1931.

NEW ZEALAND.

DEPARTMENT OF AGRICULTURE.

ANNUAL REPORT FOR 1930–31.

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

SIR,— Wellington, 31st July, 1931.

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, 1931.

It will be seen that, notwithstanding difficult working conditions due to the necessity for economy, the varied services of the Department for the agricultural industries have been well and efficiently maintained. On the scientific side much valuable work is recorded from the Plant Research Station at Palmerston North, while the Wallaceville Veterinary Laboratory report indicates a keen attack on animal health problems, in keeping with similar work overseas. The Chemistry organization continues to do most useful work, particularly in connection with soil and pasture deficiency investigations.

In all this scientific work close touch is maintained with the related Imperial Agricultural Research Bureaux and overseas research centres. I wish to acknowledge with much appreciation the valuable grants made by the Empire Marketing Board towards the cost of various important investigations. Never has agricultural research been of greater moment than at present, and it may be fairly claimed that the Department is giving a good return for the expenditure by practical application of the knowledge gained.

A feature of the past agricultural year has been a continued increase in production of most of our primary staples. On the other hand, a substantial decline in the Dominion's sheep-stock is recorded after a series of years marked by rapidly increasing numbers. This check, however, may be largely ascribed to causes capable of rectification. Arable production was satisfactory in general, despite weather handicaps, a fact which reflects improved farming practice, based largely on the Department's experimental work and advice.

On the marketing side our agricultural industries have had to face the prevailing universal economic depression. While the increased output of marketable products provided a valuable offset to this, the position calls for special effort by producers towards the reduction of costs and a related increased per-acre yield. Various measure are being taken to this end, and the Department of Agriculture is endeavouring to carry out its share of the Government policy.

The dairy industry has gone through a difficult year, falling market-values for both butter and cheese, combined with the development in the British market of a strong prejudice against cheese standardization, being outstanding features. The improvement of cheese quality is having marked attention, and it is realized that those engaged in cheese manufacture fully appreciate the necessity for this. The Department's specialist officers are working in close co-ordination with the Dairy Research Institute in its investigations.

The increase in the Department's estimates of expenditure for the current financial year is due to its taking over the whole cost of the concessions on railway freight-rates for the carriage of farm fertilizers and lime. The shrinkage in the use of fertilizers of late, owing to financial stress, is recognized as a matter of the utmost concern, and the Government is using the organization of the Rural Intermediate Credit Board to facilitate advances to farmers on this account.

Some encouragement in the present position is afforded by evidence that bedrock has apparently been reached in the price-level of our main exports. Hard work, improved practice, and mutual sacrifice among all interests will go far towards the economic advance of our agricultural industries.

I have, &c.,
A. J. MURDOCH,
Minister of Agriculture.

His Excellency the Governor-General.

REPORT OF THE DIRECTOR-GENERAL.

THE HON. THE MINISTER OF AGRICULTURE. Wellington, 30th June, 1931.

I submit the following report concerning the work of the Department during the past official year, together with Division and Section reports, and a statement from the Phosphate Commissioner. Some details of the activities of the Plant Research Station and the Wallaceville Laboratory are included in an appendix.

THE ECONOMIC POSITION.

The downward trend of prices, which has been in evidence of late years, was again responsible for a further substantial decline in the national income.

The quantity of lamb, mutton, veal, butter, and cheese exported for the twelve months ended 31st March, 1931, was substantially greater than that of the preceding year, but the declared values for the three first-mentioned products showed an increase of only £278,064, while in the case of butter and cheese values showed a decline of £1,724,270. The total decline for the main pastoral products—viz., wool, lamb, mutton, and beef—was £5,047,550, or 25·06 per cent., while the percentage decrease in value for butter and cheese was 9·47.

The lower prices realized for all classes of produce appears to have been due principally to the adverse economic conditions operating in Great Britain. Special efforts are being made to widen the markets for New Zealand produce in Great Britain. Definite progress in this connection is being made, and, as economic conditions improve, substantial benefit should accrue.

To meet the position which has developed by reason of the low returns from farm-produce, it is increasingly important that every means should be adopted to increase production and reduce costs wherever possible. This end can best be achieved by an extension of the intelligent use of fertilizers, better grassland management, and improvement of stock.

CLIMATIC CONDITIONS AND PRODUCTION.

Weather conditions have a potent influence on either increasing or decreasing farm-production, and those of the past year tended to have a depressing effect reflected by a lightening of the wool-clip, an increase of undergrade lambs, a reduction in individual yield of cows, and a lowering of crop yield. Climatic conditions as a whole, however, have really been more unfavourable than is indicated by the actual volume of production; and the remarkable manner in which production has been maintained, and in certain cases increased, can be held to be due to the better management methods that have coincided with the increase in production over the past six or seven years.

The case of the wheat crop is an example. The conditions for wheat have been such that it was anticipated that the average yield would be well below the average, and yet the threshing returns show that the yield will be quite as high, if not higher, than last year. This can be entirely attributed to the almost universal adoption of fertilizing the wheat crop, together with the more general use of a high-yielding variety such as Solid-straw Tuscan. Had the crop not been fertilized, the 4 or 5 bushel increase that the Department has shown can be credited to the application of superphosphate would not have been realized, and the yield would have been in the vicinity of 25 bushels per acre. The expansion of butterfat-production by some 8,000,000 lb. in a year when conditions were distinctly unfavourable is clearly traceable to improved management, in which top-dressing, herd-testing, and better grassland utilization all played their part.

ANIMAL HEALTH AND ANIMAL HUSBANDRY.

As will be gathered from the report of the Director of the Live-stock Division, the various stock troubles present in the Dominion have been the subject of close observation by the field staff, while a large volume of research and investigation work has been carried out at the Veterinary Laboratory at Wallaceville and by the specialist veterinary officers in the field. Details of this will be found in the appended report of the Laboratory. It is satisfactory to note that encouraging progress has been made in our knowledge regarding the causes of temporary sterility of dairy cows and the measures which may be found of value towards its prevention. Control measures in contagious abortion and mammitis of dairy cows have also been the subject of much investigation, and our knowledge regarding these is increased as a result. Constant

touch has been maintained with similar work being done in other countries, and the reports just received of the International Veterinary Congress recently held in London indicate that New Zealand is keeping well abreast of overseas progress.

Though heavy losses occurred through drought conditions in Hawke's Bay, sheep diseases have not caused any serious mortality, the feed and weather conditions in the past autumn not being conducive to large losses of hoggets such as occurred in the North Island in the late autumn of 1929. As a matter of fact, much of the trouble occurring among both sheep and dairy cattle can be prevented by the exercise of the best-known management methods, and endeavours have been made to still further develop advisory services specially directed to this end. The Field Veterinarians, in connection with their general work of investigating disease outbreaks and unusual troubles among farm stock, make a point of advising farmers on preventive measures, most of which are directly associated with stock-management methods aimed at the maintenance of health and vigour in stock. Side by side with this, the Stock Inspectors are being more and more converted into animal-husbandry advisory officers in conjunction with their statutory duties, the good knowledge of stock-management which by observation and experience they have gained rendering them well fitted for advisory work of this character, especially when the technical knowledge of the Veterinary staff is translated into suitable propaganda material for their use among farmers.

Advantage has been taken of an offer from the Dominion Group Herd-testing Federation to allow its testing officers to collaborate with the Department by collecting data regarding the actual incidence of disease among dairy cows and other causes necessitating removals from the herd. The testing officers in the course of their duties have good facilities for obtaining this information at first-hand from farmers throughout each milking season, and the information supplied by them has enabled the Department's Farm Economist to compile some very useful and illuminative statistical figures based upon results in 2,547 dairy herds containing an aggregate of 128,283 cows. This shows that the wastage in these herds from all causes during the 1929-30 season was 10·7 per cent., of which 3·7 per cent. was on account of sickness or disease, including breeding troubles, and 5·3 per cent. on account of low production. This compares favourably with other dairying countries concerning which similar information is available. In Denmark, for instance, the annual wastage is stated to be 16·7 per cent., of which 10 per cent. represents breeding difficulties. There is still plenty of room for improvement in New Zealand, especially as figures taken over the whole of our dairy herds would probably show a higher average. The considerable number of cows culled on account of low production emphasizes the value of herd-testing.

