1935.

NEW ZEALAND.

DEPARTMENT OF AGRICULTURE.

ANNUAL REPORT FOR 1934–35.

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

Wellington, 28th August, 1935.

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, 1935.

The report provides a summary of the principal farming developments of the year and of the comprehensive and numerous activities of the Department in the work of fostering the growth and maintenance of rural industries in the manner most compatible with the national well-being. It shows that the work of the Department has followed generally the lines that have been adopted in recent years, and that it has been associated with considerable advances in our agriculture in point of both quantity and quality of produce. Apart from the regulatory services, fresh ground has been broken in investigations relative to animal and plant husbandry, and by close interlocking of this work with the advisory work of the Department satisfactory progress has been made in the translation of our knowledge, new and otherwise, into practice.

In rural industries, despite a prolonged adverse summer period in many districts, the volume of production has been well maintained at a point that indicates increased production capacity under normal seasonal conditions, which reflects most commendable efficiency of our farmers when facing relatively difficult and sometimes even depressing conditions. Indeed a close knowledge of the developments in our farming during the past five years or so suggests that the achievements in farming have reached a plane which farmers themselves a few years ago would have said could not be attained.

During the year the upward trend in the number of sheep, including an increase in the number of breeding-ewes, has been maintained, while at the same time the number of lambs slaughtered for export has increased. A relatively small increase in the number of dairy cows in the Dominion has been linked with a fairly substantial decline in the amount of butterfat produced—this as a direct result of the unfavourable summer in the main dairying districts. The decrease in the production of butterfat resulted in a decrease of £1,413,014 in the value of butter and cheese exported.

A marked feature of the year was the decline in the value of wool exported—in the year ended 30th June, 1935, 582,763 bales, valued at £6,327,793, were exported, whereas in the corresponding previous year 822,396 bales, valued at £13,287,458, were exported. However, the stocks of wool in the Dominion at the 30th June, 1935, were greater than at the corresponding date in recent previous years.

There was a welcome increase of £1,473,854 in the value of the frozen lamb exported, while there was a smaller increase in the value of the total other meat exported.

For the first time, the annual value of pig-meat exported exceeded £1,000,000, 485,677 cwt., valued at £1,313,502, being exported for the year ended 30th June, 1935, the corresponding figures for the previous year being 397,031 cwt. and £950,183.

The year was marked by the fact that record quantities of fertilizers were carried by rail. Most of the fertilizer is applied to grassland, and the increase in the quantities of fertilizers carried by rail is expected to prove valuable in maintaining the vigour and productivity of our pastures, which, certain evidence suggests, were beginning to react to the reduced top-dressing programmes of recent times.

Probably the development of most potential importance during the year was the appointment of the Executive Commission of Agriculture as provided in the Agriculture (Emergency Powers) Act, 1934. Under Part I of this Act the Minister of Agriculture is the Chairman of the Commission; the remaining personnel of the Commission is—Sir Francis V. Frazer, Deputy Chairman; Geo. Duncan, Esq., and David Jones, Esq. The functions of the Commission as set out by the Act may lead to the Commission becoming a valuable factor in the future of New Zealand farming.

As previously, the Department has administered or assisted measures designed to help farmers particularly in the difficult times that have been experienced. These measures include the subsidies on the manufacture and railage of fertilizers, concessions in respect to railway freights on lime and on primary produce under certain conditions, and contributions to the funds of fruit-export and of herd-testing organizations.

The agricultural legislation of the year has been important; it has included the Agriculture (Emergency Powers) Act, 1934, to which reference has been made already, the Noxious Weeds Amendment Act, the Slaughtering and Inspection Amendment Act, the Stock Remedies Act, the Canterbury Agricultural College Amendment Act, the Orchard-tax Amendment Act, and special provisions in the Finance Act, 1934–35, relative to the export of fruit.

The Dominion is not yet clear of the marketing difficulties which at a corresponding stage last year clouded the outlook of farming, and these difficulties are receiving the closest attention: in this there is a full realization of the need for making all possible provision and arrangements with overseas Governments for exploiting all potentialities of the various sections of the trade in farm-produce.

I have, &c.,

CHAS. E. MACMILLAN,
Minister of Agriculture.

His Excellency the Governor-General.

REPORT OF THE DIRECTOR-GENERAL.

Wellington, 20th August, 1935.

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, despite unfavourable weather in large areas of the Dominion, the gratifyingly high standard attained in the 1933–34 season was closely approached in the 1934–35 season, when decreases in the production of such major lines as butter, cheese, frozen beef, cereals, and apples were offset to some extent by increases in respect to other important lines such as frozen lamb, mutton, and pork, preserved milk, and sheep-skins. However, despite the highly satisfactory manner in which farm-production was maintained there was a sharp decline in the value of the exportable surplus; in terms of New Zealand currency, the exported farm-products listed in the table relative to overseas trade published by the Government Statistician amounted to £39,404,963 for the year ended 30th June, 1935; the corresponding figures for the year ending 30th June, 1934, were £45,695,416: the decrease of £6,290,453 is approximately 13 per cent. Some minor farm-products included under the general item "other New Zealand produce" are omitted from the above totals. The decrease was due principally to the difference in the values of the wool exported in the respective years—£6,327,793 in the year ending June, 1935, in comparison with £13,287,458 in the corresponding previous year. In this connection it is of interest to note, however, that in 1934, the end-of-season (June) stocks held in New Zealand were 29,000,000 lb. less than the corresponding stocks in 1933, while in 1935 the estimated stocks held at the end of June were 37,000,000 lb. greater than those held a year previously, so that the difference in the values of the wool exported in the respective seasons diverges substantially from the difference in the values of the wool actually produced in those seasons.

The weather conditions varied widely throughout the main districts of the Dominion. In North Auckland abundant rainfall was reflected in abnormally heavy growth of pastures: in the remainder of the Auckland province the year was satisfactory from a fattening point of view, but somewhat unsatisfactory for dairying because of hot, dry summer conditions. Generally in the southern half of the North Island results both in dairying and in sheep-farming suffered firstly from a cold spring and secondly from dry summer conditions, to which may be attributed a decline in the production of butterfat and in the average weight of fat lambs slaughtered for export. In the South Island generally, the weather conditions and the effect of these on farming were analogous to those in the southern half of the North Island, although in parts of Otago a fine warm spring followed by satisfactory summer conditions for the greater part of the season enabled lambs to thrive at the outset, and resulted in the quality being well maintained although average weights were lower.

Outstanding Features of the Year.

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

1. A decrease of 4·831 per cent. in the production of butterfat for the twelve months ending July, 1935, as compared with the corresponding period of the 1933–34 season—this is correlated firstly with the fact that an interim estimate of the average butterfat-production of all dairy cows in 1934–35 is 210 lb., whereas the final estimate for 1933–34 was 220·8 lb., and, secondly, with the fact that there was a decrease of £1,413,014 in New Zealand currency in the value of butter and cheese exported during the year ended 30th June, 1935.

2. An increase of 247,139 cwt. in the weight and £1,473,854 in the value of frozen lamb exported during the year ended 30th June, 1935.

3. An increase of 88,646 cwt. in the weight and of £363,319 in the value of the frozen pork exported, which for the first time has reached an annual value of over £1,000,000 in New Zealand currency.

4. A decrease of approximately 21,000,000 lb. in the weight and £260,000 in the value of fresh apples exported.

5. A decrease of 239,633 bales in the quantity and £6,959,665 in the declared value of the wool exported.

6. A decrease of 23 per cent. in the estimated acreage and a prospective substantial decrease of approximately 5 bushels an acre in the yield of the wheat crop, resulting in a prospective crop of approximately 6,500,000 bushels of wheat grown in the 1934–35 season, in comparison with an ascertained yield of slightly over 9,000,000 bushels in the 1933–34 season. The evidence at present available suggests that the local wheat crop may be insufficient to meet local requirements.

7. Little change in the acreage but decreases in the yield per acre of oats, barley, and potatoes.

8. An appreciable increase in the amount of phosphatic fertilizer and of lime used.

That the position in respect to farm-production has been so satisfactory despite adverse circumstances may be attributed partly to the fact that the improvement in the standard of efficiency in our farming which has been in evidence over a period of years has been maintained even though the effect of this on production has been masked to some extent by the unfavourable weather experienced during the year; it also may be attributed partly to the fact that various long-range projects, such as systematic improvement of stock and crops have now reached the stage when their beneficial results are being reflected more freely in production.

TREND TOWARDS INCREASED EFFICIENCY.

In last year's report certain trends towards increased efficiency which were then evident were discussed, and it is satisfactory to note that these trends continued to be apparent during the year now under review.

Among the matters indicative of endeavour likely to bring about greater efficiency is the wide attention given to the use of certified seed. While there was a decrease in the areas of wheat and of perennial rye-grass harvested for the production of certified seed, it is to be noted both that this decrease was due primarily to the unfavourable season and that it was relatively small. On the other hand, there were substantial increases in the areas harvested for certified seed in the case of potatoes, white clover, red clover, and cocksfoot, and, while exact information is not available, it seems certain that all these increases affect for the present not so much the export trade in seeds as the use of improved seed within the Dominion.

A trend which generally will bring about lowered costs of production, which was noted last year and which has continued, is that towards increased use of phosphatic fertilizers. In fact, the fertilizer-consumption for the year attains record proportions. Up to the end of March the increase was confined wholly to the North Island, a slight decrease being recorded in the South Island; but this decrease easily could be changed subsequently into an increase when the manuring of cereal crops was taken into account.

The increase in pig-meat production as an auxiliary to butterfat-production which was forecast last year has been fully realized, and a further substantial increase seems imminent provided the current widespread interest in improved pig husbandry is maintained and reflected in practice. The data available point to the conclusion that the Dominion's production of carcasses of porker weights now makes available for export a supply which approximates that which can be disposed of satisfactorily overseas, and, this being so, further expansion should be in the production of carcasses of baconer weights. Such a development probably would call for important adjustments in our pig-keeping, and about these adjustments that desirable type of knowledge which is based on thoroughly examined farm practice is not freely available. Hence there is urgent need for further investigation relative to several matters bearing on economic pig-production under the circumstances which seem likely to develop. This is being undertaken by the Divisions of this Department directly concerned. The following three problems are of outstanding importance: (1) The general production of pigs which provide the type of carcass suited to the needs of the prospective markets; (2) the association of good type of carcass with economical conversion of feeds into flesh—investigations already have established that there are strain variations in pigs in this respect analogous to the strain variations in dairy cows in their ability to utilize the feed provided; (3) the economical provision of feed to supplement dairy by-products when the supply of these is inadequate—this introduces crop-production and pasture-utilization problems which are being investigated by the Department. Work already done indicates clearly that a matter most acutely in need of improvement is the feeding, especially that of breeding-animals during the period when dairy by-products are in scant supply. Until this, in conjunction with the general care of the stock, is made reasonably efficient, the considerable potential benefits from improvement of the class of pigs kept cannot be satisfactorily realized.

During the year under review the potentialities of chilled beef as a more efficient medium of converting our feed into a product more readily saleable on the overseas markets have been further examined. There is some evidence of successful development relative to the corresponding stage a year ago when the Dominion's chilled-beef trade was largely in its experimental stage; in the meantime overseas exports have increased to 52,987 quarters for the ten months ending 31st July, 1935, from 17,958 quarters for the corresponding period of the previous season. While the substantial increase is gratifying, it is improbable that it is completely indicative of future considerable expansion in the trade, although this may quite well occur provided the producers give sufficient study and attention to the type of beasts required and arrange to bring them to export condition at a suitable age—*i.e.*, in the vicinity of three years or less. Favourable reports have been received regarding the quality and the dressing of the shipments already made, and the high standard of much of the grassland of the Dominion greatly favours the production of beef of high quality. A vital question to which there is as yet no definite answer is whether the future prices obtainable will give the necessary economic inducement to stimulate a considerable supply of chilled beef of the requisite quality. By their actions in respect to equipment a number of companies, both shipping and freezing, seem to indicate an expectation that future prices will justify expansion, and their enterprise is most commendable. Interest attaches to small shipments of chilled beef that are being made to Honolulu.

There is gratifying evidence that sheep-farmers continue to consolidate their position. An illustration of this is provided in the interim official statistics of live-stock for the 1934–35 season. These disclose that despite a record killing of lambs for export there has been a substantial increase in the flocks in the Dominion at 30th April, 1935, which are estimated to number 29,078,678, whereas the final number for the corresponding previous period was 28,649,038. The number of sheep in the Dominion at 30th April, 1935, is the second highest ever recorded, being approximately one million below the highest recorded—30,841,287, in 1930—and represents a second consecutive increase since 1933, when the reduced flocks totalled 27,755,966. A further noteworthy fact is that the estimated increase in breeding-ewes accounts for more than half of the total increase in the 1935 flocks. This is to be accounted for largely by the fact that the estimated number of 1934 lambs exceeded that of any previous year. It is probable that strengthening of the sheep-farming position also is being brought about by increased use of fertilizers on grassland; although exact evidence on this point is not available, reports regarding fertilizer sales point to increased top-dressing by sheep-farmers.

A welcome fact is that the latest available data are indicative of a general upward trend in the acreage devoted to crops grown specially for feed to be used when that directly available from grassland is likely to be below economic requirements. Increased acreages are recorded in respect to cereals and other crops yielding green fodder, turnips, rape, mangels, carrots, and lucerne. Against this, however, is to be set a decline in the area, which previously was undesirably low, devoted to hay and silage. The decrease in the area devoted to hay was substantially greater than in that devoted to silage. It is considered that neither decrease was due to a decrease in the value popularly attached to these feeds, but that both decreases were due partly to seasonal conditions and partly to the joint influence of restricted top-dressing programmes over a series of seasons and increases in the number of stock, resulting in a smaller surplus of summer growth of grassland being available for ensilage or haymaking. Any trend towards less hay and silage, if not associated with a greater total provision in other ways of reserves of special feed, would be definitely regrettable: a real step towards more economic farming would be the better adjustment of seasonal feed-supplies to seasonal feed requirements by means of suitable special provision of feed for use in periods of scant supplies from pastures.

For the second year in succession the sales of lucerne cultures by the Department have been sufficient to treat the seed required for the sowing of approximately 6,000 acres. The annual sowings of lucerne do not represent a net increase in the Dominion effective acreage: they are offset by the portion of previously established lucerne which each year goes out of production on account of its age, &c.; but the official statistics show that when allowance is made for this there is a steady increase in the Dominion acreage of lucerne. While this increase is not as great as the merits of lucerne would justify, it is probable it will be greater in the immediate future. This is partly because the recent dry summer has provided many striking demonstrations of the outstanding value of lucerne when dry conditions are experienced, and, judging by the number of inquiries received, has greatly increased the popular interest in the inherent value of lucerne under a wide set of circumstances in which lucerne is not at all freely utilized to-day.

The Dairying Position.

The complete figures for the dairying season ended 31st July, 1935, indicate that there is a decrease of 4·813 per cent. in butterfat-production for the twelve months in comparison with the record production for the corresponding period in the 1933–34 season. For the twelve months ended 31st July, 1935, the salted butter graded was 131,270 tons and the unsalted 4,947 tons, a total of 136,217 tons, compared with 135,584 tons, 4,641 tons, and 140,225 tons respectively for the corresponding period of the preceding season—a decrease of 2·86 per cent.

The quantities of cheese graded for the twelve months ended July, 1935, were—White, 63,602 tons; coloured, 29,071 tons; a total of 92,673 tons, compared with 69,870 tons, 33,812 tons, and 103,682 tons respectively for the corresponding period of the previous season—a decrease of 10·62 per cent.

Despite a falling-off in the amount of butter exported from this Dominion, New Zealand has for the first time supplanted Denmark as the principal source of butter imported by Great Britain. This is accounted for by the fact that while the imports of butter by Britain from New Zealand for the seven months ending July, 1935, were less by 9,781 tons, those from Denmark were less by 13,447 tons. While the decline of imports from Denmark may be of some significance as reflecting the reaction of that country to the market position during recent years, some significance also attaches to the fact that the total imports of butter by Great Britain during the period specified decreased by 17,644 tons. It is noteworthy that this decline appears to be associated with under-consumption rather than with over-supply: while the consumption of butter was 25·2 lb. per head last year, representing an increased average consumption of 6½ lb. *per capita* since 1930, health authorities state that the average consumption of butter for each individual should approximate 52 lb. per annum as a fairly liberal estimate—each increase of 1 lb. *per capita* per annum in Britain would absorb approximately 20,000 tons additional butter.

New Zealand continues to be by far the biggest supplier of cheese to Britain. The decline of 12,074 tons in the cheese imports by Britain from New Zealand during the seven months ended 31st July, 1935, is associated with a decrease of 8,655 tons in the total cheese imported by Britain during the same period—the discrepancy between the decrease in supplies from New Zealand and that in total supplies is accounted for principally by increased supplies from the Netherlands.

As was forecasted in this report last year, the number of dairy cows has increased, but the increase for the year has not been so great as in recent previous years.

It is of some practical moment that the decrease in the total amount of butterfat produced has coincided with an increase in the number of dairy cows, the interim total of which was 1,949,505 at 31st January, 1935, whereas the final total at the same date in 1934 was 1,932,511. The joint effect of the downward movement in total production and the upward movement in the total number of cows is a fairly substantial falling-off in the annual average production of our dairy cows. The direct principal cause of this was the adverse season, due to the dry summer—evidence which shows that our herds are very sensitive to the degree of efficiency in their feeding, and which suggests that any substantial upward trend in average herd-production must be based upon an improved general standard of feeding. In short, in the future, better breeding without better feeding of our stock does not promise much general advancement in average production per cow. Despite a season which, mainly because of the hot summer weather militated against high quality in dairy-produce, the quality of both butter and cheese forwarded for grading was well maintained. An increase in the proportion of cream delivered daily is considered to have assisted materially in bringing about an increase in the average grade of butter for the year. Although the position in respect to the quality of our dairy-produce has been kept satisfactory, it is well recognized that there is still scope for improvement in the condition in which some of our dairy-produce reaches the consumer, and certain means that would tend to bring about some improvement in this respect are specified in the appended report of the Director of the Dairy Division. Other possible ways of obtaining improvement are the subject of current research.

When all aspects of the dairying position are considered it becomes clear that the dairying community deserves congratulation and commendation for the way its difficulties have been dealt with—at the end of a period of stress, production and quality have been well maintained; by the developments in respect to pig-keeping a source of additional income has been exploited increasingly and still further exploitation of it seems in prospect; and by attention to such matters as pasture-improvement, semi-official testing, and herd-testing, a good deal of building for the future has taken place. Further progress towards the fullest possible efficiency promises

to be largely by way of decreased costs of production and improved quality of products. Relative to these a good deal is already in the hands of the industry itself, and in this connection it seems noteworthy that, despite the generally recognized advisability of national farm-dairy instruction, only eighty-four of a total of 368 dairy companies operating in the Dominion are at present co-operating with the Department in the employment of farm-dairy Instructors. Some other important matters bearing on quality and costs call for specialized effort beyond what can be undertaken by practising farmers. These matters include disease of dairy stock and the manufacturing and marketing of produce. The Department is concentrating much effort on both the control of stock-diseases and on manufacturing processes in respect to which the special investigation in cheese-manufacture at Rukuhia may be cited.

The economic importance of the diseases of dairy-stock may be measured from the fact that the annual losses occurring in the Dominion from mammitis and from reproductive troubles are very heavy. That such serious losses are far from peculiar to New Zealand dairying is indicated by the standing committee of the Council of Agriculture for England, which, in a report published in July, 1935, showed a heavy incidence of contagious abortion and mastitis. These have been and continue to be the subject of much investigation overseas, the results of which are followed closely by New Zealand veterinary workers, who also, as indicated in the appended report of the Director of the Live-stock Division, have been actively investigating mammitis and reproductive troubles in New Zealand.

The Sheep-farming Position.

The markedly buoyant condition of sheep-farming in 1934 was replaced by a much less satisfactory one in 1935. The change was due primarily to the great change in the price for wool. The quantity exported during the year ended 30th June, 1935, fell by 239,633 bales (29 per cent.), and the average declared value per bale (£10 17s. 2d.) was 33 per cent. less than the previous year's figure of £16 3s. 2d., with the result that the declared value of wool exported in the year ended 30th June, 1935, was less by £6,959,665 than in the corresponding previous year. On the other hand it has been computed by the Census and Statistics Office that the quantity of wool in store in New Zealand at 30th June, 1935, represents approximately 87,300,000 lb. in the grease, as compared with 49,800,000 lb. at 30th June, 1934, and 78,600,000 at 30th June, 1933.

Statistically the world wool position appears distinctly satisfactory from the viewpoint of producers. While estimates of the world sheep population may be far from accurate, it is noteworthy that recent decreases in the flocks of the major sheep-producing countries have been observed in almost every case. On the other hand the sheep population of New Zealand has increased in both 1934 and 1935, so that at 30th April, 1935, it is 29,078,678, compared with 28,649,038 at the same date in 1934: the 1935 total is only about 6 per cent. lower than the peak-level attained in 1930. Further, statistics indicative of the stocks of wool on hand in the principal consuming countries point to lower totals than at the corresponding times last year—*e.g.*, stocks of wool in warehouses in the principal ports in the United Kingdom totalled 165,000,000 lb. at 30th April, 1935, compared with 215,000,000 lb. at the same time last year, and stocks of raw wool in Japan at the end of February, 1935, were 45,800,000 lb., whereas at the same date in 1934 they were 60,000,000 lb. Finally, data relative to the trade in woollen goods are encouraging to producers. Though returns compiled by the British Board of Trade reveal slightly decreased activity in the woollen and worsted and hosiery trades in the first quarter of 1935, compared with the position in the corresponding period last year, the exports of woollen goods during the five months ended 31st May, 1935, were higher on the average than during that period of 1934. Activity in the woollen-manufacturing industries in the United States recently has increased substantially, but this is offset by the fact that in France and Germany it is at a lower level than was the case last year. The export trade of Japan in woollen goods has increased substantially during the past year.

The generally favourable weather prior to shearing was reflected in the condition of the wool-clip, in which there was more combing wool than in the previous season. The "binning" by wool-brokers of the wool of owners of small flocks, which is becoming standard practice, is justified by the results.

The serious decrease by over half a million in breeding-ewes in 1932 was followed by an increase of 146,637 in 1933, and another increase of 361,729 in 1934. Interim figures give an increase of 237,493 in 1935, resulting in a total of 17,808,919 breeding-ewes at the 31st April, 1935—the highest number ever recorded. The estimated average percentage of lambing in 1934 (89·24 per cent.) was slightly less than in 1933 (89·82 per cent.), but appreciably above the average of the twelve-year period ending 1934.

For the year ended 30th June, 1935, the frozen lamb exported amounted to 2,796,037 cwt., of a declared value in New Zealand currency of £8,832,289, the corresponding figures for the previous year being 2,548,898 cwt. and £7,358,435. The killings for the ten months ending 31st July, which enable a better comparison between seasons to be made were 8,828,487 in 1934–35, compared with 8,742,972 in 1933–34. The average weight of lambs killed for export up to 30th June was 32·7 lb., the lowest average weight during the past ten seasons and attributable to the unfavourable summer conditions. During the ten months ended 31st July, 1935, there were killed for export 948,259 wethers and 1,192,996 ewes, the figures for the corresponding period in the previous season being 841,242 wethers and 988,122 ewes. The average weight of wethers killed for export for the nine months ended 30th June, 1935, was 53·3 lb. and that of ewes 53·4 lb. The average weights in the 1933–34 season were wethers, 54·7 lb.; ewes, 54·4 lb. The increases in the killings of wethers and ewes are reversals of what took place in 1933–34, and it is noteworthy that the number of ewes killed for export during the ten months to the 31st July, 1935, exceeds that for any other season since 1923–24, except that of 1931–32, when the prices obtainable for wool and for all classes of meat were abnormally low.

The data available are not indicative of any appreciable change in the position relative to beef-production. The interim live-stock statistics indicate a falling-off in the number of cattle other than dairy cows as at 31st January, 1935, of approximately 28,000 in comparison with the previous year. It is probable that any rapid substantial future change in the beef position is dependent upon developments in the chilled-beef trade to which reference has been made above.

Horses.

There has been a slight decrease in the number of horses. In general, the market for draught horses for farm work continues to be strong, and there is some evidence of a tendency towards an expansion in the amount of horse-breeding. The present good market for farm horses may be attributed mainly to a decline over a series of years in the number of horses in the Dominion, coupled with a general upward movement in the total acreage in arable crops, which rose from 1,645,000 in 1925–26 to 2,064,000 in 1933–34. Some significance, however, may attach to the fact that in the intervening period the number of agricultural tractors has increased from 1,026 to 5,062, slight increases in the number in the two latest years for which returns are available replacing a previous decrease. Though there was an increase in the number of draught horses exported to Australia, the export trade is relatively small.

Quality of Pastoral Produce.

The quality of pastoral produce continues to receive much attention, and apart from the satisfactory results in regard to dairy-products, to which reference has been made already, it is gratifying that the normal high quality of New Zealand meat has been well maintained in the year under review; this does not overlook the fact that because of the dry summer there was a fall in the average weights of lambs, and this resulted in the number of lambs graded second being somewhat higher than in a normal season. Though there seems to have been less comment about the quality of products than in recent previous seasons, this is no justification for any slackening in systematic endeavour to produce goods of the quality and type suited to the markets that it is desired to supply.

Fruitgrowing.

The area in commercial orchards in the Dominion is practically stationary at 27,000 acres, any planting of new areas being offset by certain other areas becoming unprofitable and going out of production. A heavy yield in the 1933-34 season, combined with continued dry weather during the fruiting period, resulted in the past season's apple crop in the majority of commercial fruit-growing areas being a light one. Pear and stone-fruit trees were not affected so materially by the dry conditions, and yielded good average crops. As a result of the seasonal conditions the 1935 season's export was the lowest since 1929, the total quantity exported being 1,063,420 cases, comprising 942,296 cases of apples and 121,124 cases of pears. The total quantities of apples and pears exported from the Dominion during the previous four years were—1931, 1,349,895 cases; 1932, 1,596,058 cases; 1933, 1,430,513 cases; 1934, 1,574,912 cases.

Of the quantities exported in the 1935 season, 703,770 cases of apples and 94,159 cases of pears went to the United Kingdom, 80,164 cases of apples to the Continent of Europe, 67,747 cases of apples to North America, 42,579 cases of apples to South America, 47,028 cases of apples and 26,965 cases of pears to Sweden, and 1,008 cases of apples to the East—indicative of exploitation of a range of possible markets. Recently an endeavour has been made to improve marketing

conditions for New Zealand fruit in the United Kingdom and Europe, and one result has been a reduction in the Swedish duty on New Zealand fruit from 4s. to 2s. a case.

Reports indicated that the bulk of the 1935 fruit-exports reached their destination in good condition, with the exception of Cox's Orange Pippin, in which there was a considerable incidence of bitter-pit. The prices obtained for apples in general were considered satisfactory.

Pears were disappointing in regard to both price and condition. Their keeping quality was poor in comparison with that of the 1934 exports. This, combined with excessive supplies from Australia, resulted in low prices. It seems that the quantity of pears shipped to the United Kingdom from all countries reached saturation-point in 1935, and the matter of New Zealand exports calls for consideration.

The Government guarantee relative to the 1935 exports applied only to fruit shipped to new markets. Apart from that, the Government contributes to the New Zealand Fruit-export Control Board's Central Guarantee Fund up to £12,500. The liability of the Government under the arrangement does not exceed £12,500 for each year. Government assistance to the Central Guarantee Fund ceases with the payment for 1937, by which time it is expected that the fund will have become self-supporting. As a result of careful organization in the past, New Zealand fruit has gained a good position on overseas markets, and every possible effort is being made both to hold and to improve this position.

Citrus-growing continues to make steady progress, and there has been a further increase in the area planted in lemons and in sweet oranges, which are now receiving considerable attention. The lemon crop has been satisfactory, and shows evidence of improved quality in commercial lines.

With the prospect of increasing crops, marketing arrangements rightly are receiving attention: in North Auckland provision is being made for central grading and packing and the manufacture of by-products, such as lemon-peel and lemon-juice, is being considered.

In North Auckland the extraction of passion-fruit juice is being carried out on a fairly extensive scale. The establishment of a new cannery at Hastings for pulping and preserving fruit and for the manufacture of jams and sauces is an interesting development. A steady increase is taking place in the culture of vines for both wine and table purposes. The quantity of wine produced for the current season is estimated at 148,000 gallons—an increase of 10,000 gallons in comparison with the previous year.

The season was favourable for the more important pests and diseases affecting the main orchard crops—*e.g.*, codlin moth, leaf roller, and black spot. In general, growers adopted appropriate control measures. Fireblight made very little headway during the year.

The successful cold-storing of fruit is a very important factor in the orchard industry, and considerable work, including experiments in co-operation with the Department of Scientific and Industrial Research, has been devoted to it. The work with certain new features is being continued. While the local markets have been well supplied with fruit, some further improvement may result from cool-storage facilities which are being considered by Otago orchardists.

Other Branches of Primary Industry.

The highly satisfactory position in respect to quantity and quality of products recorded in respect to the main primary industries of the Dominion has been duplicated in certain primary industries which though smaller are of considerable current importance—importance which may readily increase if marketing difficulties increase or develop in respect to the products of the main primary industries.

PIG-KEEPING.

It has been demonstrated well and often that there are great differences in the financial returns obtained from pig-keeping as a side-line in dairying, and that the potentialities of pig-keeping associated with dairying are far from being fully realized; numerous actual farm results show that an output of 40 lb. of pig-meat per 100 lb. of butterfat produced may be obtained with little difficulty and expense. It is gratifying that this knowledge is being translated into practice more and more. As some evidence of this is the increase of approximately 100,000 in the number of pigs in the Dominion at 31st January—758,064 in 1935 and 660,393 in 1934. Other evidence lies in the killings for export. These were in the season 1925–26, 28,819 porkers and 21,184 baconers; in the season 1930–31, 110,092 porkers and 22,308 baconers; in the season 1933–34, 361,430 porkers and 103,181 baconers; from the 1st October to 30th June, 1933–34, 338,444 porkers and 102,535 baconers; for the corresponding nine months of 1934–35 season, 417,461 porkers and 148,999 baconers.

The co-operation of farmers is necessary relative to the danger of going too far in the production of porkers instead of giving to the production of baconers the attention that the market conditions warrant. The crux of the position lies in the fact that Great Britain absorbs only about 50,000 tons annually of imported porkers in comparison with over 400,000 tons of bacon, hams, and baconers, equivalent to approximately 550,000 tons of baconer pigs, so that the trade of the United Kingdom in imported baconers is approximately equivalent to eleven times that in imported porkers. New Zealand is doing a relatively insignificant share of the baconer trade, and may reasonably expect a greater share, whereas the share of the porker trade already being substantial an increase of it may not be easy to obtain: an adequate quota for New Zealand baconers arriving in the United Kingdom during the calendar year 1935 has been arranged. Hence the recent increase in the percentage of baconers shown in the above figures relative to the killings for export is satisfactory, and it is to be hoped that it is indicative of the trend of future production in which a greater proportion of baconers is deemed desirable. Any attempt to meet the market needs by producing baconers in cases in which porkers have usually been produced at once creates a need in respect to feed-supply. Often it will prove most economical to meet this need partly at least by farmers growing suitable crops on their farms specially for pigs. While considerable knowledge about such crops is already available, investigations to obtain further knowledge are being carried out at the Ruakura Farm of Instruction and elsewhere by the Department. Other matters calling for attention if the best returns are to be obtained from the export of pig-meat are the quality and the weight of the carcasses. The quality of carcasses calls for close attention to both breeding and feeding: the trend of recent work is to attach more attention than formerly to feeding as a factor in carcass quality. A fairly serious fault has been the unduly large number of carcasses which if classed as porkers tend to be too heavy, and, if as baconers, too light.

POULTRY-KEEPING.

Signs of increased activity in the poultry industry suggest that the production of eggs will be increased considerably in the 1935–36 season. During the past season 11,527 cases of eggs (30 dozen in each) were exported to the United Kingdom in comparison with 12,107 cases in the previous season.

The industry is satisfactorily taking advantage of the opportunity to organize given it under the Poultry-runs Registration Act, 1933, and the Poultry Board set up under that Act is functioning actively. Under the prices ruling in overseas markets, returns are not sufficient to encourage the export of large quantities of eggs, but nevertheless the development of the most advantageous export market possible is considered important as a means of disposing of eggs which are produced in the summer in excess of the needs of the local market, and which, if unloaded on the local market, would depress prices so seriously that eventually the industry would so contract that the needs of the local market throughout the whole year would not be met at a reasonable level of prices. In view of the preponderance of eggs from small flocks, export by individual producers of eggs is impracticable, and because of this an urgent need of the industry is a reliable, comprehensive, and inexpensive system of collective export.

An interesting recent development in the industry has been the introduction of mammoth incubators with a capacity as great as 15,000 eggs. This development brings with it the "custom-hatching" practice the advantages of which are associated with potentialities of abuse—*e.g.*, neglect of necessary attention to breeding resulting in the distribution of inferior stock.

