1934.

NEW ZEALAND.

DEPARTMENT OF AGRICULTURE.

ANNUAL REPORT FOR 1933-34.

Presented to both Houses of the General Assembly by Command of His Excellency.

Wellington, 14th August, 1934.

SIR,—

I have the honour to forward herewith, for your Excellency's information, the report of the Department of Agriculture for the financial year ended 31st March, 1934.

The report continues the story of the extensive and varied activities of the Department in its task of assisting the development of rural industries in fullest conformity with the national welfare. It shows that the advisory, regulatory, and research functions of the Department have been maintained broadly along the lines that have been adopted in recent previous years and that have been productive of good results. These results constitute evidence of sincere and successful endeavour to minimize the hampering influences of the difficulties arising from the necessity of practising the strictest national economy. It has been said that thirty years elapse before the results of research are translated into farming practice, and so it is gratifying that the report indicates that at times in New Zealand there is a much shorter interval between the discovery and the application of knowledge of practical value. This probably may be attributed in part to the close correlation of research and advisory activities which is possible when, as in the Department, both are functions of the one organization.

In the principal rural industries the past year must be characterized as very successful if viewed solely from the point of volume of production. A favourable season and increased effort and efficiency on the part of the farming community were important factors contributing towards the attainment of this result. During the year the recent downward trend in the number of sheep has been reversed. A substantial increase in the total number of sheep was recorded, and it would seem that a heavy proportion of the increase consists of breeding-ewes. There were increases also in the Dominion totals of cattle and pigs, but a slight decline in horses.

A most welcome and satisfactory feature of the farming year was the improved prices of such staple products as wool and lamb. This is reflected in the export values for the year ended 30th June, which are of particular interest in that they cover a complete production year. In the year ended 30th June, 1934, 822,396 bales of wool exported were valued at £13,287,458, whereas the corresponding figures for 1933 were 801,633 bales and £6,703,359. At the end of June, 1934, the stocks of wool in the Dominion were depleted, and were lower than at the corresponding date in any of the four seasons immediately preceding. Though there was a decline

in the weight of lamb exported for the period specified above, there was an increase of £1,135,874 in its declared value. The price position in the dairy industry was not so satisfactory, but there was an increase of slightly under £1,000,000 in the declared value of the dairy-produce exported, this being due partially to the increased production. The value of the exports of frozen pork showed a marked expansion from £393,726 in 1933 to £950,183 in 1934. In view of the important role played by judicious top-dressing in the past expansion in farm production, considerable significance is to be attached to the decrease in the amount of fertilizer carried by rail, which was the lowest since 1926–27. As an increased amount of fertilizer was used by sheep-farmers, the decrease in respect to top-dressing in dairying must have been greater than the total fertilizer figures for the Dominion suggest.

The Department continues to administer measures designed to assist farmers in their financially difficult circumstances. Among the measures taken for this purpose are subsidies on the manufacture and railage of fertilizer, and concessions in respect to railway freights on lime and on primary produce under certain conditions.

Though marketing difficulties relative to primary products have still to be faced, there is satisfaction in the view, which seems well founded, that the worst of the depression through which farming industries have been passing appears to be over. It may reasonably be expected that the improved conditions, which are developing in Great Britain and other countries devoted dominantly to manufacturing, will in due course be reflected beneficially in the markets for our farm-produce, and, this being so, it would seem that the process of recovery is already in progress. In the meantime all efforts are being concentrated on the endeavour to ameliorate the vitally important marketing position in the best way possible in the circumstances.

I have, &c.,

CHAS. E. MACMILLAN,

Minister of Agriculture.

His Excellency the Governor-General.

REPORT OF THE DIRECTOR-GENERAL.

Wellington, 18th July, 1934.

THE HON. THE MINISTER OF AGRICULTURE,—

I beg to submit the following report on the work of the Department for the year ending 31st March last, including the usual divisional reports, statement from the Phosphate Commission, and detailed reports on the activities of the Chief Chemist, the Plant Research Station, and the Veterinary Laboratory.

THE AGRICULTURAL AND PASTORAL POSITION.

In respect to production the season 1933–34 has been quite satisfactory to the farming community. This may be attributed partly to the fact that there is taking place a continuous improvement in the standard of our farming efficiency, partly to the fact that we are now obtaining more freely and more extensively the fruits of past endeavour in such matters as live-stock improvement, drainage, improvement of pastures, &c., and partly also to the fact that the weather conditions throughout the year generally were satisfactory, with the exception of northern parts of the South Island, where drought conditions prevailed—the weather in autumn, winter, and spring generally was relatively mild, and copious summer rains were experienced in the majority of the main districts.

The following are among the outstanding features of the farming industry for the year:—

1. There have been substantial increases in production in both dairy-farming and sheep-farming, although in the latter some of the increase was utilized in the building-up of the Dominion flocks and so is not reflected in the returns of killings for export.

2. Though the season has not been so favourable for grain-growing as the previous exceptionally favourable one, the threshing returns, as yet incomplete, point to the yields per acre being somewhat above the average. For example, the average yield of wheat per acre as ascertained from returns received up to the 24th May was 33·17 bushels, while the average yield for the ten-year period 1923–32 was 31·04 bushels an acre. Although the wheat crop declined both in acreage and yield per acre in comparison with the previous year, the 1933–34 harvest, supplemented by the substantial stocks of wheat in hand from the previous season, provides ample wheat for the normal requirements of the Dominion, and will possibly give a surplus. The average yield of oats based on threshing returns received up to the 24th May was 45·74 bushels, while the average yield for the ten-year period 1923–32 was 40·16 bushels an acre.

3. There has been a substantial expansion in pig-keeping. This expansion is reflected not only in an increase of 32 per cent. in the number of pigs slaughtered, but also in a substantial increase in the number of breeding stock to form the basis of the 1934–35 pig-raising operations. The extent of this increase is not as yet definitely known, but it is estimated to be sufficient to enable the production of pig-flesh to be still further increased substantially if market conditions warrant this.

4. There is a series of gratifying developments which perhaps are not of great significance taken singly, but which, when taken together, seem to constitute welcome evidence that despite difficult and at times even discouraging circumstances the farming community in a wise and foreseeing manner is consolidating and sometimes indeed strengthening its position in important respects that seem likely to be of assistance in the future.

CURRENT TRENDS TOWARDS EFFICIENCY.

Among the developments of the year indicative of a striving after greater efficiency in our farming is the much freer use of certified seed of important pasture plants. For instance, the 1933 harvest of certified perennial rye-grass was an abnormally heavy one; a portion of it was exported; a portion of it was carried over into the 1934 season; but much the greater portion of it was sown on the farms of the Dominion. Certainly a considerable incentive to the much heavier use of the certified seed was its substantially lower price in comparison with previous seasons, but, nevertheless, the certified seed was used in preference to uncertified seed, which was available at a still much lower price.

Another recent development in farming which generally is worthy of commendation is an upward movement relatively in the use of fertilizers. This is indicated by the fact that in

the period February to May inclusive in 1934 the amount of fertilizer carried on the railways was 11,404 tons greater than that carried in the corresponding period of 1933. The consumption of fertilizers for the whole year, which is discussed later, showed a substantial decline. Though definite information is not available, there is reason for believing that the increase for the period specified above is due essentially to increased top-dressing on the part of sheep-farmers, together with an increased use of fertilizer on autumn-sown cereals, and that the amount of top-dressing carried out by dairy-farmers has declined.

Another development which may be interpreted as indicative that attention is being given to future efficiency is the much increased demand and higher prices for cattle of beef type. Some of this increased demand undoubtedly arises from the recent developments in respect to chilled beef, but the greater part of it is widely considered to be due to an increased employment of cattle as essential auxiliaries in efficient pasture-management over those extensive grassland areas which were originally occupied by forest and which tend to be over-run rapidly with secondary weed growth unless stocked adequately by cattle.

That by means of pig-raising many dairy-farmers are endeavouring to reinforce their positions weakened by the unsatisfactory state of the butterfat-market is indicated not only by a substantial increase in the number of sows, but also by the greater and more widespread interest in the best available knowledge relative to feeding and breeding.

There is conclusive evidence that sheep-farmers are taking advantage of improved returns from their produce to strengthen their flocks and to put their holdings in better repair where necessary. In illustration of the latter point, the weight of plain wire imported in May 1934, was 160 per cent. of that imported in May, 1933. That flocks are being strengthened substantially is indicated not only by the interim sheep returns, which disclose an increase for the Dominion of 794,804, but also by decreases in the killings for export of sheep and of lambs, the latter being interestingly associated with a record lambing.

Judging from the sales of lucerne cultures by the Department, an area of lucerne exceeding 6,000 acres was sown during the year. After allowing for a decrease on account of age, &c., in the acreage previously established, this provides for a further increase in the Dominion lucerne crop, which has had a steady upward trend for several years. This conforms with the advice of the Department, which advocates increased sowings of lucerne in a number of districts.

Though the complete figures for the 1933–34 dairying season are not available, it is known that the season will be characterized by a new record in respect to production. For the eleven months ended June, 1934, 133,705 tons of salted and 4,632 tons of unsalted, a total of 138,337 tons of butter, were graded. In the preceding season 121,637 tons of salted and 4,390 tons of unsalted, a total of 126,027 tons, were graded. The increase for the period ending June, 1934, is 9·76 per cent. For the eleven months ended June, 1934, the quantity of cheese graded was—white, 69,499 tons; coloured, 33,640 tons; a total of 103,139 tons. For the corresponding period in 1933 the quantity of cheese graded was 71,330 tons of white and 28,794 tons of coloured; a total of 102,124 tons. When the totals of butter and cheese are converted into their butterfat equivalent, it represents an increase of 7·955 per cent. in butterfat-production for the eleven months compared with the corresponding period in 1932–33.

The estimated percentage increase in the number of cows milked in the 1933–34 season compared with the 1932–33 is slightly smaller than the percentage increase in butterfat-production, and, as any difference in local consumption may be assumed not to affect the position materially, it seems likely that the average production per cow slightly exceeds that for the 1932–33 season, when the average for total cows, dry and in milk, was 215·1 lb., and for cows milked was 230 lb., of butterfat. The local consumption of butter, which has risen steadily in the past ten years, and which is the highest recorded in the world, was 38·9 lb. a head in 1932–33—the Director-General of Health states, "The average consumption of butter should approximate 1 lb. per week for each individual as a fairly liberal estimate."

The year was marked by a substantial increase in the number of dairy cows. The total number of dairy cows in milk or dry at the 31st January, 1934, was approximately 1,927,000; the corresponding number for 1933 was 1,845,972. It is to be expected that the low prices for dairy products, in conjunction with the improved prices for meat and wool, will lead to the lessening of the substantial increases in the number of dairy cows which have been recorded during the past five years. Considerable support for this belief is to be found in the fact that the boneless beef killings for export for the period 1st October, 1933, to 15th June, 1934, exceeded by approximately 100,000 freight carcasses those for the corresponding period of the 1932–33 season. It may be assumed, firstly, that the increase in boneless beef freight carcasses is associated closely with a corresponding depletion in the number of dairy cows, and, secondly, that the provision for replacements in and additions to dairy herds is proportionately similar

to the provisions of recent years. In this connection it is interesting to recall that following the slump period 1920–21 there was a slight decline in the number of dairy cows between the 1923–24 and the 1926–27 seasons.

The fact that the estimated average production per cow for the 1933–34 season approximates the highest average production previously recorded may be attributed partly to the weather conditions, which, although extremely variable, have, in general, been favourable for the production of butterfat—a well-distributed rainfall generally in the main districts compensated to a considerable extent for the smaller amount of top-dressing which was carried out. The relatively satisfactory average herd production may also be attributed partly to better provision of reserves of feed for use in those periods when the supply of feed directly available from grassland is unsuited to or less than the current needs of the stock—the increase in the area of grass and clover cut for hay and silage from 421,582 acres in 1931–32 to 517,469 acres in 1932–33 and substantial increases in the acreages of mangels and lucerne constitute evidence of this. Better farm-management in respect to other matters, such as improved pasture utilization and previous effort towards herd improvement, almost certainly also was operative.

During the year sheep-farming was in a markedly buoyant condition in comparison with recent years. The forecast in this report last year relative to prospective wool prices was fully realized. The general position is indicated in the following extract from the May, 1934, *Monthly Abstract of Statistics*, prepared by the Census and Statistics Office: "The month of April marks the close of the wool-selling season, a total gross realization of £10,241,041 at sales held during the season just past being reported by the Wool Brokers' Association, as compared with £4,204,430 in the 1932–33 selling-season. Exports of wool during the ten months ending with April totalled 248,000,000 lb. (valued at £11,700,000), equivalent to 267,000,000 lb. in the grease. This figure is in excess of the production that might have been expected from the reduced flocks, and it appears reasonable to conclude that stocks of wool at the 30th June, 1934, will be substantially lower than at the 30th June, 1933, when they amounted to 78,600,000 lb. The export season has still two months to run."

The serious decrease by over half a million in breeding-ewes in 1932 was converted into an increase of 146,637 in 1933, during which year the sheep flocks of the Dominion decreased by 935,822. Interim returns of the sheep in the Dominion on the 30th April, 1934, show an increase of 794,804 to a total of 28,550,770. From the following further facts it may be concluded that the position of the sheep industry is being consolidated. Though the final figures are not available, it is estimated that the 1933 lambing was a record one in respect to both the lambing percentage and the actual number of lambs tailed. Incidentally, the interim estimates may be accepted as satisfactorily indicative of the position—over a series of recent years they have approached closely the actual figures, sometimes being slightly above and sometimes slightly below these. Though the total numbers slaughtered are not yet available, the general position may be deduced from the killings for export. Despite the record lambing, there has been a slight falling-off in the lambs slaughtered for export during the season from the 1st October, 1933, to the 30th June, 1934, the figures being 8,671,351 for 1933–34 and 8,729,637 for 1932–33. The killings of sheep for the corresponding periods have been 1,813,802 for 1933–34 and 2,022,246 for 1932–33. The decline in the killings of sheep is a reflection of the improved financial position of the sheep industry. It has been noted that difficult times in the sheep industry have been characterized by a drop in lambs for replacement and an increase in the killings of sheep, it being a case of the realization of capital stock as a means of meeting a depression. This was well illustrated in 1919–21 and again in the 1930–32 periods of depression, whereas this year that trend is reversed. It may be noted that the figures given in the divisional reports do not always correspond with those herein. The explanation is that the periods under review are not always the same, and, further, that figures for the financial year cover the operations of parts of two producing-seasons.

The future role of beef-production in the farming of the Dominion is receiving attention both because of problems relative to imports into Great Britain and because of the results of investigations relative to the potentialities of the chilled-beef trade. The latest available complete returns indicate a decline in cattle other than dairy cows, and this, in conjunction with evidence of a greater demand for cattle as agents in pasture management, may account for a decline in the killings of beef for export, which, for the nine-months period ending the 30th June, were 371,140 quarters and 422,063 quarters in 1934 and 1933 respectively. Chilled beef is considered to be passing the experimental stage. Late in the producing-season 16,000 quarters had been shipped. Of these, not a single quarter was lost, and evidence pointed to chilled beef being a success in respect to quality. But the fact that restricted shipments have given this result is but an

incomplete criterion of the economic possibilities of chilled beef on a considerable scale. The raising of beef cattle specifically for conversion into chilled beef of sufficient quality to enable it to compete satisfactorily with chilled-beef supplies which have already won a place in the meat trade promises to be a distinct undertaking from the raising of beef cattle which, prior to being slaughtered, serve as agents in the management of relatively indifferent pastures. The type of animal required and the cost of feeding to produce that type are matters about which further information is needed to determine the potential role of chilled beef in the farming of the Dominion.

In general, the market for draught horses for farm work has been strong. This is to some extent due to a replacement of tractors by horses. Largely it may be attributed jointly to a decline over a series of years in the number of horses in the Dominion and to a trend towards freer use of horses on farms which are devoted dominantly to grass-farming and which are now assigning more importance than they did a few years ago to arable cropping for the purpose of supplementing the pastures. Indicative of this is the fact that in 1932 and in 1933 the total importations of rape, kale, turnip, and swede seeds were greater than in any of the previous seven years. The export, at satisfactory prices, of draught horses to Australia increased, and in general the outlook for the breeder of good draught horses is encouraging. The breeding of light horses, of which there is a scarcity, is at a low ebb.

The quality of pastoral produce has received close attention during the year. The improvement in the quality of New Zealand cheese which occurred in the 1932–33 season has been continued during the 1933–34 season. It would seem that this improvement in the quality of New Zealand cheese, which was noted not only by the graders in New Zealand but also by traders and graders in Great Britain, is to some extent a result of compulsory differential payments for butterfat associated with milk-grading at cheese-factories which were brought into force in August, 1933. In general, in flavour and quality, the bulk of New Zealand cheese is commercially good, and the problems relative to texture continue to be the subject of investigation. The quality of the season's butter approximated the high quality of the previous season: as formerly, many brands have been so favourably reported upon as to leave little, if anything, to be desired. In some butters in which the quality was not so high the falling-off is considered to be due to the effects of feed, which are difficult in practice to avoid. The season provided further evidence that the greatest practicable frequency in the delivery of cream is worth striving for.

The normal high quality of New Zealand meat was well maintained during the year. As a rule, lack of quality of produce becomes less discussed as the market improves. This has been exemplified this year in the improved wool-market. The emphasis which has been placed in recent years on the importance of quality in our wool has been of distinct value in concentrating attention upon some of the main farm-management measures which affect quality. The practice of skirting the fleeces at shearing-time and arranging for the wool to be binned at the stores continues to grow in popularity among small growers, and is to be commended.

Fruitgrowing.

The area in commercial orchards in the Dominion is practically stationary at 27,000 acres. Despite changeable weather conditions during the growing-season the crop of apples and pears was above the average, but the crop of stone-fruit was somewhat light, and small fruits suffered from dry conditions. The total quantity of fruit exported in the 1933 export season was 1,430,513 cases—a decrease of 165,000 cases in comparison with the previous season. While returns at the beginning of the season were fairly satisfactory, the market later became glutted, and consequently prices were low. The export season of 1934 just ended closed with a total of 1,574,912 cases, and, as in the previous season, in general returns are disappointing. A trial shipment of peaches to London opened up in good appearance, condition, and colour, but flavour was lacking to some extent. The results were similar in respect to a trial shipment of plums.

The yield of citrus fruits in the Dominion is gradually increasing, and in this connection it may be noted that the Poorman orange is increasing in popularity and coming into use as a good substitute for imported grape-fruit. The production of lemons is excellent as regards quantity, but the marketable quality of many of these home-grown lemons is greatly depreciated through failure to subject them to a proper grading and curing process. If all our lemons were properly graded and cured there would be little need for importations of this fruit.

There has been a falling-off in the quantity of passion-fruit grown in the North Auckland District. New-Zealand-made wines are gradually increasing in favour. The season's output of wine is approximately 138,000 gallons—a substantial increase on that of the previous year.

In an endeavour to obtain a further alternative outside market the United States Government was again approached with a view to endeavouring to obtain admittance of New Zealand apples and pears into its country. Previous efforts had failed owing to the market conditions imposed in the United States against countries whose fruit was liable to be affected with the Mediterranean fruit-fly, this being extended to New Zealand (where this fly does not exist) on account of the fact that importations of fruit from other countries where the Mediterranean fruit-fly was present was permitted by New Zealand. After a period of negotiations an Order in Council was enacted prohibiting the importation into New Zealand of fruit from any country where the Mediterranean fruit-fly existed, and, as a result of this, the United States market was made available for us. Circumstances have prevented any large quantity being exported there during the present season, but as a result of the visit to Washington and New York of Mr. Campbell, Director of the Horticulture Division, it is anticipated that the United States market will be thoroughly tested out next season.

Other Branches of Primary Industry.

The high production recorded in the main primary industries of the Dominion has in general been duplicated in other primary industries which, though relatively smaller, are of considerable importance, and this may be intensified because of marketing difficulties relative to the products of the main primary industries, with which a number of the subsidiary primary industries may be linked advantageously.

The knowledge that pig-keeping properly carried out can be made to supplement valuably the unsatisfactory returns from butterfat is being applied much more freely than previously: In 1933–34 the number of pigs slaughtered in comparison with that in the previous year increased by 45 per cent. to 744,569, and the quantity of pork exported increased by 102 per cent. to 377,863 cwt. Further considerable growth in pig-keeping is being planned by dairy-farmers, and it seems probable that, while dairy by-products will continue to be a major constituent of the feed of pigs, a greater place than in the past will be given to the feeding of pigs both on pastures and on such crops as mangels, lucerne, peas, and barley grown on the dairy-farms. Increasing attention is being given to the rearing of the most profitable type of pigs available. This is due to a considerable extent to the efforts fostered by the Pig Industry Committee, on which the Department of Agriculture is represented. Recent investigation points to much correlation between feeding and the incidence of disease in pigs, and indicates that improved feeding must be a key-note of successful increased future pig-rearing. The grading of pig carcasses has recently received considerable attention; improvement has been brought about; but more attention must be given to this matter, which is of fundamental importance to the pig industry.

The Poultry-runs Registration Act, 1933, provides for the setting-up of a Poultry Board comprising two Government and four producers' representatives. The Board is charged with the administration of the Act, and is empowered to organize and develop the poultry industry. It is hoped that the weakness which has long been felt in the industry will be replaced by organization mutually advantageous to producer and consumer. The export of eggs is considered of value firstly as an initial step towards the establishment of a regular export trade, and secondly as a means of disposing of seasonal surplus, and thereby of preventing local prices falling below cost of production. The amount of eggs in shell exported was 12,107 cases of 30 dozen each—the greatest amount exported to date. In the previous season 5,264 cases of eggs in shell were exported. As in previous years, the eggs exported were well graded both in size and quality, but, because of market conditions in England, the prices obtained were lower than in previous years. The voluntary export committee handling the business did excellent work. The Wallaceville Poultry Station proves of considerable educational value. The Department's policy continues to be the advocacy of poultry-keeping not as a sole means of livelihood, but as a side-line to other branches of farming. Considerable expansion in the domestic consumption of eggs is still possible, and recent relatively low prices may assist in bringing this about.

The honey industry cannot be said to have had a good year, as climatic conditions caused a light crop. In addition, many producers have not yet been able to clear off their indebtedness to the Honey Producers' Association (now in voluntary liquidation, brought about by over-advancing). The Honey Board is now in control and is doing its best to meet the still existing difficulties of the industry, which, it is sincerely hoped, will gradually improve its position, to the advantage of a good and highly deserving section of the community.

There has been a reduction in the area in tobacco for commercial purposes, which approximates 2,500 acres. It is estimated that the area in tung-oil trees is from 3,000 to 4,000 acres. The honey exported in the year ended 31st March, 1933, was 2,005 cwt., valued at £7,014; and the corresponding figures for 1934 were 7,342 cwt., valued at £23,784.

The hemp industry continues in a depressed condition, which may be relieved to some extent by the manufacture of wool-packs and sacking, in connection with which a factory was opened at Foxton during the year. A further extension in the use of flax (Phormium) fibre may arise from trials, relative to ropes, which have been carried on by the Admiralty and in which the ropes made from Phormium fibre were gratifyingly successful.

The official certification of seeds is now a well-established service which receives the increasing support of both growers and consumers of seed. In the first place, it seems likely to become the basis of a valuable relatively stable subsidiary primary industry. In the second place, the wider use of certified seed will be reflected in better pastures generally. In 1933-34 certification was applied to seed of the following crops—perennial rye-grass, cocksfoot, brown-top, white and red clovers, potatoes, wheat, swedes, and turnips.

Use of Artificial Fertilizers and Lime.

The survey of the response of New Zealand grassland to various classes of fertilizers and to lime, which was initiated in recent years, has already provided sufficient instructive information to indicate that the trials should be increased in number as a means to greater detailed knowledge of the top-dressing requirements of the various districts, and this is being done as opportunity offers. As a result of the survey the use of not less than 1 cwt. an acre of 30 per cent. potash on a large block of grassland in North Taranaki is now being recommended. The survey also indicates that the visible field response to liming of the pastures of the various districts varies greatly, and as great differences in the response to lime at times are found in districts adjacent to one another the accurate determination of the boundaries between different types of response becomes of distinct economic value. Further investigation relative to the manuring of wheat confirms the advisability in the main grain-growing districts of using 1 cwt. an acre of superphosphate at the time of sowing, and this official recommendation has been translated into almost universal field practice.

The artificial fertilizers carried by rail for the twelve months ended 31st March, 1934, were 61,217 tons less than in the previous twelve months. The Dominion figures in tons for the years specified are—1928–29, 708,515; 1929–30, 691,604; 1930–31, 568,491; 1931–32, 570,144; 1932–33, 613,450; 1933–34, 552,233. The figures for the North and South Islands for recent years are—

	North Island. Tons.	South Island. Tons.
1931–32	435,237	134,907
1932–33	463,603	149,847
1933–34	394,156	158,077

The agricultural lime carried by rail during the year ended the 31st March, 1934, was 19,873 tons greater than in the previous year. The quantities, in tons, of agricultural lime carried annually since 1st April, 1929, are—

	North Island.	South Island.	Total for Dominion.
1929–30	60,476	111,063	171,539
1930–31	72,678	83,168	155,846
1931–32	70,570	69,766	140,336
1932–33	94,701	79,413	174,114
1933–34	99,919	94,068	193,987

Stock Diseases.

The year generally has been a normal one in respect to diseases of cattle. While there was an increase in black-leg in the Auckland Province, the number of cases noted in Taranaki was not above the average. The use of the formalinized vaccine prepared at Wallaceville is giving satisfactory results.

Cattle-ticks were more numerous than in recent years, especially in North Auckland. Regarding the cattle-tick, there has taken place a change in outlook involving a realization that the tick is not such a serious parasite as was originally considered possible, and in conformity with the current viewpoint alterations in the present regulations are contemplated by the Department. In the control of the cattle-tick much can be accomplished by the

effort of individual farmers—*e.g.*, the destruction of winter cover for ticks in conjunction with appropriate spraying and hand-picking.

Intensive investigational work is being carried out at Wallaceville in connection with mammitis of dairy cows, which seems not to have diminished. An increased number of farmers will avail themselves in the coming season of the mammitis-control scheme which was introduced a few seasons ago and which involves monthly laboratory examination of milk from all cows in a herd, and subsequent division of the cows into free and infected groups. The incidence of contagious abortion has not been abnormal. This disease is widely disseminated through our herds, but immunity against actual abortions has been established to a large extent. Despite world-wide research no practical reliable method of preventive inoculation has yet been introduced. A considerable amount of investigational work into sterility has been carried out, and it shows that probably several factors, including the following, are involved: (1) Mineral deficiency, (2) partially infertile bulls, (3) infection. Speaking generally, the use of a bone-meal and salt-lick is likely to be beneficial whenever a shortage of phosphate and lime is probable. While the control of bloat in cows is considered largely to be a question of management, there appear to be certain undetermined points, and an investigation of these during next season has been planned. Grass staggers in cows, the incidence of which has declined, has been the subject of much thorough investigation without any conclusive results being yet obtained.

The incidence of disease in sheep was particularly low. To obviate as far as possible carcasses of lamb and mutton affected with lymphadenitis reaching the overseas market, the Department has instituted a very thorough system of inspection at meat-works. The adoption of precautionary measures at shearing-time tends to lessen greatly the occurrence of this trouble. Some farmers are following the measures recommended by the Department for the control of the disease. More should do so. Apart from those in Central Otago, losses of lambs from pulpy kidney were light. In continuation of work started by Mr. Gill, a number of lambs were inoculated with antitoxin; the results were promising, but definite conclusions are not yet possible. An inflammatory condition of the sheep's skin (mycotic dermatitis) has been noted in different districts, and especially in Canterbury. The disease, for which there is no known treatment, causes considerable economic loss. It is contagious, and to prevent spread sheep-farmers should report suspicious cases to the Department.

The most momentous occurrence relative to diseases of pigs was the outbreak of swine fever which occurred near Wellington in May, 1933. It is gratifying that the outbreak was quickly suppressed, and, seeing that no further cases have occurred since, it can be concluded that this most serious disease was completely eradicated. Inconclusive evidence suggests that the outbreak of the disease resulted from illegal feeding on garbage from overseas vessels, which is prohibited. An increasing number of deaths in young pigs has been recorded. While investigation has shown some of these to be associated with certain infections, it also points strongly to the probability that the nature of the feed-supply is an important factor.

Control of Noxious Weeds.

Despite the difficult times, a fair measure of control has been obtained. Ragwort has called for much attention. The Unemployment Board's No. 11 Scheme was applied to work relative to ragwort with considerable benefit. Approximately 500 tons of sodium chlorate were consumed during the season. Though many farms have been cleared of ragwort, others probably are more heavily infested with it than they were a year ago. Other common weeds, such as blackberry, Californian thistle, sweetbrier, though less serious than ragwort, are troublesome, and considerable work is being done in respect to their control.

The Rabbit Nuisance.

The year was favourable climatically for the increase of the rabbit pest. In addition, the low prices ruling for skins and the financial difficulties of many farmers also operated against the fullest action against the pest. The Rabbit Boards throughout the Dominion are all obtaining excellent results, and the pest has been kept well in hand.

Ruakura State Farm and Farm Training College.

Though the season was to some extent an unfavourable one, because of a rainfall of 39·34 in. in place of the normal one of about 50 in., the production of Ruakura State Farm was well maintained, this being partly due to a considerable top-dressing programme. The returns in

both produce and live-stock were depressed in accord with the general low level of prices associated with the farming industry, exceptions to this being the prices obtained for wool and lambs. The accommodation available at the Ruakura Farm Training College has been fully occupied during the year, which speaks well for the reputation that the teaching in agriculture at the institution has gained for itself.

Te Kauwhata Horticultural Station.

The Te Kauwhata Horticultural Station has been conducted on lines essentially similar to those followed in recent years, the main activities relating to the vineyard and the manufacture of wine. As a result of favourable weather, the grape crop was a heavy one, and produced 15,500 gallons of wine. There was a considerable increase in the sales of wine in comparison with the previous year, this being some indication of the public demand for sound wine at a reasonable price. The returns from wine (15,846 gallons) amounted to £6,905.