One of the serious troubles of the dairy-farmer is mammitis, and it can be taken for granted that the culling on account of this by no means represents its real incidence, as many affected cows would be put under treatment and reinstated as effective members of the milking herd when their condition returned to apparent normality. At the last International Veterinary Congress mammitis was extensively discussed, and it was accepted that no method of treatment has yet been found which could be relied upon as effective for either preventive or curative purposes. The exercise of care as regards cleanliness and hygiene generally, precautions to prevent the spread of infection, and the other methods already recommended by the Department are still the best known for combating mammitis. In addition, a method of laboratory technique has been elaborated at the Wallaceville Laboratory which enables cases of what may be termed "masked" mastitis to be effectively detected. With this available, practical demonstrations have been made in the Waikato of a method of control under which the milk of each cow in an affected herd is microscopically examined, and the cows divided into three lots—(*a*) those free from infection; (*b*) those showing only slight infection; and (*c*) those showing well-marked infection. A milking routine is then established under which the healthy cows are milked first, and the well-marked cases last, proper sanitary precautions being taken throughout. So far as these very limited tests went, the results were very promising in that the extent of the trouble was much less than in previous years. In the coming season a larger number of herds will be put under similar treatment. This method is well worthy of the serious attention of dairy-farmers, and the Department's available resources in helping them to carry it out are at their disposal.

As regards swine, the greatest losses have been due not to disease in itself but to troubles resulting from wrong management and wrong feeding methods. A special point has been made during the year to improve swine-husbandry practice by systematical advisory and instructional methods, and some improvement is already noticeable.

Distemper in dogs is still troublesome, and the efforts made to prepare a reliable preventive vaccine have not met with the success desired. Improved methods of treatment are still being sought for.

The Dairy Industry.

For the first time in the history of the dairying industry in New Zealand the average grading-points for creamery butter have exceeded 93, and nearly four-fifths of the butter produced has graded finest. Considering that conditions for manufacture have not been uniformly favourable, this achievement on the part of factory-managers merits congratulation.

The main characteristics of New Zealand butter are uniformity, mild flavour, and excellent keeping-qualities, and on these it has firmly established its position on the British market. As a mild low-acid type New Zealand butter compares more than favourably with that of any of its competitors, but there are clear indications that the British consuming public would give preference to a type intermediate between the high-acid type of Denmark and the low-acid type of New Zealand. If such could be produced without any loss of keeping-quality it would be distinctly advantageous, and the Dairy Division is giving considerable attention to this point.

While the quality of New Zealand creamery butter is distinctly showing an upward tendency, the same, unfortunately, cannot be said with regard to the general quality of our cheese. The introduction of standardization, and its subsequent modification in name and percentage of butterfat to dry matter, has resulted quite unsatisfactorily. The British consuming public evidently look to New Zealand to produce a full-cream cheese, and the divergence from this by the part skimming of milk, notwithstanding the fact that the percentage of butterfat to dry matter was high in the finished article created a prejudice against our cheese output. For this reason alone standardization has been unsuccessful. From the Government standpoint standardization was viewed as probably lessening considerably the difficulties attendant on cheese-manufacture from high-butterfat-testing milk, with resulting improvement in quality. After two seasons' trial the grading statistics clearly show that standardized cheese grades on the average lower than does full cream. In other words, standardization under our present knowledge of manufacture tends to lower quality, and therefore the practice must be eliminated if any sincere effort to regain British confidence is made.

The elimination of standardization will not, however, of itself put to rights the question of cheese-quality improvement. An impartial view of the cheese situation clearly brings out that there are many factors to be considered and their influence on quality determined before the position can be satisfactorily put into order. Among these the questions of marketing a more mature type of cheese than is at present the practice is perhaps the most important, inasmuch as any definite alteration in this direction will be expensive. Again, the question of a still purer milk-supply is one that must be ultimately connected with quality, and the time is certainly opportune for the introduction of a system of milk-grading under which inferior quality is penalized. A third factor that must be determined definitely before any authoritative statement on how best to improve our general quality can be made is whether or not an increasing butterfat percentage in milk is detrimental to the manufacture of a really superior article. In addition, the questions of certain diseases in their relation to the production of milk unsuitable for cheese-manufacture, and the relation of pasture composition from the viewpoint of top-dressing to milk-quality, also merit consideration.

The Fruit Industry.

Although orchard-development from an extension point of view has been practically at a standstill for the past few years—new plantings little more than offsetting eliminations—the industry has made substantial progress in practically every other direction. Improvements in the methods of disease-control, cultivation, manuring, and general orchard-management, plus the maturing of existing trees, have led to a substantial increase in production year by year. A sound system of grading, packing, and standardization has led to New Zealand fruit securing first place on practically all oversea markets; while a very efficient scheme of organization covering the assembling, packing, shipping, and marketing of export fruit has materially improved the prospects of the industry, and has led to a continual extension of oversea markets. Markets served last season (1930) were Great Britain, Argentina, Uruguay, Brazil, British Columbia, Eastern Canada, and several countries on the Continent of Europe. Fortunately for the industry, fruit has not been materially affected by the existing marketing depression.

Last season's export was practically a record, approximately one and a half million cases of apples and pears being shipped overseas, the gross value of which was over £750,000. Unfortunately, damage occurred to one shipment of 43,000 cases, which, allegedly due to faulty transportation, arrived in an almost unmarketable condition. This is still the subject of inquiry. The prospects of the industry have been detrimentally affected in one

direction consequent upon the Government of Argentina—which country during the past few years has absorbed an aggregate of well over one and a half million cases of New Zealand fruit—having announced its intention of placing a duty of 33⅓ per cent. *ad valorem* on all fresh fruit imported into that country. This impost, when taken in conjunction with the adverse exchange position of Argentina, is likely to render that market of little value in future to the New Zealand fruitgrower. However, it is anticipated that the increasing sales being effected on the Continent of Europe will offset this substantially.

Use of Artificial Fertilizers.

It is unfortunate that farm-improvement and farm-maintenance costs leading directly to increased production on a lowering cost basis are the very ones that are first reduced by farmers when the price-level for farm-products drops. This has been most noticeable with regard to the employment of artificial fertilizers.

In the year 1923 less than 100,000 tons of artificial fertilizers was used both for top-dressing and ordinary crops. The tonnage used in the next seven years increased each year by about 50,000 tons, and in 1929 the amount of 450,000 tons was exceeded, of which nearly 350,000 tons was used for top-dressing. In 1930, consequent mainly on the serious decline in wool-values, top-dressing of sheep-country largely ceased, with the result that the tonnage fell by nearly 50,000 tons to 404,000 tons. During the last five months of the year the fall has been intensified, and much dairying country has not been treated. The figures from January to May inclusive for each of the past three years are as follows:—

	Tons.	Decrease.
1929	200,000	..
1930	184,000	16,000
1931	130,000	70,000

Since January of this year to the end of May the New Zealand farmer has cut his fertilizer bill by £350,000, compared with corresponding period of 1929—a reduction in expenditure that is likely to be reflected in a marked decrease in the volume of his production in the coming season.

Wool-production.

Details regarding wool-production will be found in the appended report of the Live-stock Division. The low values received were disappointing, but there is reason for satisfaction on one point—namely, that the general quality of our crossbred wool is showing a gradual improvement.

Noxious Weeds.