The Wallaceville Poultry Station continues to be of much value to the industry because of both its educational and its investigational services. One phase of the investigational work carried out at the station has been recorded in the *Journal* during the year. Stock of good quality have been developed at the station, and to enable this quality to be maintained birds of suitable blood are being imported from Australia, and, in addition, Langshans are to be introduced.

BEEKEEPING.

Again the beekeeping industry has had a somewhat poor year, the production having decreased mainly because the long dry summer seriously affected the pastures—only in Taranaki and South Canterbury were the returns above the average. The general position may be gauged from the fact that in 1935 5,477 cwt. of honey, valued at £17,844, was exported in comparison with 7,342 cwt., valued at £23,784, in 1934. It should be remembered in this connection that the 1934 season was the best of several recent seasons. The grading of honey for export, carried out by the New Zealand Honey Control Board under the Honey-export Control Act, 1924, seems

likely to improve overseas marketing and to assist in maintaining the high position held by New Zealand honey on the English market.

The total number of apiaries registered is 7,621, comprising 116,050 colonies of bees, and despite the difficulties which have been associated with the industry a number of apiaries are being extended or established.

In general, disease is being controlled satisfactorily, this being due partly to the valuable services rendered by private beekeepers serving as honorary apiary inspectors.

TOBACCO.

The total area planted in tobacco in the Dominion during the 1934–35 season was approximately 1,800 acres: in the previous year the area in tobacco for commercial purposes was 2,500 acres, and this represented a reduction relative to the year before it. An experimental shipment of this season's tobacco-leaf is to be made to the United States.

The small-farm settlement at Pongakawa in the Bay of Plenty grew 40 acres, in comparison with 100 acres of tobacco in the previous season, and produced a good yellow flue-cured leaf. There is renewed interest in the growing of hops, which have been increased in area because of the improved prices obtained. Considerable planting in regard to tung oil has taken place in North Auckland, the total area in tung-oil trees now being estimated at 3,500 acres.

HEMP (PHORMIUM).

The condition of the hemp industry is indicated by the fact that the number of bales submitted for grading—18,814—was 3,343 less than in the previous year. It appears that some of the initial difficulties relative to the manufacture of wool-packs and sacking are being overcome, and if so this augurs expansion of the activities of the factory opened at Foxton last year with consequent benefit to producers of flax (Phormium) in that territory.

SEED-GROWING.

The official certification of seed was extended to embrace Italian rye-grass during the year under review. A pioneering step of potential importance was the sowing of considerable areas of pasture seed originally produced at the Plant Research Station, the objective being the production of pedigree seed of strains superior to the strains commercially available. An assured result of the free use that is being made in New Zealand of certified seeds is better pastures and arable crops. A further possible result is that official certification may lay the foundation of a valuable subsidiary primary industry dependent partly perhaps on an export trade in seeds, but also on the use of locally grown seeds replacing the use of seeds now being imported.

THE USE OF ARTIFICIAL FERTILIZERS AND LIME.

The results of fertilizer trials carried out by the Fields Division over a period are being translated into practice rapidly.

Wheat-manuring trials carried out in the South Island showed that the use of 1 cwt. of superphosphate an acre with wheat gave an average increase of 4 bushels an acre. Many wheat-growers at once applied this knowledge and the number doing so continues to increase: in 1928–29 fertilizer, chiefly superphosphate, was used on 66 per cent. and in 1934–35 on 82 per cent. of the acreage sown. Similarly the results of fertilizer field trials have brought about increased use of fertilizers in potato-growing.

Kindred experiments have been, and are being, conducted in connection with pastures and other crops for the purpose of obtaining more comprehensive and exact knowledge. Though outstanding future results are not altogether likely the information already obtained points to the advisability of continuing the work as a means to greater detailed knowledge specially applicable to definite districts and conditions. The survey of the response of New Zealand grassland to various classes of fertilizers and to lime is a task of major importance which has already provided practical guidance of considerable moment. For instance, it throws useful light, possibly unexpected by many, on the variations in the response of grassland to lime from district to district. It would seem that some farmers err by spending money on lime and others by not spending enough money on lime. The position is broadly the same in respect to potash.

The artificial fertilizers carried by rail for the twelve months ended 31st March, 1934, were 74,450 tons more 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, 552,233; 1934–35, 626,021. The figures for the North and South Islands in 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
1934–35	471,876	154,145

The agricultural lime carried by rail during the year ended the 31st March, 1935, was 50,757 tons greater than in the previous year—the greatest annual increase recorded in recent years. The quantities, in tons, of agricultural lime carried annually by rail since 1st March, 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	79,713	177,117
1933–34	99,919	94,068	193,987
1934–35	116,482	128,256	244,738

This is the first occasion on which over 100,000 tons of lime have been carried by rail in one year in each Island. If it were certain that the lime-supplies were being used where farm experience and investigation have shown that they are productive of profitable results, then the recent increases in the amount of lime handled would be a matter for congratulation, but when the railage destinations of certain substantial supplies are checked against the results of field trials and veterinary experience it seems that lime is at times being used increasingly without any evidence that would justify recommending its use. From the available evidence it seems probable that some districts, with advantage, could use greater quantities of lime than are being used, while in other districts the outlay now made on lime could be made more profitably in other directions—*e.g.*, in the use of phosphates.

Stock-diseases.

The health of horses has not occasioned concern throughout the year. In general, the year has been normal in respect to diseases of cattle. Of the animals examined at abattoirs and meat-export slaughterhouses only 5·54 per cent. were found to be affected with tuberculosis in varying degrees.

The incidence of black-leg was considerably less than in the previous year, whereas there was an increase in the number of farms on which Johne's disease was found. The insidious nature of this disease and the economic loss which it may produce suggest more drastic control measures, and consideration is being given to the advisability of these. In the areas affected the presence of the cattle-tick is not looked upon as so serious as it was some years ago. But the presence of the tick is definitely undesirable, and suitable individual effort, such as spraying, hand-picking, and the destruction by burning or otherwise of winter cover for ticks is very advisable. The incidence of mammitis in dairy cows was less than in past years: this probably is attributable to the dry summer. The great importance of hygienic measures in the control of mammitis is being more widely recognized by dairy-farmers. While contagious abortion remains widely disseminated, the year was not marked by unusually heavy incidence. There appear to be a decreased incidence of temporary sterility. Some very interesting investigations on the influence on sterility of feeding to male animals diets containing a high content of protein are in progress at Wallaceville Laboratory, but have not reached the stage of providing practical guidance. Bloat in cows is being investigated both in the field and at the Wallaceville Laboratory.

The incidence of grass staggers or grass tetany in cows, which is confined mainly to the Waikato district, is stated to have been less than in previous years. Investigations particularly relative to blood-magnesium are being continued. The losses from parasitic diseases which are prevalent in young cattle could be minimized by greater attention to good feeding and care. "Foul-foot" in cattle, which still occurs in dairying districts, could be avoided to a marked extent by the provision of concrete pathways as exits from yards.

Apart from a serious outbreak of facial eczema, the year presented no abnormal features in respect to diseases of sheep. "Facial eczema" is discussed at considerable length in the appended report to the Director of the Live-stock Division.

The losses caused to sheep-farmers by internal animal-parasites in their flocks continue to be probably greater than those caused by any other trouble. Too much reliance is placed on drenching alone, while the over-riding importance of suitable management and feeding is too often ignored. The economic importance of lymphadenitis, which has been stressed in previous reports, justifies the giving of special attention to the elimination of this trouble from the flocks. The year under review has provided additional evidence of the value in eliminating lymphadenitis of manual palpation which will be demonstrated to any sheep-owner who applies to the Department. The report of the Live-stock Division goes into detail regarding this.

The inflammatory condition of the sheep's skin (mycotic dermatitis), to which reference was made in the report of last year, was noted again in the year under review in South Island flocks. The number affected in individual flocks was small. Sheepowners should report suspicious cases to the Department for investigation. "Pink-eye" (infectious ophthalmia) of sheep was common, following the dry summer, and much advice regarding suitable control measures was given. The incidence of ante-partum paralysis was low, the greatest numbers being recorded in Otago, this being due possibly to severe weather conditions in July. The general position in respect to lice and ticks is satisfactory. Reports are indicative of considerable prevalence of sheep blowfly attack, which could be minimized by more extensive use of fly-traps.

The increasing role of pig-keeping in our farming makes it particularly advisable that pig-keepers realize and apply in their practice the fact that there is a close correlation between general management and the incidence of diseases and disorders. Large numbers of pigs are rejected for export, and many of the rejections may be attributed to faulty management. Apart altogether from these rejections, which are serious in themselves, it has to be borne in mind that economic production of the pig-meat that is passed for export is intimately linked with good management, particularly in respect to feeding and accommodation.

It is gratifying that during the year the Dominion was free from swine-fever: the measures taken to deal with the outbreak which occurred last year have proved completely effective. Pleurisy in pigs is sufficiently common to cause concern in regard to exports to Britain, where the authorities adopt a stringent attitude in regard to pleurisy. Given correct feeding and adequate housing, the incidence of pleurisy should decline substantially, as also should that of tuberculosis, a lessening of which is desirable even though to a large extent the actual infection in the carcass is slight. Necrotic ulceration of the skin, which is another condition that leads to rejection of carcasses for export, could be lessened by improvement in hygienic conditions.

The Rabbit Nuisance.

The favourable weather conditions of the year, the low prices obtainable for skins and carcasses, and the financial stringency that affects many land-holders, all have militated against abatement of the rabbit nuisance. Nevertheless, the position, though not satisfactory, is not alarming, and much is being done to deal more adequately with the present undesirable state of affairs. That the advantage of Rabbit Board control is being more widely recognized, is indicated by the formation of several new Boards. The Boards in existence have carried out their work satisfactorily.

Control of Noxious Weeds.

The amendment of 1934 to the Noxious Weeds Act should lead to improved control. By this amendment County Councils are given power to assume responsibility for the administration of the Act within their respective counties, and it is significant that already several Councils have taken over the administration—at times particularly to handle the control of ragwort. The spontaneous response of these Councils to administer the Act augurs well for the future, and their action merits the fullest support and the consideration of other Councils. The present extensive use of sodium chlorate as a means of keeping weeds, especially ragwort, in control, is a direct outcome of experimental work carried out by the Fields Division, and as a result the farmer now has a reliable method of controlling ragwort and other weeds, and because of this the Government is subsidizing sodium chlorate and thus fostering its sale to farmers.

Although the weed position of the Dominion is somewhat unsatisfactory, it is now as a whole better than it has been for some years past. This is particularly true of ragwort in the North Island, where its influence, always of moment, was growing in recent years. Considerable attention has been given to other important noxious weeds such as sweet briar, blackberry, Californian thistle, and gorse.

Ruakura State Farm and Farm Training College.

At Ruakura State Farm, following the winter, grass-growth started well and continued so up to the middle of November. Then a long dry summer spell had the effect of severely checking the pastures and adversely influencing crops generally. One result was a slight reduction in comparison with the previous year in the output of butterfat. The position in regard to the sheep at Ruakura continues satisfactory. The reserves of fodder built up during the summer are estimated as 160 tons of silage and 179 tons of hay. As has been the case in recent years, no annual sale of stock was held on Ruakura, but surplus stock were sold at the Hamilton combined breeders' sale. A fairly good demand was experienced for Berkshire and Tamworth pigs, but there was little inquiry for the Large Whites.

The Ruakura Farm Training College continues to be popular, the average enrolment during the year being thirty-five students, whose general health was good. At Ruakura, as at six other smaller farms which operate more or less under the direction of the Fields Division, important investigational work has been carried out. The research work on all these farms is essentially of a type which is too intricate to be dealt with satisfactorily in the trials which are carried out extensively in co-operation with farmers on their farms and which prove of much value as a means of solving suitable problems under specific local conditions.

Te Kauwhata Horticultural Station.

The main activities at Te Kauwhata Horticultural Station have related to the vineyard and to the manufacture of wine, as has been the case over a series of recent years. The financial position is satisfactory, receipts exceeding expenditure by nearly £3,000. The grape crop was satisfactory, and produced approximately 14,500 gallons of wine: against this 15,304 gallons of wine were sold during the year.

Increased interest is being taken in both table and wine grapes, and there was a considerable demand for vines.

The Plant Research Station.

As has been the case in former years some of the activities of the Plant Research Station were 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) much work relative to pastures which was previously in progress has been continued. The search through both breeding and selection for improved types of pasture plants has been continued, and initial steps have been taken in the production of pedigree pasture seed, which it is hoped will lead eventually to strains of pasture plants superior to those available under certification being produced on a commercial scale and made available to farming through official certification of the seed. Attention has also been given to research relative to pasture establishment and utilization. One important aspect of utilization that is being probed relates to the possibility of correlation between pasture characteristics and feed flavours in dairy-products. This work is being done in collaboration with the Dairy Research Institute. Investigations relative to a wide range of arable crops are in progress at Palmerston North, Marton, and at the Government Pure-seed Station at Lincoln on land leased from Canterbury Agricultural College. In trials relative to certification of seeds 1,179 plots were sown, and in seed-testing 8,104 purity analyses, 13,306 germination tests, and 1,361 ultra-violet-light examinations were made. Work of particular potential value in view of the national importance of the crops is being done in regard to lucerne and the brassica crops (turnips, rape, &c.). The extensive work in progress in the sphere of plant-protection has yielded some significant results. One of these relates to the control of the white butterfly (*Pieris rapæ*) by parasitization. Field surveys indicate that the pupal parasite (*Pteromalus puparum*) is spreading and multiplying very rapidly, as to up 90 per cent. of the chrysalids were found to be parasitized. In Hawke's Bay, where the pupal parasite was first liberated, the menace of the white butterfly has been removed, though the butterfly persists in insignificant numbers. The latest observations point to the effective control of the white butterfly throughout New Zealand within two years.

In general, the work of the Plant Research Station and associated activities continues, and extends that of recent years. A considerable amount of detailed information about the work is contained in the appended statements relative to the activities of the various sections.

Wallaceville Veterinary Laboratory.

The Wallaceville Veterinary Laboratory deals with two phases of veterinary work—diagnostic and investigational—and it is supplemented by a subsidiary laboratory at Hamilton. The

specimens handled by the two laboratories during the year numbered 8,731 at Wallaceville and 40,340 (practically all milk) at Hamilton. The great majority of the specimens dealt with at Hamilton related to mastitis control. The work organized and carried out at Wallaceville generally has been of its previous important and extensive character. A total of 37,010 doses of vaccine for treatment of blackleg were issued during the year. Relative to contagious abortion, the number of blood-samples being received for examination is smaller, and suggests that insufficient individual effort is being made to combat the disease. The work of several years regarding the control of mastitis was finalized. The control scheme has been accepted in the Waikato as a very useful aid in controlling mastitis, but it is impossible to apply the scheme generally throughout New Zealand unless dairy companies take the matter up, the cost of doing the work by the Department alone would be considerable. The Bureau of Animal Industry appears to be taking up a somewhat similar method of control in the United States: its method includes provision for payment of compensation for condemned cows. Sterility both in cattle and sheep has been investigated, but results have not reached a stage of finality. Research has been undertaken relative to bloat in dairy cows: no evidence of correlation between the occurrence of bloat and of hydrocyanic acid was obtained. Grass staggers in dairy cows has been the subject of investigations the results of which will not be available until October or November of next year. The outbreak of the so-called "facial eczema" in sheep led to considerable investigation. The so-called "Morton Mains disease" has been investigated, and from the evidence obtained it seems probable that the mortality in lambs is due to parasites following an unsuitable type of husbandry. In regard to the sickness said to exist among Mairoa sheep, samples of blood and of bones of affected sheep have been analysed. The analyses together with post-mortem examinations of the sheep suggest that the Mairoa trouble is largely parasitic and not due to deficiencies of minerals. A poultry trouble known as leukemia has been given much consideration: experiments relative to it are incomplete. Dr. M. M. MacOwan is still holding a Carnegie Scholarship at Wallaceville and is carrying out portion of a nutritional investigation. The possibility of toxic effects from the feeding of smuts is being investigated. The wide range of important work being efficiently carried out at the Wallaceville Laboratory or associated with it is indicated concisely in the appended report of the Officer in Charge.

The Chemical Laboratory.

As normally a large amount of work of economic value has been carried out by the Chief Chemist and his staff. It has provided evidence of the efficiency of limonite in the prevention and cure of bush-sickness. Further investigations about the nature and composition of "limonites" has been carried out. A considerable amount of work has related to the value of pampas grass as a fodder. In regard to the iodine investigation, 100 samples from Westland and thirty-five from Marlborough have been collected. Soils have been analysed in connection with the survey of littoral lands. As in previous years, the services of the laboratory have been used in connection with liming materials, weed-control, feed-stuffs, pasture samples in connection with trials being carried out by the Plant Research Station, dips and stock-licks for the Live-stock Division, and tobacco-samples for the Horticulture Division. A total of 1,046 samples were received for the 1934–35 period. The Fertilizers Act was administered as formerly: some indication of the extent of this work may be obtained from the fact that the number of brands of fertilizers registered was 851, the corresponding number for the previous year being 899. The appended report of the Chief Chemist indicates at some length the varied nature and extent of activities undertaken and the results obtained during the year by the Chemistry Section.

Advisory and Instructional Work.

The volume of the advisory and instructional services sought from the Department continues to increase. The ever-increasing complexity and specialized nature of much of modern additions to our knowledge relative to farming create problems or intensify ones which already existed. These problems relate to the assimilation of the specialized knowledge into farming. Specialization during recent years has been prominent in research work relative to farming. While such specialization has certain substantial practical advantages, it also has considerable disadvantages, unless associated with effort designed specifically to give suitable consideration to the fact that sound knowledge of farming can arise only from the study of individual farms. In brief, the centre of the subject of farm-production must always be the farm itself: the problems presented in the improvement of farming cannot be split into a number of parts without danger of detriment. Fragmentation of the problems even though advisable is artificial, and may not lead to harmony

with reality unless the results of specialized effort are suitably co-ordinated. This calls for the study of farm-management which embraces stock-management and crop-management as parts of a greater whole in which a place is occupied by the farmer himself—his financial position, his supply of labour, and his markets both present and prospective. Within the Department it is fully realized that the need for attention to farm-management in its widest sense has in recent years become more acute. This is because the farming position and outlook have changed so greatly that we are virtually in a new era in which it seems likely that low cost of production associated with quality of product must be the keynote. A new era means pioneering work, but this should neither confound nor dismay us: New Zealand farming throughout has been characterized by pioneering. Relative to a very similar position facing himself, Henry A. Wallace, Secretary of Agriculture in the United States, says:—

> "The present confused state of production, to my mind, constitutes a particularly strong reason why research should be expanded. In this crisis in which we are attempting to blaze new ways out it is folly to operate under a dim light. In the first place the problem of the individual farmer is never as before keyed around economy of production and quality of product. If we are to regain our foreign markets and expand our domestic demand the the type of research having to do with production costs and quality of product is needed as never before."

The "research having to do with production costs and quality of product" is the farm-management research to which reference has been made above. In the sphere of farm-management the laboratory of the research worker is the farming community—the farmers and their farms. Fortunately, as a result of the extensive advisory and research services of the Department, there is available much real knowledge about farm-management—knowledge which when studied systematically from the viewpoint of current developments and supplemented when necessary with research should prove of great value. In this connection the dual character—both research and advisory—of the work of the Department is a distinct advantage. When the one organization undertakes both the begetting and the dissemination of knowledge the findings of research can be more quickly translated into practice.

Publications and Publicity.

The *New Zealand Journal of Agriculture*, in its reduced size, because of the desire for lowered expenditure, serves well as a means of disseminating information about activities and trends in agriculture, of conveying advisory information to its readers, and of recording the general nature and the practical bearing of completed investigational work relative to agriculture carried out by the Department and by the several other kindred organizations in the Dominion which devote their activities to increasing the general store of knowledge about means of improving farming.

The series of weekly radio lecturettes from Station 2YA, Wellington, was maintained throughout the year by officers of the Live-stock, Fields, and Horticulture Divisions along similar lines to those followed in previous years.

As occasion arose, bulletins and other publications or statements were issued as in the past to supplement the *Journal*.

Miscellaneous.

As in former years, the Department has undertaken a considerable amount of work resulting from governmental measures designed to assist the farming industry particularly in the times of stress which have been experienced in recent years. The principal measures relate to railage subsidies on lime and fertilizers, concessions on railway transport of primary produce, the subsidy to manufacturers of superphosphate, and the financing of improved facilities in dairying. The purchase of seeds and manures for Government Departments in general, which was carried out as usual and which involved considerable work, was based on the specialized knowledge possessed by the Department, and so should have resulted in efficient economical buying. In this connection the seed-testing station considered 753 lines of seed relative to the purchase of 221 tons valued at approximately £19,778, and check tests of samples drawn from bulk deliveries were made.

The 1934 Certificate of Record testing-work showed a satisfactory increase over that of 1933: 680 certificates were issued, in comparison with 545 in the previous year. In view of the general position of dairying the increase, equivalent to approximately 25 per cent., is considered eminently satisfactory. The Government subsidy to ordinary herd-testing was continued, £5,000 being granted for the past season. Under the ordinary herd-testing, 297,647 cows were tested, this number being 11,593 greater than that tested in the previous year. Approximately 92 per cent. of all cows tested during the year were under the group system.

The work of the agricultural clubs, in which the Department collaborates with the communities concerned and with officers of the Department of Education, was again characterized by success approximating that attaching to the work in recent previous years.

The movement relative to young farmers' clubs, which gives promise of future importance and value, and which was initiated by the Fields Division, is extending rapidly, and officers of the Department are fostering the movement as far as possible by assisting in respect to lectures and demonstrations, while suitable co-operative trials are being undertaken in collaboration with the clubs.

Conclusion.

The normal advisory research and regulatory functions of the Department have been supplemented during the year by considerable services, in co-operation with the Meat Board, relative to the quota and other problems in connection with meat. And as was the case with the previous Dairy Produce Control Board, the Department has been in close contact with the Dairy Board appointed under the 1934 legislation in regard to various matters affecting dairying. The aim of the Department as a whole has been to render highly efficient services at the lowest possible cost, and I desire to record my appreciation of the assistance I have had in doing this from the Assistant Director-General, the Secretary, the Directors of the Divisions, and of other units, together with members of the staff generally, all of whom, during a year of special stress in connection with the Department's responsibilities, have given consistently of their best, and thereby enabled these responsibilities to be carried through.

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.

Details are supplied herewith as to the fifteenth year of operations under Government ownership at Nauru and Ocean Island. The year terminated on 30th June last, and the shipments compare with the two previous years as follows:—

	1932–33. Tons.	1933–34. Tons.	1934–35. Tons.
Nauru	436,100	379,100	457,900
Ocean	224,200	177,489	237,982
Total	660,300	556,589	695,882

A substantial increase of 35,582 tons over the previous highest total will be noted, and in view of the expanding demand for phosphatic fertilizers, a further increase in output from the two islands is being aimed at for the current year.

Distribution of the output was as follows: Australia, 422,861 tons; New Zealand, 214,621 tons; other countries, 58,400 tons.

The proportion of the output which came to New Zealand was 30·84 per cent., as compared with 26·95 per cent. for 1932–33 and 26·76 per cent. for 1933–34.

Importations to New Zealand compared with the two previous years are—

	1932–33. Tons.	1933–34. Tons.	1934–35. Tons.
Nauru-Ocean	184,388	149,805	201,665
Outside phosphate	13,963	..	..
	198,351	149,805	201,665

Favourable weather and good health conditions prevailed at the islands during the period under review; labour conditions were also satisfactory. The Nauru loading cantilever continues to give excellent results, and it is now a frequent occurrence for vessels to arrive in the early morning and leave the same evening with a cargo of from 8,000 to 9,000 tons.

In New Zealand ports there have been further improvements in the rate of discharge, favourably influencing our tonnage arrangements.

The Commission's new motor vessel "Triaster" has entered the trade, and, similarly to the "Triona," is fitted with special equipment for lifting and relaying the deep-sea moorings at the islands, on which the success of our operations depends. The "Triaster" has a carrying-capacity of 7,900 tons of phosphate, and the "Triona" 6,550 tons; the latter vessel has now delivered forty-one phosphate cargoes in Australia and New Zealand.

LIVE-STOCK DIVISION.

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

Health of Live-stock.

HORSES.

The general health and condition of horses has been well maintained throughout the year. Interest in the breeding of draught horses continues as a result of the increasing demand for good-class animals of this type, and reports indicate a definite increase in the breeding of draught horses. The economic value of the draught horse when compared with mechanical traction is admitted, and is reflected in the noticeable trend towards increased numbers. The interest displayed in the Clydesdale classes at our principal shows is a further indication that farmers are alive to the possibility of increased revenue through the breeding of good-class draught horses. Referring to the lighter types of horses, it must be admitted that very little interest appears to be taken in selective breeding to-day, and the position with respect to suitable remount horses is almost disquieting.

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 5,875. The total number of cattle, excluding calves, examined at abattoirs and meat-export slaughterhouses was 409,861, an increase of 862 over last year's figures. Of these, 22,703, equal to 5·54 per cent., were found to be affected with tuberculosis in varying degrees.

Actinomycosis.—The number of animals condemned and for which compensation was paid totalled 655.

Malignant Growths.—The number of animals condemned and for which compensation was paid was 286.

Blackleg.—The incidence of this disease was considerably less than in the previous year, this being particularly marked in the Auckland District. The total number of calves vaccinated in the blackleg areas during the year was 27,462.

Johne's Disease.—An increase in the number of farms on which cases of this disease have occurred has to be recorded. Johne's disease is as yet known to occur only in Taranaki and the Waikato Districts. Dissemination of information to farmers respecting this disease has been increased by the field staff, and it is to be hoped that stockowners will, in their own interests, report suspicious cases, so that control-measures might be instituted. The insidious nature of the disease and the economic loss which it is capable of producing render a consideration of more drastic measures in effecting its control desirable. This aspect is at present receiving attention.

Anthrax.—Freedom from this disease has to be recorded.

Cattle-tick.—In the infested areas the presence of the New Zealand cattle-tick (*Haemaphysalis bispinosa*) is not now regarded by stockowners in the serious light in which it was viewed some years back. Whilst the presence of tick on any farm is undesirable, the tick is not in any way a dangerous stock parasite. Individual effort is very necessary in limiting the development of cattle-tick, and much good can be accomplished by periodical spraying of cattle during the season, hand-picking of ticks, and, more important still, the burning or destruction of cover which affords protection to seed ticks during the winter. In the North Auckland District a concession was permitted during the past season regarding the movement of fat cattle from the "A" area, and this has so far apparently worked satisfactorily.

Mammitis.—The incidence of mammitis in dairy cows was less than that of past years. This may have resulted from the dry summer influencing the occurrence of the disease through the effect of a diminished milk-yield. The importance of hygienic measures in the control of mammitis is receiving greater recognition by dairy-farmers, and the mammitis-control scheme introduced a few seasons back by the Department appears to be appreciated, more particularly in the Waikato District, where encouraging results are claimed by its adoption. In this procedure the monthly milk examinations as carried out by the Veterinary Laboratory have proved a very valuable service to the dairy-farmer.

Contagious Abortion.—The year was not marked by any undue incidence of abortion. Nevertheless, as stated in previous reports, the infection is widely disseminated throughout the dairying districts. An increase in the occurrence of this disease in dairy herds in Canterbury is recorded, and the activities of field officers of the Division in this district have been directed towards the dissemination of advice to farmers regarding the adoption of control-measures. This is most important in a district in which the disease has not previously assumed high proportions, and dairy-farmers would be well advised to take precautionary measures to lessen its distribution in such instances. The use of the agglutination (blood) test as carried out at Wallaceville affords a valuable diagnostic method of determining the existence of infection, and should be more extensively availed of.

Sterility.—Reports on the occurrence of temporary sterility indicated rather a decreased incidence of this seasonal trouble. Further investigation and research work has been conducted into this condition, particularly with reference to the bull as a factor. Some important observations on the influence of high protein feeding in male animals on the sterility aspect are in progress and indicate the desirability of further pursuing this point.

Tympanitis (Bloat) in Cows.—This condition was the subject of inquiry during the spring months, when the trouble is most experienced. Mr. Marshall, Veterinarian, Hamilton, carried out observations on its occurrence on several farms in the Waikato and Bay of Plenty Districts. It was noted that

the trouble was invariably associated with an excess of white clover in the pasture and in a succulent, leafy stage. Access to water immediately after the paunch is filled with this soft clover seems to favour the occurrence of bloat. Probably for this reason bloating is frequently seen as often in the afternoon as in the early morning. The condition also received investigational inquiry at Wallaceville from an analytical viewpoint of the gas-formation in the paunch, and bacteriologically on the paunch-contents. The suggestion that the trouble might be associated with prussic-acid content of the clover does not appear to be established by investigation. Amongst preventive measures, the feeding of a small ration of dry hay in the morning, as a rule, is followed by good results. Acidulation of the drinking-water by the addition of a small quantity of dilute hydrochloric acid is spoken of as being effective, but this was not entirely borne out on inquiry.

Grass Staggers in Cows (Grass Tetany).—The occurrence of this disease in cows at varying periods following parturition is mainly confined to the Waikato District. Work on the relationship of the blood magnesium to the occurrence of the trouble is being continued at Wallaceville. The incidence of the disease during the critical period of the past year in the Waikato is stated to have been less than previous years. The use of subcutaneous injections of magnesium-sulphate solution is proving useful in the subacute cases. The work carried out by Messrs. Blake and Marshall in the Waikato in connection with the various aspects of this disease is worthy of mention.

Parasitic Disease in Young Cattle.—The prevalence of parasitic disease in calves is responsible for considerable loss. Much information on the prevention and treatment of the trouble has been disseminated by the Division, yet it is difficult to bring about a realization of the efficacy of good feeding and management. Referring to this point the District Superintendent, Auckland, remarks: "Parasitic diseases among young stock are far too common in spite of the information imparted to farmers on the prevention and treatment of these troubles. Owners are far too prone to rely on all kinds of medicines, but lose sight of the fact that good feeding and careful management, especially during the winter months, play a big part in assisting calves to overcome these troubles."

So-called "Eczema" in Cows (Photosensitization).—A number of cases of this condition were met with in herds in the Waikato and Bay of Plenty Districts during the autumn period. The skin of the udder is usually involved, and the animals lose condition rapidly, with cessation of milk-production. The trouble was evidently associated with flush-feed conditions. Whilst no serious mortality resulted, the condition is responsible for disorganization of supply in a herd. Extensive advice was given by divisional officers regarding suitable control of the trouble.

"Foul-foot" in Cattle.—Reports still indicate the presence of this condition in herds in the dairying districts. There is little doubt that the bacterial infection which gives rise to the condition is favoured by muddy and dirty conditions surrounding milking sheds and yards. The adoption of concrete "walk out" pathways, as exits from the yards, has been recommended by field officers, with very good preventive results.

Chronic Bovine Haematuria.—Cases of this disease were recorded on certain isolated areas of the poorer country in the Nelson and Marlborough Districts. It is evidently associated with continuous grazing on country of particularly poor type.

Nasal Catarrh of Cattle.—This condition was rather prevalent in Poverty Bay and Taranaki. An acute outbreak in the Stratford District was believed to be associated with pollinating grasses and dry, dusty conditions.

SHEEP.

The year was a fairly satisfactory one for the sheep-farmer. Although the price of wool was admittedly disappointing, this was to a great extent counterbalanced by the good prices maintained for sheep and lambs. Sheep came through the winter well, and the lambing percentage was good.

"Facial Eczema."—A serious outbreak of this disease occurred in many districts of the North Island during the autumn period. The name "facial eczema" is not a good one, and it is better called facial dermatitis, or photosensitization. The disease is characterized by a swollen or œdematous condition of the skin of the face, accompanied by severe itching, causing the sheep to scratch the head and thereby bring about infection of the parts, which usually ends in severe scab-formation and even sloughing of the skin. The severe swelling and inflamed condition of the skin around the eyes frequently leads to temporary blindness. Intense sensitivity to sunlight is present, and affected sheep will endeavour to seek shade. As in previous outbreaks of this trouble, its occurrence in the autumn was preceded by an exceptionally dry summer period. In the Gisborne District the long dry spell broke on 7th February, and frequent rain thereafter brought on a very rapid and luxuriant growth of feed, both on the flats and on the lower hills. By the end of the month serious reports were received of widespread trouble amongst sheep in the district. The disease was investigated on the spot by the Officer in Charge of the Wallaceville Laboratory and the District Superintendent of the Wellington District, who both spent some time going very fully into every aspect of the outbreak.

The disease is a form of skin photosensitization usually affecting the uncovered and unpigmented skin of the face, and is associated with blockage of the bile ducts of the liver with inspissated bile. The skin sensitivity to the sun's rays is produced by the accumulation in the blood of a substance known as phylloerythrin, derived from the chlorophyll or green colouring-matter of plants. The precipitating factor in the condition appears to be the sudden change from hard, dry feed conditions to luxurious, lush pasture.

In this disease there is an upset in the function of the liver. The liver itself in badly affected sheep becomes cirrhotic—hard and enlarged.

The disease was not confined to the Poverty Bay district, but was also much in evidence in the Manawatu, also the Marton and Wanganui areas, and Taranaki. It was also prevalent to some extent in Hawke's Bay and the Waikato.

