weight, and there is no reason why eggs in shell should not be disposed of in a similar manner.

Parasitic Infestation and its Treatment.

It is safe to assume that, with the exception of the commonly adopted but weak policy of underfeeding fowls, parasitic infestation is more responsible for the unthrifty flocks seen and the low egg-yields secured than any other cause. In previous issues of the *Journal* particulars have been published regarding experiments conducted at the Wallaceville Poultry Station on ridding fowls of insect pests by the use of the nicotine specific Black Leaf 40. The results of the experiments demonstrated that these parasites can be more rapidly and effectively destroyed, and with less harmful effects to the productive capacity of the flock, by the use of Black Leaf 40 than probably by any other means yet discovered.

In a general way it is an easy matter to ascertain by searching among the feathers of a bird whether insect pests are present or not, but this is not the case with intestinal parasites which affect poultry. When birds are suffering from the effects of intestinal worms the symptoms are often so similar to those which manifest themselves in certain forms of disease that a *post-mortem* examination is the one and only means of making sure of their presence; indeed, there are certain kinds of worms which can be located only by means of the microscope. Among other species of these enemies of the domesticated fowl is a small tapeworm which usually makes its home in the upper part of the intestines and is so minute as to be invisible to the naked eye. Lately many cases have come under my notice, particularly of pullets, which in spite of being provided with good food and management failed to thrive and come into profit when expected, their owners being usually at a loss to know the cause. The birds in most instances were practically devoid of flesh, and showed similar symptoms in many respects

to birds suffering from tuberculosis. As a result, however, of investigation at the Department's Veterinary Laboratory the fact was disclosed that in all cases the impaired and unthrifty condition was due to intestinal parasitic infestation and nothing else.

Several experiments have been tried on the treatment of birds affected in this way, but the use of Black Leaf 40 gave the most satisfactory results. The birds were starved for a day before the dose was given, and Black Leaf 40 was used in the proportion of one liquid ounce for each hundred adult birds. This was added to the water with which the mash was moistened. In the same water ½ lb. of Epsoms salts was also added and well dissolved before stirring in the mash. Sufficient mash was moistened with the water mixed with the Black Leaf 40 and salts, so that each bird had about 1 oz. of the mash. It is important for the troughs to be sufficiently long, so that all birds in the flock can feed at once and in comfort. It must be clearly understood that Black Leaf 40 is poisonous, and on no account must the dose stated be increased, or fatal results may follow. In most cases for a few minutes after the birds have eaten the mash they will lose the power of their legs and give indications that they are likely to succumb under the treatment. This condition, however, will be of short duration, as the birds will soon regain a normal state, providing of course the amount of Black Leaf 40 is not given in excess of the quantity stated. When small flocks are to be treated it is a good plan to add 9 oz. of water to 1 oz. of Black Leaf 40, and to use 1 oz. of this mixture for every ten birds.

A common indication of worms is when the birds stretch their necks and make a screeching noise somewhat similar to a seagull; while other symptoms are poor condition, feathers loose and ruffled, comb and face pale, with frequent yawning. The effect of this treatment given after a fast will be to expel the worms. It is well to confine the affected birds to the house for at least a day after being treated, so that the cleaning-up process may be properly carried out, thus avoiding the risk of the runs becoming further infested. Care must be taken to thoroughly clean up and remove all droppings after the treatment, while, in addition, the quarters should be given a good spraying with a strong disinfectant. It is a good plan to place wire netting over and in front of the perches, so that the birds will not have an opportunity of picking among the droppings after being treated. The treatment may be repeated in, say, two weeks time.

As is the case with most troubles affecting poultry, the only feasible way of dealing with intestinal parasitic infestation is by preventive measures, which include maintaining the birds in good health and vigour by sound and liberal feeding, together with strict attention to cleanliness, and not allowing the runs to become poultry-sick.

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

THE APIARY.

Starting Beekeeping: Hints for Beginners.

THE spring is the best season of the year for starting beekeeping, especially for the beginner who is unacquainted with the practical care of bees. The time is therefore at hand when arrangements should be made for the purchase of bees and equipment. If the bees are obtainable locally the prospective beekeepers can make arrangements for the purchase of established colonies or he can wait until swarming-time when swarms are available. Perhaps the most satisfactory way is to purchase some established colonies from a neighbouring beekeeper and move them home before too much brood is present in the hives. No harm will come to bees moved in the colder months,

the same provision for screening not being so essential as when moved during the summer months. Screening the hives top and bottom is not necessary if the bees are moved only a short distance, and if the beekeeper takes the precaution of tacking a piece of wire gauze across the front entrance; this will prevent suffocation and make for safe handling in transit.