The Plant Research Station.

As formerly, much of the work of the Plant Research Station was carried out in co-operation with the Department of Scientific and Industrial Research. Both at Palmerston North (in laboratories and in field trials) and at Marton (on the Experimental Area) pastures are studied in their manifold aspects. The search for improved strains of pasture-plants continues, and trials in progress are designed to throw light upon such practical problems as pasture establish ment, top-dressing, and utilization. A wide range of arable crops is under investigation at Palmerston North, Marton, and particularly at the Government Pure Seed Station, which is located at Lincoln on land leased from Canterbury Agricultural College. Work of prospective fundamental importance at Marton Experimental Area relates to the technique of crop experiments, upon which depends the validity of conclusions from investigational work. The samples of seeds received for examination totalled 15,193—an increase of 3,243 compared with the number in the previous year—and involved 24,000 tests. Extensive work is in progress in the sphere of plant protection—*i.e.*, relative to diseases and pests of economic importance.

In general the work of the Plant Research Station and associated areas has been a continuation of and, to a limited extent, an extension of the work of recent years, some details of which are available in the appended statements of the heads of various sections.

Wallaceville Veterinary Laboratory.

The work organized by the Wallaceville Veterinary Laboratory has been of its previous important, sound, and extensive nature. Greater knowledge of mastitis and grass tetany of cows and more insight into certain diseases of pigs have been obtained. The work on semen samples from bulls, with the practical purpose of classifying bulls for use by means of sperm morphology, has been continued, as has valuable work on diet in relation to disease. A new departure is the providing of accommodation for Dr. M. McOwan, M.A., B.Sc., Ph.D., a Carnegie scholar who is working on vitamin problems. Dr. Moir, of the Dairy Division, is also stationed at Wallaceville in convenient proximity for consultations on matters of possible concern to the Live-stock and the Dairy Divisions. The wide range of activities receiving attention at Wallaceville are indicated concisely in the report of Mr. Hopkirk, Officer in Charge, which is appended.

The Chemical Laboratory.

The customary large volume of work of economic value has been carried out by the Chief Chemist and his staff. Financial assistance no longer being available from the Empire Marketing Board, work on the mineral content of pastures had to be curtailed considerably. It was demonstrated during the year that so-called "limonites" from different sources or subjected to different treatments differed greatly in their feeding or curative value. At Morton Mains, Southland, the use of limonite over two years has been associated with successful lamb-raising where previously this was not possible. Previous work relative to pampas grass as a fodder has been continued and confirmed in the field. As this has taken place on soil exceptionally rich in all plant-foods, especially phosphoric acid, it is of moment to determine the feeding-value of pampas grass on poorer soils. Bone analyses have been carried out in connection with disorders in lambs. In co-operation with the Plant Research Station in connection with manurial trials pasture samples have been analysed. An extensive iodine investigation is in progress. That the work which was carried out in connection with soils was of considerable value to the Department and

to other organizations is indicated by the appended report of the Chief Chemist. The administration of the Fertilizers Act was an important and extensive function of the Chemical Laboratory, as may be gauged from the fact that 899 brands of fertilizers were registered. A scale of fees for registration of brands was brought into operation during the year. The charging of fees seems to tend to reduce the number of brands registered.

Land Development.

During the year, especially in the Auckland Province, the Department has assisted considerably in the land-development activities of the Government. In this work it has been demonstrated that the class of land at Ngakuru can be operated satisfactorily as small dairy-farms. The results to date have been satisfactory. On the Galatea Estate, 2,700 acres were sown in permanent pasture and 650 acres in annual crops. The Lands Department is taking over the management of the block sown in permanent pasture, and the Department is released from further work at Galatea with the exception of the supervision of the Demonstration Area on the estate and the giving of advice as required relative to the general management of the sown pastures.

The development of the Whangamarino Block has been brought to such a stage that the Lands Department is arranging to settle the block in 1934. In view of this, the Department will not be specially concerned further with the block. On the Pakihi area, near Westport, some attention has been given to development work, and a block sown in grass has been taken over recently by the Lands Department.

Advisory and Instructional Work.

The volume of the Department's activities in the sphere of instruction tends to increase steadily. This may be attributed partly to the advances in knowledge which have resulted from recent investigations and to a greater realization by the rural community that these advances have taken place and are of economic value when suitably translated into farm practice. But the increased demand for departmental advice must also be attributed partly to the financial stress which has affected the farming community: this stress has forced many farmers who previously had no active incentive to better farming to explore all possibilities of improved returns, and in this they have turned to the Department for guidance. In this connection one development has resulted in a greater proportion of requests for advice relative to the management of the whole farm as distinct from the management of specific crops. In respect to this development it is of importance that farm-management problems are as a rule of greater complexity than crop-management problems, and, possibly because of this greater complexity, they have not as yet been investigated so thoroughly as have many aspects of crop-management.

The most appreciated and most efficient type of advisory service is that which involves visits to the farmers on their holdings, so that there is assurance that consideration is given to the important matter of local circumstances. As far as possible this system of advisory service is adopted. The way in which advisory officers generally have endeavoured to meet requests for their service is highly appreciated.

Publications and Publicity.

The *New Zealand Journal of Agriculture*, though reduced in size in the interests of economy, serves well as a means of recording activities and achievement in agriculture, and it also acts as a means of disseminating much advisory information. The *Journal* is supplemented, as in the past, by bulletins and miscellaneous other publications which are issued as occasion arises.

The series of weekly radio lecturettes from Station 2YA, Wellington, has been maintained by officers of the Live-stock, Fields, and Horticulture Divisions along lines similar to those followed in previous years, and evidence continually coming to hand indicates that a large farming audience obtains contact with the Department through the lecturettes.

Miscellaneous.

The considerable amount of work resulting from governmental measures designed to assist the farming industry, especially in the current abnormally difficult times, has been carried out as usual. In this connection the principal measures relate to the railage subsidies on fertilizers and lime, concessions on railway transport of primary produce, and the subsidy to manufacturers of superphosphate. The purchase of seeds and manures for Government Departments in general has been carried out as formerly, and has involved considerable work, especially on the

part of the Seed-testing Station. Six hundred lines of seed totalling 307 tons and valued at £22,000 approximately were selected. Samples on the basis of which purchases were made were checked against samples drawn from bulk deliveries.

Relatively early in the financial year the work which the Department has been carrying out under the Small-farm Plan was handed over almost wholly to the Lands Department following the appointment of a Commissioner of Small Farms, but a number of developments which had been started by this Department were carried beyond the initial to the establishment stage, and some special advisory work relative to the Small-farm Plan was also carried out.

The 1933 Certificate of Record testing-work was slightly greater than that of the previous year. This is satisfactory in view of the depressed financial condition of the dairy industry. In the Government Official Herd Testing there was also a slight increase in 1933 in comparison with the previous year. The Government subsidy to ordinary dairy-herd testing was continued—£6,000 was granted for the year.

The work of the agricultural clubs was again characterized by success. As in recent previous years, the Department's assistance was necessarily restricted.

Conclusion.

Much further information relative to the activities of the whole Department is contained in the divisional and other reports which follow. Every effort has been made to combine high efficiency and strict economy as much as possible in the activities of the Department, and I desire to state my appreciation of the assistance I have had in doing this from the Assistant Director-General, the Secretary, the Directors of the Divisions, and all members of the staff.

During the year the Department lost the services through retirement on superannuation of some of its most valued officers holding responsible positions. These officers were Mr. J. W. Deem, Director of the Fields Division; Mr. J. Lyons, M.R.C.V.S., Director, and Messrs. D. Munro, R. Wright, and W. Wills, principal District Inspectors of the Live-stock Division; and Mr. R. H. Hooper, Editor.

C. J Reakes, D.V.Sc., M.R.C.V.S., Director-General.

NAURU AND OCEAN ISLANDS PHOSPHATE.

Report of A. F. Ellis, C.M.G., New Zealand Commissioner, British Phosphate Commission.

Particulars are supplied herewith regarding the fourteenth year of operations at Nauru and Ocean Islands since the industry came under Government ownership. The year ended on the 30th June last, and the shipments compare with the two previous years as follows:—

	1931–32. Tons.	1932–33. Tons.	1933–34. Tons.
Nauru	289,340	436,100	379,100
Ocean	142,200	224,200	177,489
Total	431,540	660,300	556,589

Distribution of the output, in tons, was as follows: Australia, 356,089; New Zealand, 148,950; other countries, 51,550: total, 556,589.

The proportion of the output coming to New Zealand as compared with the two previous years is—1931–32, 33·89 per cent.; 1932–33, 26·95 per cent.; 1933–34, 26·76 per cent.

Importations of phosphate to New Zealand compared with the previous two years are as follows:—

	1931–32. Tons.	1932–33. Tons.	1933–34. Tons.
Nauru-Ocean	163,250	184,388	149,805
Outside	20,437	13,963	..
Total	183,687	198,351	149,805

During the year under review unusually good weather conditions have prevailed at both islands, while the health and labour position has been favourable.

Following on the speeding-up of both the cantilever at Nauru and the system of shipping at Ocean Island, as mentioned in last year's report, a further interesting development is the improved rate of discharge recently attained at New Zealand ports. These factors are favourably reflected in freight rates.

LIVE-STOCK DIVISION.

REPORT OF W. C. BARRY, M.R.C.V.S., DIRECTOR.

HEALTH OF LIVE-STOCK.

HORSES.

The general health of horses continues good. An increasing demand has been evident for good draught horses of the right type. This has resulted in a distinct impetus being given to the breeding of draught horses, which should prove to be quite a remunerative proposition to those farmers engaging in it. During the year the export of draught horses to Australia also increased, satisfactory prices being realized. Taken all round, the outlook for the breeder of good draught horses is most encouraging. On the other hand, the breeding of light horses, hacks, and those suitable for remount purposes is at a low ebb, and a scarcity of such horses is evident.

CATTLE.

Tuberculosis.—The total number of cattle condemned in the field as a result of clinical examination and the application of the tuberculin test amounted to 4,617. The total number of cattle examined at the various abattoirs and meat-export slaughterhouses was 408,999, an increase of 71,698 over last year's figures. Of these, 25,255, or 6·17 per cent., were found to be affected with tuberculosis in varying degrees, a large percentage being only slightly affected.

Actinomycosis.—The number of animals condemned and for which compensation was paid totalled 636, an increase of 101 over last year's figures. Advanced cases of this disease affecting bony tissues are not amenable to treatment. On the other hand, a large number of cattle affected with that type of the disease which responds to treatment were successfully dealt with. The introduction of an agglutination (blood) test for diagnostic purposes is proving useful in indicating those cases which are likely to respond to treatment. The test which is carried out at the Wallaceville Veterinary Laboratory is being increasingly availed of by field officers.

Malignant Growths.—The number of animals condemned and for which compensation was paid was 330, an increase of 49 over last year's figures.

Blackleg.—An increase in the incidence of this disease is recorded in the Auckland Province, a larger number of outbreaks occurring in the North Auckland District. It is difficult to assign a definite reason for the varying incidence of this disease in different years, but no doubt seasonal conditions exert an influence on the susceptibility or otherwise of calves. The number of cases recorded during the year in Taranaki has not been above the average. The total number of calves vaccinated in the blackleg areas during the year was 32,186. The use of the formalinized vaccine prepared at Wallaceville continues to give satisfactory results.

Johne's Disease.—During the year nineteen cattle were condemned under the Stock Act for this disease. Its presence was first discovered in Taranaki a few years ago, but cases have recently been located in the Waikato. It is of the nature of a chronic bacterial enteritis, the outstanding symptoms of which are chronic scouring with progressive emaciation. In other countries the disease is responsible for considerable economic loss, and its presence in New Zealand must be viewed with a certain amount of anxiety. Energetic measures have, however, been taken by the Department to locate centres of infection and remove affected animals. The use of the diagnostic agent "Johnin" has also been largely availed of in detecting the disease. It is hoped that with the active measures adopted and the co-operation of farmers in reporting suspicious cases the incidence of Johne's disease will be kept at a low level.

Cattle-tick.—The season was apparently a favourable one for tick development, reports indicating that cattle-ticks were more numerous than during the last few years. This was particularly marked in the North Auckland District. In this area the enforcement of the Cattle-tick Regulations has been the subject of representation to the Department with a view to modification. During recent years the whole aspect of the cattle-tick question in New Zealand has more or less undergone a change, a realization that the tick is not a dangerous stock parasite having taken the place of the dread at first created by its discovery. To meet the position to-day some alterations to the present regulations are required, and it is the Department's intention to go into this question. In the control of cattle-tick much can be accomplished by individual effort. Farmers in tick-infested areas could largely prevent tick propagation by the burning or destruction of all cover which gives the immature ticks protection during the winter months. This, combined with other protective measures, would materially tend to keep their numbers on any one farm very low. With respect to this point the District Superintendent, Auckland, makes the following remarks: "I am quite sure that ticks can be controlled to a great extent if property-owners will spray their cattle a few times during the worst season of the year, hand pick at other times, and also clean up and if possible burn rubbish in odd parts of the farm."

Anthrax.—It is satisfactory to record that with the exception of one case of anthrax, which occurred in October last on a property adjoining that on which anthrax was found during the previous year, no further cases of this disease have arisen.

Mammitis.—The incidence of this disease of dairy cows did not appear to be appreciably less during the year. Concentrated investigational work has been established by the Wallaceville staff, and further important points in connection with its development have come to light. One of these is in connection with the bacterial flora of the teat duct, which promises to yield useful information regarding the question of infection by so-called "carrier" cows.

The mammitis-control scheme introduced a few seasons ago by the Department is still being carried on. This method of control is dependent on the monthly laboratory examination of milk from all cows in a herd, and the subsequent grouping into free and infected lots. By rotational milking of those groups, coupled with certain hygienic requirements, it is claimed that the spread of infection can be materially lessened. A number of farmers in the dairying districts have adopted the method, and in many instances encouraging results have followed. The method undoubtedly involves a certain amount of trouble, but the willingness to continue the practice which has been shown by many indicates some satisfaction with the results. From inquiries received it is apparent that an increased number of dairy-farmers will avail themselves of the method during the coming season.

Contagious Abortion.—As in recent years, the incidence of actual cases of abortion has not assumed serious proportions. The infection, however, is widely disseminated through our herds, but it is evident that immunity has been established to a very large extent against actual abortion. In spite of the intensive world-wide research into this disease, no practical and reliable method of preventive inoculation has as yet been introduced. The agglutination (blood) test has, however, made available a ready means of discovering infected animals. This test has been largely carried out at the Wallaceville Laboratory in co-operation with field officers, and its value in revealing the existence of the disease is much appreciated. Advice to farmers regarding control of the disease has been largely disseminated by the Division.

Sterility.—The seasonal occurrence of the condition referred to as "temporary sterility," "not holding to bull," or "delayed conception" was again much in evidence amongst dairy herds. A considerable amount of investigational work into this trouble has been accomplished, and although a definite causative factor cannot as yet be shown to operate in all cases much light has been thrown on the condition generally. Inquiry goes to show that in all probability several factors are involved, falling under the headings of (1) mineral deficiency, (2) partially infertile bulls, (3) infection. Under the first heading fall those instances dependent on insufficiency of minerals in the feed, or their presence in a ratio unsuitable to the maintenance of the animal's requirements. In giving advice to farmers on this particular point, much stress has been laid on the beneficial results generally following the use of licks of the proper type. Speaking generally, the use of a bone-meal and salt lick is indicated wherever a shortage of phosphate and lime is suspected. Evidence collected from farmers who have adopted the use of such licks for cattle has impressed field officers of the Division with the utility of the practice in maintaining condition and lessening the incidence of breeding troubles.

Reference must again be made to the necessity of better winter feeding of our herds. The nutritional aspect at this particular time must not be lost sight of, and the aim of every dairy-farmer should be improved conditions of feeding and also of shelter for his cows during the winter months.

Investigational work has shown the bull to be responsible in many instances for the occurrence of this trouble in a herd. Certain infections of the cow's genital organs are also involved.

Referring to this condition, the District Superintendent, Dunedin, who has conducted some keen observations regarding the trouble, states in his report: "There is every possibility of some dietetic factor having an influence in the production of functional sterility."

"*Foul Foot*" *in Cattle.*—The condition known as "foul foot" in cows is in many districts a source of considerable worry and economic loss to the dairy-farmer. The actual cause of this condition has been shown to be bacterial, but certain contributory factors are involved. Some investigational work has been done regarding the disease at the Veterinary Laboratory. This investigation will be further pursued, and it is intended, when more definite information is collected regarding certain aspects, to issue a departmental bulletin on this subject.

Bloat in Cows.—The occurrence of bloating in cows during the early spring period has recently been the subject of departmental inquiry. Whilst conceding that the control of this trouble is largely a question of management, there are nevertheless certain features of pasture conditions which appear conducive to its production. In an attempt to clear up some of those at present undetermined points, a line of investigation into this condition has been mapped out which will be fully pursued next season.

Grass Staggers in Cows (Grass Tetany).—The seasonal occurrence of this condition was mainly confined to the Waikato, very few cases having been recorded in the Wellington District, and Taranaki still apparently remaining practically free from the disease. In the Waikato the disease has not been so prevalent during the past year. Referring to the lessened incidence, the District Superintendent, Auckland, states: "This was possibly due to the climatic conditions and state of the pasture at the time when the disease usually makes its appearance."

The Laboratory has been responsible for very close study of this condition during the year, biochemical research work referring to the calcium and magnesium content of the blood being extensively conducted. In the field, Mr. Blake, Veterinarian, Hamilton, has rendered very valuable service in his keen study of the clinical aspect of the disease, by which he was able to classify the condition into (1) acute, and (2) sub-acute cases. In the acute type of case the animal exhibits convulsions or fits. The sub-acute form is characterized by hypersensitivity, such cows being termed "high-steppers."

Extensive experimental work has been conducted in the field with a view to discovering a line of treatment which would either cure or alleviate the condition. As yet, no outstanding results have been obtained, but in the past season Mr. Blake has recorded some success in the treatment of sub-acute cases from the hypodermic injection of magnesium sulphate. This, however, requires further investigation before any conclusive statement can be made.

Milk Fever.—The incidence of this disease was, speaking generally, lower during the year than usual.

Pulmonary and Intestinal Parasites in Young Cattle.—Large numbers of calves are still lost or their constitution impaired as the result of parasites. In the prevention and treatment of this disease, management and feeding play a more important part than drugs. Supplementary feeding is the sheet anchor in combating the effects of parasites in young cattle, and without this any line of medicinal treatment adopted cannot be expected to give the best results.

SHEEP.

It is pleasing to record a most successful year in connection with sheep-farming. Sheep wintered well, the lambing percentage on the whole being good. The opening wool-sales were marked by the high prices realized, and, although tending to drop at the later sales, the wool-prices of the 1933–34 season will be remembered as tending towards a welcome revival to the sheep-breeding industry. From a disease point of view the year was a particularly good one, being marked by a very low incidence of those seasonal mortalities in sheep which unfortunately have to be recorded occasionally.

Lymphadenitis.—Although the effect of this disease on the general health of sheep might be said to be practically nil, its economic importance is considerable in that its presence in the glands on inspection constitutes the rejection of the carcass for export. This results from the serious view taken of the disease in the carcass by the Home authorities. In order to obviate as far as possible the chance of affected carcasses of lamb or mutton reaching the English market, the Department has instituted a very thorough system of inspection at the meat-works by which every carcass is carefully palpated to detect the presence of the disease in the superficial glands. Records are obtained of the farms from which cases of the disease are detected, investigation made, and advice regarding control given to the sheep-owner. The adoption of precautionary measures at shearing time goes a long was to lessen this disease on a farm. Manual palpation of live sheep reveals the existence of enlarged glands, and many flock-owners are now adopting this form of control recommended by the Department. Sheep found affected on examination must be separated from the flock, and got rid of as quickly as possible. By this means the spread of infection is eliminated, with the possibility of, in time, eradication of the disease.

The District Superintendent, Dunedin, has conducted some valuable observations in connection with this control scheme which illustrates very forcibly its value. The following figures show the reduction brought about in the incidence of the disease in the ewe and wether flocks on two properties on which the control methods referred to have been in operation, and are inserted to show what can be done towards eliminating the disease :—

Ewe Flock.				Wether Flock.			
Examination.	Number examined.	Number affected.	Per-centage.	Examination.	Number examined.	Number affected.	Per-centage.
			Property No. 1.				
First, 1931 ..	11,196	1,046	9·34	First, 1932 ..	4,618	370	8·01
Second, 1932 ..	10,129	377	3·72	Second, 1933 ..	4,711	149	3·16
Third, 1933 ..	11,319	209	1·85	Third, 1934 ..	4,714	79	1·68
Fourth, 1934 ..	11,353	223	1·96				
			Property No. 2.				
First, 1933 ..	3,709	373	10·05	First, 1933 ..	1,478	83	5·61
Second, 1934 ..	3,095	140	4·52	Second, 1934 ..	1,547	32	2·07

The method has also been adopted on sheep-farms in Canterbury and in the Wairarapa, and it is highly necessary that it be adopted by sheep-farmers on a much more extensive scale.

Ante-partum Paralysis in Ewes.—The lambing season was remarkably free from ewe troubles. No serious mortality such as that recorded in previous years occurring.

Parasitic Diseases.—Although present to a considerable extent, mortalities from this cause were not very extensive during the year. The influence of seasonal conditions affecting pasture growth must be regarded as a vital factor leading up to hogget mortality. Internal parasites never give rise to such serious consequences unless the lambs receive a setback in vitality through unsuitable pasture conditions. Information regarding treatment and control of this disease has been largely disseminated by field officers of the Division.

Renal Congestion in Lambs (Pulpy Kidney).—With the exception of the Central Otago District, losses of lambs from this trouble were very light. In continuation of the work inaugurated by Mr. Gill, of the Veterinary Laboratory in Otago, a number of lambs were inoculated with antitoxin during the season. The results were hopeful, but more extended trials are necessary before definite conclusions can be drawn.

"Circling Disease" of Sheep.—This trouble was reported from sheep districts of the North Island. It is more in evidence during the autumn period.

Contagious Ophthalmia of Sheep (Pink Eye).—Outbreaks of this trouble were rather numerous. The contagious nature of the disease has been demonstrated, although the actual causative organism has not as yet been isolated. Information regarding treatment of the condition has been made general.

"Stiffness" in Lambs.—This condition was rather prevalent in all districts. Although sometimes it is seen before marking, its chief occurrence is subsequent to this operation. Recovery usually takes place in a short time, but a temporary setback to the lambs is produced. Very close inquiry into the trouble has been instituted, affected lambs being followed up to the time of slaughter in order to determine its relation to enlarged joints or arthritis.

Lice and Ticks.—Close inspection at saleyards resulted in the finding of considerable numbers of lice-infested sheep being exposed for sale. In such instances prosecutions under the Stock Act were enforced against owners. The position regarding lousy sheep generally has, however, improved.

Congenital Goitre in Lambs.—Investigation has taken place into outbreaks of this condition in the Otago District occurring on iodine-deficient areas.

Facial Dermatitis in Sheep.—The District Superintendent, Dunedin, reporting on this condition, states: "Further evidence was acquired this season regarding the value of burning affected blocks of tussock country in the spring as a means of reducing the incidence of facial dermatitis in sheep."

Mycotic Dermatitis.—This inflammatory condition of the sheep's skin has been found affecting flocks in different districts. Several cases of its occurrence have been noted in Canterbury. It is an inflammatory condition of the skin, with resulting scabs, which grow up in the wool, forming dense, hard masses, which render shearing difficult or impossible. The disease is caused by a mould or fungus and is contagious. The disease is common in Australia, where it is said to occasion considerable economic loss. Moist conditions favour its development, and it is more common in districts with heavy rainfall. There is no known treatment for the trouble, and separation of affected from healthy sheep is essential to prevent spread. Sheep-farmers would be well advised to report any suspicious cases to the Department for investigation.

Deficiency Disease in Sheep.—Instances of malnutrition in sheep attributable to soil deficiencies have been inquired into. One instance, in which considerable improvement has been reported following the use of a lick prescribed by the Department, is that occurring amongst lambs in the Morton Mains district of Southland. Further investigation is proceeding.

PIGS.

The number of pigs slaughtered for the season 1933-34 was 744,569, an increase of 235,946. The quantity of pork exported was 377,863 cwt., compared with 186,652 cwt. for the previous year. The low price of butterfat has resulted in a distinct trend on the part of dairy-farmers to a greater realization of the value of pig-keeping as an adjunct to dairying. There is every indication that the pig-breeding industry will in the immediate future develop to an extent when it will be regarded as an important section of the dairying industry. With improved methods of feeding and management of pigs, the returns from this source should convince every dairy-farmer of the advantages of pig-keeping in association with dairying. The old slip-shod methods, wherein the pig was merely regarded as a means of using up surplus dairy products and not as a side-line capable of returning good profit, must be eliminated if we are to maintain a successful export trade.

The subject of the grading of pig carcasses is one which has of recent years received considerable notice. Much improvement has been established in this respect, but it is evident that further attention must be concentrated on this important feature, which has a distinct bearing on the pig-breeding industry.

Swine Fever.—An outbreak of this disease during the year on some farms in the Johnsonville and Lower Hutt districts, near Wellington, has to be recorded. A brief history of the outbreak is as follows: During May, investigation of some reported mortalities in pigs in the Johnsonville district led up to the discovery of the existence of swine fever, confirmation of the disease being established by blood-transmission tests carried out at the Wallaceville Laboratory. As a result of intensive inspection of all farms in the district, further unreported centres of the disease were located. Quarantine restrictions were immediately imposed controlling the movement of pigs, and the risk of spread was thus minimized.

The pig-farms on which the disease occurred were all of the same type—viz., pig-farms on which pork was produced for sale to Wellington butchers. In every instance the pigs were garbage-fed, the garbage being collected from hotels, &c., in Wellington. It thus became evident from the start that garbage-feeding was the means by which the infection was spread, as interchange of garbage tins from farm to farm was common. Regarding the manner in which the infection reached Wellington, the closest inquiry failed to definitely decide this point. The inference is, however, very strong that the virus was introduced in garbage from an overseas ship. Although it was not possible to prove the point, a strong suspicion exists that garbage from an overseas ship had in some way reached a piggery, thus conveying the virus infection in meat scraps. This remains the only feasible explanation, in spite of the fact that the removal of garbage from overseas vessels has been prohibited by regulation for some years.

The existence of the disease at Johnsonville was confirmed on the 12th May, and from then to the 7th July, when the final slaughterings took place on a farm in the Lower Hutt area, thirteen pig-farms were discovered to be infected. All affected and in-contact pigs, totalling 1,920, were slaughtered, and buried in deep trenches dug for the purpose. All piggeries were demolished and destroyed by burning, compensation being paid on stock and buildings according to valuation.

The cases met with in the Lower Hutt in July proved to be the last, as, although careful inspection was still maintained in the quarantined areas (Hutt and Makara Counties), no further evidence of swine fever was discovered. The first restocking with pigs took place in January of this year, and by the end of March five of the previously affected pig-farms had resumed operations. Regular inspections of those premises have been maintained, and it is satisfactory to record that all pigs introduced have remained healthy. The outbreak was successfully stamped out in a short period of time, thus removing the existence of a disease which, had it persisted, would prove a menace to the pig-breeding industry. The work involved in the control of the outbreak, including slaughter of pigs, digging of trenches, burning of piggeries, &c., added to the intensive inspection of all farms where pigs were kept throughout the Makara and Hutt Counties, threw a tremendous amount of work on the field staff of the District Office, Wellington, who performed very excellent service in quickly handling the position. In this respect a special word of praise is due to Mr. J. E. McIlwaine, Veterinarian (at present Acting District Superintendent, Wellington District), and to Messrs. Wilson and Sim, Stock Inspectors, Wellington; also to Mr. B. Grant, Stock Inspector, Palmerston North, who carried out an intensive inspection of farms in the Levin and Otaki districts. Credit is also due to the Wallaceville Laboratory staff for the expedient manner in which laboratory diagnostic work in connection with the outbreak was performed.

Pasteurellosis and Suipestifer Infections.—An increasing number of mortalities in young pigs have to be recorded. Investigation has shown these to be associated with certain infections giving rise to (*a*) infectious pneumonia (pasteurellosis), or to a type of infection referred to as (*b*) suipestifer (paratyphoid), in which severe inflammation of the intestines is frequently observed. The occurrence of these diseases has led up, through investigational work carried out at Wallaceville, to the very strong assumption that the nature of the food-supply is a strong contributing factor. Skim-milk alone does not contain the vitamin content necessary for young growing pigs, with the result that they are prone to those infections. Correction of diet and management enters largely into preventive methods. Further work into this inquiry is in progress. I have to place on record the excellent work performed by Mr. D. Marshall, Veterinarian, Hamilton, in connection with disease in pigs in the Waikato. This officer's sound observations and his study of the conditions are much appreciated.

Mange.—The position in regard to the occurrence of sarcoptic mange in pigs is satisfactory. Cases have been dealt with in the Waikato, Wairarapa, and the Manawatu districts, and two outbreaks recorded in the Southland area. In each instance the disease has been eradicated. Dipping in crude petroleum has proved a very effective means of eradication on infected farms.

Necrotic Ulceration of the Skin.—This skin disease of pigs is very prevalent in the dairying districts. Insanitary conditions are a predisposing factor. A new line of treatment recommended by the Department for this condition is proving very successful.

Dairy Inspection.

This feature of the Division's work has received close attention during the year. The importance of the purity of the milk supplied to the public for human consumption cannot be gainsaid, and it has been the aim of the Department, through its inspectorial staff, to definitely improve the hygienic production of milk. In a period of economic depression and low prices for the dairyman it is not always easy to enforce structural alterations to dairy premises, nevertheless it can be stated that steady improvement has been maintained respecting the sanitation of dairies registered for town supply.