Immediate treatment of affected sheep necessitates their removal to shade—away from sunlight, the application of suitable dressings to the face, and the drenching of sheep with Epsom salts, the latter being considered an essential factor to recovery. Prevention lies in the direction of removal of sheep from long, succulent feed to barer pastures, with the provision of dry feed to the sheep. Field observations carried out by officers of the veterinary staff showed that the preventive and curative treatment advocated by the Division was effective where it could be thoroughly carried out. Information respecting the disease was largely disseminated by the Department through the medium of local papers.

The disease is one of those seasonal sheep troubles which are precipitated to a great extent by climatic conditions affecting pasture growth. Much investigational work has been conducted at the Wallaceville Laboratory into the various aspects of the disease, and this inquiry is being maintained more particularly to observe the possible after-effects in sheep which have suffered from the condition.

A serious outbreak of facial dermatitis occurred in the Mackenzie County during the month of January. In this instance a botanical survey of the tussock country was carried out by an officer of the Plant Research Station, Palmerston North, and although this did not lead to any definite conclusion regarding any contributory factor in the herbage it was nevertheless valuable in other respects. In outbreaks of facial dermatitis in sheep on tussock country the good effects, from a preventive point of view, of burning off the tussock in the spring have been commented upon by the District Superintendent, Dunedin.

Lymphadenitis.—The economic importance of this disease in sheep, from the meat-inspection point of view, has been stressed in previous years. No carcass of mutton or lamb which on inspection at the works is found to be affected with lymphadenitis can be passed for export. The elimination of the disease from flocks is therefore of great importance, and it is highly desirable that sheep-farmers should take steps to lessen or eradicate this disease from their sheep by adopting the measures recommended by the Division. Precautionary measures at shearing-time are necessary, but, in addition to this, manual palpation of live sheep will reveal the existence of enlarged glands, and such sheep should be eliminated from the flock. This procedure has been in force on several large sheep-stations, and its value is proved by the decreasing numbers of affected sheep found each succeeding year on examination. The following figures are supplied by the District Superintendent, Dunedin, as the result of examination of sheep carried out on two properties for some years back :—

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	Fourth, 1935 ..	5,025	62	1·23
Fifth, 1935 ..	10,563	182	1·72				
			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
Third, 1935 ..	2,875	78	2·71	Third, 1935 ..	1,482	14	0·94

The District Superintendent, Christchurch, reports on the results obtained in palpation of sheep on a Canterbury station. The procedure was initiated last year, when the examination showed 12 per cent affected with lymphadenitis. This year's examination showed a reduction to 8 per cent.

The decreasing incidence of lympahdenitis in the above figures shows the value of the annual examination of sheep for this purpose. The method will be demonstrated to any sheepowner who makes application to the Department, and its adoption cannot be too strongly recommended in the interests of our export trade in mutton and lamb.

Mycotic Dermatitis.—This inflammatory condition of the sheep's skin was referred to in the last annual report. During the past year further evidence of its existence in flocks in the South Island came to light. The number affected in any particular flock is small, but, nevertheless, the condition should not be allowed to go unnoticed, as under favourable conditions spread of the infection is probable. The disease is characterized by the formation of hard scabs, which grow with the wool, forming hard masses, rendering shearing of an affected sheep almost impossible. Sheepowners are advised to report any suspicious cases to the Department for investigation.

Infectious Ophthalmia of Sheep (Pink Eye).—This condition was very common in sheep, following the dry summer experienced. It is extremely contagious, and will quickly spread through a flock unless control-measures be adopted. Advice regarding treatment and control has been largely given.

Pregnancy Toxæmia of Ewes (Ante-partum Paralysis).—The incidence of this disease at lambing-time was low, the greatest number of cases occurring in the Dunedin district, due, no doubt, to the check received by ewes as result of severe weather conditions which prevailed in this district during July.

Infectious Entero-toxæmia of Lambs (Pulpy Kidney).—In the South Canterbury District this condition was fairly prevalent. In the Otago District losses of lambs from this disease were reported as below the normal.

Parasitic Disease.—The losses occasioned to sheep-farmers through parasitism of their flocks is probably greater than from any other cause. Much information regarding the control of parasites in sheep has been disseminated by the Division during recent years, but too much reliance is placed by sheep-farmers on drenching alone, whilst neglecting the adoption of methods of sheep management and feeding, without which lasting results cannot be obtained. The influence of the nutritional aspect of the sheep in combating the effect of parasites is a very vital one, hence the necessity of maintaining lambs on short pasture providing the maximum of nutrition.

During the summer a detailed investigation was carried out by officers of the Wallaceville Laboratory into the aspect of parasitism as affecting lambs in the Morton Mains district of Southland; this was decided upon in view of the opinion previously held that parasites were to a large extent responsible for the loss and unthriftiness in lambs experienced in this district. The inquiry revealed a degree of parasitic infestation which in itself is quite capable of producing serious loss. It is the Department's intention, provided the assistance of local interested parties is forthcoming, to arrange the supervision on a selected farm of operations designed to put into effect methods of control calculated to combat parasitic infestation. The results would not be apparent until the measures had been in force for some time, but would be of great value eventually.

Contagious Ecthyma (Sore Mouth).—Outbreaks of this condition, affecting lambs and hoggets principally, have been recorded. The disease is due to a virus, and the possibility of preventive vaccination on properties where the trouble occurs is being given consideration by the laboratory.

Lice and Ticks.—It is pleasing to record that, with the exception of the Poverty Bay District, the position regarding lice-infested sheep is satisfactory. In the district referred to, however, it became necessary to institute numerous prosecutions under the Stock Act against owners for exposing lice-infested sheep in saleyards.

Sheep Blow-fly.—Reports indicate considerable prevalence of blow-fly attack. Methods of control have been strongly stressed by the field staff in those districts where the condition is bad. The more extensive use of fly-traps by farmers would materially help in lessening loss from this trouble.

PIGS.

The development of pig-breeding as an adjunct to dairy-farming is one of the most outstanding features of recent years. A further increase in the number of pigs slaughtered during the past year has to be recorded, the figures being 924,979, as against 744,569 last year, an increase of 180,410.

With a realization of the importance of the pig-breeding industry arises the necessity for improvement in the general methods of pig management and feeding. The need for improvement in this direction is very evident, as is shown by the large numbers of pigs which are rejected for export on examination at the works, these rejections being in a large percentage of cases due to conditions which are directly attributable to faulty pig-management. Much prominence has been given to this aspect by the Department, but it is apparently very difficult to awaken pig-breeders to an appreciation of what is a very pressing necessity.

Swine Fever.—It is gratifying to record the Dominion's freedom from this disease during the year. The outbreak which was reported upon last year as having occurred near Wellington has not been followed by any recrudescence of the disease, which affords evidence of the effectiveness of the measures taken to stamp out the infection.

Pleurisy in Pigs.—This condition, found on inspection of pig carcasses, is all too common. On account of the very stringent attitude regarding the presence of any trace of pleurisy in the carcass taken by the British inspecting authorities it has become necessary to considerably tighten up inspection here with respect to this condition, and pleurisy is to-day responsible for a large percentage of unexportable pigs. A certain percentage of pleurisy cases are caused by specific infections (suipestifer and pasteurellosis), but collectively the condition can be said to be largely influenced by faulty methods in pig-management. Given correct feeding, and adequate housing to protect young pigs from the effects of cold and damp conditions, the incidence of pleurisy should be materially decreased. An intensive propaganda towards this end is most desirable.

Necrotic Ulceration of the Skin.—This is another condition leading to the rejection of carcasses for export. Improved hygienic conditions are essential in its prevention. The disease is a particularly common one, but is amenable to treatment, and excellent results have followed the use of tartar emetic (potassium antimony tartarate) as a skin-dressing, this being advocated by the Division.

Mange.—Outbreaks of this disease in pigs were not numerous during the year. Those that occurred were quickly controlled, and the disease eradicated.

Tuberculosis.—The degree of infection by this disease in pigs examined on slaughter for the past year is 10·31 per cent. To a large extent the actual infection in the carcass is slight, being mainly found in the throat glands. Owing to the necessary very rigid inspection of the carcass for the presence of tuberculosis a lessening of the incidence is highly desirable. In this direction the question of the better housing and management of pigs by the farmer is at present engaging attention. The possibility of a percentage of tuberculous-infection in pigs being due to an avian source is a matter also receiving investigation at the Wallaceville Laboratory.

Meat Inspection.

The very great increase in slaughterings, particularly with respect to pigs in the North Island works generally, called for an increase in the meat-inspection staff. This has been met by the appointment of six Veterinarians and eighteen additional lay Inspectors. Some further appointments are, however, necessary to replace numerical vacancies on the staff created by retirements and transfers. To cope with the very exacting requirements of the Home authorities at the present time the addition to the staff was urgently necessary, and it is anticipated that as a result, and also the provision of improved conditions for inspection of pig-carcasses which is being provided at certain works by an alteration to the height of the rails, that meat-inspection work will be on a much better basis for the coming season.

Dairy Inspection.

During the year some amendments to the regulations under the Dairy Industry Act dealing with the inspection of dairies registered for the sale of milk for human consumption were introduced. These included provision for the requirement of proper sterilization of bottles in cases in which bottling of milk takes place on the farm.

This important phase of the Division's work has received special attention throughout the year, directed towards instructional service in improved hygienic methods of milking, and compliance with required sanitation of sheds, &c. As a result, a steady improvement in conditions tending towards a purer milk-supply can be claimed.

In certain municipalities bacteriological examination of milk-samples is conducted, and the information thus obtained regarding the production of milk at any particular dairy must be regarded as very helpful to the Dairy Inspector in his efforts to raise the standard of production.

Biological examination of composite milk-samples for the detection of tuberculosis was carried out at the Laboratory during the year, 707 samples being dealt with. Of this number, 8 (1·13 per cent.) were positive. The usual action regarding tuberculin testing of the herd was carried out in order to effect removal of tuberculous animals.

During the year the application of the tuberculin test to herds registered for local supply was largely increased. I would, however, advocate the compulsory tuberculin testing of all cows supplying milk for human consumption.

Live-stock Statistics.

The 1934 sheep returns, collected as at the 30th April, showed that sheep flocks in the Dominion increased by 893,072 to a total of 28,649,038. An increase of 359,290 occurred in the number of breeding-ewes. The number of sheep-owners has decreased by 263 to a total of 29,800. The number of cattle in the Dominion as at the 31st January increased by 109,105 to a total of 4,301,128. The number of dairy cows within the total shown increased by 86,539 to a total of 1,932,511. The number of pigs in the Dominion as revealed in the 1934 enumeration was 660,393, being an increase of 68,811 on the previous year's figures. Horses have continued to show a decline, the number being 273,906, a reduction of 2,991.

Slaughter of Stock.

The number of sheep and lambs slaughtered show an increase on last year's figures. The total number of stock slaughtered at registered premises were: Sheep, 3,335,943; lambs, 9,690,054; cattle, 488,982; calves, 746,771; swine, 892,372.

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, 1935.	Year ended 31st March, 1934.	Increase.	Decrease.
Cattle	239,877	254,201	..	14,324
Calves	675,488	904,717	..	229,229
Sheep	2,569,573	1,972,678	596,895	..
Lambs	9,562,797	8,551,838	1,010,959	..
Swine	694,770	532,972	161,798	..

For further purposes of comparison the following table is given, showing the killings of sheep and lambs at meat-export slaughter-houses 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.	1931–32.	1932–33.	1933–34.	1934–35.
Sheep	2,614,378	1,649,363	1,293,617	1,735,237
Lambs	5,822,728	6,433,741	6,030,575	6,626,315

These figures show an increase of 595,740 lambs and of 441,620 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, 1935: Cattle, 409,861; calves, 744,700; sheep, 3,128,324; lambs, 9,668,022; swine, 866,993.

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

Stock.	Abattoirs.	Meat-export Slaughterhouses.	Bacon-factories.
Cattle	169,984	239,877	..
Calves	69,212	675,488	..
Sheep	558,751	2,569,573	..
Lambs	105,225	9,562,797	..
Swine	132,028	694,770	40,195

Stock slaughtered at ordinary slaughterhouses during the year ended 31st March, 1935, was as follows: Cattle, 79,121; calves, 2,071; sheep, 207,619; lambs, 22,032; swine, 25,379. Carcasses of pork killed and dressed by farmers, sent into butchers' shops and small factories, and examined by departmental officers numbered 32,607. 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, 15,399; calves, 5,659; sheep, 122,656; lambs, 81,663; swine, 56,801.

Compensation paid for Stock and Meat condemned.

Compensation to the amount of £8,746 was paid out during the year for animals condemned in the field for disease under the provisions of the Stock Act, and £15,026 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.

The following stock was imported during the year: Cattle, 20; sheep, 484; pigs, 15; horses 13 (9 draught). Of the above animals, the following were placed in quarantine for the respective periods required: Cattle, 19; sheep, 14; pigs, 15; horses, 4; and, in addition, 23 dogs.

Exportation of Stud Stock.

During the year under review the following animals were exported: Sheep, 1,353; cattle, 299; pigs, 25; horses (draught), 112. There was the usual movement of thoroughbred horses to and from Australia.

Poultry.

Indications point to increased activity in the poultry industry, and it is safe to say that the production of eggs will be considerably increased in the coming season.

It is satisfactory also to note that the opportunity to organize given under the Poultry-runs Registration Act, 1933, is being actively prosecuted by the Poultry Board set up under that Act. In view of the fact that the bulk of the eggs marketed come from comparatively small flocks and that producers cannot individually become exporters, the necessity for some stable collective system of export during the flush season makes organization a paramount necessity.

During the past season 11,527 cases of eggs (30 dozen each) were exported to the United Kingdom, as compared with 12,107 cases for the previous season. The difficulty of securing suitable shipping space, particularly in respect to Otago, accounted for the fact that more eggs were not exported. Export of large quantities of eggs under market prices ruling abroad during the flush laying-season here can hardly be expected, but in order to supply the local market with eggs all the year round there results a summer surplus which would seriously depress the local market if adequate export was not arranged. It has still to be recognized that the poultryman's best market is the local one, and while it is necessary to unload the surplus by export it is also incumbent that the local market be fostered and a greater consumption of eggs be encouraged.

The introduction of Mammoth incubators of up to as high as 15,000-egg capacity is an indication of the great progress that has taken place from nature's provision of the hen and her brood of chickens, and demonstrates how quickly the poultry industry could be built up to an over-production point. The Chief Poultry Instructor, referring to the advent of these huge capacity incubators and their possible effect on the industry, makes the following comment:—

> "An item of interest regarding the development of the industry is the introduction into this country of the Mammoth incubators, and one machine with a capacity of 15,000 eggs, and several of a 10-000-egg capacity, have been installed. The owners of these machines are catering for custom hatching business, a branch of the industry that is becoming popular.
>
> "So long as these machines are in the hands of conscientious poultry-keepers who will see that only eggs from selected stock are used for hatching purposes they will be an asset to the industry; but reports from other countries indicate that the introduction of the Mammoth incubators has been the means of distributing a poor class of stock, owing to some poultry-keepers setting eggs from unselected breeding-birds and selling the chickens at a cheaper rate.
>
> "Owing to the fact that diseases amongst poultry are more prevalent now than was the case a few years ago, and more cull pullets are to be seen in auction-marts, the question of something being done to check the sale of inferior stock is a matter that may have to be considered in the near future."

The Wallaceville Poultry Station is still serving a useful purpose. The demand for stock has shown an increase, and the Overseer reports that the number of visitors seeking advice has been greater than in previous years. Some useful investigational work was carried out, and results were made available through the *Journal*. The stock on the farm built up from New Zealand birds is of good quality, but in order that it might be maintained, arrangements are in hand for some fresh blood from Australia. It is also proposed to introduce sone Langshans to the station.

This section of the report can hardly be concluded without a reference to the early retirement on superannuation of Mr. F. C. Brown, who for over twenty years occupied the position of Chief Poultry Instructor in this Department with distinction and acceptance to the Department and producers alike. Mr. Brown's personality will be missed on all occasions when poultrymen meet, as will also his advice and guidance.

Wool.

With favourable weather conditions throughout the year the wool clip opened up in fair-to-good condition, with more combing wool than in the previous season. The practice, which has been advocated for some years past, of owners of small flocks skirting their fleeces and arranging for them to be "binned" by the respective wool-brokers has become an established practice, and is recognized as a decided advantage alike to the seller, the buyer, and the wool-broker.

The wool sales opened at Auckland on the 27th November, 1934, and closed at Wellington on the 12th April, 1935. The prices ruling for wool through the selling season were considerably below those of the previous year, although an advance as much as 1½d. per pound on the earlier sales took place towards the end of the season. A noticeable feature of the sales was a better realization in respect to neck pieces which more closely approximated their value when compared to prices received for fleece wool. During the selling season 521,625 bales of wool were offered, and 466,495 bales were sold, averaging 6·519d. per pound, equal to an average of £9 7s. 2·428d. per bale, showing a drop of 4⅝d. per pound, or £7 1s. 7d. per bale.

During the year lantern lectures and practical demonstrations were continued, aiming at improvement of wool by more careful selection of the rams, and to assist in this staples of wool from rams were examined and reports made, these serving as a guide to the owner in discarding faulty-woolled rams from their flocks. The number of sheep-owners in the Dominion as at the 30th April, 1934, was 29,800, this being a decrease of 263 on the previous year's figure.

Rabbit Nuisance.

The favourable climatic conditions of the past year in combination with the very low prices offering for carcasses and skins and the pecuniary embarrassment of many landowners have together accounted for an unfortunate increase in rabbits in many districts throughout the Dominion. The position, however, while serious enough to cause concern, has not assumed alarming dimensions, and where appropriate action has not already been taken arrangements are in train for systematic and simultaneous poisoning operations during the late autumn and winter months. Relief labour made available by the Unemployment Board was of material assistance in several areas during the past season.

The various Rabbit Boards have carried out their work satisfactorily. The advantage of Board control is now more widely recognized, and several new Rabbit Boards have been formed.

Industrial Rabbits.

Practically no interest is now being taken in the farming of Angora rabbits for wool and of other breeds for pelts, and district reports indicate that a number of rabbit-farmers have disposed of their stock owing to the time and trouble involved and the low returns obtainable. The Department has never fostered this industry, as its views did not coincide with the claims of the promoters.

Noxious Weeds.

Notwithstanding the fact that considerable areas of land throughout the Dominion are weed-infested, and that in some instances the weeds are inclined to spread, there is justification for the contention that the position as a whole is better than it has been for the past few years. This remark is particularly applicable as regards ragwort in the North Island, where for a long time, with its insidious effect on stock and pastures, ragwort was an ever-increasing menace. For this weed large quantities of sodium chlorate have been put into use and applied either as a spray or in the dry state with lime, while the co-operation of the Unemployment Board in making available considerable relief labour for the clearance of weeds has been no small factor in the control of ragwort and in the results that are now becoming apparent. Some settlers complain of the cost of sodium chlorate as a weedicide, but the expense of application is really small compared with the old methods of clearing. The Government, however, subsidized all sales by 1d. per pound, thus rendering direct financial assistance for this work.

Attention has been given to other noxious weeds, principally sweetbriar, blackberry, Californian thistle, and gorse, in the respective districts in which they are more or less prevalent. The first-named is becoming a problem in some of the back country of the South Island, and trials with several specifics have been carried out with a view to finding the most practicable method for its eradication. As regards blackberry, it is pleasing to report that considerable areas have been cleared on the better class of land.

A noticeable feature of the season's work is that the administration of the Noxious Weeds Act has been carried through with practically no friction between officers of the Department and the settlers. Further, compared with previous years, there has been less adverse criticism concerning weeds on Crown and Native lands, on which considerable quantities of sodium chlorate and lime were used.

The amendment of 1934 to the Noxious Weeds Act should lead to better control. By this amendment County Councils are given power to assume responsibility for the administration of the Noxious Weeds Act within their respective counties, and at the end of the year nine Councils had taken over the administration of the Act, particularly in order to deal with ragwort. The amendment also simplifies the problem of dealing with defaulters and altogether will be helpful in bringing about an improvement in future years. The spontaneous response of these local authorities to administer the Act within their respective boundaries augers well for the future and merits the fullest support that can be given. It is anticipated that other bodies will follow suit when the benefits become apparent.

Staff.

I am again pleased to express my appreciation of the services so loyally and efficiently rendered by the staff of this Division in every section and branch of its activities.

WALLACEVILLE VETERINARY LABORATORY.

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

This report deals with the two aspects of veterinary work, the one diagnostic in character and the other investigational. It is difficult to separate the two classes of work entirely. The work of the subsidiary laboratory at Hamilton, and the investigational work of the Field Veterinary Officer stationed at Hamilton, is also included.

The New Plymouth Laboratory was closed down at the end of the last year following the transfer of Mr. W. M. Webster to Wallaceville. Mr. D. A. Gill, who has been on leave in Sydney, accepted the position of District Superintendent of the Wellington District, and consequently has not returned to Wallaceville. Mr. H. A. Reid, O.B.E., F.R.C.V.S., D.V.H., F.R.S.E., has been stationed in the laboratory temporarily to assist with the work. Dr. M. M. MacOwan is still holding a Carnegie Scholarship at Wallaceville, and is carrying out portions of work for the Department in conjunction with Dr. I. J. Cunningham's nutritional investigation.

The staff otherwise is carrying out its several duties well, and is to be commended for its thoroughness.

The actual specimens put through the two laboratories for the year may be tabulated as follows:—

——	Wallaceville.	Hamilton.
Mastitis milk samples—		
Routine—		
Positive	380	219
Negative	457	630
Miscellaneous milks	..	2,695
Mastitis control—		
Group A	2,389	25,652
Group B	1,445	6,501
Group C	274	2,434
Quarter samples	..	1,425
Contagious abortion—		
Whey samples—		
Positive	..	38
Negative	..	261
Blood samples—		
Positive	326	76
Negative	683	250
Milk biological examination for tuberculosis	707	..
Cattle specimens	285	3
Cattle bloods	70	..
Sheep specimens	427	..
Sheep bloods	254	..
Pig specimens	121	..
Pig bloods	8	..
Poultry specimens	126	..
Poultry bloods	284	..
Horses	32	..
Dogs	4	..
Rat bloods	174	..
Bone analyses	128	..
Miscellaneous	157	156
Totals	8,731	40,340
Blackleg vaccine issued	18,175 doses	18,835 doses
Tuberculin issued	2,267 c.c.	..

CATTLE DISEASE.

Diagnostic Routine.—Of the 285 cattle specimens, the most important have been suspected Johne's disease gut. Sixty-three specimens were received on account of this disease, thirty-nine specimens being definitely positive. Sixteen new affected farms have been detected, making a total of forty known affected farms. The Johnin kindly presented by Mr. Dunkin is in use, but the exact reliability is as yet not defined. There have been two cases of positive Johne's disease not picked up by Johnin.

Milk Samples for Biological Test for Tuberculosis.—Seven hundred and seven samples were inoculated into guinea-pigs. Of these eight were positive: Auckland, 4; Wellington, 1; Hawera, 1; and Dunedin, 2. Ten per cent. of guinea-pigs died from peritonitis.

In this work the abortus infection present was noted as in past years, and gave the following results, Number of guinea-pigs examined for abortion lesions, 637; lesions in spleen, 100; positive sera from guinea-pig: 106; positive cultures from cream, 24.

Blackleg Vaccine.—The vaccine is still proving efficient, a total of 37,010 doses having been issued for use over the year. No definite cases of death due to failure of the vaccine to immunize have come under notice. In specimens of blackleg received for diagnostic purposes, the unusual almost invariably turn out to be from cases of malignant œdema.

Contagious Abortion.

The number of blood samples coming forward for examination from the field—986—is unsatisfactory, and suggests that no effort is being made to combat the disease and to clean up farms. This, no doubt, is due to the apathy of the farmer on this question.

A number of cases of undulant fever reported during the year by the Health Department made it necessary to test the blood and culture the milk from the resultant positive cases in suspected herds, in order to find whether massive excretion of organisms was taking place. This work also is unsatisfactory, as no power exists to have suspected dangerous cows destroyed or otherwise controlled.

Mastitis.

The work of several years, performed to find whether the scheme-grouping could be relied upon, was finalized during the year and put into the form of a thesis.

The immense amount of work carried out in connection with the routine examination of milk samples can be seen in the first table. Mr. A. E. Kidd, working in Hamilton, has kept farmers of the Waikato belonging to the control scheme interested and enthusiastic. He is to be congratulated on his work. In his annual report he has shown that the farmers in the scheme have been able to increase the number of their cows annually, probably as a result of the benefits derived from the scheme, in that culling has been considerably reduced. In the 1931–32 season the average number of cows milked in each herd was 50·3 per cent.; in 1932–33, 55·1 per cent.; in 1933-34, 58·8 per cent.; and in 1934–35, 62·2 per cent.

It is very satisfactory to note that the acute cases of mastitis in the scheme have dropped from 11·5 per cent. last year to 7 per cent. this year, and that normal cows have advanced from about 70 per cent. to 74 per cent.

The Ngakura herds under Government supervision have definitely improved since their entry into the grouping-system.

Mr. T. A. Blake, performing investigation work in the field, has shown that in his experimental herds, although a slight drop has occurred in his number of normal cows, yet such herds are still on a high level of efficiency this year, even though a number of old standing mastitis cases have been retained in the herds since 1930.

As far as the mammitis-control scheme goes, it has been accepted in the Waikato as a very useful aid in controlling mastitis. It is, however, impossible to make such a scheme New-Zealand-wide unless the factories take the matter up and appoint assistants to examine samples from suppliers regularly. It would cost a considerable amount for the Department to open up the necessary centres for the work. The scheme could do with more supervision by a specially appointed officer, and this might be borne in mind as the number of herds in the scheme increases. Apparently the Bureau of Animal Industry is taking up a somewhat similar method of control in United States of America, and intend paying compensation for condemned cows.

Mr. Blake has carried out treatment trials with some success in certain of them. With azamine and entozon results were not striking. With chlorine, however, ten quarters were successfully treated, while three resisted treatment. This chlorine treatment will require much more extensive trials this coming season, and if at all beneficial might be taken up by advisory departmental officers.

Sterility.

The work on sterility of a temporary nature has been carried on by Messrs. T. A. Blake in the Waikato, and W. M. Webster at Wallaceville. Further feeding experiments with rats on proteins have been carried out by Dr. I. J. Cunningham at Wallaceville. Mr. Blake has carried on with his seminal examination for morphological changes in bulls, and also in boars and stallions. His total classification figures over a period of years are as follows:—

Fertility.	Number of Bulls.	Average Percentage of Successful First Services.	Average Number of Cows served.
Good	87	69	36
Fair	56	55	37
Poor	55	41	32
Bad	53	29	30
Sterile	13	..	20

Some of the bulls have been kept under observation for three years. In order to gain more information as to the cause of the poor morphology Messrs. Webster and Blake worked together for some weeks. Mr. Webster has a method of collection of seminal fluid into a sterilized container which, although not perfect, gives a fairly reliable indication of the state of the semen from a bacteriological viewpoint. The sheath method has been used for bulls, rams, and boars and works satisfactorily. As a result of the bacteriological examinations, it has been found that certain bulls with a fairly good sperm morphology but producing few calves were affected with streptococci in a similar way to many bulls in Taranaki reported some years ago. Mr. Webster considers that in the Waikato, of the bulls he examined, those inefficient by reason of bacterial damage are as 1 : 2 of those inefficient by reason of some other factor. The reverse is true in Taranaki. It is suggested that this nonbacterial factor is a dietary one. The diet factor is possibly associated with the protein value of the pasture, and more work is planned to investigate this point. At present rats, boars, and ram lambs are being fed high-protein diets at Wallaceville, while cockerels and rats and boars are on a maize diet, which appears to be deficient in one of the amino acids necessary for the upkeep of the testes. We are as yet too short of the necessary information to advocate different pastures for bulls, but it is hoped to finalize that phase of the work in the coming year.

Dr. Cunningham has noted that sterility in males arises from high first-class proteins in the diet of rats and also when the protein is derived from maize, though with a wheat protein the rat remains normal. Atrophy of the testis occurs, but the growth of the rat is not interfered with in maize-feeding. With high-protein feeding growth is partially stopped. Females receiving both maize and high-protein diets remain fertile.

Sterility in sheep has also been the subject of investigation by Mr. Webster, and in his examination of seminal fluid he has noted that in the past tupping season the seminal fluid has been excessively alkaline while morphology was normal. Both Wallaceville rams suddenly developed sterility and finally failed to produce sperm for a short period. This was a common experience amongst sheep-farmers following the excessive drought conditions and the heavy flush of pasture shortly before tupping commenced.

The insemination method tried in the ewe flock at Wallaceville and mentioned in the last report was very successful, for 70 per cent. of the inseminated ewes held to first attempt, while to ram service 82 per cent. of the ewes held. The method is being tried by a prominent breeder with an imported ram.

Tympany of the Rumen in Dairy Cows.

Mr. Webster undertook a preliminary examination into bloat in dairy cows while material was available. A series of electrometric pH determinations were carried out by Mr. Josland, while Dr. Cunningham performed analyses of the rumen gases from normal and tympanitic cows. Dr. Cunningham reports that there is a wide variation in both normal and bloated cows in such gases as carbon dioxide, oxygen, methane, nitrogen, and hydrogen.

Two cows given hydrocyanic acid in non-lethal doses did not bloat when placed on damp early-morning pasture at the laboratory. Also in picrate paper tests no excess H.C.N. was found in rumen contents of bloated animals.

During the short season that bloat was in evidence a large amount of preliminary analytical and bacteriological work of an exploratory nature was undertaken. Apparatus was devised for collecting samples of rumen gases from both normal and bloated cows for chemical analyses, and the results suggested that in cases of bloat there may be quite a wide deviation from the normal admixture of gases. Samples of rumen juice were also collected for bacteriological examination and pH estimations. The latter readings suggest that bloat may be associated with a decrease in the normal acidity of the rumen contents. By means of physostigmin injections large quantities of saliva were collected for in vitro digestion experiments of herbage from "healthy" and "bloating" pastures. A number of unexpected difficulties arose in the bacteriological work, but these were in large measure overcome by the end of the bloat season, and it is anticipated that in the coming year definite progress will be made.

Grass Staggers in Dairy Cows.

Dr. Cunningham has carried the investigation into this disease a little further. Dolomite-feeding has been found to be an effective and relatively cheap method of increasing the blood magnesium of cows, and experiments have therefore been arranged to ensure a supply of this material to animals on farms usually affected with grass staggers. Two and a half tons of ground dolomite have been distributed to five farmers; on two farms the dolomite was incorporated with the ensilage as it was made; on two farms the dolomite will be sprinkled on the ensilage as it is fed out to cows; and on the fifth farm, where no ensilage was made, dolomite will be used as a lick, and, with molasses, will be sprinkled on hay as it is fed out.

The results of these experiments will not be available until October or November of next year.

To investigate the possibility of increasing the magnesium content of pastures by manurial treatment with magnesium compounds sixteen plots were laid down in 1933 in a Latin square with four replications of the following treatments: (*a*) Epsom salts, 8 cwt./acre; (*b*) dolomite, 7·3 cwt./acre; (*c*) calcium carbonate, 4·4 cwt./acre; and (*d*) control. Eight further plots were subsequently added giving—(*a*) Epsom salts, 1 ton/acre; (*b*) Epsom salts, 2 tons/acre; (*c*) and (*h*) control; (*d*) and (*g*) super, 10 cwt./acre; (*e*) dolomite, 1 ton/acre; (*f*) dolomite, 2 tons/acre.

Three cuts have so far been made of the Latin square and one of the last eight plots, and the following average results are available:—

Manurial Treatment.	Percentage MgO on Dry Matter.		
	First Cut.	Second Cut.	Third Cut.
Epsom salts, 8 cwt./acre	0·586	0·587	0·468
Dolomite, 7·4 cwt./acre	0·503	0·518	0·453
Calcium carbonate, 4·4 cwt./acre	0·479	0·505	0·421
Control	0·496	0·499	0·400
			First Cut.
Epsom salts, 2 tons/acre	..	..	0·647
Dolomite, 2 tons/acre	..	..	0·426
Control	..	..	0·388
Super, 10 cwt./acre	..	..	0·361

Manurial treatment with magnesium will, therefore, increase the magnesium-content of the pasture, but the process could not be made a commercial possibility with the present prices of Epsom salts and dolomite.

A more thorough investigation is being made of the question whether magnesium deficiency is the cause of grass staggers. The work is proceeding along the following lines:—

(i) The examination of magnesium-content of milk and urines from affected animals to determine whether an abnormal exercition of magnesium occurs via these paths.

(ii) Examination of the magnesium-content of the bones and organs of affected animals.

(iii) Analyses of forage samples from affected areas and also of monthly analyses of pasture samples from four farms to determine the seasonal variation.

(iv) Attempted production of grass staggers in cows at Wallaceville by feeding rations low in magnesium.

It has been found that milks and bones have a normal magnesium-content while urines are very low in magnesium. Low urine magnesium correlates well with the low blood magnesium. Specimens other than bones have not yet been obtained from affected animals, but several series of organs from normal slaughterhouse animals have been analysed to serve as controls. Work on affected animals will proceed during the next season.