The beginner will be well advised to procure only strong healthy colonies from a reliable beekeeper who can furnish a guarantee that the bees are healthy. Upon this depends much of his future success. The keystone to this condition is the permit issued by an Apiary Inspector under the Apiaries Act. The first question to be asked by the beginner of the seller is, "Have you the necessary permit to sell?" If this is forthcoming he may rest assured that he has a reasonable chance of getting clean bees, apart from any of the other conditions which go to make a good hive. Although the purchase of first-class colonies is probably the most expensive way to commence beekeeping, they have the advantage that they are more easily kept in order than colonies which have been neglected, and which require to have corrected the faults of the previous owner who has not learned to make his beekeeping profitable.

Since it cannot be expected that the beginner should know what constitutes a good colony, he should only deal with a beekeeper of some standing. Everything with bees depends upon starting right. The possession of a colony in prime-working condition gives the beekeeper a standard with which to compare other colonies, and enables him to avoid costly mistakes in their management. If the cost of starting a small apiary has to be considered the beginner will find it an advantage to arrange for the purchase of as many first swarms as are wanted. These may be obtained in boxes, and subsequently transferred to frame hives. Only early and prime swarms should be stipulated for, otherwise they will not build up in time for a crop.

The hives when placed in their permanent position should be sheltered and face the north. Protection from cold winds is important, but the hives should not be placed under trees, as this has a tendency to make the bees vicious. The hives should be set on four bricks, as this allows for a free circulation of air under the bottom-boards, which will rot if placed directly on the ground. The hives require to be level crosswise and have a slight cant lengthwise. This prevents driving rains from lodging within the hives, which is likely to render the combs mouldy. A watertight roof and sound bottom-board are just as essential to the welfare of bees as are good floors and roofs in human dwellings.

A certain amount of working equipment is necessary. However, if provision is made for a smoker, bee-veil, hive-tool, and a pair of gloves, such other articles can be added as they are needed. Until such time as the beginner has got used to the stings he will find it an advantage to wear gloves, although he should accustom himself to do without them. In the course of time gloves become impregnated with poison, and this will irritate one's flesh on hot days; moreover, it is resented by the bees. There is much difference in the temper of bees, Blacks being much more troublesome to handle than Italians, but with a little care in carrying out hive-manipulations and the free use of smoke most colonies can be handled with very few stings.

At all times when handling bees the beginner should be prepared to complete the work and not allow himself to be driven from the hives. By "the free use of smoke" it is not meant that the bees should receive an overdose, as this may demoralize them and render them liable to attack from other colonies. Moreover, it does not bring them under control, but tends to aggravate them. It has the further dis-

advantage that as the bees are driven from the combs they form in clusters on the bottoms of the frames and the sides of the hives, making it well-nigh impossible to locate the queen and to carry out other essential work with any degree of success.

The best fuel for the smoker is dry, clean sacking, no other material being as good. Avoid oily waste and cotton materials, as the smoke from these articles makes the bees vicious. When starting to manipulate a hive puff a little smoke in at the entrance, and, having removed the roof, puff a little more smoke on the frames as the mat is peeled off. This operation being complete, the frame nearest to the operator can be taken out, allowing of the prizing-apart of the remainder of the frames preparatory to making a complete examination of the whole. When handling bees all operations are best carried out in a gentle manner, avoiding at all times quick movements and clumsy manipulations which may crush them. It must be remembered that nothing irritates bees more than the odour of the poison which fills the air when bees are crushed.

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

HORTICULTURE.

The Tomato Crops.

THE tomato crop under glass is usually planted out, in the middle districts, towards the end of August. It is important to plant deeply and firmly. While such houses should be aired well at every opportunity in fine warm weather, the ventilators should be closed early in the afternoon before the temperatures commence to fall; 55° to 65° F. is a suitable range. If the temperature is allowed to rise much above this maximum it makes the plants tender and more liable to injury during a cold snap.