The matter of production of clean milk does not, however, end with the provision of a sanitary shed and dairy; the personal element enters largely into it, and failure on the part of the milker to observe the ordinary rules of hygienic milking and handling of milk might easily result in a product of high bacterial count, notwithstanding the fact that the shed itself be quite an up-to-date one. It is apparent, therefore, that the Dairy Inspector, in the performance of his work, not only must see that regulations are complied with, but has an important instructional and advisory function to perform. Inspection of the cows in registered dairies has been well maintained, the tuberculin test being applied to any suspected animals. In many instances tuberculin testing of the whole herd is carried out at the owner's request. Biological examination of composite samples of milk for tuberculosis is conducted at the Laboratory. During the year 587 such samples were dealt with, of which 11 (1·87 per cent.) proved to be positive. When a positive reaction is obtained the herd is at once tested and tuberculous animals removed. The use of the sediment tester by Dairy Inspectors still continues. This appliance has been found most useful in demonstrating neglect of proper precautions as to cleanliness in milking.

Live-stock Statistics.

The 1933 sheep returns showed that sheep flocks in the Dominion decreased by 935,822 to a total of 27,755,966. An increase of 146,637 occurred in the number of breeding-ewes. The number of sheep-owners has decreased by 386 to a total of 30,063. The number of cattle in the Dominion has increased by 119,640 to 4,192,023. The number of dairy cows increased by 143,898 to a total of 1,845,972.

The number of pigs in the Dominion as revealed in the 1933 enumeration was 591,582, being an increase of 78,166 on the previous year's figures. Horses have continued to show a decline, the number being 276,897, a reduction of 4,097.

Slaughter of Stock.

The numbers of sheep and lambs slaughtered show a decrease on last year's figures. The total number of stock slaughtered at registered premises were: Sheep, 2,867,245; lambs, 8,726,390; cattle, 475,149; calves, 945,853; swine, 744,569. The following table shows the stock slaughtered during the past year at freezing-works only, the previous year's figures being shown for comparison:—

Stock.	Year ended 31st March, 1934.	Year ended 31st March, 1933.	Increase.	Decrease.
Cattle	254,201	197,218	56,983	..
Calves	904,717	541,668	363,049	..
Sheep	1,972,678	2,561,306	..	588,628
Lambs	8,551,838	9,463,846	..	912,008
Swine	532,972	347,998	184,974	..

For further purposes of comparison the following table is given, showing the killings of sheep and lambs at meat-export slaughterhouses over four periods, 1st October to 31st March in each year, as indicative of the slaughterings from the beginning of each season to 31st March:—

Stock.	1930–31.	1931–32.	1932–33.	1933–34.
Sheep	1,671,493	2,614,378	1,649,363	1,293,617
Lambs	5,531,021	5,822,728	6,433,741	6,030,575

These figures show a decrease of 403,166 lambs and one of 355,746 sheep compared with the same period last year.

Following are the numbers of each class of animal slaughtered under direct inspection during the year ended 31st March, 1934: Cattle, 408,999; calves, 974,360; sheep, 2,640,924; lambs, 8,698,347; swine, 686,787.

The following table indicates the respective classes of premises at which these animals were slaughtered:—

Stock.	Abattoirs.	Meat-export Slaughterhouses.	Bacon-factories.
Cattle	154,798	254,201	..
Calves	69,643	904,717	..
Sheep	668,246	1,972,678	..
Lambs	146,509	8,551,836	..
Swine	117,931	532,972	35,884

Stock slaughtered at ordinary slaughterhouses during the year ended 31st March, 1934, was as follows: Cattle, 66,150; calves, 1,493; sheep, 226,321; lambs, 28,043; swine, 24,342. Carcasses of pork killed and dressed by farmers and sent into butchers' shops and small factories and examined by departmental officers numbered 33,440. In connection with the animals shown in the above tables as slaughtered at meat-export slaughterhouses, the following numbers are returned as having gone into consumption within the Dominion: Cattle, 12,497; calves, 2,897; sheep, 132,095; lambs, 83,907; swine, 15,393.

Compensation paid for Stock and Meat condemned.

Compensation to the amount of £6,832 was paid out during the year for animals condemned in the field for disease under the provisions of the Stock Act, and £12,488 for carcasses or parts of carcasses condemned for disease on examination at the time of slaughter at abattoirs, meat-export slaughterhouses, &c., under the provisions of the Slaughtering and Inspection Act.

Importation of Stock from Abroad.

The following imported animals were placed in quarantine during the year for the respective periods required: Horses, nil; cattle, 8; sheep, 16; swine, 13; dogs, 61.

Exportation of Stud Stock.

During the year under review the following stud stock was exported: Sheep, 1,774; cattle, 24; swine, 12; horses, 60 (draught). There was the usual movement of racehorses to and from Australia.

Poultry Industry.

During the 1933 session the Poultry-runs Registration Bill, which had been before Parliament in 1932, became law, and is now in operation. The Act provides for administration by a Board of six, comprising four producer representatives and two representing the Government, and this Board, having been set up, is now functioning. The principal objective is the organization of the industry in its own interests, and it is hoped that the weakness which has for long been felt in this industry will now be replaced by a strong organization working in the interests of producer and consumer. There are possibilities of further development of the poultry industry both in respect to increased local consumption and to export, the latter being a necessary concomitant to the former, as any development along the lines of increased internal consumption throughout the year must necessarily create a surplus during the season of heaviest production. Apart from this, however, the export of eggs from New Zealand opens up possible prospects of further expansion. The conditions operating against export from New Zealand have been the heavy costs—approximating 7d. per dozen—connected with the crating and shipping of eggs to England, and also during the past few years the great expansion that has taken place in regard to egg-production in Great Britain itself, and in exports from other Empire countries more favourably situated in regard to low-priced grain foods than we are. Costs incidental to export may be capable of reduction with increased quantities, and with improved economic conditions in consuming countries shipments of eggs from New Zealand may present an opportunity of further increasing the value of our exportable products.

The quantity of eggs in shell shipped overseas during the past season reached the highest yet—viz., 12,107 cases of 30 dozen each. As in previous years, the eggs were reported to be well graded both in respect to size and internal quality, but owing to the fact that very large quantities of eggs were being landed in England from other countries simultaneously, and difficulty was experienced in marketing them, the prices realized were somewhat lower than in previous years; nevertheless, it is understood that they allowed of a payable return at least equal to local prices being paid out to producers.

The Wallaceville Poultry Station continues to serve a useful and valuable purpose as an educational and instructional centre, and has enabled instructional officers to disseminate information of an authoritative nature gained from practical experience, and in this connection alone fully justified its existence.

The industry has demonstrated its value during the years of low prices for many of our primary products as an adjunct to the farm, and while the Department's policy has not been in the direction of encouraging an increase of poultry-farming as a sole means of livelihood it has ever championed the keeping of fowls as a side-line to other branches of farming, and this policy is undoubtedly the safe one. The consumption of eggs within the Dominion is capable of great expansion, and with prices in favour of the consumer there seems to be no reason why this should not be accomplished.

Wool.

The past wool season has been one of the most satisfactory experienced for a number of years. The opening of the season indicated that a strong demand existed for wool, particularly for the finer qualities, and this demand was maintained practically throughout the season, and only towards the final sales of the season when buyers' requirements had been satisfied did wool show a decided downward price tendency. During the season 655,220 bales were offered for sale by auction, of which 613,262 bales were sold, the average price per pound being 11·31d., equal to £16 8s. 9·31d. per bale, as against 5·16d. and £7 10s. 5·72d. respectively for last year. The practice of skirting the fleeces at shearing and arranging for the wool to be binned at the wool-stores is being availed of to a greater extent each year by small growers, and has much to commend it. It is estimated that approximately 70,000 bales were so dealt with. Wool held over from previous years was disposed of at practically the same price as this season's wool, and those farmers and others who had such wool in store benefited according to their holding.

Rabbit Nuisance.

Throughout the Dominion the past season was a favourable one climatically for the breeding and increase of the rabbit pest, nevertheless a very fair measure of control has been maintained in practically all districts. In some areas, mostly back country districts, where rabbits showed a tendency to increase suitable action has been taken to have thorough poisoning operations put in hand.

While favourable climatic conditions were largely responsible for the natural increase of this pest, another factor was the low price ruling for rabbit-skins. Further, the financial position of many farmers has also militated against good work throughout the year, and to assist in this direction every facility to obtain assistance through the Unemployment Board was arranged, and many availed themselves of this. The recent strong upward trend of prices for skins and carcasses augers well for rabbit-destruction measures in the coming winter. Strychnine is becoming more and more the principal lethal agent for the riddance of rabbits, and last year the Department imported 14,000 oz. for sale to settlers. As a consequence there is a diminishing demand for phosphorized pollard and oats. Where availed of, the Unemployment Board's No. 11 Scheme was of considerable assistance in many parts, where settlers combined for the utilization of relief labour for rabbiting. Unfortunately, it is impossible to assess the number of rabbits disposed of under this scheme, but where properly organized much good work was done. The Rabbit Boards functioning throughout the Dominion are all doing good work and showing excellent results. They continue to keep the rabbit pest in their respective districts down to a minimum, and, despite the favourable breeding-season, have the pest well in hand.

Industrial Rabbits.

A considerable number of permits to keep these rabbits, mostly Angoras, are still in force, and in all cases the conditions set down are being well observed. If the present price for Angora wool is maintained, there is a better prospect for those engaged in rabbit-farming, so far as that breed of rabbit is concerned.

Noxious Weeds.

Taking noxious weeds on the whole, a fair measure of control has obtained. Ragwort has been the chief source of complaint, and in respect to it the use of sodium chlorate has helped to clean many properties, both by spraying and dry methods of application. In many cases where sodium chlorate could not be bought, largely on account of finance not being available, resort was made to clearing by pulling up or cutting. The Unemployment Board's No. 11 Scheme was also made available for this class of work with resultant benefit to many settlers and their holdings, particularly in badly infested areas of the North Island.

Despite the fact that a great deal of clearing has been carried out, ragwort has become so widespread that it might appear that no real headway has been made in its eradication or proper control. It must be borne in mind, however, that approximately 500 tons of sodium chlorate went into consumption during the season, and this, with other methods of destruction, must account for no small measure of success in clearing. Many individual farms have been cleared and kept clear of ragwort, but, on the other hand, there are many that are probably worse than they were a year ago. Special efforts have been made to keep the already clean districts clear of ragwort.

Other noxious weeds, particularly blackberry, Californian thistle, gorse, and broom, are much in evidence in different parts, while sweetbrier is prevalent and inclined to spread in certain areas of the South Island. This weed is a most difficult one to deal with, but some clearing is being attempted. These latter weeds, although more or less troublesome, have not assumed the menace of ragwort, and, generally speaking, a fair amount of work is being done in respect to their eradication. In time a great deal might be possible in the way of confining them to rough and useless areas.

Staff.

Mr. J. Lyons, M.R.C.V.S., relinquished the Directorship of this Division in November last, and I took over control of the Division shortly after.

I must express my appreciation of the loyal and efficient services rendered by the staff in all sections and branches of the Division's activities. Particularly would I mention those prominent officers who retired at the end of the year, Messrs. D. Munro, R. Wright, and W. Wills, Principal Inspectors at Auckland, Wellington, and Dunedin respectively, who each had a long period of service in the Department and were officers of outstanding ability.

WALLACEVILLE VETERINARY LABORATORY.

REPORT OF C. S. M. HOPKIRK, B.V.Sc., OFFICER IN CHARGE.

A review of the year's work in diagnosis and in research into animal-disease problems shows some progress, but such progress has not been spectacular. Undoubtedly greater knowledge of mastitis and grass tetany of dairy cows and insight into pig diseases has been obtained, but the work lags for want of senior officers. Too much lies on the shoulders of those at work, and it is recognized that no new investigational work can be performed under constant pressure, and that time for reading and reflection is needed by workers for the birth of new ideas.

The New Plymouth and Hamilton Laboratories have been busy with milk samples, Hamilton on an unprecedented scale, the bulk of this work having fallen on Mr. A. E. Kidd, who deserves credit for his handling of such numbers of samples with the assistance of a female temporary officer only. Mr. T. A. Blake has continued his work on semen samples from bulls with the practical idea of classifying bulls for use by means of sperm morphology. Mr. D. A. Gill, unfortunately for the main Laboratory, accepted a temporary position in the Veterinary School in Sydney to lecture in Pathology. He obtained leave of absence for this object. Consequently Mr. W. M. Webster had to be moved from New Plymouth to Wallaceville to undertake the diagnostic and investigational work usually performed by Mr. Gill. Mr. Webster had at the same time to supervise several mastitis experiments which he had in hand in New Plymouth, and therefore made several visits back to New Plymouth during the later part of the year. Dr. I. J. Cunningham is continuing and is of great assistance in work on diet in relation to disease. The Dairy Division, represented by Dr. G. M. Moir, still occupies a room at Wallaceville. A new departure has been made during the year also in providing accommodation for Dr. M. McOwan, M.A., B.Sc., Ph.D., a Carnegie Scholar who is working on the Vitamin A and D content of fish oils, and who is also helping with our own experimental work with pigs by performing the vitamin content of milk. Dr. McOwan had had experience in research work in the Rowett Research Institute (three years) and the Lister Institute of Preventive Medicine for one year, and is therefore competent to carry out the highly specialized vitamin-assay work upon which she is engaged.

Diagnostic and research work are so wrapped together that it is difficult to separate the two for purposes of tabulation, and therefore the following figures refer to all samples received at the Laboratory except several thousands of experimental milk samples examined in mastitis research.

Specimens and Samples received for Diagnosis during the Year.

—	Wallaceville.	New Plymouth.	Hamilton.
Mastitis samples—			
Routine	1,033	499	2,109
Mammitis control scheme	4,184 (A. 2,386; B. 1,382; C. 416)	4,183	34,146 (A. 22,818; B. 7,378; C. 3,950)
Bacteriological	?	1,820	..
Experimental	?	517	774
Quarters	?	..	2,047
Can curd samples	..	..	2,609
Composite milk samples for tuberculosis	601	..	..
Agglutination test: Blood samples contagious abortion	707 (pos. 313; neg. 394)	1,032 (pos. 325; neg. 707)	266 (pos. 64; neg. 202)
Whey samples contagious abortion	..	..	416
Tumours	63	..	..
Cattle specimens	230	..	..
Sheep specimens	303	..	..
Pig specimens	205	..	..
Poultry specimens	78	..	..
Blackleg vaccine	17,850 doses	..	25,000 doses.
Tuberculin issue	1,900 c.c. crude	..	..

DAIRY-COW DISEASES.

The main advance in knowledge of the year in cattle diseases has been in mastitis, but phases of sterility, contagious abortion, and grass tetany, have been under close investigation.

Sterility in Dairy Cows.

The Field Research Officer at Hamilton, Mr. T. A. Blake, was again able to examine a large number of bulls during the season in his study of sterility, temporary or otherwise. He found, as in past years, that wherever sterility was evident in a herd to an excessive extent examination should always be made of the bull's seminal fluid, and almost invariably the bull in such cases was found to be at fault, and by replacing with a bull of good sperm motility and morphology the cows held well.

Mr. Blake's work has passed the investigational stage and has now become diagnostic.

Classification of Bulls according to Service.

Classification.	Number of Bulls.	Average Percentage of Successful First Services.	Average Number of Cows served.
Good or fairly good	64	68½	36
Fair	51	51½	33
Poor	50	36½	38
Bad	49	30½	26
Sterile	12	0·25 (One cow in calf)	20

The reason why bulls become low in fertility is not known. In some cases high protein feeding has been considered a possibility, and in one case of such nature the bull when put on poor pasture was able to get 93 per cent. of 43 cows in calf as against 13 per cent. the year before. However, in the third season the bull got two cows in calf out of twenty-four, and he has been discarded. The one season's results is nevertheless felt to be significant. Unfortunately the dairy-farmer is not in a position to put his bull on poor pasture, but he could feed grain meals to assist in widening the ration. In other cases of low fertility infection has been suspected, but a considerably greater amount of work is desirable in this direction before the question of temporary sterility can be considered settled.

Mr. W. M. Webster has, with a view to using the information on sterility experimental work, tried artificial insemination of ewes in the Wallaceville flock. The method is simple and as reliable as ordinary ram service and could easily be utilized by farmers if they wished to do so.

Mastitis of Dairy Cows.

Considerable work involving the examination of very large numbers of milk samples was undertaken for the year, and, apart from routine examination in connection with the mastitis-control scheme, several thousands of samples were put through a variety of tests, leucocyte and bacterial counts, to further verify that the method of examination being adopted for the control scheme—viz., leucocyte assessment of gravity cream—was a fair test compared with any other tests which could be applied. In a paper presented to the veterinary faculty of the Melbourne University this and previous work has been tabulated and shows—(1) The method of sampling of milk from the cow gave comparative results, (2) the method of smearing for examination gave comparative results, (3) the assessment and actual counts were in agreement, (4) the organisms depending on numbers and depending on toxicity of the type present induced definite leucocytic reactions which were comparable, and (5) leucocyte assessment agreed or was superior to indicators, chloride, catalase, sediment, and bacterial plate tests.

The control scheme is believed by farmers practising it to be efficacious in enabling control of the disease to be exercised. Up to the present enough comparable herds have not been under trial for a sufficiently lengthy period to evaluate the effect of the scheme on a statistical basis. However, the farmer particularly appreciates the fact that he can use better judgment in culling cows seasonally.

Examination of figures throughout the mammitis-control scheme shows that more or less acute mastitis in herds at any one time is in the vicinity of 10 per cent. to 12 per cent. on the average.

During the year the percentage of cows which showed acute mastitis during the season was 23 per cent. in forty-eight herds, but only 6·4 in heifers in those herds. Quarter samples showed that at any one time 20 per cent. gave a high leucocyte count. Mr. Webster has been able to carry out cultural work on a herd commencing as heifers, and his results after a few seasons' work should be of value. A second herd commencing as heifers was able to be immunized experimentally against cowpox, and at the end of the first season the state of the udders of this herd was much better than is generally seen in Taranaki, no cowpox having been seen during the season. Only two quarters had shown streptococcal infection in this herd during the year.

Mr. Blake has produced the following table (which shows the percentage of normal cows) from four herds which he supervises himself where there has been definite increase in absolutely normal cows. This is attained by culling and building up with heifers each season.

Herd.	1930.	1931.	1932.	1933.	1934.	Treatment.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	
P.	24	53	52	59	67	Mammitis-control scheme.
M.	15	60	40	46	47	,,
B.	..	48	48	59	63	,,
K.	26	66	28	31	47	Vaccines only.

Trials of entozon, azamine, and chlorine as curative agents and of vaccine as an aid to suppressing the purulent types of mastitis have been carried out by Mr. Blake, who is of the opinion that some good can be got from all these methods. In the hands of Mr. Webster rivanol and entozon were not of much benefit, while at Wallaceville rivanol was found to be at times successful in treatment, more particularly in dry cows.

Work on mastitis from a different angle than heretofore was tried at Wallaceville. It was thought that the udder was frequently not invaded by organisms which, however, appeared in large numbers in the milk, and that frequently large numbers of streptococci, for example, might be found in milk which was to the naked eye normal. A swab method of examination was therefore devised, plating on blood agar. This proved most useful and suggested that the leucocyte count was very largely connected with the flora (quantity and type) of the teat-duct, that portion of the teat enclosed by the sphincter muscle. In furtherance of this idea organisms of various kinds were placed by swab into the teat-duct and the rise of leucocytes noted. On occasion the organism as it establishes itself may get into the udder and set up acute inflammation of the gland, but as a general rule there was a rise in leucocytes only in the milk obtained by test-tube. There is a tendency in teat-ducts to have one type of flora predominating or even present in pure culture. The suggestion from this work is that many cows are carriers of streptococci, staphylococci, or other organisms which get established by accident in any one duct and, depending on the leucocytic response from the gland, mastititis may or may not develop. Leucocytic response observed in the milk suggests acute mastitis in many cases, but samples taken from the body end of the teat by test-tube rather tend to deny this condition. Confusion may therefore exist in differentiating mastitis from duct inflammation in simple leucocyte assessment. Such confusion does not matter in the control scheme, as one is thereby picking out carriers. Treatment of the duct by swabs dipped in antiseptic solution does on occasion clear up the flora and reduce the leucocyte count, but such treatment is as yet unreliable.

Contagious Abortion.

The number of blood samples received decreased considerably at Wallaceville but increased in Taranaki. No experimental work has been able to be carried out in this disease during the year. Several herds which have been negative for some time are being blood-tested from time to time. Two of these herds have allowed infection in through carelessness, and one of these already has had a serious abortion storm through buying in affected in-calf heifers.

Of the 601 guinea-pigs killed after inoculation with town milk-supplies 117, or 20 per cent., gave positive abortion lesions, while 148, or 24·6 per cent., gave a positive agglutination titre in their sera. Only 24 (4 per cent.) showed the organism by cultural method.

Grass Tetany.

While fewer blood samples were received for diagnosis of grass tetany, this disease has been given extended laboratory study during the year, particularly from the magnesium viewpoint. The results are summarized in the reports of Dr. Cunningham and Mr. Josland appended hereto. As a result of their work, Messrs. Marshall and Blake tried magnesium sulphate in drinking-water as a preventive on several farms in the Waikato, but they were not able to say whether the method was successful or not in the one season. They also carried out magnesium-sulphate inoculation in grass-tetany cases, and in the Waikato, curiously enough, Mr. Blake was successful in curing a number of cases of a subacute type, while Mr. Marshall had only indifferent success. Magnesium sulphate apparently acts as a sedative, but when acute cases do not respond to treatment as do milk-fever cases to calcium, one must conclude that magnesium deficiency is not the actual cause of the disease. So many healthy cows at that time of the year are deficient in serum magnesium that it might seem that magnesium deficiency is being given too much prominence.

Biological Examination of City and Town Supply Milk Samples.

Five hundred and eighty-seven samples were received throughout the year, and fourteen were repeated, mainly in an attempt to find whether affected animals had been eliminated. Number of samples received once, 587; eleven T.B. positive; 1·87 per cent. Repeat samples, 14; three T.B. positive.

Johne's Disease.

Nineteen positive specimens of Johne's disease were received during the year. Twenty-five infected farms are now known. Testing with Dunkin Johnin has been attempted with some success by Messrs. Stephens and Marshall, but owners of affected cattle do not, as yet, seem to have become aware of the dangerous nature of the disease.

Actinomycosis and Actinobacillosis.

The field staff is taking advantage of the agglutination test for actinobacillosis, the importance of the test being clearly realized.

Blackleg.

Specimens were not as numerous as in past years, and the formalinized culture is proving of material benefit in conferring immunity on calves; 42,850 doses were issued, more than half going to the Waikato.

Anthrax.

Anthrax was diagnosed in a farm adjoining the farm of the previous year's outbreak. Only one death occurred.

SHEEP DISEASES.

Three hundred and three specimens were received for the year, 163 being samples of blood for agglutination test for arthritis.

Caseous Lymphadenitis.

During the year the palpation of flocks commenced three years ago has been continued. While the South Island flocks under trial showed a considerable reduction in numbers affected down to the vicinity of 2 per cent. below which it is difficult to reduce the disease, the North Island flock under investigation has risen from last year's 2·7 per cent. almost to its first-flock percentage of just over 3 per cent. There has been a change in glands affected in the North Island flock, for the majority of the abscesses palpated this year have been found in the supramammary glands. This fact, taken in conjunction with a very much lessened incidence of caseous lymphadenitis in dry ewes, suggests that two factors operating in the North Island flocks under observation are of greater importance than the shearing factor. These are crutching and lamb carriage of the disease from ewe to ewe by mismothering at docking. Crutching wounds must become infected in places other than yards and sheds, and possibly in the more heavily stocked areas some consideration must be given to sheep night camps.

Enzootic Icterus.

Liver elimination tests in this condition have shown that the liver is not functioning as it should. Many sheep have died recently from enzootic icterus in the Waikato, and in each case there has been some suspicion of eating of ragwort. In a few of these icterus cases there is a tendency for soreness of the lips and legs to occur, evidently from the action of sun's rays on the bile sensitized skin.

Pulpy Kidney and Circling Disease.

Pulpy kidney and circling disease specimens have been received for diagnosis, but no experimental work has been undertaken since Mr. Gill's departure. Circling disease has been much more noticeable this autumn, due possibly to the abnormally dry conditions.

Contagious Ophthalmia or Pink-eye.

This disease in sheep was given attention, but no definite organism could be shown to produce the condition. Every organism culturable was tried with negative results. Tears were of course able to produce the disease in other sheep, but filtered tears were negative. Tears, unfiltered or filtered, placed intravenously into sheep did not produce the disease. Sheep sprayed up the nostrils with diluted tears 1–100 became infected. Sections of cornea showed a gram positive diphtheroid type of organism, which appeared in culture but which did not set up inflammation experimentally. No richsettia bodies could be demonstrated. It was noticeable that the weather conditions were such as to produce a dry pasture, with a deficiency of accessory food factors such as Vitamin A, which it is suggested may be a factor in the spread of this disease.

Calves and rabbits did not become infected experimentally.

SWINE DISEASES.

Two hundred and five pig specimens were received, the chief being mange-scrapings, blood for test for *Br. abortus* (all negative), and material from pigs dying from the effects of B. Suipestifer and Pasteurella. A definite swine-fever outbreak occurred near Wellington.

Swine Fever.

Swine fever took up a large amount of time for some weeks early in the year, and was the subject of a detailed report at the end of the outbreak. Diagnosis of the first suspicious cases was made by blood inoculation, by filtrate inoculation, and by contact, and later by feeding, so that no doubt could be entertained as to the possibility of the disease being other than swine fever. The main lesions in the outbreak were the acute inflammation of the mucosa of the colon and usually the caecum, with only rarely definite ulceration, stomach lesions, petechiation of the lungs, and occasionally, spleen hæmorrhages, heart petechiation, and hæmorrhages and kidney petechiation. It was this last-mentioned lesion that permitted a line of dressed pigs on the rails to be diagnosed as suspicious, and, after test, caused their condemnation; so that it may become important on occasions.

The large number of specimens received through the fear of swine fever being present in pigs in many parts of New Zealand showed the extensive losses in young pigs which were taking place in the pig industry throughout the country. Swine erysipelas was found definitely for the first time, but is not common. Infection with B. Suipestifer is, however, remarkably common, and that organism setting up necrotic enteritis combined with the Pasteurella is responsible for the majority of deaths in young pigs of from two to four months of age. That being the case, experimental work on feeding of pigs preventatively has been undertaken.

Pig-feeding Experiments.

Groups of pigs from the same litter were fed after weaning, the one group on whole milk and the other on skim-milk of 0·15 per cent. fat content. Both groups were given meat-meal only as a supplement, but no green food. After three weeks, when they were settled on these foods and were growing well, B. Suipestifer was introduced by culture into both groups. The skim-milk group scoured badly, one died, and one became very ill but later recovered. This group was put back over 10 lb. on the average at this stage and did not catch up with the whole-milk group. This latter group did not show any effect whatever from the Suipestifer culture, for they grew well and were extraordinarily good pigs. At post-mortem the blood was found to be normal chemically in both groups, with no significant difference, there was a positive agglutination in all pigs to B. Suipestifer antigen, this being absent at the commencement of the experiment, and the organs were on the whole normal except in the heaviest and best pig of the whole-milk group, which had an ulcerated caecum. The protective power of the whole milk was therefore evident. Other experiments on these lines are being planned for the new year. Dr. MacOwan very kindly tested the Vitamin A and D content of the whole and skim milk by rat tests. Skim-milk was found to be almost entirely deficient in Vitamins A and D while whole milk contained twenty-eight units of Vitamin A per pint, a fair but not a high figure. Vitamin D results are not yet finished.

This shortage of Vitamin A in skim-milk is quite likely to be responsible for the trouble in young pigs, which ranges from alimentary and respiratory infection to nerve degeneration, ending in paralysis. Luckily feeding with materials rich in the accessory food factors offers no management difficulties.

POULTRY.

An increasing number of birds have been sent in for diagnosis of mortalities in commercial poultry-runs. Almost invariably the conditions are parasitic enteritis, whether the parasite be *Nemetodes*, particularly *Capillaria retusum*, or *Coccidia*. It would seem that here, as in pigs, the basal factor is a dietetic one, and it is hoped later to carry out work along dietetic lines to prevent these ravages amongst poultry. *Neurolymphomatosis gallinarum* was seen in one flock during the year, but the condition has not reached serious proportions. Another case of that curious bone disease resembling Paget's disease of human beings was again received.

THE FARM.

The farm has been managed with a minimum of labour and outlay. Top-dressing at the rate of 1½ cwt. per acre over the farm was carried out, together with a small quantity of lime (6 tons in all) on several of the paddocks. The last of the old plots was ploughed for the first time, and will later be laid down in permanent pasture. Planting of trees on the hill was continued.

The general health of stock has been good and a better price was realized for lambs and for wool. The farm overseer, Mr. J. Evans, is to be commended for the way he is keeping the farm in spite of the lack of labour and the minimum of expenditure.

NUTRITION RESEARCH WORK PERFORMED BY Dr. I. J. CUNNINGHAM.

The following sub-report is by Dr. Cunningham:—

Throughout the year studies on problems surrounding grass staggers and on the connection between high protein feeding and sterility have been continued. In addition certain aspects of vitamin work have been commenced.

Grass Staggers in Dairy Cows.

Preventive and Therapeutic Methods.—Experiments in these directions have been aimed at the discovery of practical methods whereby the level of blood magnesium in dairy cows may be increased. It was reported last year that in rats the blood-magnesium content was found to vary in a direct manner with the proportion of magnesium in the diet. Similarly, in sheep it has been observed that the blood magnesium could be increased by drenching with magnesium sulphate or magnesium carbonate, but more readily by the first-named. The rise in blood magnesium was roughly proportional to the amount drenched. The blood calcium fell in proportion as the blood magnesium increased.

For the extension of these results to dairy cows the milking herd at Wallaceville was made use of as experimental material, and magnesium was supplied in three ways—(*a*) as magnesium sulphate (Epsom salts)

dissolved in drinking-water to make ½ per cent. solution, (*b*) as dolomite (magnesium calcium carbonate) sprinkled on ensilage, and (*c*) as licks composed of 50 per cent. agricultural salt and either Epsom salts or dolomite. Method (*a*) was successful in producing a small but definite increase above the normal blood magnesium, accompanied, however, by a small drop in blood calcium. The consumption of water was not affected by the presence of Epsom salts, the cows appearing, in fact, not to object to the taste. Method (*b*) also produced a similar rise in blood magnesium, but without the fall in blood calcium—this doubtless being due to the influence of the calcium in the dolomite.