The results from the analyses of forage samples show that in the Waikato samples there is a general tendency for the magnesium-content to be lower than the usual figures. Spring grass in some instances contained as low as 0·3 per cent. magnesium, and ensilage samples are often even lower.

The seasonal variation in the magnesium-content of Waikato pasture is not marked, the lowest value being recorded in December, with increased values in the growth following February rains.

For the attempted production of grass staggers at Wallaceville, ensilage has been prepared from maize, which is low in magnesium. This ensilage will be fed to two cows for three months before calving, after which the animals will be given only green oats. These experimental conditions will impose the strain of magnesium deficiency on the cows during the last three months of pregnancy, while the green oats will stimulate the conditions of young-grass feeding in the grass staggers area. It should be mentioned that grass staggers has been recorded in Australia with oats feeding.

SHEEP-DISEASES.

Specimens for the year numbered 183, together with 244 blood samples for arthritis agglutination tests and 254 blood samples for biochemical examination. Many of the specimens have been gut contents from lambs to be tested for ovitoxicus toxins in connection with work at Lincoln Agricultural College by Mr. A. Leslie, F.R.C.V.S., brains for circling disease in sheep, parasite identification, wool rot, and mycotic dermatitis, enzootic icterus, &c.

Arthritis in Lambs.

A number of blood samples were collected through the agency of Inspectors of Stock and Veterinarians, but after collection it was found that the antigen prepared for agglutination tests was unsatisfactory. Many attempts were made to get a reliable antigen, but all except one batch failed. Results have therefore not been obtained.

This problem requires considerable attention, but must be commenced with post-mortem examination of lame young lambs.

Photosensitivity.

Breeding experiments are being carried out with a Southdown ram and a few Ruakura Southdown ewes to find whether it can be proved that there is transmission of photosensitivity in certain Southdown strains. The ram has been reared from birth and is highly sun sensitive, so much so that he is blind as a result of rubbing his face on fences, &c., in sunlight. The Rose Bengal test shows that the liver of this ram is markedly inefficient in elimination of deleterious matters in the blood. The ewes are clean and normal. The results will be available in September next.

Facial Eczema.

So-called facial eczema is also a form of light-sensitivity. During the year following the dry season and with the flush of growth many sheep all over the North Island became light-sensitive. Considerable investigation into the reason showed that the condition was similar to sensitization of skin from absorption of phylloerythrin, a fluorescent breakdown product of chlorophyll, as seen in South Africa. The part of most interest in the outbreak was not the actual photosensitivity but the previous liver damage which caused bile to appear in the blood stream. The cause of the damage requires considerable further work, but a theory has been put forward that constipation in dry weather has brought about bacterial invasion of the bile-ducts causing thickening of the walls and damming back of bile, particularly in the left lobe of the liver. Increase of bile-ducts has taken place and cirrhosis has occurred. Jaundice also became a feature of this phase as the blockage of bile-ducts increased. Blood tests showed that the bile in the blood was due to damming back of bile in the liver and not to other causes.

Preventive treatment and treatment of the actual photosensitized sheep was suggested, but there will be considerable trouble throughout the following year in those flocks where facial eczema was prevalent.

An article on this condition will shortly be prepared for publication.

Mycotic Dermatitis.

Mycotic dermatitis is slowly becoming more evident in the South Island flocks of Corriedales and Merinos. The number of sheep affected is not alarming, but more station-owners are noting affected sheep at shearing-time. In connection with this also is the diseased condition known as "Devil's Grip," a persistent diseased condition of the skin of the back which causes trouble through blowing by fly larvæ.

Rickets.

Several cases of bandiness in sheep have come under notice. The bones have been collected for analysis and for histological examination by Sir Arnold Theiler. In one case of a flock of ram lambs which had been left several months on green oats the analysis of the oats showed an excess of calcium and too little phosphate, suggesting that the bandiness resulted from excess osteoid growths and too little mineral deposit, the latter being due to lack of lime rather than to lack of phosphate, which is considered to be, and probably is, the chief cause in New Zealand of the condition.

Contagious Ophthalmia.

Cases of ophthalmia were very common this season following the dry spell and during the facial eczema outbreak. No connection, however, could be noted between the two diseases.

Morton Mains Disease: So-called.

For some reason the Morton Mains area has been classed as iron-deficient and therefore bush sick mainly on unsound clinical grounds. Chemical work has been carried out on this premise. The veterinary opinion is that the area requires a special type of farming practice, and the lambs suffer from parasitic gastro-enteritis. To clear up the point, Mr. W. M. Webster and Mr. S. W. Josland were sent to the district to investigate, and Mr. Webster has reported that in his opinion the mortality in lambs is due to parasites following unsuitable husbandry. One of the unusual features was the large number of coccidial lesions found present. As, however, a survey of other parts of New Zealand has not been made for these parasites, it is yet too early to say definitely that they are actually causative. The large and varied numbers of nematodes found present, however, in affected lambs may be noted in the table prepared by Mr. Webster:—

Sheep No.	Ostertagia.	Hæmonchus.	Nematodirus.	Tricho-strongyle.	Cooperia.	Bunostomum.	Chabertia.	Trichuris.	Œsophagostomum.	Dictyocaulus.	Coccidiosis.
1 ..	9,040	27	1,970	370	..	..	..	31	..	..	+++
2 ..	2,850	..	1,320	8,170	250	..	..	19	..	..	+++
3 ..	4,234	..	3,510	220	17	..	..	26	..	..	—
4 ..	Very numerous	..	11,740	7,560	..	..	..	25	..	3	—
5 ..	5,710	161	6,880	13,070	520	..	..	11	..	29	+
6 ..	1,889	9	1,889	2,113	360	..	63	37	..	..	+
7 ..	4,410	..	4,320	870	..	..	..	34	..	..	+
8 ..	3,290	..	7,820	640	..	..	..	27	..	..	+
9 ..	1,760	..	..	2,550	..	..	..	26	..	..	+++
10 ..	4,420	1	11,530	7,840	30	..	..	44	..	7	+
11 ..	140	..	7,590	10,270	..	..	13	67	..	..	++
12 ..	3,780	..	2,680	11	..	..	..	23	..	..	+++
13 ..	22	..	160	..	..	..	1	7	..	..	++++
14 ..	1,998	..	10,890	..	..	..	..	38	..	..	—
15 ..	29	..	370	..	..	..	..	11	..	..	++++
16 ..	610	..	..	108	273	2	31	19	..	3	++++
17 ..	1,120	..	41	950	420	..	..	..	..	..	++++
18 ..	379	3	29	710	230	..	..	1	..	..	++++
19 ..	540	21	760	630	810	..	5	181	14	17	++++

When cattle were used to control pasture he found lambs were in a normal state of health.

Mr. Josland reports that the blood of affected lambs showed only a slight anæmia with a normal colour index. Judging by controls the blood calcium, magnesium, NPN, leucocyte count and differential leucocyte count were normal. Inorganic phosphorus and total solids were slightly lowered. There was also a slight degree of imperfect calcification of bones.

Mairoa Mortality in Sheep.

Opportunity was taken to analyse a few samples of blood and bones from sheep showing anæmia and cachexia, typical, it was said, of the sickness said to exist amongst Mairoa sheep. In blood the values for calcium, magnesium, and non-protein nitrogen were within normal limits. Hæmoglobin and red-cell counts were markedly lowered. The ash-value for bones in one case were 54·3 per cent. and 56·1 per cent. in the heads of the femur and humerous respectively. It has been found by Mr. Josland that these two points of the bones are the first two to show a lowering in ash-content when defective mineralization is occurring.

Post-mortem examination of the Mairoa sheep under discussion revealed many Bunostomum species present, and with the analyses suggests that the Mairoa trouble is largely parasitic and not due to deficiencies of minerals.

PIG DISEASES.

One hundred and twenty-nine specimens were comprised very largely of lungs, spleen, and blood from pigs which had died from doubtful cause. Many such mortalities were considered to be due to *B. suipestifer*, and that organism was as often present in lung lesions as in pericarditis as was the *Pasteurella* organism. A certain amount of testing by the agglutination reaction on blood was carried out to find adult carriers, but much more of this type of work should be done.

POULTRY DISEASES.

Owing to lack of facilities very little investigational work with diseases of poultry has been carried out. One condition known as leukemia was, however, given serious consideration by Mr. Webster, and experiments are still incomplete. Mr. Webster reports:—

An outbreak of fowl-leukemia occurred in one pen of mixed White Leghorn and Black Minorca pullets. The pen in question contained in the vicinity of one hundred and eighty birds of the two breeds, in approximately equal numbers. In the course of six weeks seventeen cases of leukemia occurred among the Minorcas, but not a single case was seen in the Leghorns. Attempts were made to transmit the disease by various methods—(*a*) Feeding minced neoplastic tissue; (*b*) intra-venous inoculations of emulsified neoplastic tissue; (*c*) tissue-grafts of tumour beneath the liver capsule; (*d*) intra hepatic inoculations of tumour emulsion. These transmission experiments were undertaken in both Minorcas, which were presumably susceptible, and in Leghorns, which under natural conditions appeared immune. The tumour tissue used was taken from leukemic birds slaughtered in an advanced stage of the disease, and the transfers were made with a minimum of delay. The results were consistently negative, save in one Leghorn pullet fed minced tumour. This bird died a month later from generalized leukemia. It appears extremely doubtful, however, if this isolated case can be regarded as a successful transmission, and much more probable that it was a spontaneous case of the disease already present in the early stages when the bird was selected for experimental purposes.

Microscopic sections were prepared from liver, spleen, kidney, ovary, and bone marrow in every case examined. A study of these sections showed that in every instance the leukemia was of the lymphocytic type. There are three types of this disease recognized—viz., leucocytic, erythrocytic, and lymphocytic. Other workers state that the two former are definitely transmissible, whereas the latter is not. The work undertaken at Wallaceville seems to support the latter statement, if the case of the disease in the experimental Leghorn bird is considered as spontaneous and not transmitted.

The blood picture of the affected birds showed very little abnormality until the latest stages of the disease, when an increased white-cell count was manifest. At this stage, however, the clinical symptoms are obvious. Blood counts were made on all the birds in the affected pen when the disease first became apparent, but they did not afford any information as to which birds were later to succumb.

According to some workers, an hereditary factor plays a part in the appearance of this disease, and with a view to watching this possibility the Laboratory has taken over a hundred chicks hatched from eggs laid by Minorcas in the affected pen. These birds have now reached the laying stage, but so far no cases of leukemia have appeared.

It has been recently claimed by an American worker that the disease is not transmissible and is not neoplastic in the true sense, but is in the nature of a hyperplasia of lymphoid tissue in response to the stimulation of continued infection with one of the Salmonella group. An experiment is at present under way to test this hypothesis. Minorca cockerels have received daily intravenous injections of 1 c.c. of a broth culture of six different Salmonella strains over a period of three weeks, and are now under observation to see whether leukemic lesions will manifest themselves.

Considerable green-leg was evident in the early summer in young birds due to overcrowding and exceptional warmth.

MISCELLANEOUS.

Vitamin D assay of several New Zealand fish oils has been completed by Dr. M. M. MacOwan. The results expressed in international units per gram are as follows, and may be compared with good cod-liver oil which would contain 100 international units per gramme: eel-body oil, 47; ling-liver oil, 500; groper-liver oil, 2,250 red-cod-liver oil, 10; whale-body oil, nil. The Vitamin A and D contents of fresh grass and of hay have been assayed biologically as the petroleum ether extract of grass and hay. Fresh grass is higher in Vitamin A than hay, while the Vitamin D content is the same in both instances.

Ragwort Alkaloid.—An alkaloid prepared by Dr. J. R. Hosking of the Dominion Laboratory from *Senecio jacoboea* was fed to guinea-pigs in varying doses over a period of four weeks, but no liver lesions were produced. A further alkaloid similar to that isolated by Manske and called Jacobine, is under trial.

Smut Feeding Trials with Rats.—Smuts supplied by Dr. G. H. Cunningham of the Plant Research Station, from New Zealand forage plants, are being fed to rats, and the toxic effect noted with a view to extending trials to larger animals, should any of the fungi be found toxic.

THE FARM.

With the assistance of a carpenter the farm staff succeeded in building a six-compartment concrete and wooden pigsty for experimental work with young pigs. The numbers of stock carried on the farm have increased slightly, following the better pasture provided by the newly laid down paddocks. The last of the five plots in native grass has now been ploughed up and put down in permanent English pasture. The health of stock has been good, and all animals came through the dry weather very creditably. The Farm Overseer, Mr. J. Evans, in spite of difficulties, has kept the farm in very good order.

A fire swept over the hill, burning five hundred young trees.

NUTRITIONAL RESEARCH WORK PERFORMED BY DR. I. J. CUNNINGHAM.

Dr. Cunningham supplies the following sub-report :—

During the year work has continued on grass staggers and magnesium metabolism, on the relation between dietary portein and sterility, and on vitamins. New work concerns the toxicity of the common smuts affecting New Zealand forage-plants and the composition of gases in the rumen of bloated cows.

GRASS STAGGERS IN DAIRY COWS.

Preventive Treatment.—Dolomite-feeding has been found to be an effective and relatively cheap method of increasing the blood magnesium of cows, and experiments have therefore been arranged to ensure a supply of this material to animals on farms usually affected with grass staggers. Two and a half tons of ground dolomite have been distributed to five farmers : on two farms the dolomite was incorporated with the ensilage as it was made, on two farms the dolomite will be sprinkled on the ensilage as it is fed out to cows, and on the fifth farm, where no ensilage was made, dolomite will be used as a lick, and, with molasses, will be sprinkled on hay as it is fed out.

The results of these experiments will not be available until October or November of next year.

To investigate the possibility of increasing the magnesium-content of pastures by manurial treatment with magnesium compounds, sixteen plots were laid down in 1933 in a Latin square with four replications of the following treatments : (*a*) Epsom salts, 8 cwt./acre ; (*b*) dolomite, 7·3 cwt./acre ; (*c*) calcium carbonate, 4·4 cwt./acre ; and (*d*) control. Eight further plots were subsequently added giving—(*a*) Epsom salts, 1 ton/acre ; (*b*) Epsom salts, 2 tons/acre ; (*c*) and (*h*) control ; (*d*) and (*g*) super, 10 cwt./acre ; (*e*) dolomite, 1 ton/acre ; (*f*) dolomite, 2 tons/acre.

Three cuts have so far been made of the Latin square and one of the last eight plots, and the following average results are available :—

Manurial Treatment.	Percentage MgO on Dry Matter.		
	First Cut.	Second Cut.	Third Cut.
Epsom salts, 8 cwt./acre	0·586	0·587	0·468
Dolomite, 7·3 cwt./acre	0·503	0·518	0·453
Calcium carbonate, 4·4 cwt./acre	0·479	0·505	0·421
Control	0·496	0·499	0·400
			First Cut.
Epsom salts, 2 tons/acre	..	..	0·647
Dolomite, 2 tons/acre	..	..	0·426
Control	..	..	0·388
Super, 10 cwt./acre	..	..	0·361

Manurial treatment with magnesium will therefore increase the magnesium-content of the pasture, but the process could not be made a commercial possibility with the present prices of Epsom salts and dolomite.

A more thorough investigation is being made of the question whether magnesium deficiency is the cause of grass staggers. The work is proceeding along the following lines :—

(i) The examination of magnesium-content of milks and urines from affected animals to determine whether an abnormal excretion of magnesium occurs via these paths.

(ii) Examination of the magnesium-content of the bones and organs of affected animals.

(iii) Analyses of forage samples from affected areas and also of monthly analyses of pasture samples from four farms to determine the seasonal variation.

(iv) Attempted production of grass staggers in cows at Wallaceville by feeding rations low in magnesium.

It has been found that milk and bones have a normal magnesium-content, while urines are very low in magnesium. Low urine magnesium correlates well with the low blood magnesium. Specimens other than bones have not yet been obtained from affected animals, but several series of organs from normal slaughterhouse animals have been analysed to serve as controls. Work on affected animals will proceed during the next season.

The results from the analyses of forage samples show that in the Waikato samples there is a general tendency for the magnesium-content to be lower than the usual figures. Spring grass in some instances contained as low as 0·3 per cent. magnesium and ensilage samples are often even lower.

The seasonal variation in the magnesium-content of Waikato pasture is not marked, the lowest values being recorded in December, with increased values in the growth following February rains.

For the attempted production of grass staggers at Wallaceville, ensilage has been prepared from maize, which is low in magnesium. This ensilage will be fed to two cows for three months before calving, after which the animals will be given only green oats. These experimental conditions will impose the strain of magnesium deficiency on the cows during the last three months of pregnancy, while the green oats will simulate the conditions of young grass feeding in the grass-staggers area. It should be mentioned that grass staggers has been recorded in Australia with oats feeding.

DIETARY PROTEIN AND STERILITY.

Work in this connection has been continued in collaboration with Dr. Hopkirk. The outstanding result of the year is the discovery of a diet which provides for good growth, and is even sufficient for female fertility, but on which males eventually become sterile. Such sterility is temporary and can be cured by change to the stock ration. It appears that this diet, which contains 70 per cent. of maize, is deficient in certain constituents necessary for the proper nutrition of the testis.

A feature of these sterile rats is that the testes are much smaller than would be expected from the size of the animals. This is not the case in the rats made sterile with high-protein feeding.

A corresponding diet with wheat replacing maize produces fertile rats. It is hoped that, working with the deficient diet as a basis, it will be possible to discover the factors necessary for the proper development and function of the testis.

Two types of male sterility have now been produced :—

(i) That resulting from feeding diets with excess protein :

(ii) That resulting from some dietary deficiency possibly of amino acids.

Females remain fertile under the same dietary conditions which produce male sterility.

"Bloat."

Analyses of the gases from the rumen of bloated and normal cows have been made. The results show wide variations for both bloated and normal cows; carbon dioxide, oxygen, methane, nitrogen, and hydrogen being present in variable amounts.

Toxicity of Smuts.

Samples of certain smuts which occur commonly in New Zealand forage plants have been supplied by Dr. G. H. Cunningham of the Plant Research Station. These are being fed to animals, and observations of their toxic effect are being made.

Vitamins.

Assay of several New Zealand fish oils for Vitamin D has been completed by Dr. M. M. MacOwan. The Vitamins A and D content of fresh grass and of hay have been assayed biologically as the petroleum ether extracts of the grass and hay. The results are given in the accompanying report of Dr. Hopkirk.

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

Mr. Josland supplies the following sub-report:—

Liver-function Test.—The Rose Bengal excretion test was carried out on six healthy pregnant ewes. In five cases more than 50 per cent. and in one case a 40 per cent. elimination of dye from the blood stream was obtained in ten minutes.

Bloat in Cattle.—Electrometric pH determinations were made on rumen contents and grass extracts under varying conditions.

Grass Staggers.—A further series of blood analyses and urinalyses were carried out, the main feature being the low serum magnesium-content. Albumen and acetone were generally present in the urine. Values for creatin and creatinine in the urine were fairly constant and within normal limits.

Mairoa Disease in Sheep.—Blood analyses and bone-ash determinations were made on several affected animals. In blood, values for calcium, magnesium, and non-protein nitrogen were within normal limits. The hæmoglobin and red-cell count were markedly lowered. In one case under examination ash-values of 54·3 per cent. and 56·1 per cent. were obtained from head of femur and proximal epiphysis of the humerus.

Leukæmia.—Serial blood counts were made on healthy and affected birds. A constant feature in affected birds was a high polymorph differential percentage count.

Morton Mains Disease in Lambs.—Analyses of the blood of affected lambs showed a slight anæmia with a normal colour index. Compared with those obtained from healthy normal lambs, values for blood calcium, magnesium, non-protein nitrogen, leucocyte count, and differential leucocyte count were normal. Values for inorganic phosphorus and total solids were slightly lower. Lowered ash-content of the head of the femur and proximal end of the humerus suggested a mild degree of imperfect calcification.

Facial Eczema in Sheep.—The serum contained a large amount of bile pigment. The Rose Bengal test gave results indicating impairment of liver function.

Mineral Metabolic Experiment.—Analyses on rat and sheep bloods have been made in co-operation with Dr. Cunningham's experiments.

Total Number of Specimens.—Sheep blood, 254; cattle blood, 70; rat blood, 174; fowl blood, 284; rabbit blood, 45; pig blood, 8; urine, 15; bones, 128; pH electrometric, 44; cerebral spinal fluid, 5; miscellaneous, 10: total, 1,037.

FIELDS DIVISION.

REPORT OF R. B. TENNENT, DIRECTOR.

The work of the Fields Division is aimed in general at improving the farming of the Dominion. Broadly speaking, it consists of advising and instructing farmers and others with respect to all improved methods in grassland management, top-dressing, silage-making, the growing and improvement of all farm crops, and such matters. Research work with a view to finding improved methods of farming practices, improved strains of grasses and clovers, &c., is undertaken, and any desirable improvement is rapidly brought to the notice of the farming community, mainly per medium of the extension staff of the Division and the columns of the Department's Journal. Undoubtedly the Fields Division has a real place in the rural life of the Dominion.

The major operations of the Division are reported on below under specific headings and following a few comments respecting the weather conditions generally during the year, and the outcome of the season's cereal crops.

Weather Conditions.

These varied widely in different parts of the Dominion, and the outstanding points in the several main districts were an exceptional rainfall in North Auckland with consequent phenomenal pasture growth, while in the remainder of the Auckland Province hot and dry summer conditions burnt up pastures badly. In the southern half of the North Island a boisterous and rough winter with a rainfall below average was followed by hot and dry weather which, as the summer progressed, amounted almost to serious drought conditions. About mid-February welcome rains relieved the position. In the South Island an extremely wet winter was followed by a wet early spring which greatly retarded cultural operations. When the weather did take up extremely dry conditions set in, and this state of affairs persisted in the majority of districts right throughout the summer and early autumn, and it was not until March that ample rains relieved the position.

Arable Crops.

The vagaries of the weather, taken as a whole over the year, were not conducive to exceptional yields in the arable crops. Nevertheless, although below the previous year's figures, the yields obtained have been quite good.

As regards the wheat crop, that portion of the crop threshed during the period January–March, 1935, amounting to 4,347,750 bushels, gave an average yield per acre of 26·98 bushels, as against an actual yield for the 1933–34 season of 31·56 bushels per acre. The whole area in wheat for 1934–35 is estimated to be only 77 per cent. of that for the previous season, and the total yield of wheat for the current season is expected to be approximately 6,500,000 bushels only, as against an ascertained yield of 9,036,017 bushels for the 1933–34 season. The total yield of wheat will hardly be sufficient unless the actual yield over the season is greater than is estimated for Dominion requirements, and in these circumstances the importation of some milling-wheat would undoubtedly have to take place.

The yield per acre of oats has also dropped appreciably when compared with that obtained in 1933–34. The estimated area sown to oats for 1934–35 was 312,000 acres, as against an actual area harvested the previous season of 296,498 acres. Actual threshings for the January–March, 1935, period disclose a per-acre yield of 38·17 bushels, as against an actual yield over the whole Dominion for the 1933–34 season of 41·39 bushels. The area from which oats were threshed for the five seasons ended 30th March, 1934, averaged 23 per cent. of the total area under that crop. Assuming that a similar proportion is threshed this year, the total yield of grain should be approximately 2,670,000 bushels, as against 3,242,500 bushels for the season 1933–34.

It is estimated that 22,600 acres were sown in barley for the 1934–35 season, as against an actual area harvested the previous season of 21,801 acres. As in the case of both wheat and oats, the yield per acre of the barley crop for 1934–35 is estimated to be lower than for the season 1933–34. The actual yield per acre for the latter season was 34·77 bushels, while the estimated yield for the 1934–35 season is 28 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 total yield of grain should be approximately 450,000 bushels, as against 730,963 bushels actually obtained for the season 1933–34.

The area in potatoes in 1934–35 was estimated at 20,300 acres, as against an actual area for the Dominion for the previous season of 25,028 acres. It is impossible at the present date to forecast the yields of the main crop of potatoes. In most districts, however, it is anticipated yields generally are likely to be considerably lower than the previous season, as most crops suffered severely from the hot dry weather experienced over such a long period during the summer and early autumn.

Agricultural Instruction.

The agricultural advisory service is a principal activity, and undoubtedly is highly valued by the farming community, this being indicated by the ever-increasing demand for visits and revisits of a personal nature. Farmers' methods are examined, their farms studied, and expert advice as to how best to utilize the land is given. Higher and more economical production can in no small measure be credited to this activity.

One of the essentials necessary in conducting a sound advisory service for farmers is the need for advisory officers keeping abreast with the advance of research and translating the findings of research workers in such a manner that they can be used in the every-day practices of the farmers. The

advisory officers of the Division are particularly well equipped for carrying out this important function, inasmuch as most of them having been trained at various agricultural training centres are fully conversant with the research work conducted at such institutions, and from their contact with farmers are able to gauge the applicability of such research work to farming practice. Apart from this, the field research work carried out by the Department's own research workers and Instructors has proved a most fruitful source of information, and, as has been amply demonstrated, has conferred considerable benefits on the farming community.

The close co-operation which exists between research workers and the extension service again amply demonstrates how inter-dependent they are, and emphasizes how the work as a whole would, to a large measure, be stultified if the various phases of activity were divorced from each other. Only by the successful co-operation which exists can field problems be intelligently approached and the necessary field experience and assistance be secured, and to this co-ordination in large measure is due the advances which in recent years have been made in field research.

Introduction of Sodium Chlorate.

The present wide-spread use of sodium chlorate as a means of keeping weeds, especially ragwort, under control in our grasslands is the direct outcome of experimental work initiated by the Fields Division, in which it clearly demonstrated that the use of this material when applied in certain strengths effectively killed the weeds and thus enabled farming operations to be carried out in districts where grazing, especially with dairying cattle, was at least a precarious undertaking.

As a result of this experimental work, the farmer has now a reliable method, which is extensively used, for controlling ragwort and other weeds, and due to the fact that the Government is subsidizing sodium chlorate, and thus facilitating its sale to farmers, the general outcome of the initial experimental work carried out by the Division has proved and will continue to be inestimable value to the Dominion.

Experimental Plots.

The solving of farmers' problems in the field by means of experimental trials in connection with such matters as pastures, manures, crops, &c., is an important function of the Division. Much of the instructional work is based on the results of these trials. To determine the value of manures, strains of grasses, and varieties of crops, &c., work must be localized, and the co-operative trial, where the farmer supplied the labour and the Division the material and supervision, is an important activity. Many modern practices and the breaking-down of much conservative procedure are two matters upon which local experimentation has had a bearing. At present approximately eight hundred co-operative trials are being carried out by the Division.

Wheat Manuring Experiments.

Wheat-manuring experiments conducted in the South Island over the past twelve years showed that the use of 1 cwt. of superphosphate with wheat gave an average increase of 4 bushels per acre. This represented a profit of approximately 300 per cent. on the outlay for manure.

Moreover, the trials have indicated that it is unwise to use a larger quantity of super than 1 cwt. per acre, since the returns from the extra quantity do not give yields commensurate with the extra cost.

The use of fertilizer, chiefly superphosphate, has increased in the South Island from 66 per cent. of the acreage sown in 1928–29 to 82 per cent. in 1934–35.

Wheat Variety Trials.

A large number of wheat-variety trials have been carried out in the South Island. These have proved the undoubted superiority of Solid Straw Tuscan over other standard varieties in most districts in Canterbury, but they have also been the means of eliminating many new varieties, chiefly novelties from abroad, which have been shown to be unsuitable for Canterbury conditions.

The farmer may lose heavily in growing on a large scale new varieties which have not been proved, and it is claimed that the trials referred to above have been the means of saving much expenditure and disappointment which would inevitably result if individual farmers experimented with new varieties.

Wheats: New Varieties.

Close co-operation has been maintained with the Wheat Research Institute in trying out on a field scale varieties which have shown promise in small trials at Lincoln.

Notable among these is Cross 7, which is a cross between White Fife and Solid Straw Tuscan, and combines the high milling and baking qualities of the former with the heavy-yielding qualities plus high wind resistance of the latter. Extended trials during the past two years have shown that Cross 7 yields on the average only a fraction of a bushel per acre below Tuscan, but as the Cross is expected to command a premium in view of its quality it is likely to be grown fairly extensively in the future.

Preliminary trials with two Portugese varieties indicate that in these we may have available a satisfactory wheat for spring sowing. The latter has been a long-felt want among wheat-growers in the South Island.

Turnips and Swedes.

Several varieties of swede and turnip which are highly resistant to club-root have been introduced, and have been put under thorough trial in competition with standard varieties, chiefly in Southland.

After several years of trial the Bruce turnip and the Wilhelmsburger Otofte swede have proved highly resistant. It is not too much to say that the use of such varieties as these on badly infected land means the difference between a reasonable crop and an utter failure in many cases.

Liming.

A series of grassland trials carried out in Canterbury clearly indicated the importance of lime in conjunction with superphosphate on grasslands. In 1931–32, 85 per cent. more lime was used in Canterbury than in the previous year. It is fairly certain that this increase is largely due to the demonstrations provided by the experiments mentioned.

Potatoes.

A large number of manuring experiments on the potato crop in the South Island have been carried out. These have shown that the increase due to the use of 3 cwt. superphosphate in forty-eight experiments conducted since 1925 was on the average 19 cwt. of table and 6 cwt. of seed potatoes per acre.

The addition of 1 cwt. sulphate of ammonia gave a further increase of 10 cwt. table and 6 cwt. seed potatoes per acre.

In 1928–29 the proportion of the crops fertilized in the South Island was 50 per cent., while in 1934–35 approximately 60 per cent. of the area sown in potatoes was fertilized. Moreover, the average quantity applied—viz., 3 cwt. per acre—was the same in both the seasons mentioned.

The fact that the proportion of crops treated has increased in spite of difficult times may be largely attributed to the good results secured from fertilizers in the Department's trials.

A fuller report on the field experimental work of the Division as prepared by the Crop Experimentalist is attached.

Experimental Farms.

Situated in various parts of the country the Division has control of seven experimental farms whereon important investigational work of an intensive nature is carried out. At times special experiments and demonstrations on a scale and of such an intricate nature that they would be impossible for a co-operative trial require to be carried out, when these farms have a very definite value. The Ruakura Farm of Instruction trains annually a number of students in all branches of farming-work and at the same time provides an excellent grounding in the more theoretical aspects of rural lore.

Seed Improvement.

Close co-operation has, as hitherto, taken place between the agronomical section of the Plant Research Station and the Division in regard to effecting improvements generally in agricultural seeds, and some of the major activities in this connection are given.

The Production of Pure Wheat.

From the viewpoint of the miller and baker it is important that pure, sound wheat should be available. From the viewpoint of the farmer it is important that his crop should be pure, uniform in type, and free from disease. The production annually of pure smut-free seed wheat on the Government Pure Seed Station is a direct and effective means of attaining these desired results.

Oat Improvement.

The oat crop in New Zealand is both impure and heavily infected with smut. To meet the present need, pure seed of all the standard varieties has been raised, and pure smut-free, certified seed oats will be available to the farmer in 1936–37.

Oat Variety Introduction.

New Zealand devotes 80 per cent. of the oat area to two varieties. It is unlikely that these two varieties are best capable of serving, as they do at present, virtually the whole requirements for feed oats, milling oats, chaff, and green feed in all the various climatic conditions of both Islands. Steps are being taken to determine in several centres the agronomic value of the more promising varieties from the wide range of material obtainable from other countries.

Rape Improvement.

The rape crop is a very important adjunct to the fat-lamb industry. We import rape-seed to the value of £10,000 annually, yet we can grow excellent seed, and its production could be made economically sound. The best rape types have been selected, mother seed has been produced, and this seed distributed to farmers willing to undertake seed-production.

Turnip-seed Growing.

The possibility of growing in New Zealand excellent swede and turnip seed had been proved, but it yet remains to induce the merchants and growers to give preference to locally produced seed. In the meantime activities are directed to the production in New Zealand, under certification, seed of those varieties possessing resistance to club-root, so as to ensure that the seed distributed is of a club-root resistant strain.

Field-pea Production.

The field-pea crop of New Zealand affords a very useful export trade, the expansion of which lies in the direction of reduced costs and the production of a type of pea for which there is a demand overseas. The Partridge pea is by no means the most satisfactory for all purposes, and an extensive breeding programme is in hand the object of which is the raising of varieties superior for certain specific purposes to those now generally grown.

Garden-pea Production.

The trade in garden peas is very specialized, and a high standard of purity has to be maintained. The importation of pure seed stocks to replace those which, from various causes, have become impure involves the trade in considerable expense. The Department undertakes the production of pure seed stocks on the Government Pure Seed Station, and merchants may now obtain their requirements at less expense and with greater reliance than has been possible hitherto.

Potato Improvement.

The general standard of the potato crop in New Zealand has been greatly improved as a result of the combined effect of certification, the production of nucleus lines of virus-free seed from the Government Pure Seed Station, and the distribution of varieties introduced from overseas. The latest introductions are two mosaic-resistance varieties from the United States of America, and certain of the species collected by Russian and German explorations in South America.

Seed Certification.