Fresh stable manure should be accumulated for hot-beds and carefully prepared. When it is in a suitable condition a foot or two in the bottom of a glass frame will provide sufficient heat, in moderately warm districts, on which to place seed-boxes for raising tomato and other half-hardy plants. In cold districts the usual hot-bed, 2 ft. to 3 ft. in height, will be required, and the frame placed on top. In large establishments the sterilization of the soil for seed-boxes has become a usual practice and much difficulty is avoided in this manner; but fungus troubles sometimes do occur, and in such cases a solution of permanganate of potash is an easy and convenient remedy. A stock solution may be made up, and a small quantity, diluted as required to a pink colour, may be sprayed on the plants from time to time, or they may be watered from a can with a fine rose. The permanganate may be used up to a strength of 1 oz. to 2 oz. of crystals to 4 gallons of water.

Small-fruits.

Light cultivation in bright dry weather should be given to increase fertility and destroy seedling weeds. In many instances at this season it is advisable to apply bonedust and other suitable fertilizers between the rows just before hoeing, and so work the material well into the soil.

The Market-garden.

As the rising temperatures encourage the growth of weeds as well as crops, the former should be eliminated from the competition before they gain any size. This is best done in bright windy weather, and every opportunity of the kind should be taken. This operation also increases fertility and affords a suitable occasion for working in such dressings of fertilizers as may be required. Not only should growing crops be given

this treatment, but it is also an excellent method of completing the preparation of fallow land for planting or sowing.

Spring cabbage, cauliflower, and salad plants generally that have been planted out and are now well established will receive benefit from a dressing of sulphate of ammonia at the rate of 1 oz. to the square yard, repeating the dressing two to three weeks later. Manure also established crops of asparagus and rhubarb; they both have healthy appetites and respond to generous feeding.

Crops of parsnips left in the ground over winter should now be lifted, or a second growth will spoil the flavour. If they are stored in dark, cool, humid conditions they will remain useful as long as possible. Late-sown carrots should also be lifted to avoid splitting.

How to make an early crop of broad beans "set" is a problem which often receives consideration, and ends usually in blaming the bees for destroying the flowers. The truth seems to be that the bee punctures the base of the flower as the shortest cut to the supply of nectar, which it takes without rendering the plant the kindly assistance in pollination with which bees are generally credited. Seeing a quantity of bean straw in the early summer that had evidently borne a heavy crop, the problem was raised with the grower, who stated that his method was to use a switch on the plants a few times when in flower and during the middle of a fine day. He stated that he had used the method for two or three seasons with good results each time. The switch is made of a bundle of fine twigs, such as manuka or birch. This treatment evidently improves the distribution of pollen, and is well worth a trial. We are indebted to Mr. H. J. Gilberd, of Epsom, Auckland, for this demonstration, which will very possibly be found generally useful.

Towards the end of the month in most districts cucumbers may be planted out in heated glasshouses suitable for the purpose. Set the plants deeply and not too firmly in mounds or ridges composed of two parts good fibrous loam mixed with one part of decomposed stable manure and a 5-in. pot of bonedust to every barrow-load of the compost. Let the leader growth run to the top wire before stopping, and stop the lateral growth at the first point beyond the young fruit. When the temperature rises to 90° F. ventilation should be given. As the white rootlets push through the surface of the soil a top-dressing of the above-mentioned compost should be made.

The main crop of parsnips should now be sown, as they require a long season of growth; also melons and cucumbers under glass for planting outside later. Sow also, outside, early carrots, turnip-rooted beet, broad beans, main-crop cabbage and cauliflower, lettuce, early peas, parsley, spinach, and turnips. Sow thinly, and so reduce the work of thinning the young plants later. An amount of 1 oz. or 2 oz. of superphosphate per square yard before sowing, and a light dressing of nitrate of soda after thinning, will suit most of these crops.

Where it is intended to plant out permanent beds of asparagus and rhubarb this should be done now if the land is rich, clean, and deeply cultivated. Without this preparation it is best to defer the planting for another season. For asparagus plantings good selected one-year-old plants are best. They should be set deeply 18 in. to 24 in. apart, with 4 ft. between the rows, when planting large areas. For commercial cropping a moist, sandy, well-drained loam is required. Where small areas are being dealt with the best spacing generally is 18 in. between plants, and between the rows 18 in. and 4 ft. alternately, thus making beds about 3 ft. wide with alleys between. Early potatoes and artichokes may also be planted.