No blood analyses were made in the case of the lick experiments. It was observed that the animals at first ignored the licks but later took the Epsom salts or dolomite lick with equal readiness, although both were presented side by side. Again the taste factor of Epsom salts was negligible.

The general conclusions from this work are that the blood magnesium of dairy cows may be increased by feeding magnesium, and that simple methods of doing this are by dissolving Epsom salts in drinking-water or by sprinkling dolomite or Epsom salts on ensilage or hay. Since grass staggers is characterized by a very low blood magnesium it is possible that prevention might be achieved by supplying magnesium during the period of greatest susceptibility.

As a *therapeutic agent* sugar-cane molasses was investigated. This material contains considerable amounts of calcium and magnesium. Experiments on sheep have shown that the calcium and magnesium are very readily absorbed into the blood stream, producing considerable increases in the concentration of these constituents in the blood. The effect was greater than that produced by inorganic salt mixtures containing the same quantities of calcium and magnesium. Molasses may therefore be shown to be valuable against both grass staggers and milk fever, and if successful would be particularly useful since it may be advised for use by the farmer himself when the case is inaccessible to a veterinarian.

To determine the influence of manurial treatment with magnesium on the magnesium and calcium content of pasture, sixteen plots have been laid down in a Latin square with four replications of the following treatments: (*a*) Epsom salts, (*b*) dolomite, (*c*) calcium carbonate, and (*d*) control. Results are not yet completed.

Cause of Grass Staggers.—Sheep are being used in the preliminary phases of this work since they are cheaper and more easily handled than cattle. The experiments owe their inception to the fact that whenever grass staggers occurs the onset is practically always associated with ingestion of young growing grass. Sheep are being kept on hay and drenched with substances which occur in young pasture. So far malic and citric acids have been tried. It has been found that ingestion of malic acid has no influence whatever on blood calcium or magnesium. Citric acid, however, causes a temporary rise of from 10 per cent. to 15 per cent. in both of these constituents soon after drenching with moderately large quantities. This effect is possibly due to some favourable influence in absorption. Further experiments are proceeding.

Determination of Magnesium in Blood.

An investigation into the method for this determination, which has been conducted in collaboration with Mr. S. W. Josland, has been concluded satisfactorily.

High Protein Feeding and Sterility.

This work on rats is being continued in collaboration with Mr. C. S. M. Hopkirk. Rats are being fed on diets containing different levels of protein of both animal and vegetable origin, and periodic examinations of sperms and testes are being made. The report made previously that high levels of protein in the diet do not influence the fertility of females has been confirmed in a more comprehensive experiment.

Growth of Wool on Angora Rabbits.

Investigations of the complaints of angora-rabbit breeders that wool production was small showed that the diets commonly employed were inadequate chiefly in protein, calcium, iron, and Vitamin D. Two breeders are carrying on experiments on their own rabbits in which these deficiencies are made good by supplying blood meal, calcium carbonate, limonite, and cod-liver oil.

Vitamins.

Vitamin work is being carried out by Dr. Marion M. McOwan, who has been granted a Carnegie Scholarship for work in New Zealand. The main work involves a survey of the Vitamin D content of New Zealand fresh-water and marine fishes. The preliminary results show that whale oils, eel oil, and tarakihi-liver oils are high in Vitamin D content. In addition to this the Vitamins A and D in skim-milk have been assayed, using samples from milk employed by Mr. C. S. M. Hopkirk in a feeding experiment on young pigs. It has been found that skim-milk contains practically no Vitamin A or D, whereas fresh milk has a fairly good supply. The observed deficiency of Vitamin A in skim-milk assisted in implicating avitaminosis A in the widely observed paralysis in young pigs fed mainly on this substance.

BIOCHEMICAL WORK PERFORMED BY Mr. S. W. JOSLAND.

Mr. Josland supplies the following sub-report:—

Method for Determination of Magnesium in Serum.—As a result of several modifications in technique the micro method now in use gives satisfactory results. Using the modified technique the following values have been obtained on serum from several kinds of animals:—

	Mg. in Serum (mgms. per 100 c.c.).				
	Cattle.	Sheep.	Rat.	Pig.	Cows with Grass Staggers.
Average	2·3	2·5	2·5	2·5	1·1
Range of variation	1·7–2·8	1·9–3·1	2·0–3·0	1·9–3·8	0·7–1·7
No. of determination	22	70	59	17	11

Normal Values for Pigs.—The following values in mgms. per 100 c.c. were obtained by blood analyses of nine healthy pigs after a twenty-four-hour fast :—

——	Average.	Highest.	Lowest.
Calcium	11·8	12·2	11·3
Inorganic phosphorus	9·5	10·1	9·0
Magnesium	2·5	3·8	1·9
Sodium chloride	450	480	420
Sugar	88	105	77
Non-protein nitrogen	26	35	18

Liver Function Test.—The Rose bengal test for liver function has been tried on sheep and cattle. The test depends on the rate of dye elimination from the blood stream by the liver. For the performance of the test 10 c.c. of a 1-per-cent. solution of Rose bengal in normal saline containing 5 per cent. of dextrose is injected intravenously. At intervals of two and ten minutes 10 c.c. of blood are withdrawn and oxalated. The samples are then centrifuged and a quantitative comparison of the dye present in the plasma made. In healthy sheep and cattle a 50-per-cent. elimination of the dye in ten minutes has been regularly obtained.

Cerebro-spinal Fluid.—Analyses have been made on several samples of cerebro-spinal fluid from healthy cattle. The fluid is generally clear, pH 7–8, does not contain more than 10 leucocytes per c.mm., and does not react to Pandy's test for globulin. The average values (mgms. per 100 c.c.) for 3 samples were as follows: Calcium, 4·1; potassium, 41·2; sodium chloride, 355; non-protein nitrogen, 26; magnesium, 2·1.

Glucose Tolerance in Ewes.—Blood and urine samples were taken before and after drenching healthy ewes with glucose. A rise of about 30 mgms. occurred in the blood-sugar level during the first hour after drenching; the level remaining at the higher level for 2–3 hours, gradually falling to normal over a period of twenty-four hours. No sugar could be demonstrated in the urine during the experiment. The delayed return of the blood sugar to normal may be due to the slow absorption and passage through the rumen.

Fasting.—Experiments are being conducted to determine the effect of fasting on the concentration of certain blood constituents in sheep. It has been shown that fasting causes an increase in the inorganic phosphorus of 2–3 mgms. per 100 c.c. in twenty-four hours. No significant changes have been observed in the concentration of blood sugar, non-protein nitrogen, and cholesterol during fasting.

Pregnancy and Parturition.—Regular blood and urinary analyses were made on four healthy ewes during pregnancy. No appreciable changes in either serum calcium or magnesium were observed during a period of two months prior to and six weeks after parturition. Values for inorganic phosphorus fell slightly at or near the time of parturition. The results of these experiments were published in the *New Zealand Journal of Science and Technology*, Volume XV, No. 5.

Mineral Metabolic Experiments.—Analyses have been made on sheep and rat bloods in connection with Dr. Cunningham's experiments.

Anaplasmosis.—Early in the year a large number of blood smears from cattle in the North Auckland district were examined for the possible presence of anaplasma with negative results.

Grass Staggers.—Analyses of serum from eleven cases were made. A constant feature was the low magnesium content, which varied from 0·7 to 1·7, with an average of 1·1 mgms. per 100 c.c.

Circling Diseases in Sheep.—In several cases investigated, the blood calcium, inorganic phosphorus, magnesium, and non-protein nitrogen were within normal limits. Blood-sugar values have been above normal, frequently reaching 0·190 per cent. These high sugar values may be caused by injury or pressure on the fourth ventricle. The cerebro-spinal fluid is invariably cloudy under pressure, gives a marked Pandy reaction for increased globulin, and contains large numbers of leucocytes.

Enzootic Icterus.—In one case under observation at Wallaceville, calcium, inorganic phosphorus, magnesium, non-protein nitrogen and sugar in the blood were normal. Bile was present in the serum. A differential leucocyte count showed polymorphs 53 per cent., lymphocytes 45 per cent., eosinophils 1 per cent. Urinalysis gave the following result: pH 7·5, SG 1·020, albumen present, no sugar or acetone, urobilin present. The centrifuged deposit contained leucocytes and amorphous phosphates but no R.B.C. A few granular casts were seen. A Rose bengal liver function test showed marked impairment of liver function. After ten minutes 12 per cent. only of the dye had been eliminated (normal = 50 per cent.). The test was repeated one week and four weeks later, during which period clinical improvement had occurred. On these occasions a 30-per-cent. and a 43-per-cent. elimination of dye occurred in ten minutes.

Photosensitisation.—No marked deviations from the normal have been observed in the chemical composition of the blood in several cases examined. Blood counts have been normal. With the exception of traces of bile, the urine has been normal. The Rose bengal test showed impairment of function.

Total Number of Specimens.—Sheep blood, 500; bovine blood, 99; porcine blood, 27; rabbit blood, 8; horse blood, 3; rat blood, 61; fowl blood, 2; sheep urine, 60; cow and horse urine, 6; cerebro-spinal fluid, 4; milk samples, 26; livers for fat, 6; calculi, 2; bones (femurs), 8; miscellaneous, 17: total, 829.

FIELDS DIVISION.

REPORT OF R. B. TENNENT, DIRECTOR.

The weather conditions generally throughout the year were satisfactory, with the exception of the northern portion of the South Island, where drought conditions prevailed, particularly in parts of Marlborough and Nelson. The autumn and winter were comparatively mild and dry, while the spring was also mild, and it was not until well on in the summer that copious rains were experienced in the majority of districts. The pastures generally have shown quite normal growth, except in the districts which suffered from the drought.

Arable Crops.

The cereal crops of the Dominion have not fared as well this season as in the previous season, and owing to broken weather at harvesting-time some difficulty was experienced in certain districts in getting the crops cut. The yield from both wheat and oats will not be up to last year's average.

As regards the wheat crop, that portion of the crop threshed during the period January–March, 1934, amounting to 4,387,472 bushels, gave an average yield of 32·44 bushels per acre, as against an actual yield for the 1932–33 season of 36·54 bushels per acre. From the area under crop and at the yield being obtained it is estimated that the total yield of wheat for the season 1933–34 will be approximately 8,500,000 bushels, as against an actual yield of 11,054,972 bushels for the season 1932–33. Although the total yield will be considerably less this season than in the previous season, the position is made much better by the fact that at the end of November, 1933, stocks of wheat held by millers, merchants, and farmers totalled 3,891,706 bushels, as against 1,360,052 bushels at the same date in 1932. It was estimated early in the season that a total area of 294,500 acres was sown to wheat in the 1933–34 season, as against an actual area of 304,711 acres harvested the previous year. Taking the stocks on hand at the end of November, 1933, and the estimated total yield from the 1933–34 season's crop, there should be ample wheat for the requirements of the Dominion and possibly a surplus available for export.

As in the case with wheat, the yield per acre of oats has dropped considerably when compared with that obtained in the season 1932–33. The estimated area sown to oats for 1933–34 was 336,500 acres, as against an actual area harvested the previous season of 375,500 acres. Actual threshings for the January–March, 1934, period disclose a per-acre yield of 43·47 bushels, as against an actual yield over the whole Dominion for the 1932–33 season of 44·16 bushels. The area from which oats were threshed for the five seasons ended with 1932–33 averaged 24 per cent. of the total area under that crop. Assuming that a similar proportion will be threshed this year, the total yield of grain should be approximately 3,200,000 bushels, as against an actual yield of 5,132,183 bushels for the season 1932–33.

It is estimated that 27,500 acres were sown in barley for the 1933–34 season, as against an actual area harvested the previous season of 17,196 acres. As in the case of both wheat and oats, the yield per acre of the barley crop for 1933–34 is estimated to be lower than for the season 1932–33. The actual yield per acre for the latter season was 34·34 bushels, while the estimated yield for the 1933–34 season is 33 bushels per acre. Assuming that the same percentage of the barley crop as was threshed last year will be similarly dealt with this year, the toal yield of grain should be approximately 650,000 bushels, as against an actual yield of 561,017 bushels for the season 1932-33.

The area in potatoes in 1933–34 was estimated at 22,350 acres, as against an area in the previous season of 24,605 acres. At certain seasons of the growing period the weather conditions were unfavourable to the potato crop, and it is doubtful if the crop as a whole will be as heavy as the previous season. Even should the crop be lighter, however, it is considered there will be ample supplies of potatoes for our requirements and possibly a surplus available for export, although such surplus will not equal in quantity that available for export from the 1932–33 season's crop.

Artificial Fertilizers: Top-dressing.

While the prospects for profitable returns for dairy-produce appear decidedly gloomy, many dairy-farmers are endeavouring to fulfil their usual top-dressing programme as far as possible. At the same time, there is no question that the low prices of butterfat are steadily forcing a reduction in the area of grassland top-dressed, and the problem is becoming increasingly difficult. Fertilizer-works report an increase in the output of super, but the utilization of this additional material is due not to an increased area being top-dressed, but to a curtailment in some districts of the use of basic slag, which has risen to a prohibitive cost and is being replaced by super.

Instruction in Agriculture.

The instructional services of this Division continue in great demand, and during the past season it has been difficult to attend to all requests as rapidly as possible owing to the staff for the greater part of the year being engaged in connection with the Small-farm Plan scheme. However, a

Commissioner of Small Farms was appointed by the Lands Department during the year, and his office took over the Small-farm Plan work which had hitherto been carried on by the Division, thus enabling greater attention to be given to instructional services.

One of the strong features about instructional services is that so far as possible officers are given facilities to deal with the inquiries on the farm. It is this personal contact between the officer and the farmer that is essential to efficient service by way of advice and instruction. The districts controlled by each Instructor are extremely large, and with the increase in demand for instruction and advice the work is now even more than the staff can satisfactorily cope with.

Experimental Farms and Areas.

Marton.—The work conducted on this property has been confined almost entirely to that of an intensive technical nature, and has been carried on by the specialist officers engaged in grassland research work.

Gore.—Owing to financial exigencies this area was closed during the year, and was finally handed back to the lessees on the 31st March, 1934. Although the closing of the area has in some degree meant a diminution of experimental activities in eastern Southland, arrangements have been made to conduct much of the experimental work previously carried out on the area on a co-operative basis with farmers in the district.

Subsidized Farms.

The farms of this nature located at Stratford, Manaia, Dargaville, and Winton respectively have continued during the year, and, as in the past, much useful demonstration work in the respective districts in which they are situated has been undertaken.

A similar demonstration area at Katere, near New Plymouth, has proved its worth to the district. The work undertaken there is almost entirely confined to the improvement of pastures.

Ruakura Farm of Instruction.

The pastures on the Ruakura Farm of Instruction have produced fairly well during the year. Ample feed was available for the stock during winter and early spring. An area of 112 acres was top-dressed with superphosphate in the autumn of 1933, 130 acres during the spring of 1933, and a further 118 acres in the autumn of 1934. The rainfall in the Hamilton district, where Ruakura is located, was much below average, being only 39·34 in., as against an average yearly rainfall of 50·17 in.

The annual sale was held at Ruakura during the month of August, and although a fairly large number of people attended competition was not extremely keen. The prices obtained for the stock were low, due entirely to the slump conditions existing. The prices, however, were much on a par with those obtained at the annual sale in August, 1932. Thirty-four yearling bulls were disposed of at an average price of 13½ guineas, while in 1932 thirty-seven yearling bulls realized an average of 14½ guineas. The demand for pigs at the commencement of the year was not very keen. Later in the year, however, a fair demand set in for Berkshires and a keen inquiry came for Tamworths, but the Large White breed was not much sought after. Prices realized for pedigree pigs at the annual sale were very disheartening, the average price being 4·30 guineas, as against 4·32 guineas in 1932. While the prices obtained in 1932 and 1933 were much on a par, they were considerably below the average price obtained at the 1931 annual sale, when it was 7·74 guineas. With the milk-production herd the maximum number in milk for the year was 120 in November and December, and finished up with 101 cows in the shed at the end of March. The actual quantity of butterfat sold was greater this year, but, unfortunately, the average price received was less, being for 1933–34 8·83d., as against 9·47d. in 1932–33. The position with regard to the flock sheep at Ruakura is satisfactory, and increased prices were obtained both for lambs and wool.

Ruakura Farm Training College.—For the current year the accommodation at the Ruakura Farm Training College has been full, and it speaks well for the regard in which this College is held when this position obtains notwithstanding the bad time that the country has been going through. The general health of the students at the College throughout the year has been good.

Boys' and Girls' Agricultural Clubs.

A further successful season of work in connection with this movement has again to be recorded. This is all the more pleasing in view of the reduced assistance granted by the Department to the movement. The fact that the value of boys' and girls' clubs is appreciated is exemplified by the donation to the majority of clubs of seeds and manures by merchants dealing in those commodities. As in the previous year, the Department's assistance was confined to the provision of stationery, a small monetary grant to the old established clubs, and, as far as time and circumstances would permit, to the judging, more particularly the judging of the root plots.

Land Development Schemes.

During the year the Division has in certain districts carried out a considerable amount of work in connection with the land-development policy of the Government. This applies more particularly to the Auckland District. In this district the development of the Ngakuru Blocks, the Galatea Estate, and the Whangamarino Block has been carried on. In the case of Ngakuru, it has been demonstrated that that particular class of country can be satisfactorily farmed as small dairying farms, and during

the year arrangements were made for a further batch of share milkers to work some of the sections. The pastures and the carrying-capacity of this country are so satisfactory that the Lands Department contemplates throwing open the balance of the Ngakuru Blocks for settlement in the near future.

With respect to the Galatea Estate, 2,770 acres were sown in permanent pasture and 650 acres in annual crops. Dry soil conditions, particularly during the summer months, decided the Lands Department to amend its proposals as regards the settlement of Galatea. The Lands Department is taking over the management of the block sown to permanent grass, and intends working it in conjunction with the remainder of the Galatea Estate. This Division is therefore released from further work on Galatea, with the exception of the supervision of the Demonstration Area on the estate and the giving of advice as required relative to the general management of the sown pastures.

In connection with the development of the Whangamarino Block, pastures were grazed and top-dressed during the year and a temporary water-supply reticulation scheme was installed. The pasture establishment has been quite satisfactory, and the Lands Department is arranging to settle the block in May or June, 1934. In view of this, this Division will not be concerned further with this block other than, as may be required, the tendering of advice to the incoming settlers. During the past few years some development work was attempted on the Pakihi land, near Westport. A small area was sown to grass. This block has quite recently been taken over by the Lands Department.

Farmers' Field Competitions.

These competitions, the value of which it is difficult to overestimate from the point of view of agricultural instruction, have been continued in various parts of the Dominion on much the same lines as in past years. These competitions provide a means whereby both the local farmers and the departmental officer for the district gain first-hand information and valuable field experience. The actual competitive side of the movement, whilst necessary as an initial step, actually later becomes the least important aspect of the movement.

Field Experiments.

The programme of work in field experimentation has been conducted at about the same volume as the previous year. The number of experiments and demonstrations has been curtailed during the last two or three years as a matter of necessity due to economy, but, nevertheless, with the large number of other functions performed by officers throughout the year, particularly the Small-farm Plan work, the experiments in operation have been as many as could be satisfactorily handled by the field staff. There is no doubt that the number of questions to be decided by field experiment is very large, and the provision of additional finance to allow of an extension of this work is desirable. One outstanding feature during the year of the field demonstrations has been the placing of potash in its right perspective as a top-dressing for a large block of country in North Taranaki. As a result of this work the Division has recommended the use of not less than 1 cwt. of 30 per cent. potash per acre on the country in question, even although, for financial reasons, it means reducing the usual amount of phosphate applied. The response to potash top-dressing in North Taranaki is so marked that it requires to be seen to be believed. A short article dealing with this matter was published in the Department's *Journal* for April, 1934.

Crop Certification.

The certification operations in so far as certain field seeds are concerned has been continued with minor amendments. A major amendment was made by the deletion of first-harvest seed from the classes of rye-grass. All such seed now comes into the ordinary permanent-pasture-seed class. The variety of seeds dealt with in certification has been increased by the inclusion of swede and turnip seed. During the season 1933–34 approximately 130 acres of these two seeds have been inspected in the field and the produce sealed pending machine-dressing.

The major certification operations relate to perennial rye-grass, and with respect to this crop the acreage entered for certification for 1933–34 showed a reduction of about 45 per cent. on the area entered in the 1932–33 season. Not only has the area greatly decreased, but it is anticipated that the yield per acre will be lighter this year than last, and, in consequence, the amount of seed forthcoming is not expected to exceed about half the quantity certified in the 1932–33 season. At one stage it was feared that there would be a heavy carry-over of certified seed from the 1932–33 season, but in the spring of 1933 stocks of seed changed hands rapidly, and most of the 1932–33 seed was absorbed prior to the 1933–34 season's seed coming on the market. Such a state of affairs to my mind indicates clearly that were it not for the present financial crisis the Dominion could quite easily absorb large quantities of good certified strains of pasture seeds for some years to come. It is undoubtedly a fact that an increase in the use in the Dominion of certified seed would be reflected in the agricultural position of New Zealand.

The certification operations generally are reported on more fully in the report of the Agronomist.

Ensilage.

The making of ensilage on an increasing number of farms is apparent. Farmers are rapidly realizing the value of this as a winter fodder and also as a stand-by in times of drought. There is no question that the ensiling of surplus fodder is being practised more and more each season. Not only does the ensiling of this material ensure the farmer against the shortage of feed in seasons tending to a shortage, but it also assists in keeping pastures in better condition.

Purchase of Seeds and Manures for Government Departments.

The arrangement made whereby this office undertook the purchasing of all seeds and manures for Government Departments has continued. In so far as seeds generally are concerned, only the highest quality seed is purchased, and the check system in operation, by which a composite sample from the bulk supply is tested and compared with the figures on which the purchase is authorized, has proven that in not one instance has a delivery of a poorer purity and germination been supplied. One feels sure that the sowing of seed of known good purity and germination must in the very near future be apparent from the pastures of Government institutions and development blocks where the seed has been sown. As a matter of fact, pastures sown with seed purchased by this office in the earlier years of this arrangement—viz., in 1931 and 1932—are proving the truth of the latter statement.

Small-farm Plan Scheme.

As intimated earlier in this report, this Division was relieved of any work in connection with the Small-farm Plan scheme during the year. The release was brought about by the appointment by the Lands Department of a Commissioner of Small Farms. The release of our officers from Small-farm Plan duties has been very welcome and has enabled our regular work to be given more attention.

The Hemp Industry.

This industry continues to experience the bad times it has been going through during the past several years. The one bright spot in the hemp industry is the establishment of a large wool-pack and sacking factory at Foxton. This opens up at least one other avenue for the consumption of our Phormium fibre. If this industry of manufacturing wool-packs and sacks proves successful, there appears no reason why the whole of the wool-packs and general sacking required in the Dominion should not be manufactured in the country. It is understood that to do this some 8,000 tons or 9,000 tons of fibre would be consumed annually, and, adding to this quantity the fibre used by local rope and binder-twine manufacturers, it would mean that approximately half the available quantity of fibre being produced in New Zealand in recent years would be utilized in the Dominion.

The amount of hemp and its by-products graded during the year ended 31st March, 1934, shows a decrease when compared with the figures for the year ending 31st March, 1933. During 1933–34, 22,157 bales were graded, as against 25,733 in the previous year—a decrease of 3,576 bales. Likewise, the quantity of tow graded has decreased by 2,146 bales, the actual quantities graded being for 1933–34, 4,795 bales, and for 1932–33, 6,941 bales.

Staff.

During the year Mr. J. W. Deem retired on superannuation after completing over forty years of duty in the Department, the last four years and a half being as Director of this Division.

The whole of the staff, both field and office, have during the year been working at high pressure, and appreciation of the loyal service rendered during a particularly busy year is placed on record.

REPORT OF THE PLANT RESEARCH STATION, PALMERSTON NORTH.

THE activities of the Plant Research Station have been well maintained during the past year, 1933–34, notwithstanding the prevailing financial restrictions. The appended reports of the several Section heads outline the main features of the work, and afford a good indication of its wide scope.

As previously, the Department of Agriculture has had the co-operation of the Scientific and Industrial Research Department in certain parts of the work.

A. H. COCKAYNE, Director.

AGRONOMY SECTION.

J. W. HADFIELD, Agronomist.

PLANT RESEARCH STATION, PALMERSTON NORTH.

The work at this Station in the Agronomy Section deals mainly with investigations bearing on problems relating to seed and crop production.

Rape.—Previous investigations had revealed the fact that three main types of rape were available on the New Zealand market. One of these, a swede-like rape, proved to be very unproductive, and seed importation and seed production of this type has ceased. The other rapes offered were either Giant, Dwarf Essex, or a mixture of these. It became necessary to determine the relative agronomic value of these types. Fattening trials were therefore conducted at Marton Experimental Area by the Crop Experimentalist during the seasons 1932–33 and 1933–34, and by the Fields Division in several centres. Some of these results have already been published. Arising out of this, steps were taken to raise pure seed of these types so that such seed could be passed over to growers and further distribution effected under certification. This stage has been reached and several farmers are now raising commercial seed of pure types. As a further stage we have pure lines of the two types, which are now being seeded for distribution next season, and should prove better than any commercial seed offered in the past. Finally, we have crossed the best of the inbred lines, thereby regaining lost vigor. The best of these have to be selected, and they should form the final product of our work. We have also crossed the two types, and have F1 plants now growing, but it is too early to predict any possible development in this direction.

Swedes and Turnips.—Trials this season may be regarded as the final of a series laid down in connection with varietal nomenclature, and it is intended shortly to publish results of observations made.

Brassica Crosses.—In view of the interest being taken in the production of seed of swedes, turnips, and rape, it was thought desirable to study the results of hybridization between these crops and with wild turnip. The F1 plants have been studied this past season, and it is hoped to publish results in the near future.

Lucerne.—Breeding and selection work on lucerne commenced in 1931, and as the work has progressed several problems have presented themselves. The breeding proper has resolved itself into the selfing of the best plants within the best families. L2 seed is now being threshed, and L2 families will be under trial next season. Selfing has resulted in such marked reduction in plant vigor and seed production that it seems impracticable to proceed further in this direction. It may be that the lost vigor will be re-established when unrelated L2 plants are crossed; but even if this does not eventuate the selfing will have indicated the best parental types, and all parents, both original and L1, have been preserved. Thus it will be possible to return to those parents which are indicated as the most promising by the behaviour of their selfed progenies. Clones have been raised from what are judged to be the best original parents, and bulk seed from these has been produced. This will be tried against commercial seed next season. Clones are now being propagated from the most promising L1 parents. These will be allowed to interpollinate next season and produce seed. Observations on bees and other agencies which might bring about tripping and cross-pollination have been made in the field. This led to a controlled experiment in which bumble bees, black, Italian, and hybrid honey bees have been used as pollinating agents. Results are not yet complete. Since self-pollination no doubt commonly occurs in lucerne, a measure of heterosis has been made, and results demonstrate beyond doubt the desirability of establishing insects capable, not merely of tripping flowers, but of effecting cross-pollination, The yield of seed under various pollinating conditions has also been studied and further supports the desirability of cross-pollination.

Peas.—In an endeavour to improve the yield and quality of our field peas, numerous crosses have been made, and from these F3 segregates, homozygous for the main seed characters, have been retained. Such material will be grown at the Pure Seed Station in Canterbury for fixing and the study of yield and other characters not expressed in this district. Other F3 material heterozygous for the desired seed characters but desirable in other respects will be grown on at this station for the purpose of extracting homozygotes. The following varieties are receiving attention: Partridge, White Ivory, Blue Prussians, and Harrison's Glory.

Single-plant selections of all standard varieties of garden peas are made each year and increased once at this Station. They are then transferred to the Pure Seed Station, Lincoln, and increased to commercial proportions. The only breeding has been in connection with Greenfeast. F3 segregates from Greenfeast × Great Crop are now being studied. A genetical analysis of the transmission of the seed character, smooth, dimpled, and wrinkled, has been completed and is shortly to be published. Investigation on these matters was found essential to the satisfactory performance of our breeding work. It has revealed the genetical constitution of the smooth and wrinkled as more complicated than has been supposed.

Oats.—Seed samples were collected from numerous sources and grown to determine the general standard of seed oats in respect to varietal purity and smut infection. The trials afforded material from which type descriptions have been prepared of all the more important varieties. Results of this work have now been published.

Potatoes.—A trial of lines of seed potatoes collected from farmers in the Manawatu district has revealed a very serious position. Varieties are badly mixed or wrongly named, often unsuitable varieties are grown, and except for those not many years removed from certification, virus infection is said to render the seed quite unproductive.

GOVERNMENT PURE SEED STATION, LINCOLN.

Satisfactory progress has been maintained in the production and distribution of pure-seed stocks.

Wheat.—There was a ready sale for the seed wheat produced in the 1932–33 season. The present harvest has been very satisfactory. Pure lines of all the commercial varieties are being maintained, but there is little demand

for varieties other than solid straw Tuscan and Hunter's. This is probably due, in part at least, to the efforts of the Wheat Research Institute in improving the milling and utilization of flour made from solid straw Tuscan wheat. During the past season attention has been devoted mainly to—(i) The production of seed wheat of solid straw Tuscan, Jumbuck, Dreadnought, and Cross 7. (ii) Yield trials of solid straw Tuscan 13/28 (a Station selection), which has outyielded the standard Tuscan during the past two seasons and is to be tested extensively in the field next season. (iii) The propagation of a large number of selections from Jumbuck, over twenty of which did not segregate. This will enable 2 acres of pure Jumbuck to be grown next season as a nucleus line for distribution. (iv) A very extensive yield trial of twenty-five selections from Hunter's II, each selection replicated ten times with Hunter's II as control. (v) The propagation of single-plant selections of Cross 7 with the object of purifying existing stocks.