The outstanding feature with regard to noxious weeds has been the unqualified success of sodium chlorate in the destruction of ragwort. Over 400 tons of the material have been imported, and tens of thousands of acres have been sprayed. So far as the small dairy-farmer is concerned, he need no longer fear serious trouble from ragwort. The fact also that spraying can be effectively carried out throughout the growing-season enables the labour necessary to be spread, so that it need not interfere with the normal operations of the farm. The efficiency of sodium chlorate in the destruction of Californian thistle has also been well demonstrated, and considerable quantities have been used for this purpose. More than one application is, however, needed for complete eradication.

The price of the material—namely, 5d. per pound—has been the subject of criticism, but as the business was an entirely new one to New Zealand merchants, costs could not be brought to the point they can be now the trade has been firmly established.

Ruakura Farm of Instruction.

Notwithstanding increased production, the gross income of the Ruakura Farm of Instruction shows a sharp drop as compared with the previous year, due entirely to the heavy decline in values of farm-produce. A very close watch has been kept over expenditure, and it is satisfactory to be able to record that a considerable saving has been effected.

Following a very favourable autumn the winter of 1930 was commenced with pastures well covered and stock in good condition. For the fourth year in succession the winter stocking was increased, and it is now approximately 70 per cent. higher than it was five years ago. All classes of stock wintered well, and, after making reasonable allowances for lambing deaths

among old ewes, the mortality due to all causes was very light. One hundred and thirty cows and heifers were calved with a minimum of trouble, and for the fourth year in succession the herd has been perfectly free from milk-fever; 124 pedigree calves were reared, and of this number sixty-four bulls will be distributed per medium of the annual sale in August next. As these animals are all from very high-producing stock, their distribution should exert a marked influence in increasing production in the herds to which they eventually go.

Continuing the policy of recent years, eighteen young cows were placed under C.O.R. test, and the records established by these at the end of the season will be very satisfactory.

The annual sale which was held at the farm in August of last year proved highly successful in so far as the demand was concerned, but values showed the same sharp decline which was experienced at all other stud-stock sales during the season, the average prices realized for bulls of the different breeds being as follows: Shorthorns, £34 4s. 2d.; Ayreshires, £15 15s.; and Jerseys, £30 18s. Pedigree pigs were in strong demand, and the large offering realized high prices. The gross proceeds of the sale were £2,205, as against £3,056 for the previous sale, which was easily a record for the farm.

The herds of Large White and Berkshire pigs have continued to improve both in quality and breeding-power. Exhibits were made at the last two Auckland Metropolitan Shows, and on each occasion the farm's entries proved highly successful against strong competition from leading breeders in the province. One hundred and fifty breeding-pigs of all ages will be offered for sale at the annual sale in August next.

During last winter a consignment of twenty-seven Large White - Berkshire - cross pigs was forwarded to Smithfield for exhibition and sale and to obtain a report as to the suitability of the animals for the English market. The report received was highly satisfactory from every point of view. A further trial shipment of bacon-pigs, consisting of purebred Large Whites and Berkshires, and the first cross between these two breeds, will be forwarded to London at an early date, and the report on the different types should prove interesting and instructive.

Farm Training College: The students' accommodation has been fully occupied during the year, and everything connected with the school has proceeded smoothly and efficiently. Forty-eight youths are now in residence.

Land-development Work.

Excellent progress has been made with the breaking-in of land on behalf of the Lands Department under the provisions of the Land Laws Amendment Act, 1929. Two blocks, known as Ngakuru No. 1 and Ngakuru No. 2, are being dealt with in the Rotorua district, and one at Te Kauwhata. On Ngakuru No. 1 1,213 acres have been cleared, and of this area 1,160 acres have been sown in grass, with plantations, &c. On Ngakuru No. 2 an area of 1,975 acres was cleared to the 31st March, and 400 acres cultivated. Only a small area was sown in grass in the autumn of 1931, and the remaining portion of the block, consisting of approximately 3,000 acres, is to be grassed.

A very careful record of the cost of development of these pumice lands is being kept. The actual cost of getting the land down in good pasture, based on a minimum wage paid of 14s. per day, works out at £7 15s. per acre. Provided that by suitable management and reasonable top-dressing the pasture can be maintained in a satisfactory manner, such expenditure should be payable. One section on Ngakuru No. 1 has been fully equipped as a demonstrational dairy-farm. Excluding stock the cost will work out at approximately £20 per acre, this including all necessary buildings and subdivision into small paddocks. Dairying will be commenced on this area approximately within twelve months of the burning of the scrub.

The progress of this developmental work on waste pumice lands must be watched with great interest. If it proves successful, the potentialities of settlement on a large scale are great; if it does not, it will prove once for all whether the settlement of such land is a sound policy, as the very best and most modern methods of grassing and maintenance of pasture are being adopted. It is interesting to note that the certified rye-grass in the seed-mixture used has given outstanding results, and emphasized the necessity of attention to strain in the laying-down of grassland on virgin country.

At Te Kauwhata a block of approximately 1,000 acres of wattle plantation is being converted into eight dairy-farms. Practically all the necessary work on three farms has been completed, and the sowing of the fourth should be completed next spring. The remaining area is being cleared of fallen timber, and will be ploughed during the winter and sown next autumn.

The Phormium (Hemp) Industry.

The past season has been a disastrous one for the phormium industry. Export prices being well below the cost of production, the majority of the mills suspended operations during the year, as is indicated by the fact that only a little over 5,000 tons of hemp was produced, in comparison with over 12,000 tons for the previous year. The award rate of wages was reduced during the year by 33 per cent., but even then, at the ruling prices for hemp, it was impossible to mill at a profit, except in those instances where little or no royalty had to be paid for the leaf.

The immediate prospects in front of the industry show no improvement, and it is unlikely that milling will be resumed on any extensive scale in the near future. The enforced cessation of cutting will in many cases be advantageous so far as the growth of flax is concerned, but, unfortunately, owing to the uncertainty of reasonable royalties being conceded, many areas are being converted into grazing land.

The possibility of making use of a considerable tonnage of New Zealand hemp for conversion into sacking for woolpacks and corn-sacks is at present being explored by private enterprise, and if it is found possible to establish a payable business in this direction, a revival of the phormium industry could quite well take place. So far as binder-twine and cordage are concerned, ample supplies of sisal and manila are still being produced, but as prices for both these fibres, as in the case of our hemp, are well below their cost of production, supplies must sooner or later fall away, with consequent tendency towards payable prices being again realized.

Phosphate Supplies.

The remarkable increase in production which has been manifest during recent years is largely due to a better appreciation by farmers of the benefits accruing from the regular application of fertilizers. A definite impetus to the wider use of phosphatic fertilizers was given by the acquisition of the phosphate deposits at Nauru and Ocean Islands by the British, Australian, and New Zealand Governments after the war. In 1921 the quantity of phosphate rock imported into the Dominion from these islands amounted to only 4·69 per cent. of the output, whereas in the past three years New Zealand has absorbed approximately 25 per cent. of a greatly increased output. This rapid development has been made possible by the policy of the Commissioners in making supplies available to manufacturers as cheaply as possible, and to this end the c.i.f.e. price has been steadily reduced from £4 5s. per ton to a little over £2 per ton. Unfortunately, the demand during the past year has not reached expectations, with the result that a loss on the year's operations will probably result. Every effort is, however, being made to meet the position to the best advantage in the interests of consumers in the Dominion.

Carriage of Fertilizers by Rail.

In pursuance of the policy of encouraging the use of fertilizers, the concessions granted in respect of the carriage of fertilizers by rail have been continued. In the case of lime, free carriage is granted up to 100 miles, while in the case of other fertilizers a reduction of 40 per cent. in the freight charge was made a few years ago. The value of the concessions thus granted for the past two years is as follows:—

	1929–30.	1930–31.
	£	£
Lime	49,576	49,212
Fertilizers	131,832	120,122

Conclusion.