Perennial Rye-grass.—Since the inauguration of certification in the 1929–30 season, well over half a million bushels of perennial rye-grass seed has been sealed and tagged as certified seed. In the 1932–33 and 1933–34 seasons almost one-third of the total perennial rye-grass seed production has been certified, while it is probable that a certain proportion of the uncertified seed can be traced back to a certified origin.

The ear-marking of this quantity of seed has given purchasers an opportunity of selecting high-quality seed in a market where previous to the introduction of certification good, medium, and poor strains were sold more or less indiscriminately.

Examples are frequent of a farmer sowing a portion of a paddock with certified seed and the rest with uncertified, and having to plough up the uncertified portion within a year or so, while the certified portion has developed into a good permanent pasture.

White Clover.—In overseas countries in the past New Zealand white-clover seed has had the reputation of showing a wide variation in type from one line to another, some being classed as very good, others as very poor. This has been confirmed by investigational work here, and the application of certification to this seed has resulted in the purchaser being certain that the produce he buys is of the superior type. This is reflected in the average export price of white clover, which for the period May–December, 1933, was quoted as—Certified seed, 27·3d. per pound; uncertified seed, 15·3d. per pound.

Reports recently received from numerous institutions overseas all indicate that New Zealand certified mother seed is superior to practically all other strains of white clover tested.

Brown-top.—Approximately 90 per cent. of New Zealand's brown-top seed production has received the hallmark of certification. So much importance is attached to this by purchasers that uncertified brown-top seed is hard to quit. Overseas trade to-day is practically based on the certified article, and certified seed usually is supplied for all overseas orders except where uncertified seed is specified.

Cocksfoot.—Prior to the introduction of cocksfoot certification in the 1930–31 season, the position in regard to the type quality of internal supplies of cocksfoot-seed was largely controlled by the regulation requiring that all imported seed be stained. Thus growers were in a position to avoid, should they so wish, the purchase of imported seed which was largely of an inferior strain.

The export trade of cocksfoot has greatly benefited by the introduction of certification, however. For example, the Australian Government requires the staining of all imported cocksfoot seed except certified seed. For eight months of the year 1933 New Zealand exported to Australia $4\frac{2}{3}$ tons of certified cocksfoot-seed to every ton of uncertificated seed.

The sealing of sacks with a Government seal is adequate protection against the practice of refilling sacks bearing a New Zealand brand with seed grown in another country.

Red Clover.—While the certification of Montgomery red-clover seed is yet on a very small scale, the quality and appearance of New-Zealand-grown seed is such that it should be in a position to compete with English-grown seed when the supply increases to a sufficient quantity.

Locally also benefits should be derived in that through certification a distinction is being shown between the two widely divergent types of red clover at present on the market.

The Value of Certified Seed Potatoes.—In trials conducted over the last two seasons twenty lines of certified seed potatoes gave an average yield of $11\frac{1}{2}$ tons per acre, whereas seventy-seven lines of uncertified seed grown under identical conditions gave an average yield of $7\frac{1}{2}$ tons per acre.

In 1934 1,800 tons of certified seed was produced for sale apart from the quantity replanted by growers themselves and that sold without the final tuber inspection by the Department's officers. Thus approximately 10 per cent. of the Dominion acreage for 1934–35 season would have been sown with certified or provisionally certified seed.

In the trials above mentioned the average yield of all lines was 8·5 tons per acre. Taking the lines under trial as representative of the general run of potatoes grown in New Zealand, and working on the basis of 5·4 tons as the average New Zealand yield, we find that the certified seed yielded an equivalent of 7·4 tons per acre—under average conditions a 2-ton increase.

Taking into account approximately 2,000 acres sown with certified seed in 1934, the 2-ton increase over this area gives a total increase in yield due to the use of certified seed of 4,000 tons. This is the benefit from one season's planting only and does not take into account the cumulative benefits which must be derived from season to season.

Seed Wheat.—The certification of seed wheat has given the farmer an opportunity to purchase with certainty seed of high varietal purity and freedom from smut diseases. While the quantity of seed finally certified is not enormous, it is quite sufficient to maintain a supply of good quality seed on the market, the distribution of which materially assists in maintaining a good standard in regard to the wheat crop in general.

The attached report of the Agronomist gives fuller details relative to the work of crop improvement and seed certification.

Ruakura Farm of Instruction.

The pastures on Ruakura produced sufficient feed for the stock during the winter of 1934. Following the winter, grass-growth started well in the early spring and continued up till the middle of November, when dry weather set in. This particularly long spell of dry weather, which lasted until about the middle of February, had the effect of severely burning up the pastures and also had an adverse effect on the general crops on the farm. An area of 41½ acres of grass was converted into ensilage and 90 acres were cut for hay. The quantities of these fodders produced are estimated at 160 tons of ensilage and 179 tons of hay.

No annual sale was held on Ruakura as had been the usual custom for some years past. All surplus stock was sold at the combined breeders' sale, this having the effect of lessening the expenses of selling. The sale in question was held at Claudelands about mid-September. Seventeen yearling bulls were disposed of at an average price of 17·76 guineas, while 7 yearling bulls, subsequently disposed of by private treaty, lowered the average to 16·37 guineas for the 24 yearling bulls sold.

As regards pigs, a fairly good demand has been maintained for Berkshires and Tamworths, but very little inquiry exists for the Large White breed. Prices realized for pedigree pigs at the sale were slightly in excess of the average prices at the 1934 sale. The average prices obtained for the different breeds were—Berkshires, £5 7s. 10d.; Tamworths, £5 0s. 5d.; Large Whites, £4 3s. 2d.

The dairying operations on Ruakura were affected considerably by the drought conditions extending from November to February. The shortage of succulent feed produced on the pastures caused the milk-supply to drop steadily, with the result that the output of butterfat showed a slight reduction on the previous season. Several of the cows were submitted to testing, but no outstanding yields of butterfat were produced by any cows of the four breeds under test. The average price per pound of butterfat received in 1934–35 showed a slight increase on the price for the previous season, the actual figures being 1934–35, 9·03d. per lb.; 1933–34, 8·83d. per lb.

The position with regard to flock sheep at Ruakura is satisfactory.

Ruakura Farm Training College continues in popularity, and during the year the average enrolment of students was 35. The general health of the students at the college throughout the year has been good.

Purchase of Seeds and Manures for Government Departments.

The arrangement whereby the Fields Division attended to the purchase of seeds and manures required for Government Departments has operated smoothly throughout the year. The longer this system of the purchase, particularly of seeds, is in operation the more one is convinced that the inauguration of this system of purchasing was a move in the right direction, the seeds obtained being purchased essentially on a purity and germination basis. It is undoubtedly reflected in the quality of the pastures being secured on the farms of Government institutions.

Young Farmers' Clubs.

This movement, which eventually must play an extremely important part in furthering the general application of good farming, was started by the Fields Division, but the degree of extension reached within a comparatively few years meant that governing bodies had to be set up. The Division is strongly represented on these bodies, and takes a very active part in the club work. Lectures, demonstrations, and field days are arranged for the clubs, while co-operative trials are also being undertaken in conjunction with them.

Boys' and Girls' Agricultural Clubs.

The agricultural clubs, in which many hundreds of the rural youths of the Dominion participate, annually serve to create an agricultural bias, and provide a wealth of knowledge in respect to general farm practices.

Farmers' Field Competitions.

In this activity valuable use is made of crop, silage, and pasture competitions, which are conducted in co-operation with farmers' organizations, which provide concrete demonstrations of sound practices and which attract hundreds of competitors annually.

The Hemp Industry.

The hemp industry has shown no indication of an improvement. During the year less hemp and tow was submitted for grading than in the previous year. For 1934–35 the actual number of bales of hemp graded was 18,814, a decrease of 3,343 bales on the figures for the previous twelve months. Likewise, the quantity of tow graded showed a decrease of 1,285 bales, the actual figures being 1934–35, 3,510 bales; 1933–34, 4,795 bales.

Staff.

I desire to acknowledge the excellent service rendered throughout the year by the staff of the Division.

FIELD EXPERIMENTAL WORK.

Mr. J. W. Woodcock, Crop Experimentalist, supplies the following sub-report :—

The total number of experiments being carried out by officers of the Fields Division is 771, compared with 557 for the corresponding date in 1934. The large increase is mainly due to the establishment of a number of trials on the inoculation of clover, an extension of the strain trials, and also to a large number of observational trials being laid down during the year.

Description and Progress of Experiments.

Research into Fundamental Grassland Problems.

Experimental Farm, Marton.—Eleven trials are now being carried out under the "alternate mowing and grazing technique." Four investigate the relative merits of different kinds and methods of applying phosphatic or nitrogenous fertilizers. One of these, which has served its purpose, is shortly to be discontinued. Two experiments are concerned with an investigation into the liming of grassland, one being a trial of different methods of applying ground limestone, while the other, which has only recently been established, aims at a determination of the relative merits of the coarse and fine fractions respectively of ground limestones from two sources. A further trial is designed to investigate the effect of pasture cultivation with a penetrating harrow. The remainder of these trials are being carried out in collaboration with the Agrostologist to compare the production of various strains of grasses and clovers.

Ruakura Farm of Instruction.—An experiment is being carried out here under the "mowing and grazing" technique which has for its object a comparison of no-manure, with super, and with super plus lime, the latter being applied by two different methods. Lime is giving quite a marked response.

Grassland Investigations and Demonstrations.

Observational Top-dressing Experiments.—There are at present in existence throughout New Zealand 430 observational top-dressing experiments with the object of surveying grasslands from point of view of their response to lime, phosphate, and potash.

Responses to phosphate occur on most of the soil-types on which trials have been laid down. Nevertheless, in some districts it has become evident that the effect from phosphate is only slight unless either lime or potash is applied in addition. In parts of Westland, Canterbury, and Southland, the marked effect of lime has been recognized for many years. Trials in North Auckland now indicate that lime is a major limiting factor on the clay and the ironstone soils in that region. There are also some of the volcanic soils of South Auckland which respond quite well to lime.

Potash has been effective in experiments laid down in North Taranaki and in parts of South Taranaki. In the former region about a hundred small plots were laid down last spring to define, if possible, the limits of the potash responsive areas. Unfortunately, the subsequent abnormal dry summer conditions mitigated against securing on these the same marked results from potash as have occurred in previous experiments. In the Waihi district of the Auckland Province a number of trials recently laid down have indicated that good results from potash might be expected in that region. Various forms of phosphate are being compared in many trials. Slag is generally quite effective, but is not superior to super or to super and lime except in isolated cases. Rock phosphates have been invariably less beneficial than the superphosphate and basic slag.

Demonstrations and Trials of Grass and Clover Strains (in collaboration with the Agrostologist).—There has been an increase in the number of these demonstrations during the year. They are proving of great value not only for purposes of testing strains of grasses and clovers in different localities, but also for demonstrating to the farming community the importance of sowing approved strains and grass-seed mixtures. Such areas are almost ideal for field days, and in that respect are of great help to the instructional staff in furthering knowledge gained at research centres and in emphasizing the importance of sowing better strains of herbage plants. Alongside these demonstrational areas top-dressing experiments have been laid down.

Grazing Trials.—There are nine experiments in which the production as measured in grazing-days of one field is compared with that of another differently treated. Four trials investigate the relative production of good rye-grass strains and poor rye-grass strains respectively, one trial in Canterbury compares fields treated with lime with an unlimed field, while two experiments in Taranaki are designed to further investigate the use of potash. At Marton Experimental Area, records are being kept from fields under different methods of management.

Legume Inoculation Trials (in Collaboration with the Mycologist).—About a hundred simple experiments are being carried out to determine the effect of inoculating red and white clover, lupins, and field peas. Positive results from inoculation in a small number of the earlier trials resulted in an extension of the experiments during the past season, particularly those including clover. In a few trials on peas outstanding responses have been secured, although in others no differences have been observed. The evidence available so far, however, does not warrant any general recommendation regarding the inoculation of any of the crops mentioned.

Cereal Experiments.

Wheat Manuring.—Only one experiment was laid down during the past season. During the coming year a large programme of work has been planned to investigate the use of nitrogenous fertilizers on wheat crops sown after a previous stubble crop. Experimental results in the past have indicated that under the latter conditions nitrogen applications are most likely to be effective, but that results vary considerably according to the season. Results from trials in Australia have indicated that response to nitrogen is largely bound up with the nitrogen-content of the soil, and this aspect will be investigated in the trials to be carried out by this Department during the coming season.

Wheat Variety Trials.—Trials were carried out in collaboration with and on behalf of the Wheat Research Institute on twenty-five farms in the South Island, but seven of these experiments could not be harvested owing to lodging. In the majority of these the new variety, Cross 7, was compared with Solid Straw Tuscan.

In seven trials, including three in Marlborough, Cross 7 was superior to Tuscan, while in nine experiments it was lower in yield than Tuscan. The average difference was in favour of Solid Straw Tuscan to the extent of a $\frac{1}{4}$ bushel per acre.

Seven trials included a comparison of a selection (13/28) of Solid Straw Tuscan, brought out by the Agronomist, with ordinary commercial Solid Straw Tuscan. Although there was no difference between the two when the average of all trials are taken into account, the superiority of the selection in a trial at the Pure Seed Station, Lincoln, suggests that it may be superior on certain soil-types. Further trials in selected localities are to be laid down during the coming season.

Other varieties under trial were Jumbuck, Marquis, and certain Portugese varieties. The latter show promise of being very suitable as varieties for spring sowing, since at both centres where they were tried their yields were considerably better than those from Solid Straw Tuscan. They are to be under further trial during the coming season.

Wheat: Rate of Seeding Trials.—Nine trials were laid down, in each of which seedings of 60 lb., 90 lb., 120 lb., and 150 lb. per acre were compared. Three of these had to be abandoned on account of lodging. The average increase in yield of 90 lb. seeding over 60 lb. was 1·7 bushels per acre, the 120 lb. seeding was better than 90 lb. on the average by 0·5 bushels, while the 150 lb. seeding showed an average increase over the 120 lb. seeding of 1·3 bushels per acre. These results tend to confirm those secured in previous seasons and support the contention that more rather than less seed should be used in practice.

Seed Treatment of Cereals (in collaboration with the Mycologist).—Further observational experiments were carried out to investigate the merits of "Ceresan New" as a seed-dressing for cereals. In several of these the thicker and more vigorous germination of the Ceresan-treated cereal was apparent in the early stages, but as the dry season mitigated against the occurrence of disease in any of the trials, no data as to the effectiveness of Ceresan in combating smut as compared with formalin, copper carbonate, or no-treatment was available.

Potato Experiments.

Manuring.—Eleven experiments were laid down in 1934, but the crops have not yet been dug. These trials investigate the effect of the addition of sulphate of ammonia and sulphate of potash to the standard dressing of 3 cwt. superphosphate on the lines of previous experiments.

Source of Seed Potatoes.—This series of experiments is being continued with the Dakota variety, seed of which is being grown at nine centres. The results of trials up to the 1933–34 season were published in the *Journal* for February, 1935.

Swedes and Turnips.

Manuring.—Three experiments have been laid down during the current season.

Varieties.—Various trials are being carried out to compare New-Zealand-grown seed with imported seed (in collaboration with the Agronomist) and to test the relative immunity to club-root of varieties or strains (in collaboration with the Mycologist).

Rape.

Several trials are in progress to investigate the performance of two lines of rape selected by the Mycologist as being relatively resistant to club-root.

Miscellaneous.

A number of experiments are being conducted which cannot be classified under the headings above. Included among these are trials of lupins in combination with other crops, trial of pampas grass as a stock-food for cattle, the control of ragwort and other weeds by spraying, and experiments on the manuring of lucerne.

REPORT OF THE PLANT RESEARCH STATION, PALMERSTON NORTH.

The activities of the Plant Research Station have been well maintained during the past year 1934–35. The appended reports of the several sectional 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 Department of Scientific and Industrial Research in certain parts of the work.

A. H. COCKAYNE, Director.

AGRONOMY SECTION.

J. W. HADFIELD, Agronomist.

The work of the Agronomy Section deals mainly with investigations and research bearing on seed and crop production. It is undertaken partly at the Plant Research Station, Palmerston North, and partly at the Government Pure Feed Station, Lincoln.

Potatoes.—Each year "seed" is raised and sold from the Pure Seed Station. The main objective is the production of pure and relatively virus-free "seed," and in this respect a satisfactory standard is being maintained, and there is a ready demand for the "seed" produced from the 10 acres planted annually. The 1933–34 crop was very satisfactory; the yield of the 1934–35 crop now about to be dug is relatively poor on account of the dry season.

Trials of local Manawatu lines of "seed" were again made, and afforded further evidence of the necessity for growers to purchase certified "seed."

A consignment of South American varieties of potatoes was received from the Imperial Bureau. These were planted rather late in the season, but sufficient "seed" will be secured to carry on. Importations were also made from the United States of America and Scotland.

Wheat.—As in the past, pure and smut-free seed wheat of the more important varieties has been raised and distributed by the Pure Seed Station.

A Pure Seed Station selection of Solid Straw Tuscan (13/28) has, for the fourth year in succession, outyielded College Tuscan by 2 bushels per acre. Unfortunately this characteristic has not been maintained in general field trials. A new variety which has also outyielded College Tuscan is now under field trial for the first time.

Selection work in all varieties continues with the object of raising pure seed. This has been particularly important in the case of Cross 7. A very extensive yield trial of selections from Hunter's II has been continued.

Oats.—Steps have been taken to raise pure seed of a number of commercial varieties, and some seed is now for the first time available for distribution.

There is considerable variation to be found in certain varieties, particularly Algerians and Duns, and it will become necessary to test out these variants before seed is increased. This work is progressing in co-operation with the Crop Experimentalist.

Observational trials of a number of varieties of which little is known are being conducted at four centres. Some of these varieties have been imported from Australia. The trials may be regarded as preliminary to any field trials that may be conducted, and permit the elimination of a large proportion of the varieties.

Breeding-work has been commenced, and F2 seed has been harvested of crosses between some of the varieties possessing special characteristics.

Lucerne.—Yield trials have been laid down to compare Marlborough with Hunter River, South African, Tivicata, and Subtergrim. The two latter are varieties raised in New Zealand.

Breeding commenced in 1931, and satisfactory progress has been attained. By selfing selected individuals it has been possible to locate parents which have produced satisfactory and vigorous progeny to L2. There has been a steady loss in vigour and seed-production as selfing has advanced, but some families have retained a vigour equal to Marlborough and are extremely uniform in type. The work is progressing along three lines: (*a*) The parents which have produced the most vigorous inbred progenies—irrespective of type—have been seeded together. The resulting seed has been sown in an increase block and is being subjected to thorough rogueing. The progeny of this increase block will give the first bulk selection in 1935–36. (*b*) Selected parents have been hand-crossed one with another, affording ninety separate crosses. These are to be grown out next season to determine the best combinations from which to build up a second selection. (*c*) The best of the L2 progenies are to be hand-crossed next season. This is the best breeding material available, and it should be possible to build from it a highly satisfactory type.

The pollination of lucerne is a matter of considerable importance, having as it has a direct bearing on seed production and heterosis. A study has been made of wind and various insects as possible agents in this respect. The great importance of cross-fertilization in its effect upon seed-production and the vigour of the resultant plants has been amply demonstrated. Of the pollinating agents the following have been compared: Humble bee, black honey bee, Italian bee, hybrid honey bee, Carneolan, and Caucasian. The Apiary Instructor, Palmerston North, has co-operated in these trials.

Rape.—Mother seed of the two types, Broad Leaf Essex and Giant, is produced each year for distribution to growers who are producing seed. That distributed this season is a blend of selected lines. Next season hybrid seed of the two most promising selections will be available, and following this will be the most promising selections from this cross. Thus an advance is being made each year.

Breeding of rape types is progressing. Crosses between the various types have been made of which F2 seed is available and also F1 seed of back crosses.

Swedes and Turnips.—Investigations regarding varietal nomenclature has been completed and the results offered for publication.

Trials have again been undertaken to compare the yield and purity of New-Zealand-grown certified seed with that of imported seed.

Brassica Crosses.—Inter-specific crosses were made originally to study hybridization between the various *Brassicae* in view of the interest being taken in seed-production.

The majority of the roots died, but some of the hybrids produced F2 seed. Back crosses have been made, and some of the material may possibly be of economic interest.

Garden Peas.—The production of pure lines of the more important varieties of garden peas continues to be an important activity of the Pure Seed Station, to which about 10 acres is devoted each year. These selected lines are purchased by merchants to replace existing stocks and build up from them their lines for export.

Most of the selected lines were grown this season in comparison with stocks obtained from merchants, and in almost every case the selected lines were more vigorous and productive, and all were decidedly more uniform.

A study of the tare leaves and other variants in peas has been continued. The problem is of great economic importance, but one that is proving very difficult to solve.

Little actual breeding-work has been undertaken, but crosses between Great Crop and Lincoln have now reached F4, and some segregates are promising.

Field Peas.—Several new varieties of field peas have been placed under trial and a few are showing promise.

An extensive programme of breeding has been undertaken and F4 seed has been harvested. Field peas form an important crop in New Zealand and warrant considerable research in the development of a smooth, yellow pea, with a colourless seed-coat that is better than those generally grown. These types are used in the manufacture of split peas. Improvement could also be effected in Partridge by producing an earlier ripening strain for North Island conditions. Some promising material is available.

Problems relating to the genetic analyses of certain seed characters have been concluded, and the results are to appear in the *Journal of Agricultural Science.*

Onions.—After several years' work, what appears to be a very desirable type of onion has been selected. Sufficient bulbs have been raised this past season to produce a quantity of seed next season.

A yield trial designed to compare the selection with a number of standard varieties failed on account of dry weather.

Mangels.—A collection has been made of all varieties available in New Zealand. These are now growing and it is proposed to describe the varieties, and the Analytical Chemist intends to determine the dry-matter content of each.

Tomatoes.—A number of standard varieties were crossed in 1933–34 and the hybrid seed grown this past season with a view to determining hybrid vigour. Increased vigour was very evident in vegetative growth, but an increase over both parents in fruit-production occurred in only one cross.

SEED CERTIFICATION.

The Agronomy Section has been responsible for the organization of the seed-certification activities of the Fields Division. The scheme has been extended in the past season to include the certification of Italian rye-grass seed.

Standards.—Purity standards in regard to machine-dressed seed, which had previously applied to perennial rye-grass seed only, have in the 1934–35 season been adopted for all certified grass and clover seeds. The standards set vary for each kind of seed, and are such that only the definitely inferior lines are rejected for purity.

Perennial Rye-grass.—A further reduction of 10 per cent. has been recorded in the acreage entered for certification during the season 1934–35. An alteration to the scheme has involved the deletion of the clause permitting the entrance of areas on an age basis only. All areas now to be eligible must either have been sown with certified mother seed, or have had a satisfactory trial report on seed previously harvested from the area.

On the other hand the scope of the scheme has been extended to include a class designated "Certified Commercial Perennial Rye-grass Seed." Seed to be eligible in this class must have been placed under test by means of ultra-violet light and reported upon as suitable for certification in the relative class. The method obviates the necessity of field inspection and paddock sealing, but on the other hand is an indication of perenniality only and not of type.

Cocksfoot.—While all entries of cocksfoot-seed are not yet to hand, indications point to an increase in the acreage entered for the 1934–35 season. By far the greater proportion of the seed being harvested is eligible for certification in the mother-seed class.

White Clover.—Due mainly to the entry of a considerable number of areas which have been sown down with mother seed, the acreage of white clover entered for certification is at least twice that entered in the 1933–34 season. The yields obtained from those areas harvested to date appear to be quite satisfactory.

Red Clover.—There is an increase in the acreage of Montgomery red clover entered for certification in the 1934–35 season. Most of the areas are located in the South Canterbury and North Otago districts, and, in general, have been sown down with seed certified under the Department's supervision.

Brown-top.—No returns are yet available in connection with the acreage of brown-top entered in the 1934–35 season. An increase was recorded in this figure for the 1933–34 season, but indications are that this total will not be exceeded in the present season.

Potatoes.—An alteration was made in connection with the classification of the produce of crops certified in the 1933–34 season. In addition to the group classification adopted in the previous season, two major classes were made—namely, certified mother seed and certified commercial seed.

Growers purchasing certified seed for sowing in the 1934–35 season were permitted to enter their crops only provided they obtained certified mother seed. Thus, while larger quantities of good certified seed were available, only areas sown with the very best of this seed could obtain re-entry into certification. This has in no way limited the number of entries received for the 1934–35 season. On the contrary, the number of entries received constitutes a fresh record, while the general standard of the crops entered would appear also to be very satisfactory.

Wheat.—Wheat acreages entered for certification in the 1934–35 season are rather lower than those returned for the previous season. Owing to adverse conditions, the general standard of crops also appears to be lower. A feature of this year's returns is the entry of a considerable acreage of the new variety "Cross 7."

Italian Rye-grass.—A number of areas of Italian rye-grass sown with approved lines of imported seed were accepted for certification in the 1934–35 season.

General.—Practically no entries of swedes and turnips were received for certification in the 1934–35 season. Two small areas of rape-seed were entered. These areas had been sown with seed from plants selected by this Section.

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

Seed.	Acres inspected each Season.							
	1927–28.	1928–29.	1929–30.	1930–31.	1931–32.	1932–33.	1933–34.	1934–35 (approximate).
Potatoes	821	909	1,200	1,334	1,146	1,154	1,322	1,927
Wheat	473	1,184	2,277	3,289	1,063	1,873	2,937	2,600
White clover	..	325	664	311	31	100	538	1,300
Perennial rye-grass	..	..	3,028	6,539	9,709	22,917	13,236	11,500
Brown-top	..	..	22,000	24,901	18,297	14,860	17,150	Not available.
Cocksfoot	..	..	..	..	4,226	5,097	5,485	6,500
Montgomery red clover	..	..	..	..	9	71	168	350
Swedes and turnips	..	..	..	..	..	..	128	..
Italian rye-grass	..	..	..	..	..	..	..	300
Totals	1,294	2,418	29,169	36,374	34,481	46,072	40,964	..

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 past year has been one of intense activity, and the whole staff concerned has been working at very high pressure.

Field trials and farming experience have again emphasized the enormous value to New Zealand of "strain" in grasses and clovers as a factor to progress. Reports from the South Island from even the most arable districts are extremely encouraging, particularly from the point of view of the rye-grass strain used. New Zealand certified strains are being increasingly demanded. Plot trial, field trial, and farm-scale experience is also emphasizing the value of the New Zealand No. 1 white-clover type, and this fairly bids to rival certified perennial rye-grass in importance viewed from the point of view of strain.

A marked step forward in the year under review is the debut of herbage seeds of a pedigree standard, some 220 acres having been sown out specifically for pedigree seed-production purposes from seed originally bred at the Plant Research Station. Certain of this is grown on contract to the Department who will resell to interested merchants for seed-production purposes under certification. By the resale of this contract-grown seed it is hoped to make revenue-producing the raising of nucleus pedigree stock seed and thus enable the Station work to be placed on a sound and businesslike basis in regard to equipment and labour. At the present time the grassland work is conducted part on the Plant Research Station area, part on Massey College property, and part on city-lease property, and it is highly problematical whether this arrangement will stand for an indefinite period, apart altogether from the inconvenience of working. Some small blocks apart, however, are necessary for isolation purposes when dealing with species like perennial and Italian rye-grass or strains of these that freely hybridize when grown in contiguous blocks.

The present labour requirement is met by unemployed labour, and this is for the most part of a most unsatisfactory nature. The measurement work in relation to production from species and strains, alone and in mixtures, and a grazing trial to study reaction of species and strains to different systems of grazing have been continued at Marton, but the distance away is a factor in seeing these trials sufficiently often to get the best results from a research worker's point of view. A plea for the consolidation of this work at Palmerston North is again made.

The activities of the Station have been extended during the year in co-ordination with the Dairy Research Institute in the matter of our inquiry into the problem of feed flavours in cream and butter. Grassland research has a twofold scope—(1) The production of quantity and quality of herbage; and (2) the effects of such herbage as feed for animals and effect on animal products. Pedigree pastures demand a quantitative and qualitative measure, and the only satisfactory way of getting that measure is by means of the animal itself. The collaboratory work with the Dairy Research Institute on the influence of feeds, fed pure and in mixtures, in particular reference to feed flavours in butter, is a welcome commencement of this work. Plant chemistry is an integral part of such an investigation, and the close co-operation of the Plant Research Chemist (Mr. Doak) is being fully utilized. The Chemistry Section is of very great value to agrostology, both in research and as a routine aid to type determination for certification purposes, particularly in so far as white clover is concerned.

The following are the main activities of the Agrostological Section during the year :—

GRASSES.

Perennial Rye-grass.

Certification and other Plot Trials.—The following are the number of plots sown at the times indicated : Autumn, 1934, 1,581 plots; spring, 1935, 357 plots; autumn, 1935, 855 plots.

The majority of these plots are sown in connection with certification. Most of the first two lots have been finally reported on. The dry weather experienced during the past summer has emphasized and defined very clearly the relative qualities of various types of rye-grass. The following points have been most marked : (*a*) The superior rust resistance of the certified type over old pasture lines from Canterbury, Southland, Marlborough, and some from Wairarapa. (*b*) In a block of spring-sown plots the whole area was badly infested by fat-hen. In the late summer when this had died out the New Zealand certified type was conspicuous by its good dense and even sward. British indigenous types showed a very marked thinning-out of the sward, due to slow establishment and consequent smother. (*c*) In the main, Scottish, Irish, British indigenous, and Australian lines have proved themselves to be definitely poorer than the New Zealand certified type.

Elite Strain Work.—The block of ¾ acre of selected pedigree rye-grass was harvested for seed and yielded 762 lb. of roughly dressed seed. The major portion of this seed has been sown out locally on 20 acres for increase growing under contract. The above yield will show how rapidly valuable stocks of seed may be increased. In 1934 300 grammes were harvested; a portion of this (about 100 grm.) was sown out in a nursery bed. Later some 33,000 plants were transplanted from this bed to the increase area of ¾ acre, from which 762 lb. of seed were harvested. Owing to the very hot weather experienced during flowering time, this year's selection within the glasshouse set only a very small amount of seed. This has been sown out in boxes for later planting-out.

Relative Yield of Pedigree Mother Seed Rye-grass, Ordinary Certified Rye-grass, and British Indigenous Rye-grass.

The following green weights were taken on each of 100 plants of the following on the 18th April, 1935:—

	Weight.	Relative.	Difference from Mother Seed.
	Oz.		
Certified mother seed	591	100	..
Selection	1,175	199	+99
British indigenous	303	51	−49

Low Germination of Rye-grass.—In an experiment designed to test the value of treating seed with hot water with the object of deciding whether or not any influence is made on the resulting seed crop, no conclusive results were obtained. From other evidence it would appear that hot-water treatment has no beneficial effect.

A further experiment has been laid down at Winton and duplicated at Palmerston North. In this the problem is viewed from the strain point of view. A large number of as many strains as possible have been sown out. These will be harvested and germination figures determined. In this manner it is hoped to locate definitely which strains produce high germinating seed and which produce low. From this stage it is hoped to work up a strain which in type is up to certification standard and which will germinate well when seed crops are grown in a normally wet climate.

Single-plant Study.—Four thousand single plants (forty lines) of low ultra-violet testing South Island perennial rye-grass have been put out for selection and study. Routine work in connection with planting out of tiller rows has been continued.

Cocksfoot.

Certification and other Trials.—The following number of plots have been sown: Spring, 1934, 72; autumn, 1935, 136. There is nothing further to report in connection with the above, as this testing has developed into simple routine. The only fact worthy of notice is that New Zealand cocksfoot as a whole is dominantly of the certified type. No Danish cocksfoot is showing in the many lines tested. New Zealand cocksfoot from the type point of view is in a very satisfactory position.

Single-plant Study.—Twelve hundred plants of Akaroa and Plains cocksfoot have been planted out for study. Up to the present no differences have been noted between Akaroa and Plains, but a marked non-uniformity of plant type in both Akaroa and Plains is noted.

Thirty tiller rows of various types of cocksfoot have been planted out for study of their behaviour under grazing.

Brown-top.

As with cocksfoot the strain position of brown-top is very satisfactory, there being extremely few samples containing red-top.

Sowings made are as follows: Spring, 156 plots; autumn, 170 plots. The most satisfactory sowing for brown-top strain trials is in rows sown in the early autumn.

Italian Rye-grass.

The following plots have been sown: Spring, 155; autumn, 112. The testing of Italian rye-grass is most satisfactory if two sowings are made. The autumn sowing distinguishes the Italian and Western Wolths from perennial of poor type and the spring sowing distinguishes Italian from Western Wolths. On the whole the New Zealand Italian rye-grass is poor, and the Department has this season inaugurated a certification scheme for Italian, the certified lines being of Irish and French origin. A number of lines of imported Italian are being tested as single plants with a view to selection.

Elite Strain Work.—See genetical report.

CLOVERS.

White Clover.

Certification Trials.—A total of 1,179 plots have been sown. Spring sowings consisted of 845 plots, and the remaining 334 have been sown in the autumn. Notes have been taken and a herbage test has been made by the Chemist on each of the spring-sown lines. All the 978 lines sown the previous year have been finally reported on.