Oats.—This is a new venture in an attempt to produce pure and smut-free seed of the more important varieties. Unfortunately varieties that have been in cultivation for a number of years show such variation that it becomes necessary to isolate the more promising variants and place these under trial before any reliable progress can be made.

Potatoes.—There was a ready sale for all the seed produced in the 1932–33 season. The season was dry and yields were very poor. The 1933–34 crop now being dug is very promising. A satisfactory standard is being maintained in regard to freedom from virus by making, each season, tuber unit selections and multiplying these within the main crop of that variety.

Seed of the following varieties is raised and distributed each season: Up-to-date, Dakota, Great Scott, Iron Duke, Arran Consul, Aucklander Short-top, Aucklander Tall-top, and Arran Banner. The varieties Arran Chief and King Edward are not included, since satisfactory seed of these varieties is being distributed from Southland.

Peas.—Pure stocks of the main varieties of garden peas are maintained. The 1933–34 crop has been satisfactory, and for this there has been a ready sale to merchants who are growing peas on contract with farmers. An attempt to select superior lines within such varieties of field peas as Partridge, Blue Prussian, and White Ivory has been abandoned and replaced by a trial designed to discover first which of the many strains on the market is the most desirable, and then to undertake selection within that strain.

Linseed.—This crop has gone almost completely out of cultivation during the last year or two, and therefore the selection so far made will be held pending market developments.

SEED CERTIFICATION.

The Agronomy Section has continued to organize the seed-certification activities of the Fields Division. The scheme has been extended during the past season to include swede and turnip seeds.

Perennial Rye-grass.—The 1933–34 season has shown a marked reduction (45 per cent.) in the acreage entered for certification. Added to this a lower yield per acre will mean that the amount of seed finally sealed for the season will probably be in the region of half that sealed for 1932–33 season. An alteration to the scheme has been the deletion of the sub-classes of permanent-pasture seed—*i.e.*, first-harvest seed and seed eligible for reclassification as mother seed. All such seed now comes into the ordinary permanent-pasture seed class.

Cocksfoot.—It is too early yet to give an estimate of the acreage of cocksfoot under certification this season. However, indications point to a reduction in the Akaroa district, which will be balanced only in part by an increase in acreage in the Mid-Canterbury district. Yields also are likely to be lower than those obtained in 1932–33.

White Clover.—No information is yet available as to the acreages of white clover likely to come under certification. There will, however, be a considerable increase on the 100 acres entered during the 1932–33 season. Owing to a frost during the flowering period of clover in the Canterbury district, yields from this locality are likely to be much below the average.

Red Clover.—The acreage of Montgomery Red clover entered for certification has shown a further increase, but it is too early yet to estimate what yields may be expected.

Brown-top.—The acreage of Brown-top under certification in the 1932–33 season showed a considerable reduction. Applications for certification of the 1933–34 season's seed are only now coming to hand, so that no idea can be expressed as yet of the quantities likely to be handled.

Potatoes.—An increase is expected in the acreage of potatoes entered for certification during the current season. The number of crops being inspected is the highest on record.

Wheat.—The acreage of wheat inspected for certification reveals an increase. There has been a greater proportion of crops rejected this season than in the previous one, the main reason for rejection being the presence in the crop of weeds of an undesirable nature.

Swedes and Turnips.—The certification of these seeds has been introduced during the 1933–34 season, when approximately 130 acres has been subject to inspection and the produce sealed in the field.

The following table of areas inspected indicates the progress made since the inauguration of seed certification in 1927:—

Seed.	Chief Consideration upon which Certification is based.	Acres inspected each Season.						
		1927–28.	1928–29.	1929–30.	1930–31.	1931–32.	1932–33.	1933–34 (approx.).
Potatoes	Varietal purity, cropping power, and freedom from virus diseases	821	909	1,200	1,334	1,146	1,154	1,450
Wheat ..	Varietal purity and freedom from loose and stinking smuts	473	1,184	2,277	3,289	1,063	1,873	2,900
White clover	Age of pasture 1928–31. Type of clover 1931–34	..	325	664	311	31	100	Not available.
Perennial Rye-grass	Genuine perennial type conforming to certain standards of purity	..	..	3,028	6,539	9,709	22,917	12,500
Brown-top	Freedom from red-top (*Agrostis palustris*)	..	..	22,000	24,901	18,297	14,860	Not available.
Cocksfoot	Type as exemplified in the produce of Banks Peninsula	..	..	..	..	4,226	5,097	Not available.
Montgomery Red clover	Type conforming to that of English-grown Montgomery Red clover	..	..	..	..	9	71	200
Swedes and turnips	Varietal purity and freedom from disease	..	..	..	..	..	..	130
	Total	1,294	2,418	29,169	36,374	34,481	46,072	

ACKNOWLEDGMENTS.

Mr. Calder has been engaged wholly on the investigations undertaken at this Station. Mr. Thomson is in charge of the Pure Seed Station at Lincoln, and Mr. Claridge has devoted all his time to the organization of seed-certification. Recognition is here accorded to the valuable services rendered by these officers and to the helpful co-operation afforded by specialists attached to the Station and officers of the Fields Division.

AGROSTOLOGY SECTION.

E. Bruce Levy, Agrostologist.

The significance of strain-testing and strain-building as foundational to pasture production and pasture improvement is emphasized again in the work of the past year in both plot and field trials. Certified seeds and pedigree seeds will go a long way towards cheapening production. They give a greater response to manures and ensure no leakages in our artificial and stock manuring programme. Like a high-producing cow or ewe they return the greatest profit for food consumed. Certified seeds are capable of a greater production and give a better seasonal spread of that production: they make specialist management possible and effective. They assist tremendously the breaking-in processes of virgin or deteriorated lands. Strain work widens the ecological field of research, and in this respect strain has a significance as great as that presented by one species and another. Strain-building towards pedigree standards must take cognizance of palatability and nutritional values, disease susceptibilities or resistance, persistence, and ability or otherwise of the plant to recuperate rapidly after pruning, and basal to these factors are genetical analyses to ensure that only those plants that reproduce themselves true to type are among the élite. Fine adjustments in measurement technique are essential to obtain grazing effects on stock and pasture and to give production data of a high degree of accuracy. This latter work is at present being conducted at Marton by the Crop Experimentalist. Work of an exact nature must be perpetually under the eye of the investigator, and there is a very big argument in favour of the gradual consolidation and building-up at Palmerston North of a central grassland research station that envisages all phases of fundamental grassland research from the production and testing of new strains to their efficient elaboration into animal products.

There is no parochialism in agricultural research the world over. The information is broadcast and is available for whosoever will use it. New Zealand in the past has been particularly fortunate that this is so, and, while at the moment we may regard New Zealand as evolving towards strains in plants and animals that may be superior to the original importations, yet we must not close our eyes to the fact that agriculture the world over is progressing along scientific lines and the importation of new improved stocks may enable us to make even better use of the wonderful climate, soil, and talent we possess in the competitive race for agricultural supremacy. The importation of species and strains should go hand in hand with the improvement of our own present-day species and strains.

New Zealand should build for itself first and foremost, and it is in New Zealand that the results of research should first be translated into practice, otherwise the money spent in New Zealand in research is but enabling other countries to compete on an even basis. The close co-operation of the research station with the field for verification and demonstration and an active propaganda service is essential if New Zealand itself is first to reap the benefits accruing from research.

Strain-testing and strain-building, ecological work in regard to seed mixtures, manuring, and management, productive and nutritional values of species and strains and mixtures of these, genetical work in progeny testing and in the creation of new species and strains, pedigree seed production, and the introduction of new species and strains are links in the chain of research fundamental to grassland progress. Strain-testing, strain building towards pedigree seed production, green-keeping research, and certain ecological and genetical work have occupied this section actively throughout the year.

STRAIN-TESTING AND STRAIN-BUILDING.

Perennial Rye-grass.

Certification Plot Trials.—1932–33 harvest: Up to the time of the last annual report, 1,012 plots had been sown. Further sowings made until September brought the total up to approximately 1,800 plots. The majority of these plots have now been finally reported on to the Agronomist. In connection with this season's harvest 1,634 plots have already been sown. All field-dressed certified and all trial-only lines are being sown this season.

Investigational Work.—Further plot trials of English, Irish, Australian, and old pasture South Island lines have again proved the superiority of the New Zealand certified strain. With the exception of one or two Australian lines all of these are definitely inferior to the certified lines. This inferiority was very marked during the rusting season this year. Conditions for rust attacks were ideal, and the poorer types rusted very badly and stopped growth for the season much before the certified lines. The autumn recovery of these lines was also very much slower. Many of the lines under test were up to mother-seed standard when tested under the screened ultra-violet light. This shows the absolute necessity for plot tests when the history and origin of the line is not known. Plots sown with seed harvested from single plants have shown noticeable differences. Plots sown with seed harvested from four-year-old plots of various types show a general agreement with the type sown in the original plots, although there is a tendency for an improvement in type due to the surviving of the better types and the death of the poorer types.

Grazing versus Mowing of Plots.—During the past year it has been very evident that, in order to keep plots in a good healthy growing condition, grazing and consequent manuring by stock is essential. Fairly heavy and frequent dressings of artificial manures (blood and bone, super, and nitrate of soda) have been applied, but by themselves the results have been disappointing, particularly during the summer period. This beneficial effect of stock-grazing is more marked on pure rye-grass plots than on rye-grass plots sown with clovers.

Elite Strain Work.—Production of improved lines: At the end of August one section of the newly erected glass-house was planted with tillers of six selected plants of a high-producing perennial type. A yield of 6 bushels per acre was secured. This rather low yield can be considered quite satisfactory, as the plants were put in rather too late, and a considerable amount of difficulty was experienced in providing sufficient ventilation to keep down the humidity and at the same time keep the house pollen-proof. This object was attained with a fair measure of success by fitting felt pads over all ventilators. On windy days the humidity was greatly reduced, but on calm days no reduction in humidity was noticed.

With the object of increasing this line rapidly, ¾ acre has been planted out with 31,000 spaced single plants raised from this line. This block will be harvested for seed next season.

For seed production from young plants it is essential that they should be put out no later than early winter. If put out later on in the spring the plants do not "age" sufficiently to produce a normal seed crop that autumn.

A second glasshouse was planted out with tillers of six plants of a high winter-producing but shorter-lived type. The same difficulties as encountered in the other house regarding late planting and humidity were experienced with this lot. A poor yield of 1 bushel per acre was obtained. This line does not appear to be very promising, but a block of 2,500 plants has been put out for observation and increase.

Genetical Work.—In single-plant study crosses made in 1932–33 with plants of various types show, on the whole, a lack of uniformity within each cross. Perennial crossed with Italian and the reciprocal give plants of a very undesirable type, being mostly similar to bad false perennial. One or two crosses of good plants show a fair degree of uniformity, and these plants will be useful as parent plants for building up improved lines.

In 1933–34 crosses of various types of plants were made in pollen-proof cages. The amount of seed set was very small and in many cases nil. This may be accounted for by the fact that plants were planted in the ground and not in pots as was done last season, thus making it difficult to have pairs of plants flowering at the same time. In at least one of the crosses there is evidence to show that self-pollination occurred. This self-pollination reduces the value of attempting mutual pollination.

An endeavour made to self-pollinate all plants that had been used in crosses has, on the whole, been quite successful. Plants that had been in pots for fifteen months and for three months were pollinated with equal success. It was thought that failure of last season's attempt at selfing might have been due to using plants that were potted too recently and which grew a great deal more leaf than plants which had been in pots for more than a year.

A further lot of forty-seven single plants was put out in this season. The older block of 168 plots has been reselected and reduced to thirty-seven plants. By the time single plants have been in position for from eighteen to twenty-four months they become very high in the crown and do not thrive. It is then necessary to lift and replant them several inches deeper than they were. This encourages more healthy tillering and a more natural habit.

Continuous Harvesting of Areas.—In an endeavour to decide what effect several consecutive harvests have on the plant-type constitution, an area of some four thousand single plants representing crops from ten areas which had been harvested for three or more consecutive seasons have been planted out. Notes on plant type and rusting have been taken. No conclusions can be drawn at present, as differences, if any, are very slight, there being no obvious deterioration.

Investigation into the Cause of Low Germination of Rye-grass.—A block consisting of 268 rows of rye-grass made up of a number of lines of varying germination and treated with hot water at different temperatures was harvested. No information on this season's harvest is available, but results from a similar experiment last year are not encouraging. The weather at flowering-time was unsuitable for the development of the fungus, so little information is expected.

Italian Rye-grass and Western Wolths.

An important factor entering into testing Italian rye-grass is the season in which they are sown. If sown in the autumn both types develop at approximately the same rate and differences do not show at all well except that the Western Wolths is more upright and vigorous. But if they are sown in the spring the Western Wolths type runs up to seed and dies very quickly, while the Italian is considerably slower in maturing, and, if sown late, the death-rate is very low in the first season.

The position of commercial Italian rye-grass in New Zealand is very unsatisfactory from a type point of view, there being very little Italian of a good type on the market. Of the samples tested so far very few lines are wholly of a good Italian type, the majority being very mixed and ranging from Italian through Western Wolths to lines wholly false perennial. Several imported lines that have been tested have proved to be of a good type of Italian. These lines are being increased under certification.

Plot Trials.—Plots and rows numbering 189 have been sown this year. It is considered that testing in plots is more satisfactory than testing in rows, as deaths and growth forms are much more noticeable in the former.

Elite Strain Work.—Twenty-four of the best plants were put out in the glasshouse for seeding under controlled pollination. About ten thousand plants of this line have been planted out for observation and increase. Single plants numbering 7,479 from good lines have been put out with the same object.

Cocksfoot.

Certification Trials.—This year 280 lines of cocksfoot have been sown. All spring-sown lines have been reported on. In rows sown last autumn, differences, in some cases, have been noticed between Akaroa and Plains lines, the latter being more vigorous. This point is being investigated more thoroughly. In the last spring sowings the Danish type showed out very markedly within eight weeks from time of sowing by virtue of its very rapid seedling growth.

Elite Strain Work.—To enable further tests to be made an area of 0·065 acre of Aberystwyth "pasture type" was sown out for seed production. This gave quite a good yield of 392 lb. per acre. Trials to date with this type indicate that it is likely to be of very little value in New Zealand on account of its low total production and slowness to start growth in the spring and its winter dormancy. Twelve of the best single plants available were put out in the glasshouse for controlled pollination. Little or no seed, however, was produced this year.

Single-plant Study.—Plants representing the various types of cocksfoot have been put out as tiller rows and single plants. Very wide differences have been noted from the dense leafy type to the squat, open-crowned, winter dormant type.

Brown-top.

Certification.—Owing to an unsatisfactory strike all of last season's lines have been resown on better soil. No reports have been furnished.

Elite Strain Work.—This is being carried out in connection with the greens research work.

Agropyron Species.—None of these species which are advocated in American papers appears to be of any value in New Zealand either as a lawn or pasture type. *A. Smithii* is a possible danger on account of its twitchy habit. All species are of fairly low palatability.

White Clover.

Certification Trials.—A total of 978 plots has been sown. Two series of notes have been taken and an HCN herbage test on each plot has been made by the Plant Research Station Chemist. All the 585 lines sown the previous year have been reported on. Representative types in the 1932-sown certification plots have been cut and weighed at each growth period. The selected lines have yielded much better than commercial mother-seed lines. Seventy clover areas in Canterbury were field inspected at the time of closing up for seed.

Single Plants.—Frequent notes have been recorded on the eighty-nine plants in the tiller-row trial. During the year 6,200 single plants have been put out. These consist of 5,500 from selected plants open-pollinated and 700 from mother-seed lines and their respective first-harvest progeny.

Elite Strain.—A 5-acre block at the Pure Seed Farm, Lincoln, has been sown out with a Station-selected line, and this should give a seed crop this coming year. Trial plots of this selection have shown that it is superior to any commercial mother-seed lines. A further selection has been made by intercrossing nine selected plants under controlled pollination conditions within the glasshouse. A small hive of honey-bees was placed in the house at flowering-time. All other pollinating insects were excluded by fine-mesh gauze placed over the ventilators. The seed obtained was sown in boxes and later transplanted. A block of 12,200 plants of this selection—¾ acre—has been planted out for increase and production purposes.

Genetical.—From the 1932–33 crossings of pairs of promising plants 700 F1 plants have been raised and planted out in blocks for comparison with open pollinations from the same parent plants. The progeny from controlled crossings are showing remarkable uniformity of type, and are superior in this respect to open-pollinated lots. One hundred plants were raised from each of seven crosses of varying HCN content. An HCN test has been made on twenty single plants from each cross. In this trial type and HCN content seem to be closely connected. High HCN-content plants crossed together have resulted in strong growing and good-type plants, while pairs of low HCN plants have given uniformly poor types. The crossings for this year consisted of intercrossing, in each possible combination of pairs, the nine plants used in the glasshouse selection, giving seventy-two crosses in all (thirty-six crosses and reciprocals). The seeds obtained have been sown in boxes and will later be planted out for detailed study of the breeding qualities of the nine plants which make up this year's selection. Honey-bees were used in the cages. Good seed-setting has resulted, and by introducing up to thirty bees at one time the cages required less frequent attention than when bumble bees were used.

Red Clover.

Certification.—One hundred and twenty plots have been sown. Two type notes have been taken. Reports have been issued on the seventy-five lines sown the previous year, and representative types in these sowings have been cut and weighed periodically.

Single Plants.—A block of 1,100 plants from mother seed and their first-harvest lines has been planted out for a closer study of the once-grown progeny relative to the original line.

A further 1,100 plants from élite lines have also been put out. The block of 1,600 plants from selected lines has been reduced to 200 plants and allowed to seed under open pollination.

A number of lines received from Aberystwyth and elsewhere are being tested as single plants as well as in plots. Altogether these make up a block of 1,000 single plants.

Final notes have been recorded on the 900 mother-seed and first-harvest plants put out two years ago.

Elite Strain.—Twenty-two of our best plants were seeded in the glasshouse under controlled pollination with bumble bees. The seed obtained is now being raised under glass prior to planting out an area for seed production purposes.

Genetical.—The progeny from the 1932 sowings have been grown. The parents were pairs of particularly good Montgomery plants, and the progeny are of good type also and very uniform in appearance.

Subterranean Clover.

The block of subterranean plants has been under observation only.

Lotus Major.

From the plants which have been under trial and study for two years the best are being selected to form the nucleus of an improved line.

DUAL SEED-CROP PRODUCTION.

Two blocks, one of rye-grass and selected Montgomery red clover and the other of rye-grass and selected white clover were shut up for seed crops of rye-grass. The blocks were closed up in the third week in October. From this time till the 9th November in the case of the rye-grass and red-clover block, and the 25th December in the case of the rye-grass and white-clover block, sheep (intermittently at eight per acre) were kept to eat out the bottom growth.

The advisability of this practice is questionable. Rather should the clover growth be governed by the time of shutting up. This early shutting-up of a maiden rye-grass paddock would tend to smother the clover, whereas a late shutting-up would favour the clover, as the rye-grass would be past its optimum condition to produce a seed crop. It should be noted that the above refers specifically to maiden pastures. Old rye-grass pastures with burr clover in competition present another problem that could not be overcome in the foregoing manner. It is proposed to investigate this point more thoroughly.

Machine-dressed seed yields of rye-grass in the rye-grass and white-clover and rye-grass and red-clover blocks were 24 bushels and 17·3 bushels per acre respectively. The low yield may be due partly to the dry spring experienced and the continued stocking after seed-heads had formed.

ECOLOGICAL WORK.

"Point" analyses of turfs have been made on plots sown with various seeds mixtures and with pure lines of different strains of a species.

The recording of turf changes due to seasonal influences and the competition of one species with another in the sward has been made.

Point analyses and estimations to show turf differences due to artificial manuring have been undertaken on the various mowing trials at Marton Experimental Farm.

Two comprehensive seeds mixtures trials have been sown down on Massey College farm. One area will be grazed by sheep only and the other by dairy cattle only. The effects of stock, the competition of species with one another, and any differences due to strains within species and their influence on the turf are to be recorded.

Some work has been done in connection with pasture-development at Ngakuru and Galatea, with particular reference to species and strains sown and the influence of stock-management on the development of the sward. Certified seeds are playing an enormous part in the safe development of this country and are giving excellent response to phosphate manuring and to nitrogen manuring by stock. A high per-acre stock concentration appears essential in the rapid development of pumice, and good strains that will persist and respond to treatment are essential.

FIELD DEMONSTRATION TRIALS.

A new set of demonstration trials has been devised to give demonstrational evidence of class and constitution of seeds mixtures and the part strain will play in such seed mixtures. Seed for seven trials has been made up and despatched for laying down. These trials are conducted by the Crop Experimental Section in collaboration with the Fields Division. Reports on all trials have been submitted regularly by the instructional staff of the Fields Division.

Ten strain trials have been made up and despatched for demonstration work in species and strains in schools. Several lots also have been sent overseas.

SECONDARY GROWTH CONTROL.

One visit was made to Whangamomona during the year, and arrangements made to do some manurial top-dressing of certain surface sowings laid down to mixtures containing different strains of white clover.

GREEN-KEEPING RESEARCH.

This scheme of work has progressed satisfactorily during the year. The feature of general interest is the poor production and unthriftiness of the sward, even where liberally manured, as a result of close and continuous mowing to putting-green surface for two years. This has resulted apparently in root starvation due to over-pruning and is definitely not associated with lack of available plant-food in the soil. It serves to emphasize and to support the contention that pastures generally thrive best and produce more under a rational system of rotational grazing rather than under a system of close and continuous grazing.

Weed and clover control by the use of toxic material is again illustrated. Arsenic pentoxide and sulphate of ammonia are among the foremost materials for weed and clover control. Brown-top and Chewing's fescue have again shown their superiority for lawn-making over all other grasses with the exception of Velvet Bent (*Agrostis canina*). This species is making an excellent turf, and its growth form may well fit it for closer and more continuous cutting than either Brown-top or Chewing's fescue. A superior strain of *A. canina* has been imported, and approximately 1,000 single plants of this strain have been planted out for selection and seeding.

ALTERNATE MOWING AND GRAZING TRIALS AT MARTON.

These have been continued by the Crop Experimentalist, and valuable results in actual production of the various strains under test are being secured.

DEMONSTRATIONS, LECTURES, AND CORRESPONDENCE.

Visitors to the Plant Research Station are increasingly impressed with the work done at the Station and with its significance in grassland economy. Six lectures to outside organizations were given during the year.

LAND AND GLASSHOUSE ACCOMMODATION.

The work of the section is gradually expanding and the grass work alone now occupies approximately 10 acres in plots and experiments. Six acres of this is on very unworkable land, and 3 acres cannot be stocked. A new area of 7 acres has recently been acquired, and this will be used primarily for increased growing of pedigree stocks of seeds. The Agronomist is also sharing this area. A useful glasshouse has been erected and is subdivided into four sections for the control of pollination of nucleus stocks of pedigree seeds. The erection of this glasshouse and the securing of the additional 7 acres of land is much appreciated, and will tremendously help along the project of strain-building.

FIELD EXPERIMENTS SECTION.

A. W. Hudson, Crop Experimentalist.

The total number of experiments at present being carried out is 559 compared with 568 for the corresponding date in 1933. Although this indicates that the work was kept up to about the same level as in the previous year, actually there was an increase in the number of experiments conducted on annual crops, chiefly simple trials to determine the efficacy of seed treatment on cereals, while on the other hand there was a decrease in the number of observational top-dressing experiments carried out. The latter has been due to the abandoning of many trials which had been carried on for several years and which were to have been replaced by a large number of experiments designed to further the response-to-manure survey of New Zealand. It is anticipated that many of these will be laid down during the present autumn.

RESEARCH INTO FUNDAMENTAL GRASSLAND PROBLEMS.

Marton Experimental Farm.—The nine trials described in the annual report for the period ended 31st March, 1933, have been continued under the "alternate mowing and grazing technique." Soil studies and chemical investigations of the pasture herbage are being carried out on four of these by the Analytical Chemist.

Ruakura Farm of Instruction.—The experiment carried out on the above has been abandoned and the results have been published. An area has been sown preparatory to establishing a further experiment which will be carried out under the "alternate mowing and grazing technique." This will have for its object a comparison of no-manure with super and with super plus lime, the latter being applied by two different methods.

GRASSLAND INVESTIGATIONS AND DEMONSTRATIONS CARRIED OUT BY FIELD OFFICERS OF THE FIELDS DIVISION.

Grazing Trials to determine the Relative Merits of Hawke's Bay Certified Perennial Rye-grass and Typical Canterbury "Perennial" Rye-grass.—The six trials which have been conducted in Canterbury over a period of four years are being continued. The fields sown with the certified perennial rye-grass have given up to date an average increase of about 30 per cent. more grazing than the fields sown with Canterbury rye-grass. This margin of superiority has been almost constant during the past three seasons, and it would appear as if a state of equilibrium has been reached. The individual increases in favour of the certified rye-grass range from 11 per cent. to 67 per cent.

A trial similar to the above has been laid down at the Winton Experimental Area to compare certified perennial rye-grass with a mixture of local lines of uncertified seed.

Observational Top-dressing Experiments.—There are about 250 observation top-dressing experiments now in existence throughout New Zealand in pursuance of surveying grasslands as to their response to lime, phosphate, and potash. Preparations are being made for this number to be increased during the coming autumn. An extension of the work has already been possible in North Taranaki, in which district only a limited number of trials had hitherto been established. A striking feature in most of the North Taranaki experiments was the marked response to potash within two months of application, and the results have been so consistent as to warrant a general statement being made by the Fields Superintendent regarding the advisability of farmers at least trying potash in a defined area in Taranaki. Results such as these justify the policy of establishing a large number of small, simple experimental plots throughout the country, and indicate that major soil deficiencies can be determined rapidly and cheaply. It seems obvious that potash must figure prominently in the future fertilizer programme on the more intensively farmed land in North Taranaki and also possibly to some extent in South Taranaki, and the acquiring of more exact information regarding the effects associated with different methods and frequencies of its application is highly desirable in order that farmers may be better guided into using it to the best advantage.

In addition to the common effect of phosphate, interesting results from lime, and in some cases potash, are being obtained from experiments in other districts; but the concentration of experiments in these areas has not as yet been sufficient to warrant any such definite recommendations as have been made for North Taranaki. In some districts superphosphate has given little or no result, and while this can in some instances be ascribed to deficiency of lime as evidenced by the effect of lime in the trials, in others neither super nor super plus lime has been effective. The use of basic slag as well as that of super is being investigated in experiments in these districts.

Demonstrations and Trials of Rye-grass and Clover Strains (in Collaboration with the Agrostologist).—These trials have proved of great value not only for purposes of testing strains of rye-grass and clovers under varying soil conditions, but also for demonstrating to farmers the importance of sowing approved strains. Their value for field demonstrations has been such as to create a demand for further areas being laid down in other districts. Altogether thirty-seven of these trials are now in existence and others are to be laid down during the present autumn or next spring. In addition to rye-grass and clover strains, different strains of other herbage plants and varying seeds mixtures are included in the new trials. Alongside these demonstrational areas top-dressing experiments are laid down.

Legume Inoculation Trials (in Collaboration with the Mycologist).—A large number of simple experiments to determine the effect of inoculating red clover, white clover, lupins, and field peas were sown in the autumn of 1933 and in the following spring. While results have not so far been sufficiently good to warrant any recommendation, in isolated cases there have been definite differences in favour of the inoculated seed. In nearly all the autumn-sown experiments clover establishment was a failure irrespective of treatment.

Seed Production (in Collaboration with Seed Analyst).—The experiments on manuring and different stages of cutting of Chewings fescue and perennial rye-grass respectively have been continued at the Gore Experimental Area. Seed has been harvested from these and is being examined by the Seed Analyst. Similar trials in the 1932–33 season gave no indications that manuring had any appreciable effect on germination. A trial on the effect of fertilizers on rye-grass-seed production in Central Otago could not be harvested on account of adverse weather conditions and lodging of the crop.

EXPERIMENTS ON ANNUAL CROPS CARRIED OUT BY FIELD OFFICERS OF THE FIELDS DIVISION.

Wheat.

Manuring.—Eleven experiments on the manuring of wheat were carried out in the Canterbury and North Otago Districts. Ten of these compared superphosphate with no manure, but only eight were harvested. The average increase in favour of super at 1 cwt. per acre was 2·4 bushels per acre. Since the average increase due to super 1 cwt. in 124 experiments conducted to date has been 4·1 bushels, the effect in the past season is well below the average, and due in part to the selection of one or two districts in which phosphate effect is known to be small.

One trial investigated the use of nitrogen top-dressing on a crop showing signs of nitrogen starvation. A series of such trials had been contemplated, but on account of the mild winter experienced in 1933, crops showing signs of obvious nitrogen deficiency and suitable for purposes of experiment were difficult to locate.

Variety.—Twenty-nine variety trials were carried out in collaboration with and on behalf of the Wheat Research Institute. In all but three of these Solid Straw Tuscan was compared with Cross 7, the latter being a cross of White Fife with Solid Straw Tuscan supplied by the Wheat Research Institute. In sixteen experiments Solid Straw Tuscan was superior to Cross 7, in eight trials Cross 7 was the heavier in yield, in one trial the yields of both varieties were identical, while one trial was not harvested owing to severe injury by a late spring frost. The average difference in favour of Solid Straw Tuscan was 0·7 bushels per acre. Jumbuck was compared with Solid Straw Tuscan in three spring-sown experiments, one of which could not be harvested owing to severe lodging of the crop. In another trial at Fernside there was no significant difference between the two, while in a trial in South Otago in which Marquis and Solid Straw Velvet were also included Jumbuck was 9 bushels per acre lower in yield than Solid Straw Tuscan. Severe bird damage on the earlier ripening Jumbuck may have contributed largely to the difference in yield. Solid Straw Tuscan was better than Marquis by 3 bushels, and about equal to Solid Straw Velvet in this trial.