A mass of detailed information regarding the whole of the activities of the Department will be found in the Divisional and other reports which follow. Every effort has been made to maintain all services at as high a standard of efficiency and usefulness as possible, and the excellent manner in which Divisional Directors, Sectional heads, and the whole of the staff have responded to this effort is highly appreciated.

C. J. Reakes, D.V.S., 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

THE eleventh year of operations under Government ownership at Nauru and Ocean Islands terminated on 30th June, 1931, with the following results as regards phosphate shipments, compared with the two previous years :—

	1928–29. Tons.	1929–30. Tons.	1930–31. Tons.
Nauru	342,770	296,310	240,855
Ocean	233,820	207,863	145,122
	576,590	504,173	385,977

A decrease of 118,196 tons in quantity shipped will be noted. This largely diminished output was caused by the serious drop in demand for fertilizers in Australia and New Zealand, necessitating the curtailment of operations at both islands. Of the above tonnage, Australia took 263,047 tons, and New Zealand 122,930 tons. No shipments were made to other countries during the year.

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

	1928–29. Tons.	1929–30. Tons.	1930–31. Tons.
Nauru-Ocean	138,053	117,826	112,873
Outside	29,288	49,983	22,935
	167,341	167,809	135,808

The outside importations in 1930–31 were made owing to existing contracts entered into when the demand was considerably in excess of the capacity of Nauru and Ocean Islands.

Regarding the proportion of the Nauru-Ocean output which comes to the Dominion, the figures as compared with the two previous years are : 1928–29, 24·66 per cent. ; 1929–30, 25·21 per cent. ; 1930–31, 31·85 per cent.

The year under review has seen important developments in connection with the plant at the two islands. The recently completed cantilever at Nauru for mechanical loading has been brought into regular use when suitable weather permitted ; the specified loading rate of 550 tons per hour has been exceeded, and vessels are given quick despatch. For instance, the m.v. " Glenbank," carrying 8,250 tons of phosphate, was only thirty-three hours at the island. The new steel cantilever jetty at Ocean Island is also proving suitable for conditions there. The s.s. " Triona," recently built by Messrs. Harland and Wolff, Ltd., for the Commission, is now employed in the trade, and her special appliances for laying or lifting the deep-sea moorings at the two islands will, it is considered, be very useful. These and other developments in connection with the mining and artificial drying operations will prove invaluable when the demand for phosphate again continues on the upgrade.

LIVE-STOCK DIVISION.

REPORT OF J. LYONS, M.R.C.V.S., DIRECTOR.

Pastures, Crops, and Stock Conditions.

As a result of the abnormally wet weather which prevailed during the early part of the season in the North Island particularly, a plentiful growth of quick-growing feed resulted. These conditions, while favourable to the milk-yield, were all against the fat-lamb trade, and many lambs in the early part of the season arrived at the works in a condition not as prime as in normal seasons, and consequently suffered in grade. In the South Island the climatic conditions were unfavourable to the growth of young lambs to such an extent that their arrival at the works was three to four weeks later than in previous seasons. Later on, however, better conditions prevailed, and the indications were that the seasonal killings would be up to the average both as regards numbers and quality.

Dairy cows came through the winter well on the whole, although in some districts a cold wet spell in the spring checked the milk-yield for a time. Conditions were afterwards favourable, and the individual yield will be maintained.

The season was in many parts all against saving hay crops, and it is to be feared that much of what has been saved is not up to standard as regards quality. Against this a large quantity of ensilage was saved, which will to a great extent take the place of the hay. In the Otago District farmers, on account of the season, were late in getting in their crops. The effect of this as far as grain crops is concerned is that they did not ripen in time to allow them to be harvested before the summer ended.

Although in some districts the autumn rains arrived too late to be of the greatest benefit to the pastures, the feed conditions are such that given an average winter we can look forward with confidence to our stock coming through satisfactorily.

Health of Stock.

The principal disease and troubles affecting stock are dealt with under the respective headings as follows :—

CATTLE.

Tuberculosis.—The total number of cattle condemned and destroyed in the field as the result of clinical examination and the tuberculin test amounted to 5,460.

The number of cattle examined on slaughter at the various abattoirs and meat-export slaughter-houses was 259,804, a decrease of 24,713 from last year. Of these, 11,057, or 4·25 per cent., were found affected with tuberculosis in varying degrees, a large percentage being only slightly affected. This represents a reduction of 0·86 per cent. on the previous year's showing.

The total number of swine subjected to examination was 457,355. Of this number, 46,008, or 10·18 per cent., were found to be affected with tuberculosis, and, as in the case of the cattle, a large percentage was only very slightly affected. This percentage represents a slight increase on last year's showing, but is practically the same as the percentage of the previous year.

Actinomycosis.—The animals condemned for actinomycosis for which compensation was paid was 660. The district totals are as follow: Wellington, 209; Auckland, 342; Canterbury, 42; Otago, 67. Only such cases as were showing open lesions were condemned and slaughtered. Others met with were placed under treatment.

Malignant Growths.—The number condemned for which compensation was paid was 458.

Mammitis.—Taking the Dominion as a whole, the incidence of this disease can be said to be on the down grade, no outbreaks of a serious nature having been recorded. Nevertheless, there are still too many herds where the disease is in evidence and too many cows have still to be culled from the herds for the complaint. Scientific research has not yet furthered our knowledge with regard to the effective control of this complaint from a prophylactic or curative standpoint. We still have to rely mainly on the methods of treatment in vogue during the past decade. At the same time a system of microscopical examination on approved lines has been developed which enables the diagnosis of all cases, even in the mildest form of the disease, to be made with greater accuracy, and with this in operation, together with more care in milking, thorough cleanliness and proper handling of milking-machines, and better sanitation generally, the incidence of the disease should be lessened still further.

Contagious Abortion.—This disease has reached the stage in almost every district throughout the Dominion where it is non-progressive. A few cases can be seen in almost any district where dairying is carried on without assuming epidemic propensities. If farmers individually and collectively would put more effort into the control of this disease they would be in a better position with regard to its control than they are to-day. When once an animal contracts the disease it is a well-known fact that it remains in her system for the rest of her life, and that at every calving period, whether she has previously aborted or not, she becomes a spreader of infection. If dairy-farmers would only avail themselves of the opportunity which is offered by the Department's Laboratory at Wallaceville and have their cows subjected to the agglutination test, they would then be in the position of knowing which cows were affected, and would be able to segregate them for a period after calving until all discharge had ceased. By so doing the disease could be confined to a given area on the farm and afterwards eaten down by sheep or bullocks before again being grazed by dairy stock. Young calves fed on affected cows' milk, although they do not contract the disease from this cause, pass the organism on to the pastures. Such pastures will require to be treated as affected pastures also.

Temporary Sterility.—This complaint still causes considerable inconvenience to dairy-farmers in those districts where dairying is carried on extensively. With reference to this disease the District Superintendent, Wellington, remarks, "One cannot help observing the trend amongst dairy-farmers to develop the idea that the cause of the delayed conception rests in the present-day specialization of the high-producing cow. Talk of too much being taken away without replacement is gaining ground." As a remedy for this, mineral licks are being extensively used. Results from this treatment were not encouraging. Departmental officers during the past season carried out experiments in a considerable number of herds where the disease was strongly in evidence, with mineral and vegetable tonics, and again the results were not encouraging. Treating the affected parts with various astringent antiseptic solutions has also been given a trial, and, while a certain amount of success is claimed for the use of iodized-salt solution, it cannot be held that this method of treatment is an unqualified success. In fact, entire success in the treatment of this disease cannot be claimed in this or any other country, and it would almost appear as if certain animals were demanding a rest, and will not get in calf until late in the season when they will settle down on their own account. This throws them late in coming to production the following season and necessitates winter milking, a procedure which is not appreciated by the farmers. It is felt that in these cases if the animals were not persevered with, but allowed to go through the winter without being put in calf and thus giving them a rest, such a practice would go far to lessen the incidence of the disease. It will be found that in the following spring such cows get in calf without any trouble. Research work in connection with temporary sterility has been actively prosecuted, particular attention being given to the part played by the bull, and in this connection evidence is accumulating which points to the bull being often responsible. Detailed information regarding this research work will be found in the report of the Officer in Charge of the Wallaceville Laboratory.