The Home Garden.

The planting season, for trees and shrubs especially, practically ends with the month of August, and any work of the kind that is to be done should be carried out without further delay. One or two choice decorative

plants that have been overlooked generally are Lapageria and Polianthes. The former is an evergreen climber from Chile. It is often grown under glass in this country, but should do well out of doors in the warmer districts if planted in a shaded place in rich well-drained soil and where it may be given plenty of water during the growing-season. It is likely to thrive best where it can ramble through a tree of moderate size and rather open. Rosea, albiflora, and superba (crimson) all carry bell-shaped flowers of a large size and great substance. *Polianthes tuberosa* is the well-known tuberose, a bulbous plant producing flowers of great fragrance in the autumn. If planted now in a rich soil on a warm, sheltered border it should be quite satisfactory in the milder localities.

Evergreen hedges that will stand hard cutting and have been allowed to get out of hand may now be given the necessary hard pruning to bring them back into shape. In northern districts this may be done towards the end of August, and disfigurement is soon made good by the appearance of new growth. In Southern districts the work is best deferred for another month. The same periods may be observed for pruning roses. In doing this work the common mistake is to thin the growth insufficiently. With young plants recently set out they should not only have the branches well thinned out, but those remaining should be cut back rather more severely than usual.

Where new lawns are to be sown down the work should be completed as soon as possible.

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

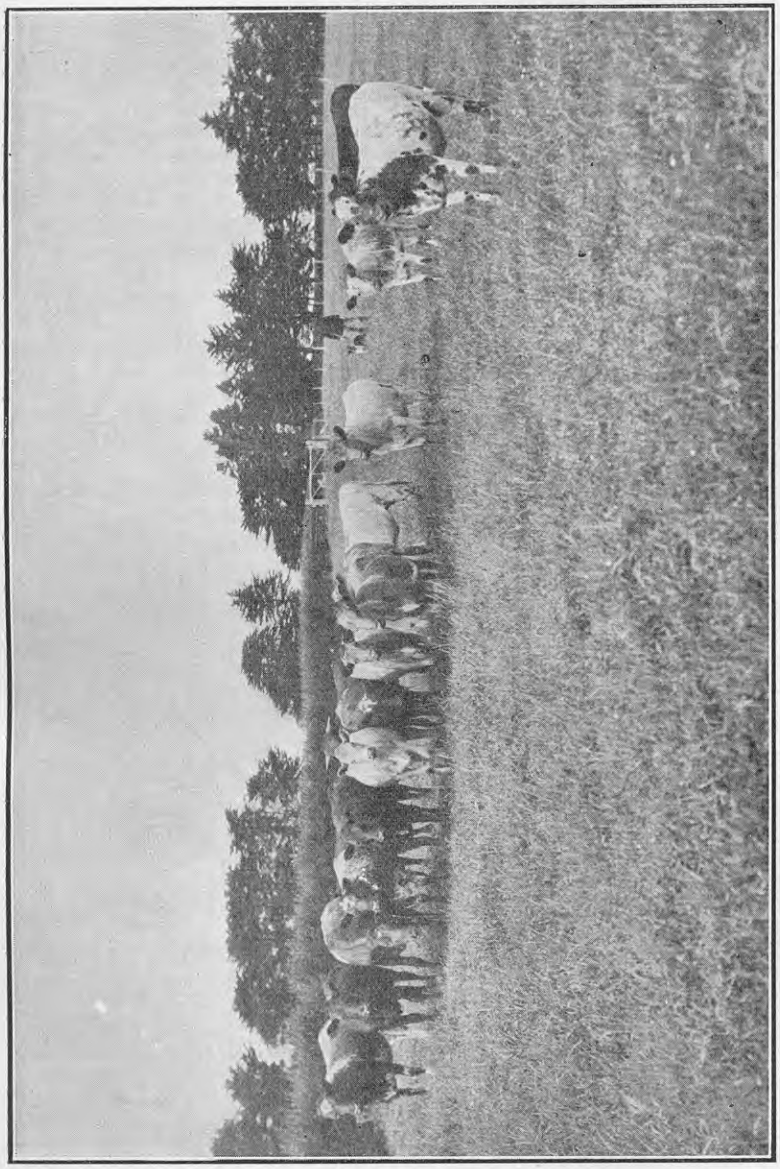
DAIRY FACTORIES IN NEW ZEALAND, 1930.