Two of the Cross 7 versus Solid Straw Tuscan trials included College Hunters, and one of these also included Dreadnought 5/27. In the latter situated at Morven both Dreadnought 5/27 and College Hunters were significantly better than Solid Straw Tuscan by 13·8 and 12·3 bushels per acre respectively, while College Hunters in the other trial, which was located in North Otago, was significantly lower in yield than Tuscan by 2·9 bushels per acre.

Rate of Seeding of Wheat.—Nine trials were laid down in each of which seedings of 60 lb., 90 lb., and 120 lb. per acre were compared, but two of these could not be harvested owing to lodging. With one exception, in which the yield from a seeding of 90 lb. was significantly lower than that from a seeding of 60 lb., increases in the rates of seeding resulted in increases in yield. The average increase in yield of 90 lb. seeding over the 60 lb. seeding was 1·8 bushels per acre, while the seeding of 120 lb. was on the average 1·8 bushels per acre higher in yield than the 90 lb. seeding. The results tend to confirm those of previous seasons and support the contention previously put forward that more rather than less seed should be used in practice.

Barley-manuring.

One experiment on the manuring of barley was laid down in Canterbury. Owing to unfavourable weather conditions at harvesting, harvest yields from the trial could not be obtained.

Seed Treatment of Cereals (in Collaboration with Mycologist).

In order to investigate the merits of Ceresan New, a proprietary seed-treating dust which it is claimed controls smut diseases of cereals, eighty-one field trials were laid down on wheat, oats, barley, or peas. These were simple trials carried out in all the principal wheat-growing areas, and each consisted of a strip sown with wheat treated with Ceresan New surrounded by the farmer's crop which had either been left untreated or treated with wet "pickle" or copper carbonate dust. A feature in many of these trials was the thicker and more vigorous germination of the Ceresan-treated cereal. In comparison with copper carbonate, formalin and bluestone Ceresan was at least as effective in controlling smut, while in some trials in which it was compared with no treatment, almost complete control of smut resulted from the use of Ceresan.

Potatoes.

Manuring.—Five experiments were laid down in 1933. The results of the 1932–33 season's experiments were published in the *Journal* for January, 1934.

Source of Seed Potatoes Experiment (in Collaboration with the Agronomist).—An experiment is being carried out in which seed of an original line of Dakotas grown at ten different centres in the South Island last season is under trial. Further crops to provide seed for next year's yield trial are being grown at the various centres. The above investigation follows a series of similar trials carried out over three seasons and concluded in 1933 on the Arran Chief variety. The results of these indicated a marked inverse relationship between the amount of virus and the yield of each line. Seed grown in four localities having milder or more humid climates showed a progressive increase in the amount of virus and relatively small yields, while seed grown at other centres which have cooler climates because of latitude or altitude exhibited no increase in the amount of virus.

Variety (in Collaboration with the Agronomist).—Trials have been laid down in eight different districts to determine the varieties most suitable for each. Twelve varieties are represented in each trial.

Swedes and Turnips.

Turnip-manuring.—Five experiments are being carried out in which mixtures of super and slaked lime are being tried out against a mixture of equal parts superphosphate and carbonate of lime, and against commercial basic super. In trials conducted over a number of seasons the use of a mixture of super and carbonate of lime appeared to provide the best means of overcoming serious germination injury likely to result from the use of super alone. Trials at the Plant Research Station with carbonate of lime from twenty different sources, however, have shown that there is considerable variation in the effectiveness of the different limestones in correcting injury caused by super. The cause of such variation and a possible remedy in the case of the more unsatisfactory lines of carbonate of lime is under investigation.

Effect of Liming and Manuring on Club-root.—Two trials are being carried out in collaboration with the Mycologist on the effect of liming on the control of club-root.

Varieties.—Various trials are being carried out in collaboration with the Agronomist or the Mycologist in which special varieties or lines of selected strains are being grown.

Rape: Feeding-value of different Types (in Collaboration with the Agronomist).

The feeding-value and relative palatability of two types of rape are under investigation in a trial at Marton Experimental Area. Lambs are being grazed on blocks of each type and live-weight increases are being recorded. Simple trials in which both types are compared with the farmer's commercial crop are being conducted on twelve farms.

Tobacco.

Manuring.—An experiment to investigate the effect of manuring on the yield and quality of tobacco-leaf has been laid down in the Bay of Plenty.

FRUIT-TREE MANURING EXPERIMENTS BEING CONDUCTED BY THE PLANT RESEARCH STATION AND THE HORTICULTURE DIVISION OF THE DEPARTMENT OF AGRICULTURE.

A total of sixty-three experiments is now under way. Fruit-manuring experiments are classified under the following headings:—

A. Experiments on bearing trees under a system of replicated plots from which yields are being recorded. Six experiments laid down in the spring of 1930.

B. Experiments starting on young apple-trees, which will be placed under measurement of yield when bearing commences. These are under a system of replicated plots. Two experiments laid down in 1931.

C. Experiments to determine the effect of a complete manure with and without lime under system of replicated plots. Five experiments laid down in 1931.

D. Simple observational experiments to determine the effect of phosphate, phosphate plus potash, phosphate plus nitrogen, and phosphate plus potash plus nitrogen on limed and unlimed ground respectively. In these there are only single plots of each treatment. Thirty-seven experiments laid down in 1931.

E. Other observational experiments involving single plots.

Description of Experiments laid down subsequent to 31st March, 1933.—New experiments aim at attacking what I consider the vital question of *method* of supplying the tree with artificial fertilizers. Five new experiments have been laid down to test the effect of concentrating phosphatic and potassic fertilizers near the tree compared with their broadcast application over the whole of the ground allocated to each tree. These are distributed as follows:—

District.	Number of Trials.	Kind of Fruit.
Auckland	2	Apples.
Hastings	1	Apples.
Mapua	1	Apples.
Central Otago	1	Apricots.

Eight experiments were established to investigate the injection of fertilizers in solution into the ground. These are simple trials in which a crowbar was used to make the holes into which the solution containing phosphate and/or potash was poured.

These experiments are of a preliminary nature pending the receipt of a special injecting outfit as used in America and Germany. When these injectors are available it is hoped that facilities will be provided for more comprehensive trials on this phase of manuring. The simple preliminary or exploratory experiments are grouped as follows:—

District.	Number of Trials.	Kind of Fruit.
Auckland	1	Apples.
Hastings	2	Apples.
Palmerston North	1	Apples.
Motueka	1	Apples.
Marlborough	1	Apples.
Roxburgh–Ettrick	1	Apples.
Central Otago	1	Apricots.

Results of Experiments as measured or observed to date.—Up to date the most outstanding feature of the trials has been the effect of nitrogen. Beneficial effect has been by no means universal, but where it has occurred it can be taken as a fair generalization that the trees exhibit in the general colour of the foliage and vigour of new growth signs of nitrogen deficiency. Nitrogen effect where it has occurred on apple trees has been less marked generally than where it has caused visible effects on stone-fruit. It would appear that the colour and general appearance of the trees gives a fair indication of whether or not a nitrogenous fertilizer is likely to influence growth. The most marked effects from nitrogen have occurred on soils which are obviously low in organic matter, and the least effect on soils such as those of the Hastings flats, which have a high content of organic matter.

In view of the marked effects on plots receiving nitrogen along with phosphate or phosphate and potash and the absence of effect where the latter are used without nitrogen in some of the trials on stone-fruits in Central Otago, it was deemed advisable to extend these trials so as to include plots receiving nitrogen only. This was done in the spring of 1933. The plots receiving nitrogen only for the first time were not as good as those which had been dressed for three successive seasons. Whether this is due to the cumulative effect of the nitrogen on the older plots or to their association with phosphate and potash can be determined only after a number of seasons.

Donation of Fertilizers.—About 5 tons of muriate of potash and a similar quantity of sulphate of ammonia were donated by Pacific Potash, Ltd., and Imperial Chemical Industries, Ltd., respectively, during the past season. These donations have materially assisted in enabling the programme of work to be carried out.

Acknowledgments.—The enthusiastic assistance of Mr. Dallas, and district officers of the Horticulture Division is acknowledged, and thanks are also due to co-operating orchardists for their continued interest.

MYCOLOGY SECTION.

G. H. Cunningham, Mycologist.

Work for the year has covered the following diseases:—

(1) DISEASES OF SWEDES, TURNIPS, RAPE, AND CABBAGES.

Dry-rot (*Phoma lingam*).

Swede seedlings raised from a Station selection of Herning, and rendered dry-rot free by treatment with hot water, were planted out on three areas made available under the Small-farms Plan. Faulty management and unfavourable seasonal conditions eliminated two of these holdings, but the third (Colyton) area produced an excellent crop of seed, which laboratory test has shown to be free from dry-rot. Six selections have been made of swedes of improved strain for mother-seed production for the 1934–35 season.

In connection with the recently introduced system of brassica-seed certification, laboratory tests have been conducted to ascertain the percentage of dry-rot present in commercial seed lines offered for sale in New Zealand. Preliminary work has shown that the petri-plate method is preferable to the Copenhagen germinator for testing seed for the presence of this disease. Successful results depend on testing large numbers of seed, a minimum being regarded as 20,000.

The disease has been isolated from rape, chou moellier, and wild turnip, all new hosts (for New Zealand) of the pathogen.

Club-root (*Plasmodiophora brassicae*).

During the year numerous selections have been made of individual lines of club-root resistant rape, swedes, and white-fleshed and yellow-fleshed soft turnips. In this manner have been produced highly resistant lines of the swede varieties "Herning" and "Wilhelmsburger Otofte," "Bruce" yellow-fleshed turnip, "Mai" white-fleshed turnip, and no less than five types of rape.

The club-root organism was isolated from soil not previously in brassicas for four years and a half, and found to be pathogenic.

In a series of thirty-nine treatments aqueous solutions of mercurous chloride and acidulated mercuric chloride proved effective soil disinfectants to employ in market-gardens for club-root control, without appreciable injury to cabbage-plants.

Turnip Virus.

A virus disease has been shown to be present in the turnip and swede crops, one symptom being "mottled heart," which is becoming increasingly prevalent in swede crops.

(2) CEREAL DISEASES.

Smut.

Eight commercial seed dusts were tested on several varieties of wheat, oats, and barley at the Station. Results showed that certain organic mercury dusts gave more efficient smut control than any of the copper carbonates, especially when the spore load was relatively high.

The influence of an overdose of copper carbonate on seed germination has been investigated. Trials showed that no reduction in germination resulted through too heavy an application of the dust.

Rusts.

In the glasshouse are being produced pure lines of cereal rusts and their hosts. Rust nurseries were established in the cereal-growing areas of the South Island; and a large number of collections were secured and despatched to the University of Minnesota for determination of the rust biotypes present in the Dominion. The object of this work is to secure information that will enable us to procure rust-resistant strains of cereals.

Maize Cob-rot (*Fusarium moniliforme*).

This disease, now prevalent in the Te Puke district, is carried with the seed. A treatment has been evolved and has proved satisfactory under field conditions.

(3) POTATO DISEASES.

Four varieties of virus-free potatoes have been grown at Tangimoana and Forest Hill. Despite adverse climatic conditions a good yield has been secured, approximately 16 cwt. being harvested. A small area of virus-free tubers were planted on a small farm at Colyton and produced a heavy and clean crop. This is satisfactory in that it is the first successful attempt at bulk production on a commercial scale.

(4) DISEASES OF LUPINS, PEAS, BEANS, ETC.

Virus Diseases.

Sore-shin of lupin has now been proved to be a virus disease which is transmissible mechanically to other lupins and to garden peas. Work is being continued to ascertain whether it is seed-carried, and insect vectors, if any.

Mosaic diseases of peas, broad beans, and red clover are apparently not seed-carried, negative results being secured in all tests in which seed taken from diseased plants were grown to maturity under controlled conditions.

Bean-wilt (*Bacterium medicaginis f. phaseolicola*).

All experiments on the elimination of this disease by seed treatment have failed. Seed selected from clean plants last season gave clean crops; and this when bulked at Tangimoana and Forest Hill produced appreciable quantities of disease-free seed. A portion of this seed was grown on a small farm at Colyton, and produced nearly 30 bushels of wilt-free seed, thus demonstrating that the disease may be controlled by this means.

Stem Canker of Clovers.

A serious disease of red and white clover in the experimental plots of the Agrostologist has been found to be due to *Sclerotinia sclerotiorum*, a fungus which carries over in the soil for considerable periods.

Legume Nodule Organism.

During the year cultures sufficient to inoculate 91,080 lb. of lucerne-seed were forwarded to farmers throughout the Dominion, an increase of more than 21,000 lb. over last season. Cultures for inoculation of red and white clover, lupins, and garden peas were also prepared and distributed.

(5) FRUIT-TREE DISEASES.

Sprays.

Continuing work on orchard sprays, papers on (*a*) arsenates, (*b*) petroleum oils, (*c*) nicotine sprays, and (*d*) combination sprays have been published. In these it has been shown that many materials used by the orchardist have little applied value. Analyses of all sprays available have been conducted, and a technique for standard analyses established.

Fungous Wastage in Storage.

The fungus responsible for black discoloration of deep scald has been proved to be *Dematium pullulans*. Studies of the fungi responsible for wastage have been completed. The fungi chiefly responsible for wastage have been found to be *Penicillium expansum* (5·6 per cent.), *Botrytis cinerea* (16·8 per cent.), *Gloeosporium perennans* (13·9 per cent.), *Glomerella cingulata* (6·6 per cent.), *Polyopeus purpureus* var. *verus* (15·1 per cent.), *Neofabraea malicorticis* (5 per cent.), and a number of others which caused losses of 1 per cent. or less.

(6) FOREST-TREE DISEASES.

Nursery Diseases.

An investigation into nursery diseases has shown that *Phomopsis juniperovora*, *Diplodia pinea*, and a *Fusarium* are responsible for losses experienced, which sometimes exceed 20 per cent.

Gummosis of Cupressus, spp.

The gummosis diseases, common on *Cupressus macrocarpa* and *C. lawsoniana*, have been shown to be due to *Pestalozzia funerea*, *Phomopsis juniperovora*, and *Coryneum* sp., the last being the chief cause of gummosis of *C. macrocarpa* in the field, the other two being chiefly diseases of nursery stock.

Seed-borne Diseases.

It has now been ascertained experimentally that *Pestalozzia funerea* is carried with *Cupressus macrocarpa* seed; *Diplodia pinea* is carried with seed of *Pinus ponderosa* and *P. laricio*. Methods of seed disinfection are being developed, tests being conducted with hot water and certain chemical steeps.

Needle Fusion.

This trouble has been found to be prevalent on *Pinus radiata* grown in the pipe-clay soils of North Auckland and the clay soils of the Moutere district. Investigations are being undertaken to ascertain whether it is due entirely to soil conditions, or whether any pathogen is associated with the trouble.

Tree Mycorrhiza.

Work has been confined to (*a*) developing a method for storing in a viable condition the mycelium of the fungi which act as forest-tree mycorrhizas, and (*b*) determining the organisms associated with Douglas fir.

Timber Decay.

Cultures have been made from numerous specimens of New Zealand timber suffering decay. From these species of *Ceratostomella*, *Graphium*, and *Penicillium* have been isolated from sap stain timber; *Fomes robustus* and *Polyporus adustus* were found to be responsible for decay of Southern Beech; and a *Stereum* was found to cause a honey-comb rot of totara.

(7) SMALL-FRUIT DISEASES.

Tomatoes.

A damping-off of tomato seedlings was found to be due to *Corticium solani*. Narrow-leaf (a hitherto undescribed virus) was found to be aphis-transmitted, and was capable of infecting *Solanum nigrum*, tobacco, and *Physalis edulis*. Mosaic was found to be transmitted from diseased to healthy plants in the process of removing laterals. Tests have shown that the decrease in fruit yield by mild mosaic may approach 36 per cent., whereas severe mosaic was found to reduce the yield (under field conditions) by 90 per cent. Both were found to be seed-carried. Black stripe of tomatoes was found to cause a severe streak disease of tobacco.

Strawberries.

Several strains of virus-free plants have been produced, and are available for bulking for commercial distribution.

Tropical Fruits.

Diseases of fruits of bananas, oranges, pawpaw, &c., were investigated during the year for the Cook Islands Department. Organisms responsible were isolated and identified, and advice given as to method of avoiding future losses.

(8) MISCELLANEOUS INVESTIGATIONS.

Tobacco Diseases.

Investigations on virus diseases (which cause upwards of 40 per cent. loss in Nelson District) have shown the manner in which these are transmitted in the field, and control measures have been worked out and applied. Mild mosaic was found to be present in *Solanum nigrum*, a weed common in tobacco-growing localities.

Latikia, several commercial varieties of tobacco, and an unnamed variety of *Nicotiana rustica* have been grown in $\frac{1}{10}$-acre blocks with a view to (*a*) determining their nicotine content for commercial nicotine production (for use as an insecticide), (*b*) determining the effects of topping on nicotine content and tobacco-leaf quality, and (*c*) the effect of mosaic disease on nicotine content and leaf quality, plants being artificially inoculated for the purpose. Leaf has been harvested and at present is being air-dried.

Grass Diseases.

Control of red-thread, a disease of grasses, troublesome in lawns, due to *Corticium fuciforme*, is being studied. Similar work is being undertaken with brown-patch (due to *Corticium solani* and *Sclerotinia trifoliorum*), experimental plots having been laid down at the Greens Research Area. A fungus, *Cephalothecium roseum*, has been isolated from rye-grass seed. This organism appears to destroy the seed while on the plant and thereby impair the germination percentage of the sample. Rusts of selected strains of perennial rye-grass, and virus diseases of red and white clovers are being investigated.

Silage Production.

The effects of (*a*) molasses, (*b*) bacterial cultures, and (*c*) whey on the production of quality silage are being investigated. Preliminary work indicates that silage production may be standardized and simplified by the use of certain of these agents.

Control of Mould Fungi in Foods.

Experiments for the control of moulds on the woodwork of dairy factories and meat-works have been partially completed. Work is being continued on the effects of these organisms on deterioration of food.

Sterilizing-agents.

A series of tests have been conducted to ascertain effective methods of sterilizing woodwork of dairy factories, meat-works, and the like. It has been shown that chlorine compounds, generally used for the purpose, have little (if any) toxic effect on the moulds present in these places.

ENTOMOLOGY SECTION.

J. Muggeridge, Entomologist.

During the past year this section has been particularly busy both in regard to (*a*) routine and (*b*) research activities.

ROUTINE.

Routine activities involved a large amount of correspondence and time in replying to requests for the identification of insect specimens sent in, and methods of control to be adopted in regard to them. That phase of routine activities concerning the care and attention of the insect collection and correct filing of literature unfortunately did not receive the amount of attention which it needed. The neglect of this work was entirely unavoidable as other laboratory and field activities more than occupied all available time.

RESEARCH.

Experimental Work on the Control of Pieris rapae (White Butterfly) by Means of Parasites.

The most important work that this section has had to deal with during the past year has been in connection with the biological control experiments on white butterfly. A survey in the field of the places where parasites had been liberated during the previous season indicated that the larval parasites (*Apanteles glomeratus*) were at work though they were not sufficiently prevalent to offer any serious check to an increase of the butterfly. The pupal parasite (*Pteromalus puparum*), on the other hand, was found to have spread considerably from its original point of liberation, and that out of a total of 415 butterfly pupæ collected at random in the field 58 per cent. were found to be parasitized. During the present season further consignments of both larval and pupal butterfly parasites were imported and liberated. Four hundred and twenty-five thousand cocoons of the larval parasite were received from Farnham Royal, England, and from this material 240,000 parasites emerged and 5,000 hyperparasites. All of the latter on emergence were promptly destroyed. Two hundred and thirty thousand of the parasites which emerged were sent into the field. These were mainly concentrated in the Hawke's Bay locality, though a few were distributed in Gisborne, Tauranga, Taihape, Te Kuiti, and parts of the Manawatu district. From a brief survey of the Hawke's Bay locality, where the bulk of these parasites were liberated, only a small percentage of parasitized butterfly larvæ were obtained—not more than 3 per cent. were parasitized. It is not to be inferred from this, however, that these parasites are unsuccessful, as it often happens in biological control work that the insect which is the most difficult to establish subsequently proves the most effective.

With reference to the pupal parasites, namely *Pteromalus puparum*, 11,500 of these were distributed in the field, and again most of these were concentrated in the Hawke's Bay locality, though a few consignments were distributed in other places, including the Manawatu and Taihape districts. Of these 11,500 pupal parasites liberated, 8,000 were reared at the Station. A recent survey in the Hawke's Bay District, where the main body of parasites was concentrated, indicates that they have become thoroughly established there and are doing good work. They have spread over hundreds of square miles of the Hawke's Bay territory, and there seems little doubt that they were at least partly, if not wholly, responsible for the large reduction in the prevalence of the butterflies in that district. In one survey it was found that, out of a total of 5,300 *Pieris rapae* pupæ collected at random in the field, 90 per cent. were parasitized. This work to date has been so successful that it has been deemed advisable to extend our activities to the extent of attempting to rear pupal parasites in very large numbers during the coming year in order, if possible, to be able to liberate them in selected localities throughout New Zealand where the butterfly is prevalent. The work is now proceeding very satisfactorily, and we have at present 20,000 butterfly pupæ for parasitizing, and it is expected that at least another 20,000 or 25,000 will be secured before the commencement of the coming season.

Apart from the biological control methods in connection with the control of the butterfly, a certain amount of information has been gathered from experiments conducted with chemical control methods. Out of a number of materials tried, the most successful control obtained was from the use of calcium-arsenate dust used in the proportions of 1 part of calcium arsenate to 5 parts of hydrated lime. This material, if dusted at the requisite intervals as required, gives an effective control of the pest. The method, however, is only suitable for garden use or for the commercial grower of cabbages and cauliflowers. It is not a method that can be economically adopted in general farming practice in this country.

Diamond-backed Moth (Plutella maculipennis).

During the past season there has been no opportunity of furthering our studies in regard to this pest owing to the exceptionally large amount of work involved in the conduct of the white-butterfly investigations and other projects. A most important part of the work—a thorough investigation of its parasites in Europe—must remain in abeyance until further funds are available.

Greenhouse White Fly (Trialeurodes vaporariorum).

In my previous report it was mentioned that preparations for the receipt of the natural enemies of white flies from Farnham Royal were being made. I now have to report that the parasites (*Encarsia formosa*) of this pest which were imported have been successfully established, and in the late spring of last year we were able to distribute a small quantity of parasitized material to tomato-growers from the small colony which we were able to rear successfully during the winter months. Very few reports have yet come to hand concerning the effectiveness of this parasite, though in one case the report on its control was very favourable, and the grower in whose tomato-house the material had been liberated states that he had no further trouble from white fly.

Investigations of Oil Sprays for Red-mite Control on Orchard Trees.

Preliminary laboratory experiments to test ovicidal efficiency were carried out with twenty-six specially prepared oils on the winter eggs of red-mite. These oils varied in viscosities, methods of emulsification, and percentage of unsaturation. The winter eggs of two species of red-mite were used—viz., those of *Paratetranychus pilosus* and *Bryobia praetiosa*. The results obtained showed a striking difference in the killing-power of oils on these two species. *B. praetiosa* eggs were considerably easier to kill than were those of *P. pilosus*. Quickly breaking, unstable emulsions were found to be much more effective than were stable, permanent emulsions made with the same oils. The killing-power of stable emulsions was found to increase with viscosity, but with unstable emulsions a 100-per-cent. kill was secured with a considerably lower viscosity. Field experiments demonstrated that winter oils are most effective against red-mite eggs when applied as closely as possible to bud movement in the spring. Experiments have been planned for both the laboratory and the field in which relatively unstable emulsions will mainly be used, but this work is temporarily held up on account of pressure of work in connection with *Pieris rapae*.

Control of Grass-grub (Odontria zealandica) in Lawns, etc.

Experiments have shown that for turf a top-dressing of 5 lb. of acid arsenate of lead powder per 1,000 square feet of surface is an effective means of grub-proofing turf. Over large areas this quantity might be reduced to 2½ lb. or 3 lb. per 1,000 square feet to lower expenses, but the effect of the poison will not endure so long. The treatment has effectively kept out the grub for a period of twelve months after laying down, and should be effective for several seasons.

Naphthalene and similar preparations when injected into grub-infested turf have proved to be ineffective. Naphthalene dug into soil in which plants are soon after placed is liable to damage them when the dressing exceeds 3 oz. per square yard. Common salt (sodium chloride) has proved useless as a control of grass-grub. Box experiments were made to discover the effect of various manures on the effectiveness of the arsenate control. Superphosphate, sulphate of ammonia, and nitrate of soda were used. None of these impaired the efficiency of the arsenate after a period of eleven months, and there was no apparent detrimental effect on the growth of the grass. Manuring of grub-infested turf gave excellent results. The application of sulphate of ammonia in the autumn almost completely eliminated the damage caused. Further, the experiments showed that manures had no killing effect on the grub, except that calcium cyanamide proved toxic when used in pots but was non-toxic when broadcasted in the field.

Again, experiments showed that carbon bisulphide-Restar emulsion will not damage plants in open, grub-infested soil. This emulsion is safe to use on plants growing in cultivated ground during winter. Further work with carbon bisulphide-Restar emulsion has shown that watering on the chemical has no advantage over the injection method, except where it is undesirable to make holes in turf or where plants in cultivated ground are to be treated, in which case the emulsion may be applied more quickly unless a machine is used for injecting.

The use of Orach, or Canadian Spinach, sprayed with arsenate of lead again proved to be of no special value in reducing grass-grub infestations.

Bronze Beetle.

Following on from work previously reported upon, this project had been concluded. The previous work showed the value of the protection afforded young fruits by a complete cover of arsenate of lead. As stated in the last annual report, there is a minimum amount of arsenate-of-lead deposit required for effective control, and investigations with spreaders showed that these materials, while increasing the evenness of the film, were very prone to run too much spray off the fruit. The most effective type of cover that could be secured by spraying was a close "spot" one applied with a fine mist spray using acid arsenate of lead alone. Work with fish-oil and arsenate did not uphold previous results because the oil also ran too much arsenate off the fruit. Paris green gave a better killing effect on the beetle than did the same quantity of arsenate of lead, but the former material is very liable to cause injury. Barium fluosilicate gave approximately the same control as did arsenate of lead, but it too caused severe burning of the fruit. The conclusion reached in this work as far as spraying is concerned is that a good, even "spot" cover of arsenate of lead applied as a mist spray will give a good control, and where the beetle is troublesome it is advisable to endeavour to secure such a cover with 4 lb. of acid arsenate of lead per 100 gallons of spray.

BOTANY SECTION.

H. H. Allan, Systematic Botanist.

IDENTIFICATION OF SPECIMENS AND ADVICE THEREON.

As in previous years, this work has taken up a considerable amount of time, and the service is increasingly appreciated by inquirers. The interested parties are as classified in my previous reports. Interesting features of the year have been the interest taken in plants suspected of being poisonous to stock, the number of horticultural specimens sent in, and the attention to species of ecological value as indicator plants of soil and habitat conditions. The number of specimens received was about 4,000, ranging from individual examples to large collections. As one result of this work it has been possible to give timely notice of newly observed weeds likely to cause trouble if allowed to spread—*e.g.*, buffalo bur (*Solanum rostratum*), horse nettle (*Solanum carolinense*), saffron thistle (*Carthamus lanatus*) marsh thistle (*Cirsium palustre*), squirrel-tail grass (*Hordeum jubatum*). It has been pleasing to note the increased interest taken in these matters by the stock inspectors and instructors in agriculture of the Department of Agriculture.

HERBARIUM.

Numerous additions have been made to all sections of the herbarium—the indigenous, the introduced, and the exotic plants. Apart from their general utility for identification purposes, and for demonstration to visiting botanists, these collections serve as a basis for much of the systematic investigation carried out by this Section. Special attention has been paid to the grasses, and Mr. Zotov has collected largely the mosses of agricultural

importance. We are greatly indebted to Mr. G. O. K. Sainsbury, of Wairoa, for his assistance in the identification of this moss material. The policy of exchange with other institutions has been continued, much useful material having been received. In return we have been able to supply collections both of general interest and serving the needs of investigators abroad of special systematic problems. The herbarium now contains close on 20,000 sheets.

RESEARCH.

The investigations referred to in previous reports were carried on a further stage during the year. These deal with the grasses and rushes of New Zealand, the systematic description of the whole alien flora of New Zealand, with notes on the species of economic importance. In addition general researches on the systematics and ecology of various groups have been carried out. New investigations instituted during the year have been the work of Mr. Zotov on mosses and my own on lichens. In the course of the latter, opportunity has been afforded to specialists abroad to work up much material in a field that has long been neglected. I have undertaken to attend to the botanical side of an investigation into lucerne types. This is in co-operation with workers in other parts of the Empire and in Europe. The scheme is entitled an "International Test of Types of Lucerne." The types being studied at the various co-operating centres are—Khivian, Semiryechensk, Turkmen, Turkestan, Asia Minor, Hungarian, Provence, and Grimm. The aim, so far as this Section is concerned, is "to find out the regularity in the arrangements and change in morphological, physiological, and biological characters as affected by environment." The plots were laid down in January. Germination was excellent in all cases, and the plants have now been singled for study of their botanical characteristics.

ROOTSTOCK INVESTIGATIONS.

As a result of the work already carried out we have now been able to make definite arrangements for the conduct of these researches. The work has been classed under four heads: (1) The testing of the No. 1 type of Northern Spy rootstock selected by this Station against three of the East Malling types, on three scion varieties; (2) the testing of stocks derived from root-cuttings against those derived from layering; (3) the testing of various strains in different apple varieties on uniform stocks. Strains of Delicious have already been budded for this test, and other selected varieties will be taken up next season; (4) the testing of a number of stocks that have shown in orchards the production of trees of outstanding merit. The aim is to discover how far this merit is due to stock influence. Mr. Woodhead has zealously carried out his duties in this work.

SEED-TESTING SECTION.