Parturient Eclampsia.—This disease was less in evidence than in previous seasons. With the exception of a few cases seen in Hawke's Bay, it was principally confined to the Waikato district, where a considerable number of cases were seen and treated with varying success. From observations of the officers in the field it is evident that where dairy cows are carried through the winter and early spring season on a liberal supply of good hay and ensilage the incidence of the disease is very materially lessened.

Milk-fever.—Taken as a whole, this trouble, though fairly prevalent, was not so common as in previous years, and no serious mortality has to be reported. During the past season a considerable number of cases were treated with solutions of calcium injected intravenously and subcutaneously, with satisfactory results. The salts used were calcium chloride and calcium gluconate. The former is somewhat difficult to use, and must be injected intravenously if the destruction of the surrounding tissue is to be avoided. The gluconate can be injected intravenously or beneath the skin of the neck or shoulder without any danger to the surrounding tissues. As stated, both methods of treatment can be recommended with confidence. It is doubtful, however, if the calcium treatment will ever supersede the old method of inflation of the udder which has been in vogue for the past thirty-odd years. Nearly every dairy-farmer keeps a milk-fever pump in his shed which he is capable of applying, whereas calcium salts are somewhat difficult to obtain, and are beyond his means of application. It can be claimed for the new method of treatment that there is no danger of contaminating the udder, the secretion of milk is not interfered with, nor has the tedious process of freeing the udder from air to be undertaken. The use of lime in the drinking-water as a preventive for milk-fever is gaining ground amongst dairy-farmers and the results will be observed.

Blackleg.—An increased incidence in the number of cases seen during the past season has to be recorded, and this can be attributed to a great extent to the wet season experienced. Every effort has been made to check and control this disease.

Cattle Tick.—Area A, Auckland District: The position with regard to the North Auckland District, with the exception of the Dargaville, Coromandel, and Bay of Plenty districts, which remain about the same, shows an improvement on previous years.

Auckland District, Area B: The position is not quite so good as last year, an odd tick being found on holdings in various districts which previously were thought to be free from the pest. On those isolated farms where ticks were found during the previous year although a strict watch was kept there was no recurrence during the present season.

Wellington District: No further development has taken place in Area A. Several fresh outbreaks have occurred in Area B, and a few ticks have also been found beyond Area B in hitherto clean country. The question of an alteration to the boundary in this district will require to be considered in the near future.

Taranaki District: An extension of the cattle-tick took place in the New Plymouth district in January. In the Bell Block area ticks were found on eight adjoining farms, and at the Mohakatino River. A few miles south of Mokau two farms were found to be affected. In the Pongarehu district where ticks were discovered last year one farm was found to be affected this summer. No ticks were found inside the Waitara area.

In the Nelson District no cattle-ticks were found during the season, although regular inspection was maintained on all farms where ticks had been seen previously.

It is worthy of note that on well-grazed farms where the feed is kept short, and where any roughage that may make its appearance is destroyed, the tick is reduced to a minimum. In fact, it can be said that this is one of the methods whereby the menace can be controlled. Cover such as rushes, rough pastures, &c., is essential to the development of the eggs. It is therefore imperative that all roughage which is likely to harbour the tick eggs should be burned or otherwise destroyed wherever possible.

Ragwort Poisoning.—A considerable number of deaths have been reported from all districts where this weed is prevalent. Sheep will eat this plant readily, and on this account they are frequently used

as a means of control. Where the pastures are heavily infested it is almost impossible to avoid the toxic effect of the weed. Cattle, however, will only eat it under compulsion, or where the weeds are so numerous that they cannot avoid doing so. It is therefore a matter of regret that in some districts cattle pastures are allowed to become contaminated to such an extent that the stock cannot avoid consuming the plant. Now that a better means of control (sodium chlorate) is available to every farmer, there is no excuse for allowing the pastures to become infested to the extent that they become a menace to cattle.

Foul in the Foot.—A considerable number of cases have been seen in all dairying districts and consequently a good deal of monetary loss has resulted therefrom due to the fact that an animal contracting the complaint is practically useless as a dairy unit during that season. Treatment is laborious, and in the majority of cases is not carried out. As this disease is contracted through injuries in the region of the hoof, it should be the aim of every dairy-farmer to prevent such wounds by removing from the yards and roadways all such material as will injure the feet. To prevent infection all yards, &c., should be kept free from dirt, and affected stock should be isolated until all discharge has ceased.

Parasitic Disease in Young Cattle.—A considerable amount of parasitic gastritis and bronchitis was in evidence in almost every dairying district, and, although in no case was the mortality high, the monetary loss was considerable through retarded development. Parasitic invasion is chiefly seen in those herds which have been reared on skim-milk or whey where no substitute has been added to make up for the essential constituents lacking in the skimmed milk or whey and where the animals are afterwards turned out and allowed to fend for themselves as best they can. Calves reared under such unfavourable circumstances lack stamina and fall an easy prey to such troubles which would not have the same effect on calves properly fed.

Dietetic Troubles.—In the Waikato district bloating amongst cows was rather serious during the months of October and November. It was also reported in other parts of the North Island. This complaint is somewhat difficult to control during wet seasons. The use of a night paddock together with a feed of good hay for the cows before being turned out, decreases the intensity and the number of cases seen. Topping the paddocks is also beneficial.

Bush Sickness.—The use of citrate of iron and ammonia as a preventive and curative agent in this deficiency complaint is increasing year after year by farmers in affected areas, and, as a result, stock are enabled to be kept healthy and dairying carried on in these areas. In addition to the iron treatment, suitable top-dressing, good grass-management, and good herd-management are necessary.

SHEEP.

Parasitic Gastritis.—Owing to the more favourable seasonal conditions which existed last autumn, this complaint was not seen amongst our lamb flocks to anything like the same extent as in the previous season. Flockowners are also paying more attention to the rearing of their lambs by providing better pastures, drenching, &c. Wet seasons, with the concurrent long rank pastures, appear to be the deciding factors which bring about this disease, with its heavy death-rate. In order to avoid this, better pasture-management, more especially in wet seasons, is essential. With regard to this, the District Superintendent, Wellington, remarks, " Reference must again be made to the necessity for the control of sheep pastures by the increase in the number of run cattle, the avoidance of overstocking in the case of young sheep, and the adoption of more subdivision and rational grazing are the outstanding factors in better sheep-management."

Lymphadenitis.—Field investigational work into this disease, combined with inspection at the meat-works, show that this disease is prevalent throughout the Dominion, but more especially in the South Island and southern portion of the North Island. When sheep and lambs are found affected at the freezing-works the policy of tracing them to the owner's premises is still being carried out wherever possible, and instructions given with a view to controlling the disease. In addition to this, a considerable number of flocks are being palpated in the field for control purposes. It is necessary that every sheepowner should see that no sheep with enlarged or open discharging glands are allowed to remain in his flock.

Renal Congestion in Lambs.—With the exception of the Otago District, only odd cases of this trouble have come under notice. Even in the Otago District the losses were reported to be 40 to 50 per cent. below those of the previous season. Further information on this matter is contained in the report of the Officer in Charge of the Veterinary Laboratory.

Ante-partum Paralysis in Ewes.—This trouble was in evidence in almost every sheep-farming district throughout the Dominion. Although a few flocks suffered severely, and a fairly high death-rate occurred, the disease on the whole was less in evidence than in former seasons.