THE following table presents the registrations of factories under the Dairy Industry Act as at 31st March last, together with the quantities of butter and cheese forwarded to grading-stores for export during the year ended 31st March, 1929, and the numbers of milk or cream suppliers to the factories:—

District.	Number of Factories.				Forwarded for Export, 1929-30.		Number of Suppliers to Factories.	
	Butter.	Cheese.	Dual Plant.	Total.	Butter.	Cheese.	Butter.	Cheese and Dual Plant.
					Tons.	Tons.		
Auckland ..	62	35	4	101	61,247	13,335	19,176	1,339
Taranaki ..	19	73	34	126	10,705	36,369	3,226	3,961
Wellington ..	19	49	8	76	9,721	13,072	5,665	1,678
Hawke's Bay ..	10	17	1	28	4,373	3,447	4,007	672
Nelson	6	3	1	10	1,429	547	1,207	685
Marlborough ..	3	2	3	8	646	947	759	191
Westland ..	10	2	..	12	504	19	668	9
Canterbury ..	9	15	2	26	1,243	2,146	4,715	2,022
Otago and Southland	12	77	1	90	1,599	14,781	6,169	3,268
Totals ..	150	273	54	477	91,467	84,763	45,592	13,825

Whey butter was manufactured as a side-line at eighty of the above cheese-factories in 1929–30, the total quantity forwarded for export being 1,133 tons. This is not included in the total amount of 91,467 tons of butter given in the table, which refers to creamery butter only.

In the 1929–30 period there were also operating in the Dominion five milk-powder factories (three whole-milk and two skim-milk plants), six casein-factories, two condensed-milk factories, and one sugar-of-milk factory.



MILKING-SHORTHORN HEIFERS AT RUAKURA FARM OF INSTRUCTION.
Some of these two-year-olds are being offered at the Farm's annual sale next month.

WEATHER RECORDS: JUNE, 1930.

Dominion Meteorological Office.

General Notes.

The June just past was the coldest for a number of years. Though the weather was at times stormy, and showery conditions prevailed at many places, rainfall was generally much below normal and there was a large amount of sunshine. Rainfalls in excess of the average were experienced in North Auckland and about Foveaux Strait. At Tauranga, also, largely owing to a fall of 6·45 in. on the 20th, there was an excess. In all other parts there was a considerable deficit. This was most accentuated in Nelson and Marlborough and the interior of the South Island, where much of the weather was beautifully fine. At Nelson it was the driest June on record. The cold weather was accounted for by a marked prevalence of southerly winds during the month. Temperatures were from 1° to 2·5° F. below normal, and frosts were everywhere very numerous and often severe.

The month began with a vigorous cyclone operating on the coast of New South Wales, where severe floods had been caused by continued heavy rains. This main cyclone lost its energy to a large extent before reaching New Zealand, and, passing north of the Dominion on the night of the 3rd, affected our weather comparatively little. Easterly gales blew in North Auckland and short-lived south-easterlies in Cook Strait. This storm was followed by a series of similar ones which lasted until the 7th. They all took a northward track, and, except to produce southerly winds and cold weather, continued to have little influence on the South Island. Heavy rains were recorded between the 3rd and 5th in North Auckland. Puhipuhi Plantation had 13·73 in. during this period, of which 6·35 in. fell on the 4th.

On the 8th another depression of cyclonic form appeared in the Tasman Sea, and, deepening considerably during the next two days, crossed the North Island from Cape Egmont to Napier on the 10th. Rain was fairly general and there were some heavy falls, particularly in Taranaki and the northern and north-western portions of the South Island. There were westerly gales in North Auckland on the 10th during the passage of the centre, and on the following day southerly gales were widespread. Pressure became very high over the Tasman Sea following the passage of the cyclone, while it remained low to the east of New Zealand. Strong southerly winds continued, in consequence, until the 14th, with bitterly cold weather. The gale on the 11th was severe, and slight damage was done. Snow fell on the high country as far north as East Cape, while in Canterbury and Otago it extended to parts of the lowlands. Mount Egmont had the heaviest snowfall for years. Hail and sleet were recorded at many places.