Single Plants.—The original block of tiller rows has been retained. Complete records of these have been kept, and in the spring the ten best plants were selected for making a glasshouse selection and a total of twenty promising plants were selected and subjected to breeding tests by controlled crossings and selfings.

The 6,200 single plants from open pollination of selected plants and planted out in 1933 have been reduced to fifty plants. Another 700 plants from controlled crossings planted out at the same time have been reduced to twenty plants. These seventy plants, together with thirty plants from the original tiller-row block, have been planted in a new tiller-row block on the Council area.

A study of the 5,500 plants from the 1933–34 controlled crossings has been very interesting. These have shown extensive differences in uniformity and production of the F1 families, some being very good and others very poor. Type 1 plants crossed with Dutch plants show Dutch characters and weaknesses as being dominant over the desirable characters of Type 1. These F1 families demonstrate clearly the need for breeding-tests as an aid to plant selection and improvement as well as the need for a certain amount of care in preventing hybridization of good types with poor types when a pedigree seed line is being increase-grown or contract-grown for seed-production.

Other single plants studied include plants for a comparison of first-harvest progeny and plants from the original lines. The progeny from a certified mother-seed line showed very small variation in type from the original line, but that once grown from a Kentish line had become contaminated with 12 per cent. of the "ordinary" New Zealand type.

Elite Strains.—The 5-acre block drilled in at the Pure Seed Station at Lincoln has produced a good crop of seed, which has been distributed to purchasers.

The ¾-acre increase block of plants from the 1933–34 glasshouse selection yielded 244 lb. of dressed seed. Contracts have been let for increase growing 38 acres of clover sown with this seed. Some of the surplus seed has been sold as Government pedigree stock seed, and some has been used in field experiments recently laid down.

An increase block of plants from the 1934–35 glasshouse selection is being planted out to provide nucleus pedigree stocks for 1936.

Red Clover.

Certification Trials.—One hundred and fourteen plots were sown in the spring, but as most of these failed to establish on account of the dry summer season eighty-three lots have been resown this autumn. This failure in establishment has delayed the issue of reports. All the previous year's lines have been finally reported on.

Single Plants.—Notes were made on the 1,100 single plants out of mother-seed lines and their "once grown" progeny. So far the "once grown" lines show little deterioration of type or contamination with other types.

All the single plants, including those just mentioned, were trimmed back before coming into full flower. Heavy mortality of plants during the extremely dry summer period followed this cutting back.

The blocks of plants from controlled crossings have shown remarkable uniformity of type and growth. Twenty of the best of these plants were seeded in the glasshouse this year, but only a small quantity of seed has been obtained.

Forty-eight plants were selected from the 1,100 plants from Station-grown lines and subjected to breeding tests.

Elite Strain.—Plants from the 1933–34 glasshouse selection were planted out in a ½-acre increase-block and seeded this summer. This yielded 140 lb. of "nucleus pedigree stock seed." Fourteen acres have been sown with this seed on contract to the Department.

Subterranean Clover.

Thirty-four samples have been received for testing. These are being grown in rows, and single plants of thirty lots are being put out also for a study of strain differences.

Lotus Major.

The fifty-four single plants selected from the original block of 1,600 plants have been established in a tiller-row trial. In the spring eleven plants were selected from these rows for testing under selfing and crossing as a preliminary to building up a pedigree line.

Odd Species.

Samples of species of lespedeza have been received for trial. These included Korean lespedeza, Harbin lespedeza, and Lespedeza sericea. The first-mentioned is the only one that made much growth, but this was coarse and woody and could not compare with a plant like lucerne.

PLANT BREEDING.

Perennial Rye-grass.

The perennial rye-grass material used in this season's plant-breeding work comprises—(1) The six nucleus plants used as the parents of this year's glasshouse selection. They have been selfed and crossed with two plants (type 1 and type 3) of which we have some information as to segregation of important characters. (2) Twelve L1 plants from the most promising L1 generation available have been selfed and chain-crossed. (3) Twelve F1 plants from the best cross produced in the 1932–33 season have also been selfed and chain-crossed. (4) Sixteen selected plants from a high winter-producing line have been selfed and crossed in pairs.

Most of the selfing and crossing was carried out in the glasshouse, where cellophane bags were used as the isolating material. However, to provide information on the value of isolating in the glasshouse as against bagging in the open, sixteen plants were also selfed and crossed in the field by using parchment sleeves over wire frames. Although the parchment sleeves were not adversely affected by weather conditions it appears that most reliable results can be obtained from working in the glasshouse, and it is therefore proposed next season to carry out as much of the work as possible under glasshouse conditions.

The seed-setting from both selfings and crosses has been good, and 6,800 seedlings are now planted out as spaced plants in boxes.

Italian Rye-grass.

The Italian rye-grass material used this season has been selected from the two most uniform and outstanding lines available at the Station.

Sixty-six plants have been selfed and crossed in pairs. Owing mainly to adverse conditions the seed-setting was not as high as might be expected, but, nevertheless, sufficient seed was obtained to provide one hundred seedlings from most of the crosses. In all, 5,000 seedlings are at present planted out as spaced plants in boxes.

White Clover.

The white-clover crosses have been made by pairing plants in the presence of bees in cages placed in the open. Humble bees have been found to be very suitable for this purpose, and practically all of the plants have set ample seed.

The most promising white-clover plant available at the Station has been used for pairing with thirty-six other plants with the object of obtaining good combinations of character as well as for testing the material available. Nine miscellaneous crosses have also been made by pairing good plants.

Eleven F1 plants have been selected from an outstanding F1 generation and chain-crossed, while four F1 plants from another cross have been back-crossed to both parents.

Three typical plants of the Kentish type have been crossed with the type plant which has been most used in breeding-work and about which we have most information. The three Kentish plants have also been group-pollinated to test their breeding behaviour as regards type.

To provide some information on the variability in type of three quite distinct sub-types occurring within type 1, three to five plants of each of these three sub-types have been isolated together.

In addition to the crossing-work undertaken, five plants have been self-pollinated by isolating with bees in cages. The self fertility of these plants varied between 0 and 14·3 seeds per head.

From the white-clover crosses a total of 3,700 seedlings are at present pricked out in boxes.

Montgomery Red Clover.

As with the white clover, the Montgomery red clover has been crossed in cages in the open. Forty-six selected original plants have been crossed in pairs, and also twenty plants from the three most promising F1 families. The seed-setting has been quite satisfactory, and 2,000 seedlings have been planted out in boxes.

Lotus Major.

The same method of crossing as with the clovers has been used for *Lotus major*, but the seed-setting has been rather variable. Eleven selected plants have been selfed and chain-crossed, and 1,300 seedlings are available.

GREEN-KEEPING RESEARCH.

Selections of promising lawn-grass species have been made. The selections, *Agrostis canina*, are now planted out as single plants. Seed has been harvested from these and a further area has been planted out.

The manurial trials have been continued. The differences due to manuring are extremely wide, and more work on this subject is required.

Soil acidity, pH determinations, on differentially manured plots are being made. Increase of soil acidity and reductions in same can be brought about by application of different fertilizers. Good turf can be produced on soils which vary greatly in intensity of acidity.

Experiments in turf establishment by the stolon method have been commenced with fair results.

A trial in returfing of a green proved that the method is satisfactory in all respects.

Furtherwork in control of various pests has been undertaken. The control of grass-grub, *Porina* caterpillar, earthworms, weeds, and fungus diseases of turf has been continued. Results to date are satisfactory, and in most instances confirm previous findings.

The second annual report on green-keeping research was written and published during the year under review. Lectures and demonstrations to green-keepers were given at their conference.

FIELD TRIALS.

A comprehensive series of strain trials was made up for demonstration purposes by the Instructional Service of the Fields Division. Sixty-three such trials have been made up and sent out during the year.

In addition, small-scale trials consisting of twenty lines have been sent out to 112 schools. These are accompanied by detailed instructions regarding how to sow, what to look for, and how to record any observed difference. A charge of 2s. 6d. per set is made.

GENERAL ECOLOGICAL WORK.

Point analyses and seasonal notes on the composition of pasture trials at Marton have been made. Also analyses of cut herbage on a percentage-weight basis have been made with a view to determining the actual seasonal contribution of each species or strain sown in the mixtures. Pasture inspections and analyses in connection with pasture-development work with the Dairy Research Institute and Massey Agricultural College have been done in the laying-down of pastures, seed mixture trials, &c.

FEED FLAVOUR IN BUTTER INVESTIGATION WORK.

This has been conducted under the direction of Professor Riddet, Dairy Research Institute, in collaboration with the Morrinsville Dairy Co. (Mr. Stirling), the Fields Division, and the Dairy Division of the Department of Agriculture. Forty farms were inspected and botanically analysed, and these were placed roughly into four main groups. The night and morning cream from these forty farms was graded on a 0–10 basis from a feed-intensity flavour point of view, and results were then correlated up with botanical composition of the farms.

The following points have been demonstrated: (1) Evening cream shows a feed intensity 3·6 times greater than the morning cream; (2) the grass-dominant farms tend to be mild in feed flavours, and no feed flavours at all are in evidence where non-luscious grassiness predominates; (3) clover dominant farms may give a high feed-flavour intensity, and this may be given by white clover, red clover, suckling clover, or lucerne; (4) young luscious growing herbage gives a greater intensity of feediness than older and more matured herbage of the same species; (5) weeds are not responsible for the general "tang" under investigation, but specific weeds may give rise to specific flavours.

The investigation to date points to modification of pasture management as a means of lessening feediness.

Fundamental work to arrive at the actual causative factor of feediness has been instituted in collaboration with the Dairy Research Institute at Palmerston North. The following areas have been sown out for grazing purposes and for stall-feeding in measured amounts, pure and in mixtures: (1) Perennial rye-grass, (2) Italian rye-grass, (3) cocksfoot, (4) white clover, (5) Montgomery red clover, (6) broad red clover, (7) suckling clover, (8) subterranean clover. These will be available for trial during the next spring.

DEMONSTRATIONS, LECTURES, AND CORRESPONDENCE.

Visits of the public to the Plant Research Station have been frequent, and this absorbs a good deal of time. It is, however, usually good time well spent. Lectures to outside organizations were given during the year.

LAND AND EQUIPMENT.

The 7 acres of city lease secured last year is now fully occupied, and a further 4 acres is under consideration for lease from the City Council. One acre has also been secured for isolation purposes from the Massey Agricultural College. The question of isolation areas would appear to become more acute as the work develops. It would appear almost essential that strain-testing and strain-building should be conducted further apart than we are now able to do, owing to expansion by the Mycological Section on the original Plant Research Station area. An interchange of land would largely overcome the present difficulty, but, owing to the self-contained policy of the Mycological Branch, this is difficult to arrange. No fundamental grassland research work other than strain-testing and strain-building is possible on the Palmerston North area at present.

Approval has been secured to purchase power engine, seed-cleaner, and clover-huller, and these will be of great assistance to the work. The pedigree crops harvested this year were threshed partly by the aid of a tractor kindly loaned by the Massey Agricultural College and partly by the Ford car on issue to the Agronomist. Seed-cleaning was done by a station constructed Heath-Robinson winnower. Hulling of the clovers was kindly done by Mr. Callesen, farmer, at Karere. The plots were mown by the City Council mower. A light tractor of the Gravelly type, equipped with a mower attachment, is required for the use of the Station generally.

LABOUR.

The Station is run essentially with unemployed labour, twenty-seven men being so employed. This class of labour is highly unsatisfactory for much of the farm work of the Station, and it should gradually be replaced by more skilled and permanent labour. An application for one additional permanent labourer has been made.

PLANT BREEDER.

During the year, Massey Agricultural College has kindly loaned a post-graduate scholarship-holder (Mr. Corkill) for plant-breeding work on the Station, and it has now been decided to engage this worker on a temporary basis. He should be appointed to the permanent staff at an early date.

TECHNICAL ASSISTANT.

Mr. Corkill is now handling some 25,000 seedlings in connection with the present breeding-scheme as outlined, in association with Dr. Frankel, Advisory Geneticist to the Station, and some assistance will be necessary in note-taking, labelling, and recording this mass of material. An application for a technical assistant has been made.

STAFF: GENERAL.

It has been very gratifying that all officers connected with this work have performed an arduous year's work in a most exemplary manner. There has been marked co-ordination of effort and an enormous amount of work has been accomplished. The Overseer, Mr. Todd, has given the field Station work every attention, and has handled the difficult labour offering in a very creditable manner.

MYCOLOGY SECTION.

G. H. Cunningham, Mycologist.

Work for the year has covered the following diseases:—

I. BRASSICA DISEASES.

Dry-rot (*Phoma lingam*).

An investigation of the host range of this disease has been completed and the results published. It is concluded that infection of swede crops from weed or cultivated crops is rare except when following an infected swede crop. The variety of swede, Wilhelmsburger Otofte, has been substituted for Herning on the commercial seed-growing area at Colyton. It has proved under New Zealand conditions to be a better cropper and more resistant to club-root. The seed crop was exceptionally good, over 6,000 lb. of first-class seed being harvested from 2½ acres. Unfortunately, an inspection before harvest disclosed the presence of five plants infected with *Phoma lingam*, so that the seed cannot be certified as disease-free.

Stock seed has been produced for next season's seed crop from bulbs selected on club-root-infected land.

Club-root (*Plasmodiophora brassicae*).

It has been found that the control of this disease by means of applications of lime is dependent on the type of soil. Dressings with lime which give satisfactory results on some soils are quite useless in others, thus accounting for the contradictory field results obtained in the past. An investigation is in progress to find the conditioning factors.

It has also been found that selected strains of rape, turnip, and swede that resist the disease in one locality may fail to do so in others. This has greatly complicated the work of selection, breeding, and testing of club-root-resistant lines.

Turnip Mosaic.

This has proved to be a virus disease transmissible from plant to plant by *Brevicoryne brassicae* and *Myzus persicae*, the aphides commonly found on brassicas. It has been shown to spread rapidly in the field, and, in preliminary trials with rape, to cause 25 per cent. reduction in yield. It has been found to have no connection with "mottled-heart" condition in swedes.

II. CEREAL DISEASES.

Rusts.

An investigation is in progress, in collaboration with Dr. Stakman of the University of Minnesota, and Dr. Waterhouse of the University of Sydney, into the biotypes of the rust fungi of cereals and grasses present in New Zealand. This is a necessary preliminary into the work of producing rust-resistant varieties.

Ear-rot of Maize (*Fusarium moniliforme*).

Experiments have shown that seed infected with this disease may be disinfected by dipping for ten minutes in water held at 137° F., that this treatment reduces the amount of seedling mortality caused by the disease, but that there is no connection between seed infection and the incidence of the disease in the ears, the latter being due to air-borne infection.

III. POTATO DISEASES.

Corticium Disease.

It has been demonstrated that four years in grass is sufficient to eliminate corticium disease from the soil.

Verticillium Wilt.

It has been found that there is no correlation between the presence of stem-end discoloration and verticillium infection in potato tubers.

IV. DISEASES OF PEAS, BEANS, LUPINS, Etc.

Virus Diseases.

It has been shown that sore-shin disease of blue lupins is caused by the virus of pea-mosaic, and that it is transmitted by *Aphis rumicis*. Experiments indicate that it is not seed-borne.

The host range of pea-mosaic (previously known to attack peas, broad beans, and red clover) has been extended to include blue lupins, sweet peas, alsike, and subterranean clover. The disease has a very marked effect on time of maturity and yield of garden peas. Two varieties have been found that, up to the present, are immune to the disease.

A mechanically transmissible mosaic disease has, for the first time, been demonstrated to occur in French beans. Preliminary experiments indicate that it may be transmissible by aphides.

Bacterial-wilt of Beans.

A field experiment has demonstrated the possibility of cleaning up a lightly infected line of French beans by early and persistent rogueing of infected plants.

V. MANGEL DISEASES.

Field experiments with various organic-mercury dust treatments for mangel-seed yielded no results. No disease developed in the plants from either the treated or the untreated seed.

VI. FRUIT DISEASES.

Mouldy-core of Delicious Apples.

Investigations are in progress to determine the fungi responsible for the rot associated with this condition and the factors responsible for its occurrence.

Damping-off of Tomato Seedlings.

This trouble has been shown to be due to either of two fungi, *Corticium vagum* or *Phytophthora* spp. The best control was obtained by soil disinfection with steam or with Formalin.

Leaf-mould of Tomatoes.

It was shown that the best measure of control of this disease was obtained with lime-sulphur, sulphur dust, and Shirlan Ag.

Virus Disease of Tomatoes.

It has been shown that the virus disease of tomatoes in the Hutt Valley formerly called "black stripe" is in reality a "spotted wilt," and that it is prevalent also in other parts of the Dominion.

Strawberry Virus Disease.

This has been shown to occur in the nurseries which supply the plants for Auckland commercial growers. Transmission of the disease has been obtained up to 100 per cent. by means of the strawberry aphis.

Woodiness of Passion-fruit.

This is under investigation to determine the cause.

VII. TOBACCO DISEASES.

Tobacco Mosaic.

This virus disease has been shown to be spread mainly by human agency during the operation of pinching the laterals. It may also be carried in a very small percentage of the seed from infected plants and in the seed of tomatoes and the weed *Solanum nigrum*. All attempts at insect transmission have failed.

VIII. DISEASES OF ORNAMENTALS.

A disease of roses, apparently due to a virus, and the rust diseases of pelargoniums, chrysanthemums, hollyhocks, and anemonies, have been the subject of experiments with a view to finding means of control.

IX. MOULD FUNGI OF FOODSTUFFS.

Investigations into the fungi responsible for mould deterioration in meat, butter, cheese, bacon, &c., have been carried out both in Great Britain and in conjunction with the Dairy Research Institute at Palmerston North. Much knowledge has been gained on the conditions which determine mould attack, especially on chilled meat and on butter-boxes, thus enabling effective measures to be taken for its prevention.

X. MISCELLANEOUS.

Silage-making.

Experiments on the biological nature of the processes involved in the making of silage have shown that great improvements in quality may be made by the addition of bacterial culture, acid, whey, and molasses. Of these, whey and molasses have proved the most suitable in farm practice, and enable good silage to be made from otherwise unsuitable material.

Legume Cultures.

Cultures for the inoculation of over 95,000 lb. of lucerne-seed have been forwarded to growers—a slight increase over last season. Experiments are in progress in conjunction with the Fields Division on the inoculation of clovers, peas, and blue-lupin seed with the appropriate organisms—on the whole, with very encouraging results.

Pyrethrum.

An investigation is in progress with several strains of Dalmatian Pyrethrum (*Chrysanthemum cinerariaefolium*) to determine that showing the best extract for insecticidal purposes.

Steam Sterilization of Soil.

Experiments are in progress on the physical basis for the more exact determination and measurement of various processes for the steam sterilization of soils.

ENTOMOLOGY SECTION.

J. Muggeridge, Entomologist.

The very favourable, warm, and dry climatic conditions over the past season were conducive to the development of insect pests. Consequently, the amount of correspondence regarding their identification and methods of control was considerably more than that of previous years. Insects affecting potato crops were responsible for a considerable amount of loss to the potato-growers in various parts of the Dominion. Insects affecting live-stock and storage products were also more abundant than usual.

PIERIS RAPÆ (WHITE BUTTERFLY) AND ITS PARASITES.

In my last annual report two species of parasites were referred to—namely, *Apanteles glomeratus*, a larval parasite, and *Pteromalus puparum*, a pupal parasite. *A. glomeratus* attacks its host in the first larval stage. Subsequently, when the larva becomes full-grown, the parasites emerge from it, and spin small yellow silken cocoons from which they later emerge as winged adults. About 270,000 of these insects were sent into the field, but up to the present there is no evidence of their proving anything in the nature of a check to the progress of the butterfly. On the contrary, field investigations have proved the presence of hyperparasites which appear to be severely checking the progress of *A. glomeratus*. Further field work to ascertain the relationship between parasite and hyperparasite will be carried out. (Dr. Ferriere has identified the hyperparasite as an *Eupteromalus* sp. closely allied to *E. nidulans* Forst., which is very common in Europe, but apparently different from it.)

Pteromalus puparum, the pupal parasite already referred to, attacks its host just prior to pupation and in the pupal stage. The initial and outstanding success attending the liberations of this insect led the Department to concentrate on rearing large numbers of the species for liberation in the field during the summer months; consequently, during the latter part of last autumn and during the winter months large field collections of the pupal stage of the butterfly were made. Approximately 80,000 chrysalids were collected, but owing to disease and other causes only 45,000 of these were successfully parasitized. A considerable amount of experimentation to evolve suitable methods and technique for parasitizing such large quantities of material was at first necessary. The technique evolved proved highly successful, and the number of pupæ parasitized was limited only by the cool-storage space available. Of the 45,000 parasitized chrysalids held in cold storage approximately 4,000 died from disease, and from the 41,000 healthy chrysalids remaining approximately 877,000 adult parasites were reared and distributed in the field throughout the North Island and in parts of the South Island.

Field surveys indicate that the parasite is spreading and multiplying very rapidly, as up to 90 per cent. of the chrysalids collected were found to be parasitized. In Hawke's Bay, where the first liberations of *P. puparum* were made and where the butterfly had bred up in such numbers as to render the growing of cruciferous crops extremely uncertain, it is very pleasing to be able to report that during the past season the butterfly was reduced to insignificant proportions. The results of the work are proving so successful that it is anticipated that within the next two years the butterfly will be under efficient control throughout New Zealand.

CHEMICAL CONTROL BY MEANS OF SPRAYS AND DUSTS.

Experiments were conducted to ascertain the relative efficiencies of the sprays and dusts available for white-butterfly control on cabbages. The materials used were arsenate of lead, calcium arsenate, barium fluosilicate, derris preparations, pyrethrum preparations, common salt, summer oils, and nicotine sulphate. Results show that derris sprays and dusts, more particularly the dusts, are comparable in efficiency with arsenate of lead.

The feature of the derris preparations is that they are non-poisonous to humans if used as directed. Certain of the pyrethrum preparations—viz., kerosene extracts of South African pyrethrum flowers—atomized on to the cabbages gave good control. This material is also non-poisonous to humans.

The results of this investigation are being prepared for publication and will shortly appear.

TRIALEURODES VAPORARIORUM (GREENHOUSE WHITE FLY).

Small quantities of white-fly parasites (*Encarsia formosa*) were sent to glasshouse-owners during the past season. Supplies were also sent to the Australian Entomological Station at Canberra. *E. formosa* has proved a more successful parasite than was at first anticipated. It successfully over-wintered in Hawke's Bay, and during the last summer it spread north and could be found in glasshouses and in the field around about Hastings. It is remarkable, too, that the white fly was far less prevalent in glasshouses in Hawke's Bay than previously. This is explained by the presence of the parasite.

PLUTELLA MACULIPENNIS (DIAMOND-BACK MOTH).

During the past season the diamond-back moth was very much in evidence, and was responsible for very serious losses of farmers' cruciferous crops. Nothing can be done until money is available for the conducting of research into its control by natural means.

BOTANY SECTION.

H. H. Allan, Systematic Botanist.

I. ROUTINE.

Identification of Specimens and Advice thereon.

As in previous years, this work has taken up a considerable portion of the time. Over 3,000 specimens have been reported on from the usual sources. A number of new records of naturalized plants have been made, but fortunately none have been of major importance as weeds. There has, however, been evidence that a number of serious weeds are steadily increasing their areas—*e.g.*, *Psoralea pinnata*, *Eupatorium glandulosum*, and *Carthamus lanatus* (saffron thistle). Since Mr. Zotov's return to duty he has been able to render valuable assistance in this work. It is pleasing again to note the interest taken by Stock Inspectors and Instructors in Agriculture in the weeds of their districts.

Herbarium.

The policy of exchange with other institutions has been continued, and much valuable material accumulated. Additions have been made to all the sections, especially to that of introduced plants. Unfortunately space is so limited that the herbarium is badly congested, and working-conditions for my assistants are far from adequate.

Library.

The chief point to record is that the remaining volumes (some 150) of the library of the late Dr. L. Cockayne, so generously given to the Station, are now in our possession. There remain a considerable number of important pamphlets still to be received from the Dominion Museum. I suggest that permission be given me to arrange with the Director of the Museum that such pamphlets as are not actually required for the Station remain under his charge. It is extremely unfortunate that space is so limited that it is impossible to arrange the library so as to be conveniently available to workers. The time is long overdue when the Station should have a properly fitted-up room devoted to library use alone, under a capable assistant.

II. FIELD WORK.

During the year a number of excursions have been made as opportunity allowed, both by myself and Mr. Zotov. The work has been mainly devoted to study of indigenous grassland areas and ecological study on introduced plants. The most important piece of field work accomplished was a botanical survey of certain areas in the Mackenzie Country, where an outbreak of dermatitis had occurred in sheep. A full report was furnished to the Director, with a list of species found, and recommendation for further investigations on the trouble.

III. PUBLICATIONS.

The introductory book on the grasses of New Zealand has been completed and is shortly to go to the printer, while the more detailed studies in the taxonomy of indigenous grasses has been proceeded with. The work on certain genera has reached the stage when publication of the results is possible. Papers of systematic and ecological import have been published or accepted for publication by the Royal Society of New Zealand, the Australian and New Zealand Society for the Advancement of Science, and the National Society of Horticulture of France.

IV. TAXONOMICAL INVESTIGATIONS.

As indicated above, the systematic work on grasses and introduced plants has been carried on as in previous years. A good deal of work has also been accomplished on indigenous plants, and a number of other workers in this field have received assistance in their studies. Mr. Zotov has commenced a systematic study of *Pinus radiata* with a view to elucidating the status of the forms found in New Zealand, and has also commenced a study of pollen. In this work he has been assisted by Mr. Reed, who has also rendered valuable assistance in the routine work.

V. INTERNATIONAL LUCERNE TEST.

This was referred to in my last annual report, and a report is in preparation on the results of the first year's work. It is too early to draw any definite conclusions at present, but the work will be continued during the coming year. Mr. Woodhead has made detailed botanical observations on the strains under test.

VI. FRUIT RESEARCH.

As in previous years, Mr. Woodhead has devoted his main efforts to this work in a very capable manner. Assistance has also been given on the botanical side to the studies being made on "corky pit" and "mouldy core" in apples. Mr. Woodhead's report is attached.

STOCK AND SCION INVESTIGATIONS.

Mr. C. E. Woodhead supplies the following subreport:—

Stock Trials.

Apple Stocks.—In order to ascertain the suitability of the East Malling apple stocks for New Zealand conditions, and to compare their performance with that of the Northern Spy stock, trials have been commenced at the Plant Research Station and in five of the chief fruitgrowing districts of the Dominion. Particulars of these are tabulated below:—

District.	Scion Variety.	Stock.	Number of Trees in Experiment.
Auckland	Delicious ..	Northern Spy, East Malling, Nos. I, XII, XIII, XV, XVI ..	20
Hastings	Cox's Orange ..	Northern Spy, East Malling, Nos. I, XII, XV, XVI ..	12
Hastings	Jonathan ..	East Malling, Nos. I, XII, XIII, XV, XVI	22
Plant Research Station	Cox's Orange ..	Northern Spy, East Malling, Nos. I, XV, XVI	32
Plant Research Station	Jonathan ..	Northern Spy, East Malling, Nos. I, XV, XVI	12
Plant Research Station	Sturmer ..	Northern Spy, East Malling, Nos. I, XV, XVI	32
Motueka	Sturmer ..	Northern Spy, East Malling, Nos. I, XII, XIII, XV, XVI ..	13
Dunedin	Delicious ..	Northern Spy, East Malling, Nos. I, XII, XIII, XV, XVI ..	20
Alexandra	Statesman ..	Northern Spy, East Malling, Nos. I, XIII, XV, XVI ..	28

All the trees concerned in these trials were grown in the nursery of the Plant Research Station and were planted out as "year-olds" in the winter of 1934. Records are being kept of the growth, &c., of each tree.

With a view to adding to the number of stock trials already laid down, approximately 600 apple-stocks, comprising Northern Spy and five East Malling types, have this summer been budded to Cox's Orange, Delicious, and Jonathan.

Plum Stocks.—A total of 150 plum-stocks, representing the five types received from East Malling, have been budded to Monarch, Grand Duke, Kirke's, and Yellow Magnum Bonum varieties.

Northern Spy Stock: Root-cuttings v. Layers.

In previous reports reference has been made to the influence of different methods of propagation on the vigour and root-type of stocks of this variety. To discover whether this influence will be reflected in the scion when worked thereon a number of stocks raised from root-cuttings and by layering have been "budded" to Jonathan, the budwood being obtained from a single tree. These trees will be planted out in due course in a trial plot.

"Strains" of Apple and Stone-fruit Varieties.

The investigation of strains of apple varieties has been extended this year to include Cox's Orange and Sturmer in addition to the Delicious variety, upon which a start was made last year. Orchard Instructors in each district were requested to secure budwood of any strains of these three varieties that had come under their notice, and, as a result, much material has been received. This has all been worked on a single stock type—viz., No. IX—to ensure uniformity and early bearing. As soon as fruit becomes available for comparison a selection will be made of the most desirable strains. In view of the probability in the near future of extensive reworking of apple orchards, this work is of the utmost importance.

With regard to stone-fruit, two apricot and three peach varieties are under observation in the Plant Research Station orchard. It will be some time before a study of the fruit of the several strains becomes possible, as the trees are only in their first and second year's growth.

Propagation of Stocks.

Special Stocks.—The work of building up "clone" races of apple-stocks which have produced trees of outstanding merit in commercial orchards is proceeding. "Stools" have been established, and the number of these is continually being added to as further material is secured by propagation. In due course uniform material vegetatively reproduced from selected seedling stocks will be available for distribution.

East Malling Stocks.—The "stool beds" of the East Malling apple, pear, cherry, and plum stocks established some years ago are producing an increasing number of layers each season, and a surplus is now available each winter after the Station's requirements for experimental purposes have been met.

Filberts.

A further supply of trees of the species *Corylus maxima*, propagated from those originally received from Messrs. Cadburys, Ltd., was distributed for trial last winter. Trial plots have been established in five districts—viz., Auckland, Tauranga, Gisborne, Nelson—and a total of 114 trees has been planted.

SEED-TESTING SECTION.

N. R. Foy, Seed Analyst.

TESTING SERVICES, Etc.

For the calendar year ending December, 1934, a total of 14,996 samples was tested at the Station, this number representing a decrease of 197 on the total for the previous year. This work necessitated the making of 8,104 purity analyses, 13,306 germination tests, and 1,361 ultra-violet light examinations. Of the total, 11,618 samples were submitted by the seed trade, 252 by farmers, 528 in respect of State seed-purchasing, and the balance (2,598) in respect of various departmental activities, certification, investigational work, &c.

Of the total of 1,361 ultra-violet light examinations made, 1,112 represented official samples, of which 1,036 were of certified seed. The balance of 242 samples was submitted by the seed trade for classification in respect of perenniality.

One thousand three hundred and forty-three samples representing machine-dressed lines of certified seed were examined for purity, and of these forty-three, or 3 per cent., were rejected as having failed to comply with the purity standards for certified seed.

For the financial year 1934–35 selections from quotations based on unit-value were made in respect of 753 lines, representing a total purchase of 221 tons of seed, and valued at approximately £19,778. The 528 check tests made on samples drawn from bulk deliveries showed, in general, a high degree of conformation of delivery to sample specification.

For the financial year ended March, 1935, the total revenue received for the various testing services amounted to £1,457 16s.

INVESTIGATIONAL.

The work on deterioration of seed during shipment has been completed, and the results and relative discussion have been published. A large number of copies of this paper have been forwarded on request to the United States of America and to England, the principal buying countries of Chewings fescue, the seed with which this investigation was mainly concerned. As a result of the findings and recommendations published, a full-sized commercial drying plant is being established at Invercargill for the conditioning of seed for export. The Department is co-operating in an advisory capacity, in which connection certain laboratory drying experiments have been undertaken.

Picric-acid test in strain diagnosis of white clover (seed samples): This study is practically concluded, and on the results obtained a very close correlation has been found to exist between the chemical test and classification by plot trial.

Red Clover—Photoperiodism: This study was commenced with a view to differentiating between early and late flowering red clover from seed, but on the results obtained it would appear that although some indication of strain difference can be gained the method is not entirely practicable. There are indications, however, that all lines of red clover contain varying proportions of two distinct types of plants, and it is considered likely that one of these represents a persistent high-yielding type. If this is shown to be true the method may have a practical application in the estimation of the agronomic value of red clover, both early and late flowering.

Correlation of Artificial and Soil-germination Tests of Perennial Rye-grass: Work completed and the results published. It is shown that the results of artificial tests are invariably higher than those obtained in soil under optimum conditions, and that there is no basis for the frequently stated opinion that soil has some peculiar property responsible for the growth of a larger proportion of seed than is indicated by an artificial test.

Dormancy in Newly-harvested Oats: From the results obtained from various special tests it has been found that maturity can be accelerated by chilling at 3° C. prior to the employment of the usual testing methods. This technique is now being adopted for all tests of newly-harvested oats, and it is therefore possible to advise merchants of the potential growth prior to purchase. This technique is also adopted for certain other seeds.

GENERAL.

Statistical material covering seed import and export, annual and seasonal average purity and germination percentages, has been prepared and distributed.