Maggot Fly.—With the exception of several districts in the Far North this pest has not been much in evidence during the season. Owing to the past summer being a cold one, it is reasonable to assume that adverse climatic conditions have a considerable influence in reducing the number of the pest.

A considerable number of puparia from the Cawthron Institute were liberated in various districts, but as yet it is too soon to judge what the influence has been. Fly-traps are being brought into use and are highly spoken of as a measure for keeping the flies in check.

Liver-fluke.—No serious trouble was reported from this.

Lice.—I am pleased to report that a considerable reduction has taken place in the number of sheep found affected in saleyards affected with lice.

General.—A number of other minor complaints were seen in several districts, but in no case were they prevalent. Advice and assistance wherever sought was always given by the Field Officers of this Division.

PIGS.

The number of pigs slaughtered for the season 1930–31 was 479,500, as compared with 524,753 for the previous season, a decrease of 45,253. The amount exported, 150,025 cwt., as compared with 155,288 cwt. for the previous season, shows a decrease of 5,263 cwt. Even with a less amount exported, the consumption within the Dominion is considerably short of the previous year. This can be accounted for to some extent by the reduced purchasing-power of the community and the relatively lower price of other meats.

Pig-breeding as an adjunct to the dairying industry has not received the consideration it deserves. Ever since its inception those engaged in the industry have only succeeded in supplying the wants of the Dominion, with the exception of a small margin for export. The system hitherto in vogue of purchasing pigs intended for local and export trade has not been altogether favourable to the pig-producer nor did it stimulate the raising of the standard of carcass required by the consuming public or the export trade. For the most part pigs were purchased on the hoof or by weight over the scales at a fixed rate, and but little consideration is given to type or quality and a better price for high quality. During the past season an attempt on voluntary lines has been made to purchase on the hooks on type and weight. This, while not meeting with the entire approval of many farmers, is a step in the right direction, and will ultimately lead to the production of a better class of carcass and to a better price for those who succeed in producing the right type of pig.

If our export trade is to be increased farmers must pay still greater attention to the type and quality of the carcass produced. Other countries are doing so, why not New Zealand? Much more interest is now being taken in this, and the field staff of the Division is conducting advisory propaganda regarding it.

During the past season pigs on the whole have been fairly healthy, and there has been no disease amongst them requiring special mention. A few cases of necrosis due to insanitary surroundings, a number of cases of pneumonia due to cold, and a number were found suffering from paralysis due to wrong feeding. Under improved conditions good recovery was made in the majority of cases.

Live-stock Statistics.

A further substantial increase in the numbers of sheep held in the Dominion was revealed in the returns collected as at the 20th April, 1930. The returns show an increase of 1,789,905, bringing the number of sheep up to 30,841,287. Of this number the increase in breeding-ewes was 956,020, making a total of 17,564,175 breeding-ewes.

The number of sheepowners now show as 30,022, being an increase of 3,310. A very heavy slaughter of sheep and lambs took place subsequent to the 30th April, 1930, and consequent on an estimated reduced lambing return this will no doubt be reflected in the statistics for 1931. Cattle show an increase in all classes but one—that of steers two years old and over—compared with the previous year's figures. The total for 1930 is 3,765,668, including 1,440,321 dairy cows, the latter being an increase of 69,258. A further decrease has taken place in the number of swine in the Dominion, the total number as at 30th January, 1930, being 487,793 a decrease of 68,939. The number of horses shown are 297,195, being a decrease of 1,785 when compared with the previous year.

Slaughter of Stock.

The lambing season was not so satisfactory as has pertained for the past few years, the estimated lambing percentage showing a reduction for the Dominion of 4·88. This reduced lambing was most marked in the Hawke's Bay and Poverty Bay districts.

The numbers of sheep and lambs slaughtered during the year were again very heavy, especially was this so in the case of lambs. The respective numbers of stock slaughtered at registered premises were: Sheep, 3,563,952; lambs, 8,092,795; cattle, 326,136; swine, 450,490; calves, 551,762.

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 ending 31st March, 1931.	Year ending 31st March, 1930.	Increase.	Decrease.
Cattle	124,323	138,467	..	14,144
Calves	504,222	393,513	110,709	..
Sheep	2,636,820	2,598,510	38,310	..
Lambs	7,896,328	6,462,783	1,433,545	..
Swine	273,489	279,230	..	5,471

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

Stock.	1927–28.	1928–29.	1929–30.	1930–31.
Sheep	1,580,024	1,421,741	1,982,550	1,671,493
Lambs	4,093,750	4,093,332	4,431,424	5,331,021

These figures show a decrease of 311,057 sheep, but an increase of 899,597 lambs 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, 1931: Cattle, 259,804; calves, 549,836; sheep, 3,329,686; lambs, 8,065,960; swine, 428,345.

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

Stock.	Abattoirs.	Meat-export Slaughterhouses.	Bacon-factories.
Cattle	135,481	124,323	..
Calves	45,614	504,222	..
Sheep	692,866	2,636,820	..
Lambs	169,632	7,896,328	..
Swine	121,589	273,489	33,267

Stock slaughtered at ordinary slaughterhouses during the year ended 31st March, 1931, was as follows: Cattle, 66,332; calves, 1,926; sheep, 234,266; lambs, 26,835; swine, 22,145. Carcasses of pork killed and dressed by farmers and sent into butchers' shops and small factories and examined by departmental officers numbered 29,010.

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, 33,772; calves, 8,566; sheep, 228,460; lambs, 89,060; swine, 28,205.

Compensation paid for Stock and Meat condemned.

Compensation to the amount of £17,225 13s. 6d. was paid out during the year for animals condemned in the field for disease under the provisions of the Stock Act, and £14,496 11s. 11d. 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 Stud Stock from Abroad.

The prohibition imposed on cattle, sheep, and swine from the United Kingdom as a precaution against the entry of foot-and-mouth disease still exists, and the only countries from which stock may be imported subject to the regulations are: Cattle from Tasmania, Canada, and the United States (with the exception of California), and swine from Australia (with the exception of Queensland and Western Australia), and Canada, and sheep from Australia (with the exception of Queensland and Western Australia). A prominent feature was the heavy importation of pedigree cattle in comparison with former years. The following imported animals were placed in quarantine during the year for the respective periods required: Horses, 7; cattle, 87; sheep, 9; swine, 10; dogs, 27.

Exportation of Stud Stock.

During the year under review the following stud stock was exported: Sheep, 3,270; cattle, 69; swine, 10; horses, 4 (draught). There was the usual movement of racehorses to and from Australia.

Dairy Inspection.

Owing to the fall in the price of butterfat, a number of dairy-farmers in the vicinity of our cities and towns have directed their attention to supplying the population with milk, finding it more remunerative than taking their output to the dairy factories. The registration of such premises for the supply of raw milk for human consumption entailed a considerable amount of work on the part of the Dairy Inspector. There are now close on 5,000 dairies registered for supplying our cities, towns, and boroughs throughout the Dominion. Of these, 2,193 supply the four larger centres.

During the last few years a considerable advance has been made with regard to the type of dairy shed being erected. The old type of shed, which on account of its construction was difficult to keep in a sanitary condition, is fast disappearing, and new structures built on sanitary principles are being erected, with the result that the farmer is supplying a better commodity that what he was able to do previously and with less trouble to himself.

With regard to the health of cows in registered dairies, that has been well maintained. All animals are regularly inspected, and any suffering from disease are condemned or isolated. In addition to this the tuberculin test has been freely applied and all animals reacting thereto are forthwith destroyed. Further to this composite samples of the milk are taken from a number of herds and subjected to a biological test, and should there be positive results the various members of the herd are tested individually. The health of the herds and the standard of cleanliness of the sheds and surroundings are being well maintained.