N. R. Foy, Seed Analyst.

For the calendar year ending December, 1933, a total of 15,193 seed samples were received for purity analysis and/or germination tests, representing an increase of 3,243 on the number tested for the same period in 1932. This work necessitated the making of 9,000 purity tests and 15,000 germination tests—a total of 24,000 tests. Of the total, approximately 12,700 samples represented commercial lines of seed, the balance of 2,500 representing chiefly samples tested for the Department's own information, only 239 having been submitted directly by farmers. For the same period 1,824 samples of perennial rye-grass were examined under ultra-violet light, of which total 1,455 were reported for departmental purposes, mainly in respect of certification. During the year 1,608 officially drawn samples of certified seed were tested and reported to the holders of the seed. A total of 1,386 samples of certified rye-grass seed were examined and 39, or 3 per cent., were rejected as having failed to conform to the required standard of purity for machine-dressed seed. The annual revenue obtained from the testing of commercial samples totalled approximately £1,100.

State Seed Purchasing.—For the financial year 1933–34, selections based on unit value were made of 600 lines of seed, representing a total purchase of 307 tons of seed valued at approximately £22,000. Check tests were made on samples drawn from the bulk deliveries and reported to the Stores Purchasing Officer with necessary commentary as to the agreement of quality of purchase and bulk samples.

INVESTIGATIONAL ACTIVITIES.

Deterioration of Seed during Shipment.

Further experimental shipments were made during the year with Chewings fescue, the seed used being that specially grown under various manurial treatments on the Experiment Area at Gore. The 1933 season was a particularly favourable one, and as the seed was of a high vitality, marked deterioration under ordinary hold storage conditions did not occur. The specially treated lots, however, did not suffer any losses at all. The whole of this work has been tabulated and summarized and is now in the press for publication.

Production of Paspalum Seed in New Zealand.

Arrangements were made in co-operation with the Fields Superintendent at Auckland for the fencing-off of a number of small areas suitable to the experimental production of seed. Owing to a most unfavourable season very little seed has been produced this season, certainly insufficient for the experiment. The areas will be closed again next year, together with additional plots. A number of samples are being collected throughout the northern districts and will be forwarded for analysis. Further laboratory work has been done, the results of which confirm the previous impression that New Zealand growers appeared to be unacquainted with the harvesting requirements peculiar to paspalum seed.

The Use of the Picric-acid Test in Strain Diagnosis of White Clover.

Approximately 1,000 of these tests have been made, there being generally a close conformity between the classification as determined by the test and plot trial. A small number of lots which show apparent discrepancy are at present under retrial in plots, and on the results of these the degree to which the picric acid may be employed will be determined.

Differentiation between Seedlings of Early- and Late-flowering Strains of Red Clover.

Preliminary trials employing the difference in response of the two types to continuous lighting have been made, and the indications are that distinct separation can be effected. The test takes approximately three weeks to complete.

Low Germination of Perennial Rye-grass.

The work during the year has been largely confirmatory of that previously done and reported. There does not appear to be any convenient method which can be devised to control the disease responsible for the trouble in certain districts, and more particularly in Southland. The isolation in Southland of resistant native strains of a fair average type of perennial appears to be the most hopeful solution so far as seed production in that district is concerned.

GENERAL.

Statistical material covering trade matters and seasonal quality standards has been tabulated and distributed. Advisory correspondence covering questions relating to seed production, trade, quality, testing, &c., has been dealt with.

It is desired to record appreciation of the loyal co-operation of the Station staff during a record year.

CHEMICAL SECTION.

B. W. Doak, Chemist.

MARTON MOWING TRIALS.

Work in connection with pasture and soil samples from these trials has continued. Particular attention has been given to the movement of added phosphate to the soil and also to the movement of carbonate of lime applications as affected by the rate of application. Analyses are also in progress in connection with an investigation of the effect of lime applications on the movement of phosphate from superphosphate, basic slag, and North African phosphates.

RAPE.

An investigation into the chemical composition of the various types of rape was carried out at the request of the Agronomist, and an attempt has been made to correlate the chemical data with data from feeding trials.

WHITE CLOVER.

During the latter part of the year about 1,320 samples of white-clover herbage from the certification plots and the plots of the Agrostologist have been analysed for hydrocyanic-acid content. The correlation between HCN content and type has been well maintained, but in general the figures for the current year have been considerably lower than in previous years. This shows the necessity for the frequent control plots.

DAIRY DIVISION.

REPORT OF W. M. SINGLETON, DIRECTOR.

The Season.

Although the weather throughout the dairying season has been extremely variable, conditions in most districts have been fairly favourable for the production of butterfat. With the exception of Marlborough and Nelson, where an extremely dry summer and autumn were experienced, and to a somewhat lesser extent in the lower Manawatu, there has been a fairly good growth of pastures, and the maintenance of the milk-supplies has been above the average. An evenly distributed rainfall in most districts has to a great extent compensated for the lesser quantities of top-dressing fertilizers used during the year. Good hay and ensilage crops have been harvested, and in some localities excellent root crops are in evidence, and with these supplementary crops it is anticipated that dairy herds will commence the next lactation period in good condition.

Production.

In the year ended 31st March, 1934, the cheese graded reached the 100,000 tons mark for the first time in the history of New Zealand dairying, the butter having done so in 1932. During the year 142,287 tons of butter and 105,088 tons of cheese came forward for grading, as compared with 123,112 tons and 97,660 tons respectively for the previous year, an increase of 19,175 tons of butter (equal to 15·57 per cent.) and 7,428 tons of cheese (representing an increase of 7·60 per cent.). In butterfat equivalent the increase represents 18,832 tons, or 13·43 per cent.

Owing to the increased prices ruling for wool it is probable that many wool-growers who on account of the adverse economic conditions had previously established dairy herds as a side-line may discontinue supplying milk and cream to dairy companies as from the end of the present dairy year.

Creamery Butter.

The quality of the creamery butter graded has been well up to the high standard of recent years as indicated by the returns from the various grading ports. Of the total of 140,471 tons graded, no less than 109,478 tons, or 77·93 per cent., reached the finest class, 29,432 tons, or 20·95 per cent., the first grade, and 1,561 tons, or 1·12 per cent., scored under first. The latter class, where exported, is so disposed of in Britain that it does not come into competition with the better qualities. The average grade of all creamery butter graded was 93·097 points, as compared with 93·127 for the previous year.

Owing to the vagaries of the weather, feed flavours were in evidence in some districts during the earlier part of the season, and these persisted for a more lengthy period than usual. Some complaints have been received from the Trade that some of the butter packages in use are not giving satisfaction, inasmuch as dust and sawdust gain entrance to the butter and cause a certain amount of loss as well as difficulty in their disposal. It is the considered opinion of most overseas traders that all butter packages from New Zealand should be reinforced with metal binding. The universal use of a high quality package is therefore stressed. Advices received from our officers in Britain concerning the quality of the butter so examined at that end fully bear out the quality as graded in the Dominion.

Whey Butter.

The production of this class of butter shows a slight increase over last year, the figures being 1,811 and 1,797 tons respectively. A slight improvement in quality is evidenced by the grading figures, but there is still room for the quality to be further improved. Provided the cream is handled and treated carefully, good-quality whey butter can be manufactured. All whey butter exported is now disposed of so that it is not brought into competition with finest or first grade creamery.

Cheese.

It is pleasing to record a considerable improvement in cheese quality during the year. Of the 105,088 tons graded, 24·27 per cent. were scored finest grade, 73·96 per cent. first grade, and 1·77 per cent. under first grade, as compared with 19·31 per cent., 78·60 per cent., and 2·08 per cent. respectively for the previous year, the average grades being 92·086 and 91·692.

Generally speaking, the bulk of our cheese in flavour and quality is commercially good. Texture is the feature most in need of improvement, and provided all the cheese were as close as the best of many makes there would be little cause for criticism. The raising of the minimum grade points for first grade from 90 to 91, which was effected during the year, has been an incentive to improve much of the lower-scoring cheese. Increased attention to temperatures and humidity in the curing-rooms, the use of a better-quality bandage, and the absence of cracked rinds have contributed largely to a greatly improved finish.

Some difficulty has been experienced by managers in maintaining a good starter. More attention, however, is now being given to the installation of suitable equipment for maintaining the quality of the mother culture, as cheese-makers are realizing that the borrowing of starters from neighbouring factories is unreliable. The maintenance of a good virile starter is essential if consistently good cheese is to be manufactured. Reporting recently from London, our Mr. Wright states: "With regard to the average quality of our cheese there has been few complaints, and the general opinion of the Trade is that we are now building a closer cheese than was the case in the past, and this is very encouraging."

Cheese made from pasteurized milk totalled 87 per cent. During the year a regulation was gazetted prohibiting the export of waxed cheese unless by the express request of the importing firm that the cheese be so coated. As a result of the numerous requests received 52 per cent. were so treated.

Export Values.

Prices for dairy-produce during the year have evidenced a very low range, values for butter having fluctuated between 65s. and 110s. per hundredweight and cheese between 38s. and 55s. It is pleasing to record, however, that the total value of all dairy-products exported exceeds last year's figures by £603,717. According to the Customs figures of exports, values of butter, cheese, dried milk, casein, condensed milk, and cream and milk sugar totalled £16,887,854, as compared with £16,284,137 for the previous year.

Casein.

The grading of casein, which is optional, is carried out at only three ports—*i.e.*, Auckland, New Plymouth, and Wanganui. A total of 1,868 tons came forward for grading, as compared with 1,346 tons for the previous year, an increase of 522 tons. In addition, 753 tons passed through Auckland port ungraded. The total exports for the year amounted to 2,594 tons, of a value of £121,400. The quality has been uniformly high.

Testing of Butter for Moisture and Salt Content.

To safeguard the position in so far as the possible entry of overmoisture butter into Britain is concerned the system of testing a box of each churning for moisture has been continued. During the year no less than 195,512 churnings were tested, which exceeded by 19,416 the tests carried out during the previous year. Only 0·4 per cent. exceeded the legal limit of 16 per cent., and these were withdrawn from export and returned to the factories to be reconditioned.

The legal requirements for the salt content of salted butter ranges between 1·5 per cent. and 2 per cent., although consignments have been allowed to go forward for shipment containing not less than 1·25 per cent. The number of salt tests carried out during the year totalled 183,229, the percentage of churnings outside the range permitted being 0·4. These were withheld from shipment. Authenticated requests for butter with a salt content outside these limits to fill special orders have been relatively small.

Grading of Cream.

The grading of cream in accordance with the regulations is now part of the general routine at butter-factories, and cream-graders are on the whole adhering closely to the standards set for the various grades. In a few instances a tightening-up of the standards has been found necessary, but it is generally recognized that any slackening in the grading of the cream results in a corresponding lowering of the quality of the butter.

Grading of Milk.

The grading of milk with differential payments according to grade, which was introduced during the previous season, so improved the quality of the milk-supply to cheese-factories that it was deemed advisable to frame regulations making compulsory payments for two grades, first and second, giving companies the option of making payment of a higher grade with a higher payment. It was further decided to apply the grading to milk supplied to butter-factories, that the grades be three, as in the case of cream grades—viz., finest, first, and second—and that the grading of milk for cheese-making be based on the curd test in conjunction with either the reductase test or microscopic test, and of the milk for butter-making on either one of these tests or the curd test together with the reductase or microscopic test. These regulations came into force as from the 1st August, 1933.

The curd test and reductase test are almost exclusively used, and are operated on the factory premises by the certificated milk-graders. By means of the curd test it can be demonstrated to suppliers of poorer quality milk that the quality is as indicated by the grade, and in many instances steps have been taken to effect the desired improvement.

Cheese-factory managers are unanimous that this method of grading is on sound lines, and the consensus of opinion is that the quality of the milk generally has been raised to a higher standard. This is reflected in the improved quality of the cheese output for the year.

Farm Dairy Instruction.

During the year thirty-five Farm Dairy Instructors—which is one more than for the previous year—have been employed by eighty-three dairy companies with approximately 32,866 suppliers. Of the total Dominion gradings of 142,287 tons of butter and 105,088 tons of cheese, the companies under farm dairy instruction forwarded for grading 89,288 tons of butter, equal to 62·75 per cent., and 47,382 tons cheese, or 45·08 per cent., of these totals. As there are approximately 71,837 suppliers to dairy companies throughout the Dominion, there are therefore no less than 38,971 suppliers who are not under direct supervision in so far as their supplies of milk and cream to the factories are concerned.

Expensive machinery has been installed in many factories in anticipation of correcting faults which arise on the farm, but it should be realized that the resultant quality of the finished product depends largely on the quality of the raw material on arrival at the factory. With a tightening of the milk and cream grading, combined with national farm dairy instruction, a higher standard of butter and cheese manufacture could be brought about by the delivery at the factory of consistently better raw material from the farm.

Inspection of Milking-machines.

Notification of 1,781 installations of new and reconditioned milking-machine plants were received during the year, as compared with 2,042 for the previous year. As these installations require to be "passed" by officers of the Division, this duty devolves on farm dairy inspectors, the two special inspectors, and elsewhere on the butter and cheese instructors as opportunity offers. In all, 1,995 machines were inspected, 1,328 installations being passed on first inspection; 654 required further inspection, generally on account of structural arrangement in the cow-sheds not being in accordance with the requirements of the regulations; and thirteen were condemned as not being suitable. The majority of the milking-machine firms are carrying out these installations in a satisfactory manner, but in a few instances it has been found that the engine has been installed in the same room as the separator. Where such infringement has been made a notice has been issued to the effect that any such further contravention of the regulations would necessitate the institution of legal proceedings.

Check Testing Suppliers' Milk and Cream Samples at Dairy Factories.

The check testing of milk and cream samples of dairy-company suppliers is now being systematically carried out by the butter and cheese instructors and the two special inspectors, and during the year 545 check test visits were made, as compared with 485 the previous year. A regulation was gazetted recently making it obligatory for users of the Babcock testing method to provide 50 per cent. by 9-gramme test bottles graduated to $\frac{1}{2}$ per cent., and also to provide a hot-water bath from which to read the test. In factories where these facilities have not been hitherto provided this is being given attention. Reports from our officers indicate that the factory tests are being carried out satisfactorily. Complaints from suppliers are rarely met with, and it is now the exception for the Division to receive a milk or cream sample for check testing from a supplier dissatisfied with his factory test.

Dairy Laboratory, Wallaceville.

During the past year the work of the Laboratory, under the supervision of Dr. G. M. Moir, has consisted chiefly in assisting the instructional staff of the Division in their efforts to improve the conditions under which starters are kept in cheese-factories. The most up-to-date information relating to the preparation and care of starters has been gathered together and published as the Department's Bulletin No. 162, "Starters for Cheese and Butter Making." This includes also a description of a simple mother-culture outfit which was designed in the Laboratory and has been found to give very satisfactory results under factory conditions.

Many starters have been examined, and numerous reports have been received showing that, after defects have been pointed out, more care has been taken, with the result that less starter trouble has been experienced and better cheese has been made. Unfortunately, the work involved has permitted only a small proportion of the factories to have more than one examination made of their starters. As compared with the previous season the results of these examinations show an improvement, in that the proportion of badly contaminated starters has been reduced. The extension of the practice of keeping a mother culture has usually given improved results, provided a sound method is used and the necessary care taken.

An increasing number of samples of water have been examined chiefly for bacteriological contamination, and recommendations have been made for their improvement. In one case a butter-factory installed a filter based upon plans supplied from the Laboratory. The grade of the butter was thereby raised to finest, and the keeping quality was materially improved. Arrangements are contemplated to extend this class of work as far as the limited facilities permit.

With a view to encouraging factory-managers to take more care of their curing-room conditions, a short pamphlet entitled "Humidity Control in Cheese-curing Rooms" has been published and distributed to the factories.

In addition to the starter and water samples already mentioned, numerous other samples have been received for chemical and bacteriological examination. A considerable number of other tests have also been carried out in the Laboratory as a guide to the work in progress. There is no doubt that if additional assistance were available the value of the Laboratory in assisting the instructors and graders could be considerably extended.

Special Investigation: Cheese-manufacture.

In October the Division took over charge of the Rukuhia Cheese-factory of the New Zealand Co-operative Dairy Co. This was done at the request of the Dairy-produce Board, which, in conjunction with the New Zealand Co-operative Dairy Co., agreed to provide a portion of the costs. Special provision was made to provide for a milk-supply which, from a sanitary standpoint, would leave little to be desired as milk for cheese manufacture. Each farm dairy had a sufficient water-supply for cleansing and cooling purposes, and was provided with sterilizing facilities for treating milking-machines and milk utensils.

The Live-stock Division co-operated in the conduct of the experiment by examining many samples of milk from cows of the various herds, with particular reference to mammitis. The Scientific and Industrial Research Department also kindly supplied a report on the soil-survey of the farms of the suppliers to Rukuhia, together with a map showing the different soil-types on the farms concerned.

The object of the experiment was to determine whether a clean and cooled milk from healthy cows would, if manufactured under good conditions, produce a resultant cheese which would evidence all the desirable qualities of a cheddar cheese, including closeness of texture.

The work commenced on 1st October, 1933, and was continued throughout the remainder of the financial year. The suppliers' milks were graded each day by the curd and methylene blue tests at the factory, and periodically examined by Mr. Udy, Scientist to the New Zealand Co-operative Dairy Co., as for microscopic count. The manufacture was in charge of Mr. H. A. Foy, of the Dairy Division, and the company's manager of the factory, Mr. A. Laurent. The cheese has been manufactured for export, and the various consignments are being reported on by the Dairy Division's officers in London. A general summary will be compiled after the work is completed and London reports all to hand.

Dairy-factory Managers—Regulations, 1934.

At the request of the New Zealand Dairy-factory Managers' Association, regulations were framed making it obligatory on all dairy-factory managers to register as such, and these were gazetted on the 22nd February, 1934, and came into force as from the 1st April. Provision is made therein that on application and payment of the prescribed fee of 10s. every person who is employed as a manager of a creamery or cheese-factory or both on the coming into force of the regulations shall be entitled to an appropriate certificate of registration, provided he is of good character and reputation. Provision is also made for the registration of persons not employed as managers who, by virtue of their qualifications and experience, are deemed competent to perform the duties of a manager. A Board of eight members, to be known as the Dairy-factory Managers' Registration Board, has been set up, and it will be the function of the Board to administer these regulations effectively.

Inspection of New Zealand Dairy-produce in Britain.

This work, as in the past, has been carried out by Messrs. W. Wright and F. H. Taylor, assisted over a portion of this year by Mr. G. M. Valentine, who formerly was Dairy-factory Superintendent at Massey College, and who relieved Mr. G. V. Were, the latter returning to New Zealand in August last. Many reports on the quality and condition of the produce on arrival in Britain have been forwarded to the Division, which, after perusal, are sent on to the dairy companies concerned. As a means of checking up the grading at this end these reports are of the greatest value. In addition, these officers keep in close touch with and report on all matters of interest to the industry. Mr. Valentine will be returning to the Dominion towards the close of the present dairy year.

Certificate-of-record Testing.

The 1933 results for C.O.R. testing showed a slight increase over 1932. Considering that the depression was practically at its worst during the period under review, this position must be considered very satisfactory. First-class certificates of record were issued to 507 cows in 1933, and of this total 461 cows qualified in the Yearly Test Division and the remaining 46 in the 305-day Division. In addition, 38 second-class certificates were issued. These totals compare with 486 first-class (43 of these being the 305-day Division) and 25 second-class certificates issued in 1932.

The first certificates under the recently introduced "III Class C.O.R." division were issued during the calendar year 1933, the number being 86; of these, 53 were for records completed during the year, the remaining 33 applying to past records and issued by special request of the owners of the cows concerned.

Government Official Herd-testing.

Whereas the C.O.R. system is classified in calendar years, the official herd-test year closes on the 30th September, and to that date in 1933 the O.H.T. system had completed six years' operation. For the year under review 1,692 cows were tested, these being in the herds of 163 C.O.R. testing breeders. This represents an increase of three breeders and a decrease of 106 cows over the year ending 30th September, 1932. On the basis of all cows in milk 180 days or more, the average yield of the cows tested under this system last year was 309·78 lb. butterfat, as compared with 289·94 lb. for the preceding twelve months, an increase of 19·84 lb. butterfat.

Ordinary Dairy-herd Testing.

Herd-testing reached a peak during the 1932–33 season, the number of cows tested and the average production per tested cow being the highest figure yet attained. Some 286,054 cows were systematically tested, their average production being 255·57 lb. butterfat. This compared with 259,857 cows and 236·87 lb. butterfat for the 1931–32 season. Nearly 91 per cent. of the total tested were tested under the group system (259,881 cows), while 25,364 cows were tested under the Association Own-sample system, and the balance of 809 by the dairy companies on behalf of their suppliers. The tested cows represented approximately 16·6 per cent. of the total cows in milk in the Dominion. The Government subsidy to herd-testing was continued, £6,000 having been granted for the past season. Several meetings of the N.Z. Herd-testing Central Executive were held during the year.

Appreciation.

The year has been a particularly arduous one for the staff, and their able and efficient co-operation is gratefully acknowledged. Thanks are also extended to co-operating organizations for their assistance and co-operation during the year.

HORTICULTURE DIVISION.

REPORT OF J. A. CAMPBELL, DIRECTOR.

The Fruitgrowing Industry.

Notwithstanding the changeable weather conditions which prevailed throughout the growing-season, the crop of apples and pears in the majority of the commercial fruitgrowing areas in the Dominion was above the average, some localities producing heavy crops. Continued dry weather resulted in a considerable quantity of undersized fruit, which was unsuitable for export on this account. The stone-fruit crop was on the light side, and small fruits were also affected by the dry conditions. One of the heaviest late frosts experienced in Central Otago occurred on the 22nd and 23rd October last, and caused severe losses, the crop being practically wiped out in some localities and considerably reduced in others. Some damage from the same cause also took place in portions of the Nelson, Marlborough, and Hawke's Bay Districts, and a hailstorm seriously affected a number of orchards in the Canterbury District.

No serious outbreak of disease occurred during the year, the majority of orchard pests and diseases being kept under control. Mealy-bug is becoming troublesome in some districts, and its effectual control is causing concern. The operations of the natural enemy recently introduced are being looked forward to with interest. Reports to hand indicate that there has been no further spread of fireblight in the gazetted areas. A slight outbreak occurred in an isolated locality near Nelson. Steps for its control were taken immediately by the departmental officers, and so far the disease has made no further headway.

The continued depressed condition of the markets is beginning to show its effect in orchard-management generally, a great many growers, through lack of finance, finding it extremely difficult to satisfactorily carry out all the details necessary in the running of an up-to-date orchard.

A good demand has existed for New-Zealand-grown lemons, and growers have experienced a very satisfactory year. This is largely due to the embargo at present operating against the introduction of citrus fruit from Australia. There has been a tendency, however, in view of the increased prices prevailing, to market a considerable percentage of immature and poor-quality fruit. Proper grading and curing of lemons is a necessity, and the best marketing returns cannot be obtained without these. The Poorman orange appears to be gaining in popularity throughout New Zealand, and it is anticipated that further planting will be undertaken in the near future. This fruit is generally coming into favour, and will undoubtedly in time become a favourite breakfast fruit, besides being valuable as a beverage.

There has been a falling-off in the quantity of passion-fruit grown in the North Auckland District, due largely to the unsatisfactory state of the local markets and the cost of conveying the fruit to the main centres. Operations are still being continued in the extraction of passion-fruit juice, which is being shipped overseas.

In November last the Director of the Division (Mr. J. A. Campbell) proceeded to the United States of America for the purpose of investigating the possibilities of fostering an apple and pear export trade with that country. He also visited Canada to ascertain the position there, and later proceeded to the United Kingdom to look into the market conditions and the out-turn of fruit shipments arriving from New Zealand.

Export of Fruit.

The quantity of fruit shipped overseas during the 1933 export season amounted to a total of 1,430,513 cases, which showed a decrease of some 165,000 cases as compared with the previous year's figures. This was due to the apple crop being lighter than usual and a considerable percentage consisting of oversize fruit which was not suitable for export. Of the total exported, 1,055,109 cases of apples and 106,062 cases of pears were forwarded to Great Britain, 89,538 cases of apples and 154 cases of pears to the Continent of Europe, 87,186 cases of apples and 1,238 cases of pears to South America, 45,281 cases of apples and 19,228 cases of pears to Sweden, and 26,717 cases of apples to Canada.

The bulk of the fruit was exported under the Government guarantee of 10s. 6d. per case for "extra fancy" and "fancy" grades and 7s. per case for "good" grade. The guarantee was also conditional on each exporter contributing 1½d. per case on all fruit exported under the guarantee, the fund thus created to be utilized to offset claims arising from market and transportation losses. In the event of the fund not being sufficient to meet such claims, the Government undertook to bear the balance of any expense that might be involved. The bulk of the 1933 shipments arrived in good condition. Cox's Orange Pippin was, however, more or less affected with bitter pit, which considerably affected the prices realized for this variety. While returns at the beginning of the season were fairly satisfactory, the market later became glutted with very heavy consignments of apples from Australia, with the result that a downward rush of prices followed, which remained at a low figure until the end of the season. The following figures show the total number of cases of apples and pears exported from the Dominion during the last five years: 1929, 992,151 cases; 1930, 1,330,891 cases; 1931, 1,349,895 cases; 1932, 1,596,058 cases; 1933, 1,430,513 cases.

The trial shipment of 42 crates of peaches forwarded from Otago to London in April, 1933, arrived at its destination in a firm condition. Reports to hand indicate that the appearance of the fruit was quite good and colour satisfactory. It was, however, lacking in flavour, suggesting that the fruit had been shipped in a rather immature condition. Advices from London in respect to the 100 crates

of plums from Hawke's Bay stated that the fruit opened up well and gave a good impression. The flavour, however, indicated that the plums were more suitable for culinary than for dessert purposes.

The 1934 fruit export season, which is now in full swing, promises to be a heavy one, and it is anticipated the total shipments will exceed 1,500,000 cases. The first of the season's shipments left Wellington per s.s. " Mataroa " on the 7th February.

Local Markets for Fruit and Vegetables.

The local markets have been kept well supplied with fruit and vegetables during the year. Reports to hand indicate a general improvement in the grading and packing, especially in regard to vegetables, there being less evidence of topping having been resorted to. Prices realized for fruit varied according to the markets, but in the main growers had to be satisfied with fairly low returns. Vegetables, generally speaking, were in better demand, and were a more profitable proposition. A considerable quantity of fruit was disposed of in some of the main fruitgrowing centres by motor-lorry to outlying districts, and this method of distribution relieved the situation to a fair extent.

Imported Fruit, Plants, etc.

The Inspectors at the different ports of entry in the Dominion report a substantial decrease in the quantity of fruit imported as compared with the previous year's figures. This was largely due to the embargo at present in force on the importation of fruit and vegetables grown in the Commonwealth of Australia. An arrangement was subsequently entered into by the Government whereby a certain quantity of citrus fruit was allowed entry from South Australia, which is free from the Mediterranean fruit-fly.

The bulk of importations from all countries arrived in good condition, and the quantity condemned for disease infection was comparatively small. Several consignments of walnut meat were on examination found to be infected with the larvae of the Indian meal moth, and, following the usual procedure, were handed over to the Health Department for such action as was considered desirable. There was a considerable decrease in the quantity of bananas from Tonga, due to a hurricane which destroyed many of the plantations. Fruit imports from the United States of America showed a substantial increase. The first shipments of fruit from Jamaica arrived during the year, and comprised some 8,500 cases of oranges and 350 cases of grape-fruit. All the lines were very favourably commented upon.

Fruit Cool Storage.

The many problems connected with the cool storage of fruit, both in regard to shipments forwarded overseas and in the various cool stores in the Dominion, have received a considerable amount of attention.

Experiments in regard to some of the main factors influencing the keeping qualities of apples were carried out in co-operation with the Department of Scientific and Industrial Research, and included soil-type and localities, drainage of orchard soils, maturity at time of gathering, packing and other relative operations, wraps and pads (their relation to the incidence of scald in Jonathan apples), storage and transport temperatures. A trial was also carried out to test the effect of cold storage on Jonathan and Premier varieties of apples known to be affected with corky core. Other cold-storage experiments included tests with pears, passion-fruit, peaches, plums, and lemons. In carrying out the above investigations a large amount of data has been accumulated, and considerable information of immediate value to the fruit industry obtained.

The loading and stowage of fruit on board the overseas vessels has been further given a good deal of time and attention with the view of obviating as far as possible the damage caused by rough handling. While there has been more co-operation by the representatives of the shipping companies and Harbour Board officials in bringing about an improvement, more remains to be done in this direction. Numerous requests for advice on various phases connected with fruit cool storage were dealt with during the year.

Instructional and Experimental Work.

Full advantage is taken by growers and others of the opportunities existing of obtaining advice and practical instruction in all phases connected with fruitgrowing, &c., and in this connection lectures and demonstrations are given by the instructors in the various districts, and advantage is also taken of opportunities of addresses on suitable subjects by wireless. A good deal of the improvement that has taken place in the grading and packing of fruit is due to the classes on these subjects conducted by the orchard instructors in the main commercial centres during the winter months in co-operation with the Fruitgrowers' Associations. The opportunity of obtaining the departmental certificate of competency in apple grading and packing is fully appreciated by those attending the classes. The same applies to the examinations held for the certificate in orchard pruning and spraying.

A considerable amount of work has been dealt with during the year in connection with the orchard research programme in conjunction with the scientific officers attached to the Plant Research Station, Palmerston North, and the services of the field officers of the Division have been fully utilized in carrying out the details attached to the various experiments. As mentioned in my previous report, the operations are of an extensive nature and cover the testing of spraying specifics and other materials for the better and more economic control of diseases and insect pests; orchard manurial experiments; root-stock tests, including pip, stone, and citrus; pear pollination, &c.

Valuable results have been obtained in a number of instances, especially in regard to disease control, and the information is being made available to fruitgrowers, the majority of whom evince a keen desire to adopt the most up-to-date and economical methods in orchard-management generally

Spraying and manurial tests are also a feature of the work conducted at the Research Orchard, Redwood's Valley, Nelson, in co-operation with the Department of Scientific and Industrial Research, and considerable interest is being taken in the various operations by growers in the Nelson District and elsewhere.

With the object of ascertaining the commercial possibilities of filbert-growing in the Dominion, a number of trees of the species *Corylus maxima* have been distributed to several districts for trial purposes. It is also intended to carry out experiments at a later date with the species *C. colurna*.