It is desired to again record appreciation of the co-operation of the Seed Testing Station staff during the year.

CHEMICAL SECTION.

B. W. Doak, Chemist.

MARTON MOWING TRIALS.

Analyses of herbage samples from these have been continued and a considerable amount of work has been carried out on soil samples from these trials. The study of the movement of phosphate from superphosphate, basic slag, and North African phosphates, each with and without lime applications, has been continued. The results so far are very interesting, but the work needs to be continued for several years to get reliable data.

Investigations into the movements of lime in the soil as affected by rates of application have shown that after two years less than one-fourth of a two-ton per acre dressing remains as calcium carbonate. The remainder has reacted with the soil and is present in an exchangeable form. During this period there has been some movement of this exchangeable lime down below 6 in. in the soil. The effect of two ground limestones, widely separated in chemical reactivity, is being studied, both samples being applied in three grades of fineness.

REVERSION OF SUPERPHOSPHATE BY CARBONATE OF LIME.

As a result of conflicting reports on the ability of a super-lime mixture to eliminate the bad effects of super alone on the germination of turnip-seed, an investigation into the ability of ground limestones to revert the water-soluble phosphate into water-insoluble phosphate, but still leaving the phosphate in a form available to plants, has been carried out. The presence of sufficient moisture is one of the main essentials to efficient reversion. In a dry condition very little reversion takes place in spite of several months in intimate mixture. In this case reversion cannot take place until the mixture is applied to the soil. If the soil is dry and the dry superphosphate-lime mixture is sown with turnip-seed, considerable germination injury may take place. If, however, water is added to the mixture prior to sowing, rapid reversion takes place, and if not too large amounts of water are added the mixture, after reversion, will be in a dry state suitable for drilling. Fineness of grinding of the lime considerably affects the rate of reversion, but differences inherent in the original limestone are responsible for the greatest differences. For example, Waikari and Cheviot ground limestones when used with superphosphate will correct the harmful effect of the superphosphate much more effectively than ground limestone from certain other districts, although the fineness of grinding and the total $CaCO_3$ may be practically the same.

HYDROCYANIC ACID (HCN) IN WHITE CLOVER.

Determinations of the potential hydrocyanic-acid (HCN) content of approximately 1,200 samples of white clover have been carried out. This work has been done mainly in connection with the certification of white clover. Investigation has shown that while the season to season variation in HCN content may be fairly large, the day to day variation and the variation at different times of the day is not very great. There is a slight tendency towards higher HCN content during the evening, but the results are not very conclusive.

DAIRY DIVISION.

REPORT OF W. M. SINGLETON, DIRECTOR.

The Season.

With the exception of the North Auckland and Bay of Plenty Districts weather conditions during the season have been very unfavourable from a dairying standpoint. A cold dry spring followed by almost drought conditions up to mid February militated against good pasture-growth, which resulted in a considerably lessened production of butterfat. Owing to warm soil conditions and good rains towards the end of February and onwards pastures have made a remarkable recovery, and grass is now plentiful. Root crops are below the average, but in most districts good hay and ensilage crops have been harvested, which should ensure dairy cattle coming into profit next season in fair condition.

Production.

Owing to the exceptionally dry weather conditions prevailing during the flush months of the season, the production of butter and cheese shows a considerable reduction. For the year ended 31st March, 1935, 132,415 tons of butter and 94,049 tons of cheese came forward for grading, compared with 142,287 tons butter and 105,088 tons cheese for the previous year, a decrease of 9,872 tons of butter (6·93 per cent.) and 11,039 tons cheese (10·5 per cent.). Reduced to a butterfat equivalent the decrease equals 12,473 tons, or 7·84 per cent.

Creamery Butter.

Creamery butter forwarded for grading during the year totalled 130,859 tons, of which 101,707 tons, or 77·72 per cent. were graded finest, 27,272 tons, or 20·84 per cent. first grade, and 1,880 tons, or 1·44 per cent., under first grade. Exports of the latter are now so disposed of that it is not expected to come into competition with the higher grades.

During the exceedingly hot weather experienced over the summer months, difficulty was experienced in supplying milk and cream of a consistently high grade, but despite these drawbacks the butter manufactured has been of consistently high quality, the average grade for the year being 93·141, as compared with 93·097 for the previous year. An increase in the daily delivery of cream has greatly assisted in enabling a good quality of butter to be made. During the season approximately 70 per cent. was delivered daily.

The condition of some of the butter packages in use has given cause for complaint on arrival in Britain, chiefly owing to the thinness of the timber allowing dust and sawdust to gain entrance and cause damage to the butter. The more general use of a substantial type of container is therefore highly desirable. Some of these light containers facilitated mould growth on the butter, and some loss was sustained.

Whey Butter.

The quantity of whey butter graded during the year was less by 235 tons than for the previous year, the totals being 1,576 and 1,811 tons respectively. The quality of this class of butter could be greatly improved by more efficient handling and treatment of the whey cream, and by churning at lesser intervals. Exports to Britain are disposed of through the same channels as second-grade creamery, and therefore do not compete with the higher-quality creamery butters.

Cheese.

Of the 94,049 tons of cheese graded during the year, 20,512, or 21·88 per cent., were classified as "finest," 70,605 tons, or 74·99 per cent., first grade, and 2,932 tons, or 3·13 per cent., under firsts. Although cheese of a good commercial quality has been manufactured, the standard has not been quite so high as for the previous year, the average grades being 92·035 and 92·086 respectively. Owing chiefly to the abnormal climatic conditions, the season has been one of the most difficult experienced from a cheesemaking point of view. During the earlier part of the season considerable difficulty was experienced with the erratic working of starters. As the season advanced this difficulty to a great extent disappeared, but drought conditions intervening brought further troubles, with a milk-supply deficient in solids and most difficult to handle generally. During the hot weather many cheeses were detrimentally affected in quality in curing-rooms which had no means of controlling temperatures, these often ranging from 70 degrees to 80 degrees F. The installation of the requisite insulation and plant to control temperatures adequately in these rooms should therefore be given immediate attention.

Cheese made from pasteurized milk totalled 88 per cent., and wax-coated cheese 71 per cent.

Export Values.

Prices for dairy-produce, principally butter and cheese, have shown considerable fluctuation during the year, the average being slightly lower than for the preceding year. In addition exports of butter and cheese have been less by 1,983 tons butter and 1,315 tons cheese. This is reflected in the total value of all dairy-products, which is less by £745,694 than for the previous year, as indicated by the Customs values of exports of butter, cheese, dried milk, casein, condensed milk, cream, and milk sugar, which total £16,142,160 and £16,887,854 respectively.

Casein.

During the year 1,933 tons casein came forward for grading, as compared with 1,868 tons for the previous year, the quality being of a high uniform standard. The grading of this product, which is not compulsory, is carried out at three grading-ports only—Auckland, New Plymouth, and Wanganui. A considerable quantity is shipped through Auckland ungraded. The total exports for the year amounted to 2,934 tons, of a value of £148,170.

Testing Butter for Moisture and Salt Content.

The legal maximum for moisture in butter is 16 per cent., and in order to avoid the possibility of consignments being shipped overseas containing excess moisture a box from each churning forwarded for grading was tested for water-content. In all 177,144 were tested, 0·4 per cent. of which were found to exceed the legal limit. These were withdrawn from shipment and reconditioned.

Salt tests totalled 163,235, of which 0·3 per cent. were outside the range permitted, shipment of these latter being withheld. To fill special orders, a few consignments with a salt-content outside the range permitted were allowed shipment.

Grading of Cream.

The grading of cream and payment according to grade has proceeded on uniform lines, and a fairly close adherence to the standards set by the Division has been maintained. From a cream grader's as well as a supplier's point of view the season has been a difficult one, and during the hot weather many suppliers had their cream graded below finest for the first time in their experience.

The regulations gazetted some little time ago, which prevent suppliers from changing over from one factory to another during the major portion of the year, have been of material assistance in maintaining the grading standards.

Grading of Milk.

The wisdom of introducing the grading of milk with differential payments according to grade has been amply demonstrated during the season under review. Difficulty was experienced during the extremely hot weather in delivering milk of a consistently high quality, and it is the consensus of opinion that the grading has been the means of maintaining a fairly uniform standard supply. At present it is optional to grade either daily or three times during each ten-day testing period. Quite a number of companies grade daily, but the universal adoption of this method would further assist in maintaining a more uniform milk-supply.

Farm Dairy Instruction.

Of a total of 368 dairy companies in operation throughout the Dominion, only 84 of these, with approximately 34,000 suppliers, are at present co-operating with the Department in the employment of Farm Dairy Instructors. Thirty-six of these officers are engaged in this service, thirty-four of whom are in the North Island and two in the northern end of the South Island. As these officers give instruction to suppliers in the production, care, and treatment of milk and cream, and in the sanitation of the dairy premises and plant, which, in effect, goes to the root of the industry, the need for this service being made a national one is therefore paramount. Suppliers to all dairy companies total approximately 72,000, and of this number some 38,000 are without the services of a Farm Dairy Instructor, and are therefore under no direct supervision.

Inspection of Milking-machines.

In order to ascertain whether milking-machine installations are in accordance with the regulations an inspection of all new erections is made as opportunity offers. During the year 1,608 new and reconditioned plants were installed, as compared with 1,781 for the previous year. Of this total, 1,459 have been inspected, 905 of which were "passed" on first inspection, the balance of 554 requiring in most instances minor alterations to bring them into line with the requirements of the regulations.

Check-testing Suppliers' Milk and Cream Samples at Dairy Factories.

Reports received from the officers carrying out the check-testing of milk and cream samples of suppliers to dairy companies indicate that the testing is being carried out satisfactorily, and that both in regard to equipment and test-room practice there is little to which exception can be taken. Managers generally are now more favourably disposed to check-testing, and consider the system tends to considerably lessen complaints from suppliers.

During the year check tests numbering 483 were carried out.

Special Investigation: Cheese Manufacture.

The experimental work carried out at the New Zealand Co-operative Dairy Co.'s Rukuhia Cheese-factory by the Division, under the charge of Mr. H. A. Foy, Dairy Instructor and Grader, in conjunction with the company's manager, Mr. A. Laurent, which was commenced in October, 1933, was concluded in June of the following year. The object of the experiment was to determine whether a clean and cooled milk from healthy cows, if manufactured under good conditions, would produce a cheese which would evidence all the desirable qualities of a cheddar cheese, including closeness of texture.

On the completion of the experiment a full report by Mr. Foy of the investigations was published in the Department's *Journal of Agriculture*, and also in bulletin form, a copy of the bulletin being forwarded to all dairy companies in the Dominion manufacturing cheese.

The following extract is taken from the report:—

> "Taking the whole experiment generally the greatest trouble experienced was slit openness, and apart from this no difficulty in producing a sound commercial-quality cheese was experienced. Neither sound manufacturing methods nor various modifications, as detailed previously, appeared to have any permanent diminishing effect on slittiness. None of the many starters, although active, and according to bacteriological examination comparatively pure, had the effect of producing consistently close cheese. . . .
>
> "A survey of the experiment leads to the conviction that some unknown factors had a marked bearing on slit-openness and other problems, and emphasizes the necessity for further research in an endeavour to throw more light upon milk and its constituents and products."

Veterinary Laboratory, Wallaceville.

During the past year Dr. Moir, who is located at this laboratory, has continued to assist the instructional staff of the Dairy Division in connection with the examination and supply of starters for use in cheese-factories. Owing to other work in hand, fewer samples of starters have been collected from factories to be tested for contamination, only about 120, as against well over 300 the previous season. Although the interest taken by the Instructors has effected improvement in the method of treating starters, the proportion of contaminated cultures is still too high, and indicates the need for more frequent examinations. The increased use of starters for butter-making renders it desirable also to make tests of butter cultures, but this has not so far been possible.

In view of the fact that in the autumn of 1934 starters supplied from this Laboratory to several factories enabled them to win about 50 per cent. of the principal prizes at the four chief North and South Island 1934 Winter Shows, there has been an increased demand for cultures to be supplied. Although very satisfactory results have been obtained with a fair proportion of these, in other cases failures have occurred, often for no apparent reason. It has been observed that in many cases, though not all, starters returned as "dead" have been found to be unduly contaminated, but by reculturing them under good conditions they have revived and the contamination has disappeared. This would suggest that contamination is a factor associated with starter failures. Although a number of reports are to hand indicating that better facilities, together with the exercise of greater care, have reduced starter troubles, yet in some cases the use of more sensitive cultures seems to have given rise to troubles.

During the year the question of the suitability of various tests for selecting clean milk has been kept in view, and opportunities have been taken of making comparative tests. Further evidence has been collected which indicates that as a basis for judging clean milk a low proportion of coliform types is of much greater importance than a small number of germs.

In order to avoid the penalties introduced with milk and cream grading there have been some attempts to use preservatives. Attention has therefore been given to the use of suitable tests to enable such preservatives to be readily detected when the milk or cream is delivered at the factory. This can be done with some preservatives, but with others sure results are possible only when laboratory facilities are available.

During the past season some time has been devoted to perfecting a simplified colour test to assist the Dairy-produce Graders in observations upon the alkalinity of butter, especially to check over-neutralizing. The preparation of permanent standards for comparison has proved more difficult than was expected, but results so far obtained in collaboration with the Graders' testing officers indicate that some progress has been made. Before the commencement of next season it is hoped to have the test placed upon a more satisfactory basis, which will enable it to be frequently used by the Graders with the object of checking excessive or irregular neutralizing of cream.

As in previous years, there have been a considerable number of waters submitted to the Laboratory for examination, especially waters used for butter-washing. In many cases the bacteriological condition of these waters leaves room for improvement, and by means of chemical tests it is possible to form a better idea of the treatment required. Chemical tests are also of value to indicate the suitability of the water for cleansing operations in the factory and for boiler-feed purposes. Apart from economies which this knowledge makes possible, it is evident that in a proportion of butter-factories improvements could be made in the quality of butter manufactured if routine tests were regularly made of the water used. The limited facilities available in this Laboratory have prevented this very necessary work receiving adequate attention.

Apart from the particular types of testing referred to above, a variety of other samples have been submitted for examination. There is no doubt that if additional assistance were available for routine testing purposes this Laboratory could give a great deal more similar valuable assistance to Graders, Instructors, and factory-managers.

Dairy-factory Managers Regulations, 1934.

The regulations governing the registration of factory-managers, and persons other than managers, who by virtue of their qualifications are deemed competent to perform the duties of managers, came into force as from 1st April, 1934. The Dairy-factory Managers Registration Board of eight members

appointed by the Hon. Minister of Agriculture to administer these regulations held its first meeting on 15th June following, and has since held a further five meetings. To date 580 applications for registration have been received, and of this number 562 were granted certificates and the balance of eighteen declined.

Inspection of New Zealand Dairy-produce in Britain.

Mr. W. Wright, who had been in continuous charge of this work since October, 1922, having reached the allotted span, retired on superannuation at the end of November last, his position being filled by Mr. F. H. Taylor, who had been associated with Mr. Wright since 1930. Mr. G. M. Valentine, who had also been assisting Mr. Wright since November, 1933, returned to New Zealand in August, 1934, and Mr. G. V. Were, who on a previous occasion saw service in London, returned there to fill the position previously held by Mr. Taylor.

The number of inspections of dairy-produce becomes greater each year, and numerous detailed reports on the quality of dairy companies' produce come to hand by each mail. These are duly forwarded to the respective dairy companies, who are by this means kept in close touch with the quality of their produce at the Home end. Many other matters coming within the scope of these officers' work and of interest to the industry are also fully reported on.

Certificate-of-record Testing.

The 1934 results for C.O.R. testing have shown a very satisfactory increase over 1933. First-class certificates of record were issued to 639 cows in 1934, and of this total 536 cows qualified in the yearly-test division, and the remaining 103 in the 305-day division. In addition, 41 second-class certificates were issued. These totals compare with 507 first-class (46 of these being in the 305-day division) and 38 second-class certificates issued in 1933.

In the third-class C.O.R. division, 212 certificates were issued, as against 86 for the preceding year, an increase of 126. The year under review is the second season in which certificates have been issued in this Division of the C.O.R. class.

The average butterfat-production for the 536 first-class yearly certificates issued in 1934 was 527·45 lb., as against 523·10 lb. for 1933, an increase of 4·35 lb. butterfat per cow. The corresponding figures for the 103 certificates of the 305-day class were 426·23 lb., as against 447·35 lb. for 1933, a decrease of 21·12 lb. butterfat per cow.

Government Official Herd-testing.

During the year 2,185 pure-bred cows were tested under this method, these being in the herds of 184 C.O.R. testing breeders. This represents an increase of twenty-one breeders and 493 cows, over the year ended 30th September, 1933. On the basis of all cows in milk 180 days or more the average yield of cows tested under this system last year was 311·59 lb. butterfat, as compared with 309·78 lb. butterfat for the previous year, an increase of 1·81 lb. butterfat. While the C.O.R. system is classified in calendar years, the official herd-test year closes on 30th September, and to that date in 1934 the O.H.T. system had completed seven years' operations.

Ordinary Dairy-herd Testing.

The number of cows tested under this method during 1933–34 exceeded by 11,593 the preceding season's figure, which was previously the highest number tested in any one season. Some 297,647 cows were tested, their average production being 262·44 lb. butterfat, as compared with 286,054 cows and 255·57 lb. butterfat for the 1932–33 season. Approximately 92 per cent. of the total tested were under the group system (273,473), while 22,433 were tested under the association own-sample system, and the balance of 1,741 by dairy companies on behalf of their suppliers. The tested cows represent approximately 16·4 per cent. of the total cows in milk in the Dominion. The Government subsidy to herd-testing was continued, £5,000 being granted for the past season. Two meetings of the New Zealand Herd-testing Central Executive were held during the year.

Staff.

Regret is expressed at the retirement through effluxion of time of Mr. W. E. Gwillim, Assistant Director of the Division, Mr. W. Wright, Inspector of New Zealand Dairy-produce, London, and Mr. S. Clayton, Grader-in-Charge, Lyttelton. Mr. Gwillim joined the Service in 1907, and was appointed Assistant Director in 1922, retiring as from the end of August last. Mr. Wright, whose appointment dates from 1903, was the first divisional officer to fill the position of Inspector of New Zealand Dairy-produce, proceeding to London in 1911. He returned to New Zealand in 1917, was reappointed to London in 1922, and occupied that position until his retirement at the end of November, 1934. Mr. S. Clayton joined the Division in 1911 as Grader at Lyttelton, retiring from the position of Grader-in-Charge at that port at the end of October, 1934. Appreciation of their long and faithful services to the Division and to the dairy industry generally is gratefully acknowledged.

Mr. G. M. Valentine, who returned from London in August last, was appointed Assistant Director of the Division as from 1st September following.

The year has been an arduous one for the staff, and their loyal and efficient co-operation is thankfully acknowledged.

Appreciation.

Thanks are extended to all co-operating organizations for the willing assistance and co-operation given to the Division during the year.

HORTICULTURE DIVISION.

REPORT OF J. A. CAMPBELL, DIRECTOR.

The Fruitgrowing Industry.

Following a heavy yield during the 1933–34 season, combined with a long spell of hot dry weather during the fruiting period, the present season's apple crop in the majority of the commercial fruitgrowing areas was on the light side. Pear and stone-fruit trees were not so materially affected by the dry conditions, and good average crops have been secured. The unusual weather experienced resulted in the crops maturing at least two or three weeks earlier than usual.

The season was very favourable to the development of insect pests, such as codlin moth, leaf-roller, red mite, &c., and demanded extra precautions being taken by growers in spraying operations. Showery weather in the early spring rendered the control of black spot somewhat difficult, and also was largely responsible for a considerable amount of russeting on the Delicious variety of apple. Fire-blight made very little headway during the year, any slight outbreaks being promptly dealt with, and the present position is satisfactory.

Although the fruit industry is passing through somewhat critical times, an improvement is noticeable in the returns to growers during the past year, and in some cases the results have been quite satisfactory. Unfortunately the improved conditions have not been general, and there is still evidence of enforced economy in the working of orchards which is leading to a falling-off in the general state of maintenance, and is no doubt having an influence on the incidence of disease and pests.

Citrus-fruit growing continues to make steady progress, and there has been a further increase in the area planted in lemons and to a lesser extent in Poorman oranges. The lemon crop has been a satisfactory one, and, while a gradual improvement is noticeable in the grading and quality of the fruit produced commercially, closer attention to disease control and the adoption of proper methods of curing are still desirable.

In order to deal with the increasing crops in the North Auckland District, an effort is being made to establish a central grading and packing shed at Kerikeri on a co-operative basis. This is a move in the right direction in order that a uniform grade of both lemons and oranges may be marketed. With additional trees coming into bearing, there will be a considerable increase in the quantity of fruit produced in the near future. It is estimated that during the current season the output of lemons and oranges in this locality will be 4,000 bushels and 2,000 bushels respectively. The manufacture of by-products from oversize and lower-grade fruit is receiving attention, and lemon-peel and lemon-juice are being produced in increasing quantities.

The passion-fruit crop at the commencement of the season promised to be a heavy one. As a result of inclement weather, however, leaf-spot developed to a large extent, causing considerable quantities of fruit to drop before reaching maturity. Growers have realized that it is necessary to prune the vines in order to spray them successfully for the control of leaf-spot. The extraction of passion-fruit juice is being carried out on a fairly comprehensive scale by the company operating at Kerikeri, North Auckland.

A matter of particular interest to fruitgrowers in the Hawke's Bay District is the establishment of a new cannery at Hastings, which has commenced operations in pulping and preserving fruit, and also the manufacture of jams and sauces.

The total area in commercial orchards in the Dominion stands at approximately 27,000 acres, any new plantings being offset by the cutting-out of certain areas which have proved unprofitable.

The revision of a number of the departmental bulletins and preparation of new ones has taken up a fair amount of time.

Export of Fruit.

The export of fruit from the Dominion has reached considerable proportions in recent years. As the result of careful organization in the past, particularly in regard to export, New-Zealand-grown fruit has gained a very prominent position on the overseas markets, and every effort is being made to maintain the present high standard.

The 1934 crop of apples and pears being above the average, the export season for that year was a particularly busy one for all connected with the export of fruit, and the inspecting officers attached to the Division were kept fully engaged in the inspection of the various lines coming forward. Although it was found necessary to reject a fair quantity of fruit as being unsuitable for export on account of excess of blemish (russeting), slack packing, immaturity, &c., the work as a whole proceeded smoothly, the majority of growers adhering to the requirements of the export regulations.

The total quantity of fruit shipped overseas during the 1934 export season amounted to 1,574,912 cases, which shows an increase of 144,399 cases as compared with the previous year's figures. Of the total exported, 1,129,338 cases apples and 106,202 cases pears were consigned to Great Britain; 229,105 cases apples and 815 cases pears to the Continent of Europe; 51,369 cases apples to Canada; 19,086 cases pears to Sweden; and 38,897 cases apples to South America.

The bulk of the fruit was exported under the Government guarantee of 9s. 11d. per case for "extra fancy" and "fancy" grades, and 9s. 5d. per case for "good" grade in respect to certain varieties, and in regard to other varieties 9s. 5d. per case for "extra fancy" and "fancy" grades, and 8s. 11d. 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 loading and stowage of the fruit on the overseas vessels was generally careful, and there was a noticeable improvement in comparison with that obtaining in previous seasons. Notwithstanding this, a general supervision was essential. The bulk of the fruit reached its destination in good condition, and the prices realized, taking the season as a whole, were considered satisfactory, there being no recourse of any extent on the guarantee.

An interesting feature of the 1934 season's export was the record quantity exported from the Nelson Province, the total reaching 1,008,538 cases (968,611 cases apples and 39,927 cases pears). To commemorate this event, the millionth case was forwarded to London addressed to Lord Rutherford, of Nelson.

Exports of apples and pears from the Dominion during the last five years are as follows: 1930, 1,330,891 cases; 1931, 1,349,895 cases; 1932, 1,596,058 cases; 1933, 1,430,513 cases; 1934, 1,574,912 cases.

Owing to a light crop and other causes, it is expected that the quantity of fruit exported during the 1935 season, which is now in full swing, will only be slightly in excess of 1,000,000 cases. The first of this season's shipments left New Zealand per s.s. "Akaroa" on 4th February, and consisted of 6,000 cases apples and 39 cases pears.

Local Markets for Fruit and Vegetables.

A systematic inspection of locally-grown fruit and vegetables offered for sale in the shops and auction-rooms has been carried out in the main centres. While the markets have been well supplied with fruit, there has been a considerable falling-off of vegetables such as cabbage, cauliflower, &c., due to the ravages of the white butterfly, diamond-back moth, and other insects, and any good-quality lines offering have brought high prices.

The bulk of the fruit and vegetables placed on the local markets has been of good quality—clean and free from disease—and the grading and packing well maintained. However, a number of lines, consisting mainly of apples and pears, which have come under notice were of poor quality, lack of colour and wilt being the chief faults. The marketing of this class of fruit can have the effect only of lowering the prices of the higher grades.

In order to relieve the glut in stone-fruit in the Otago Central District, advantage was taken of the use of a privately owned cool store at Alexandra for the purpose of storing the surplus crop. This arrangement was more in the nature of an experiment, and, while the comparatively small quantity cool-stored did not relieve the situation to any great extent, later in the season prices obtained for fruit stored were quite satisfactory. Central Otago growers are now considering the question of establishing an up-to-date fruit cool store in a central position in their district.

Imported Fruit, Plants, etc.

The inspection of all imported fruits, plants, bulbs, &c., has been carried out carefully at the different ports of entry in the Dominion. Reports to hand indicate an increase in the quantity of fruit and plants imported as compared with the previous year. The bulk of consignments arrived in good order and condition, and it was found necessary to condemn only one small line on account of fruit-fly infection. Several lots of walnut meat were condemned on account of being infected with the larvæ of the Indian meal moth, and were dealt with in the usual manner. Oranges from the Cook Islands varied in condition, some consignments opening up in a wastey condition requiring a considerable amount of repacking.

At the request of the Cook Islands Department a visit was paid by an officer of the Division to the different Islands of the Cook Group for the purpose of investigating the cause of wastage in oranges exported from these Islands. A report covering this investigation has been duly supplied to that Department.

The fumigation of a fair quantity of grass-seed from New South Wales was attended to.

Fruit Cold Storage.

The successful cold storing of fruit is a very important factor in connection with the fruitgrowing industry, and a considerable amount of attention has been given with the view of effecting further improvements in the cold-storage methods adopted both on land and on overseas vessels.

Experimental work commenced some three seasons ago in co-operation with the Department of Scientific and Industrial Research has been continued during the year, the general aim of the investigations being to determine the effect of a number of factors on the keeping-qualities of fruit during overseas refrigerated transport and local cold storage.

Information of a valuable nature has been obtained in respect to the variations occurring in the keeping-quality of apples grown in different localities and on various classes of soils. Interesting results have also been secured relative to maturity at time of picking, use of oiled wraps, cold storage of passion-fruit, and different varieties of peaches and plums, &c. The trials with a few new features are to be continued during the coming year.

Advice has again been given in the case of a number of local cool stores which have been operating along unsatisfactory lines as far as the storage of fruit is concerned. The remedial measures advocated have been much appreciated.

Instructional and Experimental Work.

There has been a considerable demand during the year for information and advice on the many phases connected with fruit and vegetable growing and horticulture generally. The constant changing of orchard properties also entails the giving of a considerable amount of attention to the new owners who look to the Department for advice and guidance. The lectures and practical demonstrations on up-to-date methods of orchard-management given by the Instructors in their respective districts, as far as restricted travelling-expenses would permit, are of considerable assistance to growers in combating the various problems associated with fruitgrowing. Instruction has also been given in the grading and packing of fruit—a very important matter to the fruitgrowers—by the continuation of classes on these subjects in the main commercial centres, thus giving those attending the classes an opportunity of sitting for the departmental certificate of competency in apple-grading and packing. Facilities have also been given for candidates to sit for the certificate in orchard pruning and spraying.

Further progress has been made in connection with the orchard research scheme inaugurated some four seasons ago in conjunction with the scientific officers attached to the Plant Research Station, Palmerston North, and a considerable amount of detail work has been accomplished.

One of the main features of the programme being carried out is the testing-out of various spraying compounds and other materials for the better and more economic control of diseases and pests. It is expected that the results obtained will materially assist orchardists in obtaining a greater degree of protection for their crops against pests and diseases at a minimum of cost. Interesting results are also being noted in connection with the orchard manurial trials designed with the view of determining the influence of certain manures on the disease-resisting powers of the trees and the yield and quality of fruit.

Not less important to the fruitgrowing industry are the root-stock tests with different varieties of fruit-trees, including pip, stone, and citrus.

Various trials have also received attention at the Research Orchard, Appleby, Nelson, where the operations are conducted in conjunction with the Department of Scientific and Industrial Research. Several visits to the orchard have been made by members of fruitgrowers' associations and others during the year, and keen interest manifested in the work in progress.

A further supply of filbert-trees of the species *Corylus maxima* propagated from those originally received from Messrs. Cadbury, Ltd., England, was distributed for trial purposes in different suitable districts.

Viticulture and Wine-making.

A steady increase is taking place in the area planted in outdoor vines both for wine and table purposes, and there has been a considerable demand for grape-vines of different varieties.

In the Auckland Province the crop of wine grapes, taken as a whole, was above the average. The earlier and main crop varieties in the Hawke's Bay and Poverty Bay Districts were considerably reduced through damage by heavy rain during the ripening period. The quantity of wine produced from the current season's crop is estimated at 148,000 gallons, an increase of some 10,000 gallons on the previous year's figures.

The crop of outdoor table grapes, mainly of the Albany Surprise variety, was slightly below the average. Prices realized were considered to be satisfactory.

Vines grown under glass were remarkably free from fungoid disease and pests. The increasing demand for the Black Hamburg and other indoor varieties would indicate that, although the returns to growers are lower than those obtaining a few years ago, there is still a satisfactory margin of profit.

Cider-making.

An increase is noticeable in the quantity of cider manufactured commercially during the year, the total being approximately 36,500 gallons, as compared with 30,000 gallons for the previous year.

Te Kauwhata Horticultural Station (Lower Waikato).

Climatic conditions were favourable to farming operations and growth generally throughout the year. Although an unusually dry summer was experienced, there was sufficient feed for grazing purposes. A limited number of sheep and young steers were grazed for fattening, sales of live-stock amounting to £117. Some 4 acres of scrub and dead wattle were cleared for sowing in grass next autumn, and an addition of 2 acres to the vineyard partly stumped.

The grape crop was a satisfactory one, and produced approximately 14,500 gallons of wine. Some 15,304 gallons of wine which were sold during the year realized £6,842.

The interest taken in the recently introduced varieties of both table and wine grapes continues to increase, and the demand for cuttings and rooted vines was again considerable.

The financial position of the Station is satisfactory, receipts exceeding expenditure by nearly £3,000.

Tobacco-culture.

The total area planted in tobacco in the Dominion during the 1934–35 season was approximately 1,800 acres. Of this some 1,500 acres were planted in the Motueka District, 166 acres in the Auckland District, and 102 acres in the Nelson District. This shows a considerable reduction as compared with the figures of the previous year. The closing-down of a number of companies operating in the Auckland District affected the area planted in that locality. In the Motueka District, where the bulk of commercial tobacco is grown, a considerably less acreage was planted out. This shortage appears to be largely due to a lack of co-operation between the growers themselves, and also between the different companies concerned in the handling of the crop.

The dry season experienced, although retarding growth somewhat, was conducive to a well-ripened crop which was comparatively free from disease, the bulk being of good quality, for which satisfactory prices should be realized.

It is anticipated that an experimental shipment of this season's tobacco-leaf will shortly be made to the United Kingdom from the Nelson District. The tobacco will be graded and packed in accordance with the requirements of the tobacco-export regulations.

At the Pongakawa Settlement in the Bay of Plenty District, where some forty families have now been settled under the small-farm-scheme, 40 acres were grown in tobacco as against 100 acres in the previous year. A good yellow flue-cured leaf was produced at this settlement.

The experimental plot established in the vicinity of Auckland yielded a further quantity of tobacco-seed. Considerable inquiry has been received during the year for advice relative to tobacco-growing and curing.

Hop-culture.

Renewed interest has taken place in the growing of hops, the greatly improved market conditions resulting in a considerable increase in the area planted. The season's production was the largest for a number of years, the hops being of good quality, and the ultimate return to the grower should be quite satisfactory.

The quantities in hundredweights and values of hops exported from the Dominion during the last five years ended 31st March are as follows: 1931, 1,943, £9,108; 1932, 640, £2,597; 1933, 3,192, £13,793; 1934, 3,872, £17,734; 1935, 3,627, £26,522.

Tung Oil.

Considerable activity still continues in regard to tung oil, and planting-out operations in the North Auckland District have been fairly extensive during the year. The total area now planted in tung-oil trees is estimated at some 3,500 acres. In some localities where suitable conditions exist, and where adequate shelter has been provided, the trees are doing satisfactorily, some having reached the nut-bearing stage. The development during the next few years should prove very interesting.

New Zealand Institute of Horticulture.