Poultry Industry.

The poultry industry is still suffering from want of proper organization, and this hampers producers in improving local marketing conditions, and exploring the possibilities of export of eggs or egg-pulp. Properly controlled, the industry is capable of contributing a valuable quota to the already high value of the Dominion's annual production, but, on the other hand, there is a danger that without better organization and improved marketing arrangements the industry will not progress as it should. At the last annual conference of the New Zealand Poultry Association a proposal aiming at bringing about better organization within the industry was discussed and carried, and has since been submitted to the Department for consideration, as legislation is required to give effect to it. It is hoped that something tangible will result.

I append hereto the report of the Chief Poultry Instructor :—

The past year has not been a particularly good one for producers. Owing chiefly to the fall in prices on the London market, no eggs were exported from the Dominion, and, as a result, the whole of the year's output has been consumed locally, made into pulp, or otherwise preserved for use during the winter season. During the greater part of the year low prices ruled for eggs when compared with food-costs, so that the average poultry-keeper had to be content with a small margin of profit over the cost of production.

While wheat is generally regarded as the staple grain for fowls, the question of its price must be taken into account by the poultry-keeper in order to make the maximum profit over cost of production from his flock. For example, the high prices charged for what is commonly termed fowl-wheat, much of which is of inferior quality, as compared with the proportionate low prices being asked for good-quality imported pollard, &c., has led many producers to experiment with a more economical ration by using more of the above-mentioned imported foods and considerably less wheat.

At the present time a great weakness connected with the industry is the manner in which eggs generally are presented for sale to the consuming public. Realizing the weaknesses in this respect, and with a view to bringing about an improved system whereby eggs would be sold according to their quality and weight, the Department has given the marketing side of the business much serious attention during the past year. A conference was arranged between departmental officers, representatives of producers, and others concerned in the disposal of eggs, but, owing chiefly to lack of organization among producers, the desired ends could not be achieved. This is much to be regretted, for there is no doubt that one of the best means of encouraging the production of standard weight eggs—viz., 2 oz. or over—and of increasing the demand on the part of the consumer, is to place the marketing of eggs on a proper footing; and to effect this the institution of a system whereby the eggs would be sold by weight after being tested for freshness is imperative. This, however, is a result that can only be accomplished through united action on the part of producers.

The great need of the industry is a better understanding of practical poultry-keeping by small farmers in order that more eggs will be produced, particularly during the winter months. The Department is doing everything possible to assist in this direction by supplying purebred utility stock and sittings of eggs from its Wallaceville Poultry Station at moderate prices. Literature giving practical advice on all phases of the industry is also obtainable at a moderate cost, and, in addition, a practical staff of Instructors is available for the purpose of addressing public meetings, giving demonstrations, and visiting plants by request. The value of the work carried out by the Instructors, four in number, when visiting plants, particularly in regard to culling unprofitable stock and in selecting the best specimens for breeding purposes, is having a gratifying effect in raising the producing-capacity of many flocks in the Dominion and in the increased monetary results being obtained.

While outbreaks of disease have shown a substantial decline during the year, it is to be regretted that complaints regarding troubles in stock arising from internal parasitic infestation have increased, and, in fact, several producers have suffered severe losses from this cause. As a result of experiments carried out at the Wallaceville Poultry Station in co-operation with the officers attached to the Veterinary Laboratory, the question of controlling both external and internal parasitic life is now much better understood than formerly.

Wallaceville Poultry Station. — The most important of the operations carried out at this station during the year was a continuation of experimental and investigational work, the chief aim being to throw light on some of the difficulties commonly met with in the management of poultry. Among other things that may be mentioned in which investigation was conducted, are the following: Ridding fowls of internal and external parasitic infestation by a nicotine preparation; feeding brooder chickens, and the value of skim-milk as compared with water when provided to brooder chicks; experiments regarding incubation; green leg in chickens; experiments regarding cannibal habits in chickens; experiments regarding the feeding of cockle-shell and oyster-shell; feeding iodine to fowls; feeding cod-liver oil to brooder chickens. The results of several of these experiments have been published in the *Journal of Agriculture*, and others will appear as opportunity arises. A further series of experiments and investigational work has been planned, some of which is now in progress. In order that more time may be devoted in connection with investigational work, the standard laying flock has been considerably reduced.

Animal Husbandry.

In addition to the ordinary work along the lines of animal husbandry considerable propaganda work was instituted during the year in connection with the use of (1) meat-meal in conjunction with root crops for wintering store pigs; (2) meat-meal in conjunction with whey for calves; (3) meat-meal in conjunction with skim-milk for calves; (4) meat-meal for whey-fed sows; (5) meat-meal with whey for weaned pigs; (6) cattle and sheep licks; (7) the feeding of ensilage to sheep. It is recognized that whey being low in flesh-forming constituents or proteins is naturally not a satisfactory food when fed alone, and to supply a supplementary food rich in proteins meat-meal is a highly satisfactory supplement, and has the advantage that it is comparatively cheap compared with other foods which have been used and it is available throughout the Dominion as a by-product of the abattoirs and meat-export slaughterhouses. As a result of the advice given by officers of the Division individually, through the press, and by lectures, a considerable number of farmers have given meat-meal a trial, and are so satisfied with the results that it is anticipated that the use of meat-meal will be greatly extended this coming season. It is, of course, necessary that only meat-meal of good quality, free from hair and fibre, and containing from about 56 to 60 per cent. of protein be used for this purpose.

Wool.

The year has been a disappointing one for the wool-grower. Market-values were low, and the clip was not up to the usual standard either in bulk or quality, due largely to the climatic conditions which ruled in late winter and throughout the spring months.

I append hereto extracts from the report of Mr. J. G. Cook, Wool Instructor :—

The bulk of the wool did not open up well, a considerable amount of it being discoloured, owing to its having been too long on the sheep in a wet condition, and, further, there was more tender wool this past season than has been the case for some years past, this tenderness or break in the fibres being due to the check the sheep received during August and September. At the opening of the first wool-sale, held in Auckland on 25th November, 1930, there was a fairly good attendance of buyers, but prices were very poor, and, although wool was in demand by the buyers, it was evident that their price-limits were low, with the result that much of the wool offered was passed in.

I attended the first wool-sale in Wellington, held on the 8th December, 1930, when there was a better attendance of buyers, but prices were still low, more especially for qualities from 46's up. In several instances during the sale the lower-quality wool fetched better prices than the finer-quality wool in the same clip, this being due to the fact that the coarser wool with a good length in the fibre was in short supply, whereas there was an oversupply of the 46's to 50's quality. The bulk of the wool is being shipped to the United Kingdom, with France, Germany, Australia, Japan, and Belgium buying in that order. The woollen-mills operating in the Dominion were able to secure wool suitable for their purposes, while Dominion woolscourers were operating more freely in their purchase of wool than they have been for some time past.

The following table gives the average prices realized at Wellington for the last five selling seasons, including any sales which were held in April :—

Year.	Bales offered.	Bales sold.	Average Price per Bale.	Average Price per Pound.
			£ s. d.	d.
1926–27	105,927	103,311	18 5 8¾	12·287
1927–28	110,388	108,979	24 10 5	16·511
1928–29	121,396	113,626	22 4 11	14·958
1929–30	91,629	74,093	13 11 4	9·204
1930–31	104,730	93,682	8 11 1	5·895

For the last five years for Wellington sales the average is £18 0s. 6d. per bale, or slightly more than 12d. per pound. The average price for the Dominion is generally only slightly higher than the Wellington average price, and, although the price for wool this selling-season has been low, when one considers the average realized over a five-year period, it can be seen that the prices have been very fair. The point shown is that in 1927–28 wool averaged over 16½d. per pound, yet in 1930–31 similar wool averaged only slightly over 5¾d. per pound, a difference of 10¼d. per pound between the two above-mentioned years.