Viticulture and Wine-making.

An increasing interest is being taken in grape-growing in the Dominion, both for table and wine-making purposes. New-Zealand-made wines are gradually coming more into favour, and there is an indication of the demand reaching considerable dimensions in the near future.

In the grape-producing districts, with the exception of North Auckland and Hawke's Bay, where unfavourable weather conditions prevailed, the crop of outdoor-grown grapes, both for table and wine purposes, was above the average and of excellent quality. The season's output of wine is estimated at 138,150 gallons, a substantial increase on the previous year's figures, and represents a wholesale value of £48,352.

Vines grown under glass produced good crops, and satisfactory prices were realized for well-grown fruit. A gradual increase is taking place in the number of vinehouses devoted to grape-growing.

Cider-making.

A reduction is noticeable in the quantity of cider manufactured during the year, the total quantity produced being estimated at 30,000 gallons, valued for commercial purposes at £7,500.

Te Kauwhata Horticultural Station (Lower Waikato).

Although an unusually cold winter and dry summer were experienced, timely rains facilitated growth generally, and an abundance of feed was available during the whole year. Approximately 10 acres of grass were converted into hay for future use, and 2 acres of wattle plantation were stumped and added to the vine nursery.

As a result of favourable weather conditions, the grape crop was a heavy one, and produced 15,500 gallons of wine. Sales of wine during the year amounted to a total of 15,846 gallons, which realized £6,905, a considerable increase on the previous year's figures. There was a heavy demand for vine cuttings, especially of those varieties newly introduced by the Department. The financial position of the Station is satisfactory, receipts exceeding expenditure by some £2,400.

Tobacco-culture.

There has been a reduction in the area planted in tobacco for commercial purposes during the year. This was largely due to the fact that the manufacturing companies operating in the Motueka district, where the bulk of the crop is grown, intimated to growers at the beginning of the season that only the amount of leaf contracted for would be purchased, thereby placing a limit on the area planted. The total area under tobacco in the Dominion was approximately 2,500 acres, the bulk of which—some 2,000 acres—being cultivated in the Motueka district. In the other tobacco-producing districts the acreage was: Auckland, 334 acres; Nelson, 60 acres; and Marlborough, 16 acres. A considerable quantity of tobacco was also grown in garden plots for private use.

The past season was a very trying one for tobacco-growers. Continued dry weather retarded the growth of the plants when set out, and in some cases replanting had to be resorted to. A severe hail-storm in December ruined a large number of plants in a portion of the Motueka district, and that district was also visited by a disastrous frost on the 22nd January which caused serious damage.

Although the prices paid to growers were on a lower basis than those operating last year, the returns for good quality leaf were considered satisfactory.

A further twenty families have been settled under the Small-farm scheme at Pongakawa, where they are engaged in tobacco-growing. Six new flue-curing barns have been erected at this settlement, and a glasshouse provided for the raising of tobacco-plants.

Several tests in connection with leaf production were carried out on the plot established in the Auckland District, and a further quantity of tobacco-seed was produced.

Hop-culture.

In view of the market conditions for hops having shown a considerable improvement recently, an extension has taken place in the area planted, and the prospects at the present time are much brighter than has been the case for a number of years past. The season's crop, which has just been harvested, is of a good, heavy, bright quality, and satisfactory prices should be realized. The quantities in hundredweights and values of hops exported from the Dominion during the last five years ended 31st March were: 1930, 2,402, £14,378; 1931, 1,943, £9,108; 1932, 640, £2,597; 1933, 3,192, £13,793; 1934, 3,872, £17,734.

Tung Oil.

The planting-out of further areas in tung-oil trees in the North Auckland District has been steadily proceeding during the year. It is estimated that the total area now planted is between 3,000 acres and 4,000 acres. As mentioned in my previous report, it is not possible to give any indication as to the success or otherwise of this venture until the trees reach a bearing stage and nuts are available for analysis and testing. The importance of adequate shelter for the satisfactory growth of the plants is a feature that is now being more realized by the companies operating.

New Zealand Institute of Horticulture.

The New Zealand Institute of Horticulture, established in 1923, continues to carry out valuable work in connection with the various branches of horticulture generally within the Dominion. Horticultural education, including fruit-culture, forms one of the main objects of the activities of the Institute, and the opportunity thus afforded is being taken advantage of to an appreciable extent by persons desirous of sitting for either a diploma or certificate issued by the Institute. Certain revisions in the conditions connected with the Loder Cup being necessary, the usual competition did not take place this year. The cup has now been competed for in the four main centres—viz., Auckland, Wellington, Christchurch, and Dunedin.

Orchard Registration and Orchard-tax.

Registered orchards in the Dominion now total 6,406, comprising 2,873 taxable and 3,533 non-taxable, the total amount of tax payable for the year being approximately £1,350. A number of unthrifty orchards were cut out during the year, and others were reduced to less than 120 trees, thereby becoming non-taxable. Owing to the general depression some difficulty is being experienced in collecting the tax in quite a few instances. All orchard-tax collected is paid over to the N.Z. Fruitgrowers' Federation, Ltd., on behalf of the growers—less the cost of collection—to be utilized in the furtherance of the interests of the fruitgrowing industry generally.

The collection of fireblight-tax in five commercial fruitgrowing districts has also been attended to, the proceeds—less collection expenses—being handed over to the fireblight committees concerned for purposes associated with fireblight control.

Registration and Inspection of Nurseries.

A total of 669 nurseries was registered during the year, being a slight decrease on the previous year's figures. The sum of £669 was collected in nursery-registration fees.

The Beekeeping Industry.

The past year may be described as a disappointing one to the majority of beekeepers throughout the Dominion. As the summer approached, unsettled weather set in, and a continuance of unseasonable conditions resulted in the honey crop being patchy and well below normal, the poor returns applying more particularly to the South Island.

Although the industry is in a very unsettled condition, beekeepers are maintaining an optimistic spirit, and many inquiries are being received from persons desirous of engaging in beekeeping for a living. The usual demonstrations and lectures on beekeeping matters were given by the instructors in their respective districts as far as it was possible to do so.

Close attention has been given to the inspection of apiaries for disease as far as restricted travelling-expenses would permit. Valuable assistance in this connection has again been rendered by a number of honorary inspectors in several of the main commercial districts.

Tests with chlorine gas as a sterilizing agent for combs infected with foul-brood were continued. While the results obtained were considered quite satisfactory, it would appear that this treatment, on account of its cost, is more suitable for use by commercial beekeepers rather than by the man with only a few hives.

The total number of cases of honey graded for export at the various grading-stores amounted to 7,586 cases, which shows an increase of some 5,000 cases as compared with the previous year. This was mainly due to producers submitting more honey for export owing to the unsatisfactory state of the local market.

In connection with this season's production, a new system of grading of export honey was inaugurated by the New Zealand Honey Control Board. During the year several consignments of section honey were shipped to England for the purpose of testing the market there for this class of honey.

The quantities in hundredweights and values of honey exported from the Dominion during the last five years ended 31st March were as follow: 1930, 19,234, £75,623; 1931, 1,958, £7,845; 1932, 4,749, £17,606; 1933, 2,005, £7,014; 1934, 7,342, £23,784. The total number of registered apiaries in the Dominion now stands at 7,353, comprising 111,344 colonies of bees.

Staff.

I have to thank all officers of the Division for their loyal assistance and co-operation during a particularly busy year.

CHEMISTRY SECTION.

REPORT OF B. C. ASTON, F.I.C., F.N.Z.INST., CHIEF CHEMIST.

Mineral Content of Pastures Investigation.

Financial assistance no longer being available from the Empire Marketing Board this work has had to be considerably curtailed. Bush sickness and related problems have received most attention.

Pumice Lands.

Coincident with the general adoption by the farming community of the use of limonite for the prevention and cure of bush sickness has come demonstration of the fact, suspected, and the subject of warning from the commencement of the experiments, that so-called "limonites" from different sources or subjected to different degrees of heating or other conditions during preparation as a lick may vary greatly in their feeding or curative value. Outbreaks of bush sickness on several farms where limonite was being used and had previously been successful were found in each case to have followed the feeding of one manufacturer's product. A thorough investigation was made and it was found that the ineffective product differed from that originally supplied by the same manufacturer, and from the product of another manufacturer (both of which gave good results) in three particulars: (1) The source of the raw material had been changed from a soft friable deposit to a harder and more dense deposit; (2) judging by the red colour, and from information received, considerable heat had been applied in drying the material to facilitate grinding; (3) during grinding (in a cement mill) contamination with several per cent. of carbonate of lime had occurred. Laboratory experiments showed that each of these factors, under appropriate conditions, could result in a reduced solubility of the iron oxide. Ores from different deposits, having very similar chemical composition but differing in physical properties, gave, under certain conditions, widely different solubilities. Heating altered the solubility of various ores in different ways, but a temperature of from 500° C. to 600° C. was necessary before a considerable reduction of solubility could be shown by laboratory methods. When limited quantities of acid of about the same concentration as the gastric juice were used the reduction of acidity occasioned by contaminating carbonate of line reduced the amount of iron dissolved.

Lime either as carbonate or slaked lime, used as a lick for ruminants is so easily eaten in harmful amounts in bush-sick country that it is inadvisable to give this class of animals lime in this way. The use of lime carbonate as a top-dressing for pasture has proved so ineffective or even harmful to ruminants in bush-sick country that the liming of bush-sick pastures as a practice is strongly condemned.

The necessity for manufacturers of limonite for lick purposes to keep to raw materials and methods of preparation proved to be successful by field experiments is thus emphasized. The possibility of the efficacy of limonite being reduced by artificial heating was foreseen when the use of this material was first advocated by the writer of this report, and manufacturers were specifically warned against heating the limonite, although this was a procedure which would enable the material to be manufactured more easily and expeditiously (see *N.Z. Journal of Agriculture*, June, 1932). In spite of this warning, limonite was kiln-heated by one manufacturer (who fortunately has now gone out of the business). Some of the material, however, continues to be sold to farmers at a reduced price, and the lack of response in feeding this damaged limonite tends to damage the reputation of the properly prepared article.

Mr. C. R. Taylor, in charge of the field work at Rotorua, reports that the limonite treatment of ruminant stock as a remedy and means of prevention of bush sickness is now undoubtedly past the experimental stage and is firmly established throughout the affected pumice country as a sound, economic farming practice. Limonite from approved sources manufactured in an approved manner has never given cause for the least anxiety, and has been an unqualified success wherever used. It has proved the greatest boon bush-sick country has ever had bestowed upon it, and its use, coupled with sound farm-management, has unquestionably raised these undeveloped lands to the equivalent of some of the best pastoral country in the Dominion.

Referring to the ineffective kiln-dried limonite previously mentioned, Mr. Taylor states that its use was responsible for some serious loss with sheep, but that upon reverting to the use of good air-dried limonite the recovery of affected cattle not too low in condition was almost magical.

At Tokoroa perusal of the dairy factory manager's books clearly showed the relative condition of the herds consuming the two types of limonite and the rapid increase in milk production of those receiving the inferior product after being changed for only a week on to the air-dried material.

At Waotu one farmer using air-dried limonite secured 120 per cent. of lambs from 600 ewes. Of these, 100 per cent. were sent to the works as fats before December, 80 per cent. being graded "Super Downs." Two months later the 20 per cent. left on the farm were sold as fats. Twelve hundred breeding ewes are now being carried with confidence.

The management of a large farm at Lichfield in the early part of 1933 bought in 600 five- and six-year old ewes primarily for the purpose of controlling ragwort. They were supplied with a lick of common salt and limonite which was taken from May onwards very readily. They were put to black-face rams and produced approximately 100 per cent. of lambs which were subsequently sold as fats. No trouble was experienced from bush sickness during the twelve months the ewes were on the farm in spite of the property having rather an unenviable reputation in this respect.

Atiamuri Sheep Experiment.—This has now concluded. The original experimental limonite ewe lambs were kept on the farm for two years and a half, and during that period were always in the

best possible condition. As four-tooth ewes they in their turn produced just on 60 per cent. of lambs last season, which did fairly well, but unfortunately were handicapped by having only kiln-dried limonite for some months. Several died of "sickness," but the balance were sold as either store or fat lambs after a period on air-dried limonite.

Kaharoa Sheep Experiment.—In common with other farms on which the ineffective kiln-dried limonite was used, trouble was experienced in this experiment, resulting in the death of about 25 per cent. of the lambs. On reverting to the use of air-dried limonite the remainder of the animals recovered with remarkable rapidity, and the majority are now in perfect condition. No trouble from bush sickness has been experienced in the dairy herd on this farm for the past three years, and production is steadily on the increase.

At Mamaku State Farm the use of limonite has been attended with the same success as elsewhere. The carrying of sheep had become imperative in order to cope with the ragwort menace, and limonite has enabled this operation to be carried out with ease and profit instead of, as formerly, with trouble and loss. At first the sheep showed a disinclination to take the lick, but this was overcome by patience and use of chopped turnip as a bait. A fine crop of lambs was produced and these did exceptionally well.

In conclusion, it should be pointed out that the limonite treatment as a means of maintaining animal health and increasing production on bush-sick pumice country, is now generally regarded as standard farming practice, without which none of the results recorded in this report would have been even remotely possible. The use of limonite as a top-dressing for pastures is discountenanced as ineffective and wasteful.

Morton Mains, Southland.—Owing to the uncertainty in the interpretation of the pasture analyses due to the large amount of soil contamination in the majority of the samples, a special effort was made to secure samples relatively free from soil by means of enclosed plots in a few representative paddocks. The Veterinarian, Mr. Danskin, was successful in securing a number of samples much freer from contamination than any previously analysed, and these on analysis showed several interesting features. The iron was very low in the majority of the "sick" samples and somewhat higher in the healthy ones. Manganese was not reduced to a corresponding extent. The ratio manganese/iron varied from 2 to 9 for the sick pastures (uncontaminated) averaging 4, whereas for the healthy pastures it varied from 1 to 2, averaging 1·4. As it seems possible that the excess of manganese might be affecting the absorption or utilization of the iron, further analyses of uncontaminated pastures and an experiment with feeding manganese to sheep on a moderately low iron diet are planned. Field experiments at Morton Mains over two years with limonite have proved successful in raising a profitable crop of lambs where in previous years it was not found possible.

In connection with the investigation into the nature and prevention of eclampsia or grass staggers in dairy cows, it was suggested that dolomite, if finely ground, might prove a suitable source of magnesium for use as a lick. A supply of local material was obtained from Collingwood through the courtesy of Mr. Heskett, of the Onekaka Iron-works, and has been passed on to the veterinary authorities for trial. An analysis of this material showed it to contain 40 per cent. of magnesium carbonate and 54 per cent. of calcium carbonate.

Pampas Grass as Fodder.

The experimental acre of pampas-root cuttings planted at Kaharoa near Rotorua is doing well, but it will be some time yet before grazing by the dairy herd can be carried out. The plantations of the originator of the system, on the Hauraki Plains, have been extended, and he is now trying the effect of a much more extended grazing period. So far it has been ascertained that cattle will do well on pampas together with pasture in the autumn months, and it is intended this spring to dilute the young spring growth of pasture, over-rich in protein, by a ration of pampas. Chemical analyses of the soil from this farm showed it to be exceptionally rich in all plant-foods, especially phosphoric acid, and it is therefore a matter of importance to determine the feeding-value of pampas on less favoured soils. Preliminary analyses have shown a considerable amount of carbohydrate—from 30 per cent. to 40 per cent. evaluated as glucose (grape sugar)—to be present in the dry matter of the leaves and the succulent bases of the pampas leaves. The young leaves of pampas grass are exceptionally easy to browse, offering in this aspect a marked contrast to the mature toetoe grass (*Arundo conspicua*) the leaves of which at all stages of growth are difficult to break off owing to their strong fibrous nature.

Bone Analyses.

A peculiar case of a condition resembling rickets occurring in a considerable number of lambs on a Canterbury farm having apparently good pasture was considered on investigation to be due to unusual drought conditions. Analyses of the affected front-leg bones (C/614) disclosed very low figures for total ash, calcium, and phosphate, the ratio ash/organic matter being less than half the normal figure.

Analysis of the bone of a lamb (D/497) representative of a number in very poor, stunted condition from a farm on the fringe of the bush-sick pumice country showed that it was not abnormal in any respect. The ash/organic matter ratio was 1·62 on the dry fat-free bone. Bones from bush-sick animals have always been found to be of normal composition.

Bones (D/1336) from a lamb bred on high tussock country in the vicinity of Lake Ohau, where a recurring trouble of the rachitic type is experienced, were found on analysis to be low in ash in the case of the enlarged tibia joint but apparently normal in the case of the rib and femur. The condition resembled that occurring in part of the Wairau Valley, where licks are being used successfully. A thyroid gland from this lamb was normal.

Analysis of Pasture Samples for Plant Research Station.

Analyses of pasture samples from experimental manurial plots have been made as required.

Iodine Investigation.

In the North Island sheep thyroids from about 300 farms in the Auckland, Taranaki, and Wellington districts have been obtained, making a total of about 1,800 glands from the North Island. Details of these samples are nearly complete.

In the South Island some 550 farms from Canterbury, Westland, Nelson, and Marlborough Districts have been similarly sampled. A composite sample has been collected from each flock, making a total of 3,300 glands. These have all been dissected and prepared for analysis. About half are analysed. Details for almost all samples have been collected, and the remainder should be in within the next few weeks. This should then practically complete the South Island.

Results from the lick experiment in Southland continue to come in but this is not expected to yield conclusive results for another two years at least.

A paper was published in the June, 1933, "Transactions of the New Zealand Institute" embodying the work in Southland and Otago carried out in the previous year.

Officer stationed at Wallaceville Laboratory.

The report of this officer is included under that for the Live-stock Division.

Soils (Soil Laboratory).

The soils received for analysis during the year may be grouped roughly under the following headings: Special soil investigations, 123; soils analysed at the request of other Departments, 32; miscellaneous, 13: a total of 168.

Further progress has been made with the examination of littoral soils. The new areas investigated were the tidal flats bordering the North Auckland Harbours of Whangarei, Whangaroa, Kaipara, and Waitemata, and, in the South Island, parts of an area of 2,700 acres at Invercargill reclaimed by the Prisons Department. Only a broad outline of the results of analyses can be given here. The Kaipara Harbour samples were somewhat heavy in texture, indicating that care would be required in bringing them into cultivation, while those from the other harbours concerned were definitely lighter. Chemical analysis showed that the Whangarei soils alone were deficient in available and total phosphoric acid, thus differentiating them from the other North Auckland samples, and in general from the majority of littoral soils which have so far been examined. Reclaimed Whangarei soils are known to respond vigorously to superphosphate dressings.

At Invercargill samples were collected from the Borstal Farm and the Awarua Endowments. In all but a few cases the salt content was low and the texture ranged from sandy loam to loam. The favourable texture and the ease with which the land cracks on draining should facilitate the rapid removal of salts injurious to pasture growth from the soil. The chemical analysis was also highly satisfactory, particularly with regard to available phosphoric acid. The Awarua Endowments had the advantage of high amounts of nitrogenous organic matter.

Twenty samples were received from the Richmond Block, Napier, in connection with the Small-farm Plan, for determination of texture and content of water-soluble salts. The texture was of an open type in most cases, and the salt content in all but four or five soils was well below 1 per cent. Two samples in particular were abnormally high in water-soluble chloride and sulphate.

An especially interesting problem was presented by a type of soil derived directly from the underlying basalt found at Okaihau, North Auckland, and probably representative of a large area. It was stated that it had been found impossible to establish the usual grasses and clovers on this soil, and from a field inspection it appeared that the trouble might be connected with an excess of iron and alumina. A laboratory examination revealed a high percentage of iron and aluminium oxides, and a deficiency of available plant-food, especially phosphorus and calcium. The alkaline earths, potash, and phosphorus extracted by hydrochloric acid were also in low amounts. A fusion analysis gave the following composition expressed as percentages of air-dried soil: Silica (SiO_2) 28·97; ferric oxide (Fe_2O_3), 20·89; alumina (Al_2O_3), 20·83; titanium dioxide (TiO_2), 7·15; phosphoric acid (P_2O_5), 0·11; calcium oxide (CaO), 0·21; magnesium oxide (MgO), 0·58; manganous oxide (MnO), 0·09; moisture, 2·67; loss on ignition, 18·54: total, 100·04. The percentage of titanium dioxide is remarkably high, and the ratio of silica to sesquioxides low. It seems, therefore, that this soil has some of the characteristics of a lateritic type. It is known that phosphorus is fixed in insoluble form by compounds of iron, aluminium, and titanium in the soil, so that application of phosphate to this soil would not be expected to give satisfactory results. It has been found, however, that silica in the form of colloidal silica or of Kieselguhr has the effect of reducing the tendency of phosphorus to revert to insoluble forms, and the Okaihau soil suggested itself as a very suitable subject for experiment along these lines. It is remarkable that New Zealand danthonia grass grows readily in the scrub (largely *Leptospermum* (Manuka) and the naturalized *Hakea acicularis*) with which these lands are covered, being evidently able to exist as do the Australian species of danthonia under soil conditions which include very low phosphate content. This suggested that these lands might be laid down in danthonia for small sheep-runs and gradually improved into mixed grazing-farms.

The mechanical analysis of thirty soils collected by officers of the Geological Survey in the Waikato was undertaken at the request of the Department of Scientific and Industrial Research. Two soils were also received from the Forestry Department, but at the time of writing the analysis had not been concluded.

Among the miscellaneous samples may be mentioned a soil from Waitakaruru, Hauraki Plains, which, although it had had no manurial treatment, was exceptionally rich in total and available phosphoric acid, the figures being 0·40 per cent. and 0·16 per cent. respectively.

Samples of mud from the Havelock mud flats (Pelorus Sound) which it was proposed to dry and bag up for use as a fertilizer were found on analysis to have only about 0·2 per cent. phosphoric acid and 1 per cent. of carbonate of lime.

A sample of Tarawera mud used for top-dressing the bowling greens in the Government Gardens at Rotorua was shown to be rich in lime but rather light in texture, while Tuakau soil used for a similar purpose was deficient in lime but contained a good proportion of clay. It was considered that a mixture of the two soils would be useful.

Fertilizers.

During the year 187 registration certificates were issued to 98 manufacturers and brokers, with 255 branches, covering 899 different brands of straight and mixed fertilizers and fertilizing materials. The number of secondary vendors, including merchants, storekeepers, dairy companies, &c., amounted to 685, with 216 branches.

A scale of brand-registration fees chargeable to manufacturers, importers, and brand owners was brought into operation at the beginning of July last year. As a result of this regulation there was a very considerable reduction in the number of brands on the register for the period under review, and much correspondence was involved with vendors in brand and fee questions. The charging of fees has had some effect in preventing the registration of a large number of brands which were not being sold, and the cutting-down of different brands covering the same or similar formulæ can be considered as a step in the right direction towards the standardization of the great number of fertilizer recipes for different crops. It is still believed that a reduction of brands could be further extended without disadvantage to either manufacturer or consumer. Already as a result of the reduction of brands sold by individual vendors the schedules of fertilizers given in invoice certificates issued to purchasers are now much more satisfactory in that they are easier to follow.

The co-operation of analysts in private practice has been secured in connection with the framing of analytical reports on fertilizers in terms of the Act. This should assist to some degree in the standardizing of statements of quality in advertising matter.

More interest than usual was noted in the sale of animal organic fertilizers derived as by-products from meat and boiling-down works, &c. It is to be hoped that before long the Dominion market will sufficiently absorb all locally produced manures of animal origin without there being any necessity to send any to far-distant foreign countries.

The question of agricultural-lime products being brought under the scope of the Fertilizer Act has been under active consideration. Lists of lime vendors and reports bearing on proposed lime legislation were sent forward from this office from time to time. A good deal of information has been gathered in regard to the sale and composition of numerous stock-licks and foods on the market, reports being forwarded when requested. Among the various other matters receiving attention were—(1) Technical advice and assistance in connection with a synthetic process of basic-slag manufacture. Limited quantities of the slag donated for experiment are being tested in comparison with other phosphatic fertilizers on small plots situated on dairy pastures adjacent to Wellington. Growth effects following the treatment with the synthetic material are now commencing to be manifested and to date the results may be regarded as satisfactory. (2) The amount of fat in organic manurial products from meat-works, fish factories, &c., is of importance to the Dominion as fairly large quantities of such products are still being used every year. The opinion of several overseas authorities has been obtained on whether or not the presence of fat or oil in appreciable amount in organic fertilizers is detrimental in the soil to the assimilation of plant-foods. While the point still appears to be somewhat obscure and opinions are divided, fat or oil must surely be regarded as make weight or unwanted matter in a fertilizer, and its elimination as far as possible would appear to be desirable. The fat content of local organic products varies considerably, but the average would be about 12 per cent. to 15 per cent. If this amount could be economically reduced to 2 per cent. or 3 per cent. substantial savings would be effected both to consumer and manufacturer alike. A report on the subject is at present being completed. (3) Weed-killer trials under difficult conditions were conducted with a large number of chemicals in an endeavour to find a cheaper, better, and less dangerous substitute for sodium chlorate. Approximately ninety tests, mostly under field conditions, were made with thirty-six different substances, including a large number of oxidizing substances with properties somewhat similar to but less dangerous than sodium chlorate. Many of these were tried on ragwort at different strengths either with diluent or fertilizer or in solution. Using sodium chlorate as a standard of comparison the following were prominent among certain groups of substances potent in their action in killing ragwort: (1) Hypochlorites of sodium and potassium; (2) chromates of sodium and potassium; (3) thio-cyanates of ammonia, sodium, and potassium. Further experiments with these and other promising chemicals will be proceeded with if facilities and assistance are available.

Inquiries have been received relative to the establishment of dyeing with plant products as a home industry. One of the chief difficulties was the obtaining of locally grown plants yielding good blue and green dyes. It was suggested that *Isatis tinctoria* could be grown to supply the blue used by the ancient Britons under the name "woad," and some seed of this plant was obtained from England for the purpose. Plants are now growing in local gardens. For green dye, privet was suggested.

Owing to several accidents attending the use of sodium chlorate for weed-killing and various requests for information, a leaflet was prepared and printed for distribution to manufacturers and

users, in consultation with the Railways Department, Post and Telegraph Department, and Chief Inspector of Explosives, pointing out the dangers attending injudicious handling of this material and the precautions necessary to ensure safety.

Some attention has been given to the possibility of growing plants for the production of crude drugs. Through the courtesy of the Curator of the Royal Botanic Gardens, Kew, seeds of *Aconitum Napellus*, *Atropa belladonna*, *Valeriana officinalis*, *Hyoscyamus niger*, and *Chrysanthemum cinerariæfolium* were received and distributed for trial.

Work for the Departmental Divisions.

Live-stock Division.—Periodical analyses of public cattle dips, and analyses of medicines, licks, waters, and toxicological specimens, &c., have been undertaken. A locally made mammitis drench was found to consist essentially of sodium bicarbonate, magnesium sulphate, and carbolic acid. Two samples obtained at different times contained widely different amounts of these ingredients, obviously a bad feature. Another mammitis remedy consisted principally of a mineral oil, probably a crude "cracked" product, together with a small proportion of vegetable oil, and a trace of acetic acid. Several samples of capsules sold at a high price for the treatment of sterility in dairy cows proved to contain hexamine. Veterinary authorities considered this to be quite useless for the purpose. The amount to be administered was far below the medicinal dose for this drug. A powder for treatment of pleurisy, paralysis, &c., in pigs sold at the rate of £1 per 8 oz. consisted of over 90 per cent. common salt, with small proportions of magnesium sulphate (Epsom salts), and potassium permanganate, together with a trace of some plant extract, probably willow-bark. The ingredients of an alleged cure for ante-partum paralysis in sheep were common salt and sulphur. In a case where fourteen pigs died suddenly, lead was found in a stomach contents and also in whey used for feeding. The whey was pumped from a storage tank along a galvanized-iron pipe to feeding-troughs in the paddocks, and it would appear that the acid liquid had attacked the lead packing or solder in the joints.

A somewhat mystifying case of apparent poisoning of cows was attributed ultimately to the cows drinking water containing caustic alkali after having been used for cleaning the milking-machines. Tin was found in the stomach contents, and it was concluded that this had been brought into solution by the action of the hot strong caustic soda on the tinned metal surfaces.

Analysis of green oats and paunch contents of a sheep suspected of being poisoned by prussic acid liberated from the oats on digestion showed hydrocyanic-acid contents of 0·0015 per cent. and 0·0016 per cent. respectively. This is below the standard which has been proposed above which poisoning may be expected, but some loss of this volatile constituent may have occurred in transit, and the total quantity of fodder consumed has also to be considered.

The deaths of two horses and a number of sheep at intervals when grazing or fed on grain harvested from a particular paddock were suspected to be due to a plant poison. A large number of small leguminous seeds, identified as alsyke, were found in the stomach of one of the horses. According to Lander, alsyke has been known to poison horses, sweating (noted in this case) being one of the symptoms. A case was reported of severe mortality among lambs after drenching with carbon tetrachloride. No particular reason could be assigned for this occurrence. A sample of strychnine used for rabbit destruction with alleged poor results was found to be genuine and of good quality.

Fields Division.—Analysis of soils, limestones, &c.: Numerous samples of commercial ground limestone were analysed at the instance of the Railways Department acting jointly with this Department to determine the suitability of the products for receiving free railage. Special analyses of fertilizers for field experiments and of ground-limestone samples for experiments on germination injury of seeds were carried out. Samples of ashes, mixed with soil, from the burning of twitch in ploughed paddocks were found to be very low in fertilizing-value, having only about 1 per cent. of lime and ¼ per cent. of phosphoric acid and of potash.

Summary of Samples received.

Soils	194
Lime and liming materials	172
Reputed fertilizers	35
Fertilizers	18
Pastures	81
Dips	30
Licks and medicines	24
Thyroids	851
Waters	11
Toxicological	25
Weed killers	13
Limonites	59
Miscellaneous	53
Total	1,566

Approximate Cost of Paper.—Preparation, not given; printing (685 copies), £65.

By Authority: G. H. Loney, Government Printer, Wellington.—1934.

Price 1s. 3d.]