The New Zealand Institute of Horticulture continues to take a keen interest in matters connected with horticulture generally within the Dominion, and from an educational point of view its operations are destined to be of considerable benefit both to the horticulturist and the fruitgrower. Under the new conditions drawn up by the committee appointed for the purpose relative to the Loder Cup annual competition, it is of interest to note that the cup for 1934 was awarded to His Excellency Lord Bledisloe (late Governor-General) in recognition of his strong advocacy of the protection of the Dominion's native forests and the practical encouragement he has given to the growing of native trees and plants during his term of office in New Zealand.

Registration and Inspection of Nurseries.

The inspection of all nurseries raising stock for sale was carried out in the respective districts. Reports to hand indicate that the bulk of the areas are in good order and the trees and plants clean and free from disease. A considerable improvement is noticeable in the demand for nursery stock, especially shelter and forest trees. Some 652 nurseries were registered during the year, and £652 collected in registration fees.

Orchard Registration and Orchard-tax.

The number of registered orchards in the Dominion now totals 6,497, comprising 2,850 taxable and 3,647 non-taxable; and tax demands amounting to a total approximating £2,350, inclusive of penalty, have been issued for the year. By a recent amendment to the Orchard-tax Act, 1927, the orchard-tax has been increased from 1s. to 2s. per acre. A portion of the tax collected will be paid (less cost of collection) to the N.Z. Fruitgrowers' Federation, Ltd., for furthering the interests of the fruitgrowers, and the balance applied to the Department of Scientific and Industrial Research to assist in scientific research relative to matters connected with the fruitgrowing industry. Constant changes in ownership of orchards and the non-notification in a great many instances of alterations in areas, combined with the financial situation, render the work of tax-collection a somewhat difficult one. The collection of fireblight tax in three commercial fruitgrowing districts has also been attended to.

The Beekeeping Industry.

The 1934–35 season varied very considerably throughout the principal honey-producing districts in the Dominion. The conditions in the spring were very favourable to a good honey-flow, seasonable rains in most localities producing an excellent growth of clover, which gave every indication of the honey crop being well above the average.

A long dry summer, however, seriously interfered with the pastures, with the result that only light to average crops were secured in the main commercial districts, with the exception of Taranaki and South Canterbury, where the returns were above the average. Taken as a whole, the honey crop for the Dominion is below the average.

There has been very little improvement during the year in the local marketing of honey. While the operations of the newly-established co-operative company—New Zealand Honey, Ltd.—have had a steadying effect on the price of bulk honey, its efforts are largely nullified by the action of a number of beekeepers who are selling at prices which leave little or no margin of profit to the producer.

Notwithstanding that the industry is passing through a difficult period, signs of optimism are noticeable in the establishment of new apiaries and extensions to existing ones. Considerable inquiry is also being made by persons desirous of taking up beekeeping as a means of livelihood.

The weather conditions during the spring and summer months were favourable to the carrying-out of apiary inspection, and this work was maintained as far as restricted travelling-expenses would allow.

Disease is being satisfactorily controlled by the bulk of commercial beekeepers, and in this connection useful assistance has again been rendered in some of the main producing districts by a number of experienced beekeepers who offered their services as honorary apiary inspectors at no expense to the Department.

The usual practice of giving demonstrations and lectures on all phases of beekeeping was adhered to during the year by the Apiary Instructors in their respective districts, and considerable appreciation was evinced in this means of imparting practical advice and instruction.

The grading of honey for export was carried out under the new standards fixed last season by the New Zealand Honey Control Board in conformity with its powers under the Honey-export Control Act, 1924. While it is yet early to forecast the effect of the new grading-system, it is clear that it will have the effect of eliminating the low grades of honey previously sent forward by beekeepers, in the hope of getting them exported, which were unsaleable locally, and for which there was no better demand overseas. It is very evident, in order to maintain the high position our honey holds in the English market, that only the best honey the Dominion can produce should be exported.

The total packages of honey graded for export at the different grading stores for the year ended 31st March last amounted to 4,790 cases, which was a considerable decrease as compared with the previous year's figures. This was largely due to the 1933-34 honey crop being a very light one.

Quantities in hundredweights and values of honey exported from the Dominion during the last five years ended 31st March, are as follows: 1931, 1,958, £7,845; 1932, 4,749, £17,606; 1933, 2,005, £7,014; 1934, 7,342, £23,784; 1935, 5,427, £17,844.

Apiary Registration.

The total number of apiaries registered to date is 7,621, comprising 116,050 colonies of bees. It is considered that the regulations relative to the registration of apiaries have been complied with by the majority of beekeepers in the Dominion.

Staff.

I have to thank the staff of the Division as a whole for the loyal and efficient service rendered during another busy year.

CHEMISTRY SECTION.

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

Deficiency Diseases of Live-stock.

Bush Sickness.—No further trouble has been reported since only limonite prepared in an approved manner from approved sources has been marketed for stock-lick purposes. There is still considerable scope for extension in the use of this material, especially in the Bay of Plenty, where the practice of administering iron and ammonium citrate became so firmly established as to make some farmers hesitant in adopting a new remedy even on the score of much greater cheapness and ease of administration.

Mr. C. R. Taylor, in charge of the work at Rotorua, reports :—

"Were it not for the setback due to the drought it is safe to say a record production of butterfat would have resulted. The number of fat lambs sent to the works from all parts of the district has increased enormously over last year's output. The sale of fat ewes and wethers has also greatly increased. The health of all stock has been markedly good and the freedom from bush sickness most noticeable.

"Once again the wonderful condition of local stock at the recent Tokoroa Show testified to the efficacy of limonite as a cure for bush sickness.

"During the year limonite from the Ruatangata deposit has most certainly lived up to the reputation established in the Atiamuri experiment, 1931.

"The sheep experiment at Kaharoa was terminated in February, it having been demonstrated that sheep and lambs could be kept healthy on this, the worst, class of country with the aid of limonite. In the earlier part of the experiment trouble has been experienced from ragwort-poisoning and the use of ineffective limonite, but for the last fourteen months the sheep kept in good condition and there were no losses of lambs. Several ewes bred on the place (now 6-tooth) are in show condition. On the same farm the dairy cows have now been receiving no other treatment but limonite for over three years, and it would be difficult to find better-conditioned animals anywhere. Eight years ago it was necessary to change this herd to healthy pasture three or four times a year. No trouble is experienced in rearing calves, and the yearlings are a picture of health and vigour. The Tokoroa district is now reflecting the excellent influence of limonite on stock and through this the relatively high productiveness of the bush-sick pumice country. Not a few of the Tokoroa herds will finish up the present season with the splendid average of nearly 300 lb. of butterfat per cow, grazing one cow to 1½ acres. The cheese-factory found it necessary to utilize its full number of vats (five) for the first time. Approximately the same number of cows are supplying the factory as last year.

"In Waotu, Puketurua, and Lichfield districts stock-owners have been perfectly satisfied with the results obtained from the use of limonite. Ewes and lambs have done remarkably well, and some very fine results have been obtained. One farmer from 1,600 ewes had 1,750 lambs, and of these all but twenty were sold as fats. Another farmer, who in the past has had extremely heavy losses in sheep, this year shipped to England 3,600 lambs out of 4,000. The wool-clip was also much heavier."

Very heavy losses from bush sickness were experienced a few years ago in the areas around Kopaki and Mangapeehi, south-east of Te Kuiti. Several of the larger sheep-stations have now adopted the use of limonite with remarkable results.

On the Government-owned Tapuwae Estate it is reported that all the sheep came out of the wool well, with an increase of 30 bales of wool over the previous season. Not more than a dozen sheep out of the 3,000 shorn were in other than a thriving condition. There were no weeping eyes noticed amongst the lambs, although at the same time the previous year practically all were affected. In a further report received through the courtesy of the Lands Department it is stated *inter alia* :—

"Hitherto the accepted practice on the local bush-sick properties has been to change all stock at least annually, the resultant loss in depreciation and restocking being considerable.

"Definite proof of the success of the remedial measures practised on Tapuwae is the fact that this season ewes bred on the property have produced a good crop of lambs showing no symptoms of bush sickness. The success obtained has been the result of many and varied experiments, of which the breaking-in of the sheep to a limonite-salt lick has been the most successful. Probably the best indication of the success achieved has been the turning-off of over 3,000 fat sheep during the past season, one line of 1,100 wethers averaging 69·3 lb. when killed at Waitara. Cattle also have responded well to the treatment, as instanced by the fact that 816 bullocks have been fattened during the past three seasons.

"The property now winters 4,250 sheep and 700 head of cattle, and it is hoped in a few years to increase this carrying-capacity."

The general position in regard to bush sickness in the areas formerly most seriously affected may be judged by the following quotation from an article in the *Rotorua Morning Post* of 20th February, 1935 :—

"Although it has not been done with any spectacular flourish of trumpets, but in the course of careful and detailed research work, it may now definitely be claimed that the Rotorua-Tauranga-Mamaku pumice country is almost entirely free from bush-sickness.

"Officials of the Department of Agriculture who have been engaged for some years in investigating this stock malady and experimenting with methods of cure state that definite cases of bush sickness are now rare. So much so that when Sir Arnold Theiler, one of the world's leading authorities on mineral deficiencies, visited Rotorua before Christmas, efforts to find bush-sick animals for his inspection in the Rotorua, Tauranga, Matamata, and Mamaku districts were unsuccessful, despite the fact that the incidence of bush sickness had previously been most marked during the months of December and January.

"Five and six years ago large areas of country in different parts of the district were definitely 'sick,' but this has now become a thing of the past. As an example, stock-shows are now being held at Tokoroa, which was previously one of the most seriously affected districts in the whole area. Where at one time hundreds of stock were annually affected by the malady, now months pass without even a single case being reported.

"A great deal of this improvement is definitely due to the 'limonite cure,' and limonite is now firmly established and generally used as a counteractive preparation. Broadly speaking the experimental work carried out has shown that sickness is caused by lack of iron in the soil, and this deficiency limonite is designed to remedy. Citrate of iron was also largely used for this purpose, but at the present time the demand for it

has fallen to a very marked extent—further evidence of the permanent improvement that has been effected in combating the malady. Some years ago the Rotorua office of the Department was supplying an average of 40 lb. to 50 lb. of iron citrate a month for use in connection with bush sickness, but at the present time months often pass without a single pound of the preparation being sold."

The Whakamarama district, West of Tauranga, was the subject of investigation and report at the request of the Settlers' Association. Mr. C. R. Taylor in his report states that the whole district is covered with from 3 in. to 6 in. of fine Kaharoa pumice ash overlying a coarsely textured creamy-brown pumice of over 3 ft. depth. A mild degree of bush-sickness exists, especially in the early stages of development, but this has been overcome with the aid of limonite, and with correct farming practice the district should become a productive one.

Analyses of the soils showed them to be sandy silts deficient in total and available phosphoric acid, normal in available potash, and rich in nitrogen. Although they showed a fair lime requirement, liming was not advocated on account of its known unfavourable effect on pumice bush-sick soils.

In the Ruakaka district, on the south side of Whangarei Heads, there are considerable areas of soil composed of blown sand, much of it very little above sea-level. Several settlers on the portions bordering the coast have experienced difficulty in rearing calves, and some mortality has occurred in grown stock. A form of bush sickness was suspected, and this appears to be confirmed by the favourable results secured from the use of limonite. Samples of soil have been collected for analysis.

A mild form of bush sickness apparently occurs on loamy-silt pumice soils near Morrinsville. The farms concerned are on low rolling hills, and it was found that the trouble was greatest where the subsoil was lightest—that is, had the least clay. Considerable improvement has resulted from the use of limonite, and it would probably be good policy to feed a little limonite on any of the lighter soils derived principally from pumice. Even on the loam soils of the Mairoa district, where lime is deficient, it is reported that a limonite lick resulted in great benefit to a flock of sheep.

Further favourable reports have been received of the results of limonite-feeding in the Morton Mains district, Southland.

Limonite.—Further investigation of the nature and composition of various "limonites" has been carried out, and a paper was published in the September, 1934, *Transactions of the Royal Society of New Zealand*. It was also found that extracts made with tenth normal hydrochloric acid contained appreciable amounts of cobalt and zinc, and some preliminary feeding trials with these elements are being carried out. Some investigators claim that in bush sickness and similar conditions in other countries it is not iron but some accompanying metallic element which is lacking and which is supplied in traces in iron-licks such as limonite. Copper, cobalt, zinc, manganese, arsenic, are among such elements. Such trace elements may act in one of two ways: they may be essential, providing links at some stage in the metabolism of iron in the body, or they may merely be stimulants urging the blood-forming organs to greater or perhaps more economical functioning. The only element definitely proved at present to be essential to iron metabolism is copper, and there is the strongest ground for claiming that there is no deficiency of copper associated with bush sickness, the main proofs being—

(1) Numerous livers of animals dying of bush sickness have been analysed and found to contain the normal or more than the normal amount of copper.

(2) Blood analyses conducted during the year from a number of experimental sheep have shown no significant difference in copper-content between bush-sick and healthy sheep.

(3) Two healthy sheep at Kaharoa drenched daily with 1 fluid ounce of a one-per-cent. solution of copper sulphate for three months without access to limonite lost condition and became very bush-sick. On the other hand arsenic has been found in some instances to exert an apparently curative effect on bush-sick animals, but there is little doubt in this case that the action is merely a stimulating one. The effect is only temporary. Arsenic was determined on a number of bush-sick and healthy pastures, and was found to have the same range of values in both cases—namely, from 1 to 7 parts per 10,000,000 parts of dry matter. Workers in South Australia and West Australia claim that cobalt is an essential element, the lack of which is responsible for a sheep disease resembling bush sickness. Their claim cannot be considered proved, however, until animals on the affected country have been carried in health through more than one generation by means of cobalt.

Pampas-grass.

During the year a considerable amount of work has been done on the chemistry, culture, and utilization of pampas-grass as fodder. The cell-wall constituents have been determined and compared with other forage plants. Pampas-grass contained from 4 per cent. to 5 per cent. total reducing substances (as glucose), from 13 per cent. to 24 per cent. total hemicellulose (differing in composition from recorded analyses of hemicelluloses of most grasses), from 37 per cent. to 41 per cent. cellulose (Cross and Bevan), and from 17 per cent. to 19 per cent. lignin, as compared with from 6 per cent. to 17 per cent., from 16 per cent. to 21 per cent., from 21 per cent. to 33 per cent., and 18 per cent. respectively for other common fodder grasses. It is therefore comparatively very rich in cellulose and hemicellulose without a corresponding increase in lignin, and as cellulose and hemicellulose are split up by bacteria in the digestive canal of ruminants into glucose, and therefore have about the same feeding-value as starch, while lignin is indigestible and may reduce the digestibility of cellulose by its encrusting action, it is possible that in pampas the lignin has very little protective action on the cellulose against bacterial attack. This is also likely to be accentuated by the fibres in pampas being spread out in numerous fine strands so that the leaf is easily broken and disintegrated, whereas in toetoe, for instance, the fibres are collected into closely knit bundles or ribs giving the leaf great strength, while the bundles themselves are difficult to disintegrate. Pampas is comparatively poor in protein, the green leaves containing about 10 per cent. and the succulent bases about 5 per cent. in the dry matter, which is 25 per cent. of the green weight. It is therefore to be compared chiefly with other carbohydrate or energy

foods such as hay or turnips, and its use is indicated especially in two directions: (1) As supplementary winter fodder, replacing root crops, which demand much time and trouble in cultivation and are very uncertain; and (2) as a balancing ration for wastefully and perhaps injuriously protein-rich young grass pasture, which in the case of highly top-dressed rye-grass-white-clover pastures in the Waikato may contain from 30 per cent. to 35 per cent. protein in the dry matter. It has a further valuable use as a reserve succulent fodder for periods of drought, as was well illustrated during the recent hot dry summer, when the deep-rooted pampas on the Hauraki Plains was green and thriving while surrounding grass paddocks were brown and bare, and the milk-yield of a dairy herd being fed pampas scarcely dropped at all. It has been demonstrated that the plants yield and recover better if fed at six-monthly intervals, so preventing flowering, rather than at yearly intervals. Considerable mortality has occurred among root-cuttings distributed for planting, due both to frost and drought, and it is deemed advisible to strike cuttings before planting out. A better method is to plant seedlings. Seed is at present scarce, but a little was threshed from plumes gathered at Whangarei and gave a 72-per-cent. germination. Seed is also obtainable from Sutton and Sons, England, and some from this source has germinated well in New Zealand.

Iodine Investigation.

A further 100 samples from the Westland District and 35 from Marlborough have been collected and prepared for analysis. These should complete the sampling of the South Island. A few (eighty) samples collected the previous season have still to be analysed as well as those taken this year.

The lick experiments in Southland are being continued. In order to make the interpretation of these results more conclusive, samples have been taken from healthy areas to estimate the extent of seasonal variations in the size and iodine-content of lamb thyroids.

The investigation in the North Island, apart from some analyses, has been left over until the South Island has been completed.

Soils.

The analysis of soils in connection with the survey of littoral lands has been continued at the Soil Laboratory, Fairlie Terrace, Wellington. A further series of soil and water samples was collected at Napier in April, 1934. A water sample from the north end of the lagoon contained 0·34 per cent. of sodium chloride, and a sample from the south end 0·14 per cent. sodium chloride. Previous samples taken from the lagoon in May, 1933, contained over 3 per cent. sodium chloride, so that a considerable reduction in salinity has occurred. The salt content of the soils was not on the whole high for soils of this type, indicating that the mechanical texture of the soils was sufficiently coarse to allow rapid drainage. The reaction varied from pH 7·3 to 8·5, and chemical analysis showed the usual high amounts of available plant-food. An area of Crown land desired by the Hospital Board was found by field inspection to consist of two distinct formations: On the east side a strip of raupo swamp through which some fresh water from a creek flows, and on the west side a raised mud flat, fairly dry, and growing chiefly salt-weed (*Salicornia*). Analysis of samples of the two formations revealed distinct differences in texture and chlorine-content, as the following data shows: E/62, east side (raupo swamp), fine sandy loam, 0·12 per cent. Cl. E/64, west side (mud flat) loamy silt, 0·32 per cent. Cl. Further samples from the Richmond Block showed the marked effect of excess of sodium and magnesium salts on the fertility of the soil. E/66, representative of sterile patches, contained 0·59 per cent. Cl and 0·033 per cent. Mg, while E/68, from fertile areas growing maize and potatoes, contained only 0·14 per cent. Cl and 0·008 per cent. Mg. Magnesia extracted by citric acid was twice as high in the former as in the latter soil. There was no appreciable difference in the reaction or texture of the two types.

A series of soils was collected also from the Limestone Island Reclamation, Lower Harbour, Whangarei. In general, the soils growing rushes and tall fringing mangrove were found to be heavier than those growing stunted mangrove or small herbs (salt-weeds), and the richest soils were those fringing the creek and growing tall mangrove. The soils taken under other plant-associations were much poorer and lighter in texture. The larger portion of the area consists of fine sandy soil, which at present contains an abnormally large percentage of magnesium salts, but these should be speedily leached out on reclamation owing to the porous nature of the soil. The fact that the subsoils are coarser than the topsoils would assist the process. The soils of Limestone Island resemble those of the upper harbour in being very low in available phosphoric acid (see annual report, 1934). This deficiency can, however, easily be remedied by the application of superphosphate or other quickly acting phosphates. On the whole, the physical composition of Whangarei Harbour soils appears to be favourable to rapid drainage.

An interesting investigation was carried out on some glasshouse soils from Nelson. Trouble had been experienced with cloudy fruit in tomatoes, and to a lesser extent with mildew and virus diseases. It was suggested that excessive application of ammonia sulphate may have caused the trouble. As would be expected with soil of this type, the available and total plant-food was present in very large amount. The amounts of ammonia and nitrate were not, however, excessive. The outstanding feature was the high amount of magnesia extracted by hydrochloric acid. Carbonate was present in all the soils, which had a slightly alkaline reaction. Attention was drawn to the fact that the potato (a member of the same family as the tomato) is highly sensitive to alkaline soil conditions.

Previous surveys of Hauraki Plains soils have been confined chiefly to the coastal regions, where the effects of infiltration of sea-water on the fertility of the soils were investigated. In the period under review opportunity was taken to extend the survey further inland. The areas from which samples were taken for analysis varied in character from silts with little or no peat covering to deep peat land. Very little manure has been applied to the pastures, since Hauraki Plains soils as a whole have been found to be exceptionally well supplied with plant-food. Mechanical analysis showed, with one exception, a preponderance of fine silt and clay particles in the inorganic portion of the soils. The

organic matter (measured by the loss on ignition) reached the high figure of 61 per cent. for one of the peaty samples, which contained also over 1 per cent. of nitrogen. The reaction of the peaty soils was markedly acid (pH 4·3 to pH 4·5), and the lime requirement consequently very high. The other samples varied from pH 5·0 to pH 6·1. Plant-food was present in from average to high amounts, although available lime tended to be low in some samples.

The exchangeable base and degree of saturation of some typical virgin pumice soils were determined with a view to throwing some light on the problem of the unfavourable results attending the use of lime on pumice soils. The soils were all taken from undeveloped country, and were representative of both "sick" and "healthy" types. As would be expected in coarse soils subjected to intensive leaching, the exchangeable bases were very low, particularly in the Kaharoa soil, which is the worst type from the point of view of bush sickness. Determinations of exchangeable hydrogen and lime requirement by different methods showed that the amount of lime absorbed depended on the pH at the end point of the reaction. A marked degree of unsaturation with regard to calcium was found to exist in all the soils, but there was no apparent correlation between this value and the occurrence of bush sickness. The soils dealt with in this work were all from land which has never been cultivated or manured, and consequently there has been no opportunity for replacement of exchangeable hydrogen by calcium from the phosphatic fertilizers, the use of which is a pre-requisite to farming bush-sick country. Different results might be obtained if samples from phosphate-top-dressed paddocks which, however, were still bush-sick, were analysed by the same methods, and it is hoped to extend the investigation to such a series.

The occurrence of mortality in young stock and the difficulty in rearing lambs and calves on a Tuakau farm led to chemical analysis of typical soils, which revealed a deficiency of available phosphoric acid. It was suggested that the soils would respond well to phosphatic manuring, and a phosphate lick was also recommended.

Sheep sickness on parts of the Government Tapuwae Estate was on the basis of mechanical analysis and oxalic-soluble iron in the soils, considered to be identifiable with bush sickness. The soils were classified as sandy silts, while the percentage of iron soluble in oxalic acid in the "sick" soil was not only considerably lower than that in the "healthy" soil but also comparable with the amounts found in typical "bush-sick" soils.

A sample of soil from the Tairua Plantation, Coromandel Peninsula, was examined for the Forestry Department. It proved to be a sandy silt similar to other pumice soils on the volcanic plateau—very poor in available phosphoric acid and potash. The soil appeared to be air deposited and very little compacted, its great porosity leading to low water-holding capacity, which was suggested as a possible cause for the poor growth of seedling trees.

Some soils from a property in the Motu district, Poverty Bay, on which sheep are affected with a condition resembling bush sickness were shown to be sandy silts, while samples from adjacent healthy areas were sandy loams except in one case where the soil was also a sandy silt. It is possible that in this case the sheep had access to some outcrop of soil containing more clay or iron-bearing material.

A sample of so-called "Makasea" soil was analysed for the Resident Commissioner, Niue Island, to determine the possibility of converting it to a fertile medium for the growth of crops. It was simply a very pure communisted coral rock. The incorporation of any vegetable matter to give rise to humus was suggested, and especially the growing of green manure crops with the aid of phosphatic fertilizers.

Liming Materials.

A sample of commercial lime, stated on an accompanying circular to contain 25 per cent. burnt shell, 15 per cent. burnt carbonate, and 60 per cent. carbonate of lime was found to contain 77·3 per cent. carbonate of lime, and 1·8 per cent. calcium oxide present as burnt and slaked lime. Representations were made to the firm to amend the description of the material.

Samples of ground limestone from a works in the Auckland District were found to vary from 48 per cent. to 72 per cent. carbonate of lime content, and it was suggested that an inquiry be made at the works as to how such discrepancies arose, so as to suggest steps to ensure the production of a more uniform material. A sample of burnt lime from Rarotonga (probably derived from coral rock) contained 76·5 per cent. hydrated lime and 21·4 per cent. carbonate of lime.

Numerous samples of limestone rock, commercial lime, and ground limestone, were analysed and reported on for farmers.

The analysis of pasture samples for the Plant Research Station was continued as in previous years.

Miscellaneous.

The problem of weed control in the indigenous forest reserves of the Wanganui River was reported on. It was considered that small-scale experiments on forest regeneration and competition with introduced weeds in enclosed areas should be carried out before any measures such as the planting of exotic trees (conifers) were embarked upon. Chemical methods were impracticable in the special conditions obtaining.

One commercial weed-killer was found to consist chiefly of an emulsion of naphthalene and tar oil. It contained no thiocyanate or other potent weedicide. Another widely advertised weed-killer was found to be very variable in composition. It consisted chiefly of common salt (sodium chloride), with small amounts of sodium carbonate, caustic soda, and sodium chlorate. The sodium chlorate was probably the only potent weedicide in the mixture, and was present only to the extent of about 1 per cent.

Samples of alleged pollard sold in the Auckland District which appeared to consist largely of barley husks, bran, and chaff, and has a similar composition, were submitted to a feeding test at Wallaceville.

A report on the feeding test indicated that pigs disliked the material and did very poorly on it. It was considered to be quite unsuitable as a pig-food. A sample of meat meal that had been used in the feeding of pigs with injurious results was in a state of partial decomposition when received.

Bore-water which was intended for stock consumption from Awakino Point, Dargaville, but which had proved unpalatable to cattle, contained 0·6 per cent. common salt.

A sheep renal calculus from Kirikopuni consisted principally of calcium phosphate, silica, uric acid, and pigment. Renal calculi from a cow at Moerewa were composed chiefly of magnesium ammonium phosphate, fat, and pigment; another contained silica, calcium carbonate, cystine, and calcium phosphate.

A report by an English public Analyst that he had found copper in New Zealand lamb-livers to the extent of 100 parts per million was the cause of an inquiry referred through the High Commissioner's Office. Numerous authorities were consulted to determine the normal copper-content of lamb-livers, and work done in this laboratory thirty-five years ago in the course of the bush-sickness investigation, together with that done recently by a member of the staff (Dr. I. J. Cunningham) at the Rowett Institute, was quoted to show that the amount complained of lay within the limits of normal variation.

A sample of white gritty material from Waipapakauri proved to be a fairly pure aluminium silicate of similar composition to pyrophyllite.

The Sale of Fertilizers and Technical Advisory Work on Fertilizers and Related Products.

The Fertilizers Act and its regulations were administered as in previous years, involving considerable correspondence with fertilizer manufacturers, merchants, retailers, farmers, and others. The following is a summary of the registration of fertilizers during the year: Registration certificates issued to manufacturers and brand owners, 163; manufacturers and brand-owners registered, 92, branches, 239; number of brands registered, 851; total amount of registration fees collected, £479 11s.; secondary vendors registered, 415, branches, 251.

Owing to practically no inspection of either imported or locally produced fertilizers being carried out in this country, as provided by the Fertilizers Act, the volume of work, especially as regards correspondence handled at this office, has been necessarily increased. Much of the correspondence and interviewing relates to payment of fees, branding, invoice certificates, and various technical matters in connection with fertilizers generally. Reports on the testing and methods of manufacture and quality of certain fertilizers have been furnished on several occasions, one such report was furnished to the Industries Board. The fertilizing-value of a number of miscellaneous substances and the mixing of fertilizers has been reported upon at various times. The bringing of lime within the scope of the Fertilizers Act was a matter which was considered and reported upon during the period under review. The advertising of fertilizers has again received a good deal of attention, and still remains a problem which would be best remedied by an amendment to the Fertilizers Act. The question of the sale of "special mixtures" of fertilizers in branded packages was taken up with several vendors, and this practice was stopped.

Certain soft, earthy, alkaline phosphates, commonly known as guanos, imported to New Zealand in increasingly large quantities, no doubt on account of the scarcity and high price of basic slag, have been a source of difficulty at times owing to their great variability in composition, consequent mainly upon their high moisture-content.

Owing to the variations in sources of supply of potash salts also, the question of the regular analyses of shipments of this commodity requires some attention. Potash consignments have, of late, been brought in from Russia, Poland, Spain, &c. Check analyses carried out this year indicated variability, but nothing was found to be prejudicial to the purchaser.

The question of the importation of fish manures from England was gone into, as it was considered that animal-bones in a country with certain infectious live-stock diseases might possibly be employed in their manufacture. Investigations, however, indicated that the products were derived from fish-waste without addition of any animal-matter.

From experience gained since the Fertilizers Act has been in operation, it appears that not until all fertilizers for which application for registration is made are analysed and the results published annually alongside the registered brand and analyses, will a really satisfactory control of the sale of fertilizers be achieved. This system is in vogue in most agricultural countries.

Three lectures, one to the Grassland Conference, one to the New Zealand Institute of Chemistry, and another to the Philosophical Society were given during the year.

Fertilizers analysed.—The following showed special points of interest. A sample of material (unregistered) being sold on the West Coast as bone-dust was submitted for analysis on account of its unfavourable effect on turnips and similar crops. It contained only 0·28 per cent. phosphoric acid and 1·04 per cent. nitrogen. Unfortunately it was found impossible to secure an official sample. Samples of destructor ash from Auckland contained about 18 per cent. calcium expressed as calcium oxide, of which about 9 per cent. was calcium carbonate, and a little over 1 per cent. each of water-soluble potash and of total phosphoric acid.

Weed-control Experiments.

Larger-scale experiments with safer substances of promise in connection with the economic control of ragwort, primarily, and other highly pernicious weeds were actively continued throughout the summer and autumn months as opportunity and limited time allowed. The groups of chemicals showing most promise—namely, thiocyanates, chromates, bisulphites, and hypochlorites, in that order—were further submitted to a large number of trials under more varied conditions. Bisulphites were also

used in trials. Exhaustive tests are still necessary to decide the technique of using all these compounds. Many other substances were tried on ragwort, but the group of chemicals mentioned above are still the most toxic of the large number of chemicals submitted to tests and further studies of their action on ragwort, &c., is well warranted. The matter of developing a technique for the proper use of thiocyanates under varied conditions is being continued as opportunity offers.

Judging by the correspondence and the number of inquiries received during the year in connection with the weed-eradication work of this Section, it would appear that farmers are beginning to realize more fully the seriousness of the weed problem in this country, and it would seem desirable to intensify the investigation of chemical methods of weed control.

Work for the Departmental Divisions.

Live-stock Division.—The usual periodical analyses of public cattle-dips have been carried out. Other analyses include toxicological specimens, licks, medicines, meat-marking fluids, &c.

A serious case of poisoning of horses and cows occurred near Ashburton. Unfortunately no viscera were submitted, but no poison was found in samples of chaff and sacking associated with the feeding of the animals prior to their becoming ill. However, a bottle of liquid with a leaky cork which appeared to have been lying on one side for a considerable time was found to contain large quantities of copper, antimony, and arsenic.

Samples of whey and of bitumen paint were examined in connection with a case of mortality in pigs following the installation of a storage-tank and pipe-line system for distributing whey to pig-troughs. The paint was found to contain only mineral bitumen, and no tar-products such as phenol or cresol which might have been injurious. The mortality was not considered to be due to chemical poisons.

In connection with the death of two cows in the Putaruru district associated with the use of a proprietary spray for ragwort-destruction, the spray used was found to be an arsenical one, and significant amounts of arsenic were found in the liver and abomasum contents of one of the animals.

Several stock-licks were found to contain large proportions of carbonate of lime, and attention was drawn to the undesirability of such a practice, prominent veterinary authorities considering that the neutralizing of the gastric juice by carbonate of lime would unfavourably affect the digestive processes.

A considerable amount of work was performed in connection with the selecting and development of a suitable formula for a meat-marking fluid consequent upon the change from blue to brown dye in the interests of the export frozen-meat trade. Intermittent thawing and freezing of the carcass had been found to cause the brown stamp to run. Various suggested formulæ were tried out and analyses made of the unsatisfactory inks. A formula suggested by the English authorities was eventually found to be superior to those in use.

Horticulture Division.—Several selected samples both of kiln-cured and air-cured tobaccos grown in the Bay of Plenty and Nelson Districts were analysed fully. The analyses were compared with those published in other countries for various grades of leaf, and attention was drawn to directions in which the composition might be improved. Further work in this connection is contemplated.

Fields Division.—Numerous analyses of liming materials were made, particular attention being given to samples of commercial crushed limestone in connection with applications for the free-railage concession.

Samples of soil from Wharekohe Block, North Auckland, on which the owner had had very little success with market-garden crops were examined for waterproofing substances which it was thought might be causing infertility through extreme dryness of the soil. A little kauri-gum was extracted, but there was no evidence of waterproofing waxes, and it was concluded that the high lime requirement (1·2 per cent.) and acidity (pH 4·3) were probably responsible for the infertility and that liming would be highly beneficial.

Summary of samples received :—

Soils	103
Liming materials	174
Reputed fertilizers	16
Fertilizers	21
Pastures	163
Dips	36
Licks and medicines	9
Thyroids	288
Waters	33
Toxicological	23
Weed-killers	5
Limonites	24
Miscellaneous	151
Total	1,046

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