A third period of stormy weather occurred from the 20th to the 25th. A depression which crossed the Dominion on the 20th again assumed cyclonic form. Rains were practically general over the North Island, but more scattered in the South. Particularly heavy falls were recorded in the Auckland Province, the majority receiving over 2 in. The highest registration was 7·06 in. at Okere Falls, near Rotorua, but Tauranga, as already noted, received 6·45 in. and Waihi 5·14 in. There were boisterous westerly winds also in the Auckland, Thames, and East Cape districts on the 20th, slight damage being done. Another spell of strong southerly winds and cold temperatures followed. The 21st was a particularly bitter day, especially in Canterbury, Otago, and Southland. Heavy falls of snow occurred almost everywhere in these provinces, while there were frequent showers of hail or sleet. Snow and hail continued to be experienced in the South at intervals until the 25th. The conditions appear to have been most severe in the district round Gore. A severe thunderstorm occurred in Foveaux Strait during a west-south-westerly gale at 5 a.m. on the 25th.

Although there was an unusual frequency of hail and snowstorms during the month, the accumulation of snow on the ranges does not appear to have been heavy except at a few places.

RAINFALLS FOR JUNE, 1930, AT REPRESENTATIVE STATIONS.

No.	Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average June Rainfall.
		North Island.			
		Inches.		Inches.	Inches.
1	Kaitaia	8·86	22	2·86	5·53
2	Russell	..	..	..	7·15
3	Whangarei	9·38	21	2·56	6·22
4	Auckland	4·29	23	1·86	4·91
5	Hamilton	3·56	15	2·10	5·19
5A	Rotorua	5·06	4	3·27	5·24
6	Kawhia	5·06	17	1·10	5·72
7	New Plymouth	3·42	18	0·76	6·14
8	Riversdale, Inglewood ..	5·09	14	1·44	10·31
9	Whangamomona	2·83	9	0·79	7·62
10	Eltham	3·87	13	0·75	5·46
11	Tairua	6·15	11	4·56	7·38
12	Tauranga	7·87	10	6·45	5·42
13	Maraehako Station, Opotiki	5·40	11	4·04	5·99
14	Gisborne	2·38	14	0·90	5·28
15	Taupo	2·22	7	1·11	4·48
16	Napier	2·02	10	0·97	3·59
17	Hastings	2·26	10	1·21	3·37
18	Taihape	2·37	21	0·32	3·85
19	Masterton	2·49	16	0·73	3·48
20	Patea	3·57	16	0·85	4·15
21	Wanganui	2·90	9	0·68	3·19
22	Foxton	2·17	8	0·70	2·96
23	Wellington (Karori Reservoir)	3·30	12	0·94	4·63
		South Island.			
24	Westport	5·76	15	0·95	8·85
25	Greymouth	4·70	14	0·70	8·27
26	Hokitika	4·81	15	1·13	9·60
27	Ross	5·52	14	1·00	9·20
28	Arthur's Pass	4·48	4	1·83	10·12
29	Okuru	6·82	15	1·24	10·76
30	Collingwood	..	..	..	11·33
31	Nelson	0·63	3	0·42	3·69
32	Spring Creek	0·88	3	0·48	3·01
33	Tophouse	2·60	7	0·93	4·75
34	Hanmer Springs	1·96	11	0·82	3·11
35	Highfield, Waiau	1·30	7	0·44	2·49
36	Gore Bay	1·53	10	0·45	2·34
37	Christchurch	1·31	12	0·24	2·66
38	Timaru	0·64	7	0·22	1·70
39	Lambrook Station, Fairlie ..	0·59	4	0·26	1·91
40	Benmore Station, Clearburn	0·20	5	0·10	1·90
41	Oamaru	0·40	7	0·18	2·01
42	Queenstown	1·13	11	0·28	2·46
43	Clyde	..	..	..	0·98
44	Dunedin	1·64	15	0·39	3·15
45	Wendon	2·04	13	0·51	2·42
46	Gore	4·24	21	0·83	2·82
47	Invercargill	4·92	21	0·55	3·60
48	Puysegur Point	7·46	24	1·06	6·58
49	Half-moon Bay	7·87	24	1·07	4·51

—Edward Kidson, Director of Meteorological Services, Wellington, 7/7/30.

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.

MARE WITH LUMP ON SHOULDER.

"DRAUGHT HORSE," Eltham :—

I have a young draught mare which has developed a large lump on the top of the shoulder on one side. I have no doubt that this is due. in the first place, to the collar not fitting properly. The mare is abnormally big at the top of the shoulders. The ploughman tells me it was caused by a strain or knock. He has been working the mare off and on all the season. The lump does not appear to affect it in any way, but it is quite a size and is hard—in fact, feels almost like bone. Would it be any use putting a blister on the lump to reduce it? The mare works quite well, is very willing, and does her share in the plough team, but the lump is very much in the way of the collar.

The Live-stock Division :—

The first suggestion is that the case is of the nature of fistulous withers. The latter is the result of a deep-seated injury or knock often affecting the spinous processes of the vertebræ in the region of the withers. If of such a nature, the swelling may later burst, leaving a deep fistulous tract down to the seat of injury. Such a condition can only be cured by a radical operation, opening up the tract under aseptic precautions. On the other hand, the swelling may be in the nature of a tumour not uncommon in horses in the region of the shoulder, probably more commonly located at the point of the shoulder. The latter is probably the correct diagnosis in your case, as the swelling is described by you as being of a bony nature. In neither case, however, is it considered that a blister would be effective in reducing the swelling. If a tumour is present, excision of the growth is the most likely procedure. In the meantime, as the mare is working well it would be advisable to have the collar specially chambered and altered to meet the case. When the urgent team-work is over, it would be advisable to have the mare examined by a qualified veterinary surgeon.

LAWN PESTS.

W. NEWLING, Mount Maunganui :—

Will you kindly give us some information how to deal with the brown grass-grub. It is destroying our croquet-lawn, and has also started on the bowling-green.

The Horticulture Division :—

The information supplied is insufficient for definitely identifying the pest attacking your lawns. Among others the "brown grass-grub" may be the white grub or larva of the brown beetle (the chafer beetle) that commonly does great damage to grass on light land by feeding on the roots; or it may be a dark-coloured caterpillar, the larva of a moth that lies in a burrow during the day and comes out to feed on the surface at night. Both of these pests are doing serious damage to mown lawns in many districts. The best treatment for the first-named pest, so far as is known at present, is to maintain the green in strong condition by means of manure and frequent rolling to consolidate the ground and keep the plants vigorous. You might also try an insecticide, such as Jeyes powder or Cliff's insecticide, broadcast on the surface and washed in. These are sold as soil-fumigants, and some users claim that their lawns attacked in this way have been much benefited by the treatment when applied as soon as the damage commenced. For checking the caterpillar a solution of Restar is very effective. Water the lawn during an evening or in dull weather with 6 fluid oz. of Restar well stirred in 5 gallons of water. This dressing should be washed well in with a plentiful supply of water, since it then acts more quickly and is less likely to injure the grass, as it may do otherwise, particularly when applied during strong sunshine.

CONTROL OF FLEAS.

"FARMER," Motu Ora Island, Auckland :—

Please advise me how to get rid of little black fleas in dry soil and about pig-houses. It would require to be something that would not poison young pigs. I have tried lime, sulphur, ashes, disinfectant, and sheep-dip, but without avail.

The Live-stock Division :—

We would advise giving the soil a good dressing with burnt lime ; or you might try spraying the ground with a solution of formalin. The strength should be a breakfast-cup of formalin to a kerosene-tin of water. This treatment, of course, would be only of a temporary nature, and the insects would come back again. They apparently do the animals no harm, and an occasional spray of the formalin solution would be beneficial.

DESTROYING PERIWINKLE.

J. H. P., Manaia :—

Kindly advise me of a good and efficacious method of eradicating periwinkle. I have some growing near trees, also some in the open.

The Fields Division :—

Periwinkle is a garden escape which entrenches itself in some soils and is most difficult to eradicate. Probably the best-known method is to grub and burn the refuse, and, if convenient, cultivate and crop the land for a year or two afterwards. If, however, the land is unsuited for cultivation, we would advise the trial spraying by means of a knapsack spray-pump, with a solution of 5 per cent. sodium chlorate (diluted with water). Each time fresh growth shows it should be treated, and two or three sprayings may be necessary. We have had marked success with this specific on a number of weeds, though periwinkle has not been experimented with so far. Sodium chlorate is not poisonous to stock.

INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* from 22nd May to 3rd July, 1930, include the following of agricultural interest :—

No. 62975 : Milking-machine ; P. H. Sutton, Waihi Plains. No. 62988 : Churn ; F. J. M. Johnston, Sydney, N.S.W. No. 63040 : Sheep drench ; L. W. G. Lee, Canberra, Australia. No. 63172 : Cow-cover ; L. V. Dahl, Palmerston North. No. 63207 : Cooling milk ; J. V. Grantzow, Gorley, Denmark. No. 63959 : Egg-laying recording ; G. Doul, Caithness, Scotland. No. 64200 : Seedling box ; G. Fear, Wanganui. No. 64708 : Treatment of foot-rot ; E. S. Hickey and F. J. Stockman, Opunake. No. 64718 : Milking-machine indicator attachment. J. Treloar, Hamilton. No. 62713 : Manure-distributor ; W. H. Franks, Bell Block. No. 62963 : Milking-machine releaser ; J. Treloar, Hamilton. No. 63100 : Spraying-apparatus ; Booth, MacDonald, and Co., Ltd., Christchurch. No. 64456 : Bag for fruit-picker ; Alexander Thomson and Son, Ltd., Dunedin. No. 63576 : Manure-distributor ; G. E. Sargent, Netherton. No. 64041 : Wire-tying machine ; Gerrard Wire Tying Machines Co. Pty., Ltd., West Melbourne, Victoria. No. 64495 : Milk-storing vat ; E. N. Bevin, Whangarei. No. 64853 : Dipping sheep ; S. V. Wass, Nyngan, N.S.W. No. 62702 : Bail feeder ; E. J. Matthews, Palmerston North. No. 63582 : Chain harrow ; D. Hay and R. Hay, Auckland. No. 64888 : Plough ; R. W. Reid, Alexandra. No. 64935 : Harrow ; H. V. Henrikson, Tatuanui. No. 64936 : Threshing-machine ; H. G. Hall, Evanston, Illinois, U.S.A. No. 64984 : Grain-cleaning machine ; A. E. Unstead, Charlton, Victoria.

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

CERTIFICATION OF SEED POTATOES.

CERTIFICATES ISSUED ON TUBER INSPECTION, SEASON 1929–30.

FOLLOWING is a list of growers whose crops have been subjected to and have passed the final tuber inspection in connection with the system of Government certification of seed potatoes conducted by the Department of Agriculture, thus qualifying for certificates. The list comprises those crops passed up to the 30th June. Further lists will be published later.

In the May *Journal* was published a list of growers who had received provisional certificates. The acreage and relative cropping-power of each line were also quoted in that list, to which intending purchasers should refer.

Aucklander Short-top (N.Z. Sutton's Supreme).

Weeber Bros., Belfast.
F. Brundell, Kaiapoi.
J. Jellie, Russley Road, Fendalton.
W. E. Martin, E. Eyreton R.M.D.
G. Harris, Milford, Temuka.
A. J. Rich, Kaiapoi.
W. Oakley, Haikett.
D. Marshall, Killinchy R.M.D.

Aucklander Tall-top (N.Z. Sutton's Supreme).

Weeber Bros., Belfast.
J. Warren, Russley Road, Fendalton, Christchurch.

Epicure.

D. Marshall, Killinchy Rural-mail Delivery.
W. Shellock, Rural-mail Delivery, Mead, Rakaia.

Dakota.

H. M. Marshall, Rural-mail Delivery, Weedons.
W. A. McPhail, Rakaia.

Robin Adair.

D. Marshall, Killinchy Rural-mail Delivery.

Majestic.

A. J. Clarke, Rangiora.
C. H. Wilson, Lorneville, Invercargill.

Arran Chief.

G. Jones, "Vale Royal," Halswell.

Early Regent.

M. Kelly, 502 Lincoln Road, Halswell.

King Edward.

L. King, Rakahouka, Glencoe Rural Delivery, Invercargill.

INTERIM STATISTICS OF LIVE-STOCK, 1929–30.

INTERIM statistics issued by the Census and Statistics Office give the following approximate numbers of live-stock in the Dominion for the 1929–20 season (the final figures for 1928–29 being added in parentheses): Horses, 297,264 (298,986); dairy cows, 1,423,867 (1,371,063); total cattle, 3,720,969 (3,445,790); sheep shorn, 26,927,799 (25,295,560); lambs tailed, 14,823,357 (13,855,958); total sheep at 30th April, 1930, 30,637,390 (29,051,382); pigs, 483,820 (556,732). The detailed interim sheep return is printed elsewhere in this issue.