The number of sheepowners on the 30th April, 1930, was 30,022, an increase of 3,310 over the previous year.

During the past year practical demonstrations on live sheep have been given to farmers, pointing out to them the good points to breed for, and the bad points to avoid. In addition, practical demonstrations were given in various shearing-sheds as to the manner in which to prepare the wool clip in the most attractive manner for sale. Lantern lectures with suitable slides have been delivered, and all lectures and demonstrations have been well attended by the farmers.

Microscopic Examination of Wool Samples.—A considerable amount of this class of work has been carried out during the year, and reports thereon have been sent to the farmers concerned as a guide to them in avoiding the use of faulty rams in their ewe flocks.

Rabbit Nuisance.

The control of rabbits during the year has given some concern, and although good work has been done in many districts there are no doubt some localities where the incidence of rabbits is less satisfactory than in recent years. This position is due to the seasonal conditions enabling rabbits to breed up quickly during the spring and summer months, together with low prices for furs and the financial depression which placed many settlers in the position of being less able to pay for the usual suppression methods.

For several years prior to this one the high price of skins induced a considerable number of experienced rabbiters to engage in the work of rabbit-destruction with little or no cost to the landowner, but early in the present season the value of furs receded to a point where the collection of skins ceased to be a payable occupation. Rabbit-control work at once became a direct charge on the landowner at a time when very few of them were in a position to employ extra labour. The altered conditions necessitated closer attention to rabbit inspection, with the result that a good deal of work has been carried out in most districts.

Strychnine poisoning is still giving excellent results, and, although a little more costly than poisoning with phosphorized pollard, is nevertheless in favour as a reliable destructive agent. On account of the increase in the pest, a heavy demand set in for phosphorized-pollard poison, approximately 20 tons being despatched from the Frankton Poison-mixing Depot in two months.

Rabbit Boards have, without exception, carried out their work in a satisfactory way, and rabbits in their areas are well under control. Under localized Board control the work goes on systematically throughout the year, and the conditions in the various areas under their jurisdiction are striking evidence of what can be done by systematic operations and continuity of effort.

As regards industrial rabbits (angoras and chinchillas) the interest once taken in them has now declined. Many who obtained permits to keep them have given up the business, and very few fresh applications are now being received.

Noxious Weeds.

The position as regards noxious weeds, particularly ragwort, is succinctly set out by the District Superintendent, Auckland, in a report reading as follows: "The ragwort menace is still regarded as the most serious danger threatening the farmer in the more closely settled dairying districts. The control of this weed with sodium chlorate was extensively demonstrated in all districts during the early spring months, and a great deal of interest was manifested by farmers and businessmen alike. The results of the demonstrations carried out proved satisfactory in every case—practically 100 per cent. kill. A great deal of valuable work was later carried out by owners of infested properties, and all reports to hand indicate that landowners are well satisfied with the results obtained."

On the smaller holdings of high value, there is now no reason why ragwort should not be completely eradicated, but on the more extensive holdings, broken and partially cleared lands, of lower value, the control of ragwort is less easy.

Four hundred and seventeen tons of sodium chlorate were imported into the Dominion during the year and widely distributed. This material has been used with more or less success on weeds other than ragwort, but its application to gorse, blackberry, and broom has not, so far, proved very successful. Further trials on these and other plants will be put in train next season.

During the year a number of settlers in Canterbury used sodium chlorate on Californian thistle with satisfactory results. Field observations have shown the roots killed to a depth of 8 in. to 10 in. in the ground, and where a second application has been carried out there has been no appearance of fresh growths to date. The Department itself treated with excellent results considerable areas of unoccupied river-bed lands that were heavily infested with Californian thistle, and the Inspectors concerned are of opinion that the work can be done more economically than by cutting. A later inspection of the Crown lands sprayed shows that in practically all cases the roots are quite dead for a considerable depth in the ground, and any fresh growths appear to be from seedlings.

Experiments on Californian thistle carried out by officers of the Fields Division and at Lincoln College have shown that the best results were obtained when sodium chlorate was applied during the month of March or early in April. Lincoln College reports striking results. Patches that have resisted every known method of treatment for thirty years and more are apparently completely exterminated in one season, the few remaining sickly plants being easily finished off in the second year.

Shearers' Accommodation.

The inspection of shearers' accommodation was contined to be undertaken by this Department on behalf of the Labour Department. On the whole, the accommodation provided is satisfactory, although, of course, some places are more up to date than others. A good number of inspections were made and where necessary requisitions for improvements served. In many cases where on inspection only minor matters required to be remedied written requisitions were not served as a verbal request had the desired result. All complaints were investigated and necessary improvements asked for where warranted. One prosecution was instituted.

Staff.

I cannot conclude this report without a word of praise and thanks to the staff for the manner in which they have, one and all, faced the difficulties of the financial position of the Dominion, and endeavoured to the best of their ability to continue to render a valuable service to the country with a reduced travelling-expenditure. The work of the officers necessitates them going in and out among the farmer producers of the Dominion, and no one has a better understanding of the difficulties with which the farmers are faced than they and the necessity that exists to-day of economical production.

FIELDS DIVISION.

REPORT OF J. W. DEEM, DIRECTOR.

Arable Crops.

On account of the unseasonable weather in the summer the cereal harvest promised to be below the average, but the increased acreage will more than offset any lowering of production compared with last season. Actual figures are not yet available, but it is estimated that 243,000 acres of wheat were sown, as against an actual sowing of 238,653 acres in the previous season. Of this latter acreage, 237,433 acres were actually harvested for threshing, and yielded a total of 7,239,556 bushels, or 30·68 bushels per acre. The estimated Dominion yield per acre for 1930–31 season was 27·08 bushels, but actual threshings to date show that the average yield will be approximately 30 bushels.

So far as the oat crop is concerned, it was estimated for 1930–31 that 322,000 acres were sown, as compared with 257,794 acres actually harvested in 1929–30. Threshings to date for the season average 38·06 bushels per acre. This is approximately 6 bushels per acre less than was obtained the previous season, but on account of the increased acreage in oats in 1930–31 as against 1929–30 the position in respect of oats and oaten chaff is considered quite satisfactory.

Barley threshed for the five seasons ended 1929–30 averaged 97·99 per cent. of the total area under that crop. Assuming that a similar proportion is threshed for the season 1930–31, the total yield of grain should be approximately 795,000 bushels, as against an actual yield of 755,007 for the season 1929–30.

The area in potatoes in 1930–31 was estimated at 24,000 acres as against an actual area in the previous season of 23,214 acres. On the average of the last five seasons—viz., 5·56 tons per acre—the total yield from the estimated area shown for 1930–31 should approximate 133,500 tons, as against 130,107 tons last season. It is fairly definite that the quantity of table potatoes available from the 1930–31 crop will be more than ample for the Dominion's requirements.

Artificial Fertilizers.

The top-dressing of pastures, except on sheep-country, was well maintained until the present autumn, when a serious decline took place. The top-dressing of pastures calls for improved methods of grassland management, and, provided this is carried out by farmers, any diminution in the use of artificial fertilizers on grassland is to be deplored. Improvement in the proper utilization of the increased herbage produced as a result of top-dressing is as important as top-dressing itself.

The use of artificial fertilizers continues as a recognized part of cultivating routine, and it is interesting to note the extent to which farmers are now utilizing this aid to production. From statistics available it is ascertained that for the 1930–31 season 72·65 per cent. of the area in wheat, 63·97 per cent. of that in oats, 59·18 per cent. of that in barley, and 57·16 per cent. of that in potatoes have been treated with artificial fertilizers. These figures show an increase on the corresponding figures for the previous season. There is no doubt that this progressive movement has come to stay, and its trend will be maintained in the future.

Second-growth Country.

The comprehensive experimental work conducted on hill country, particularly in the Whangamomona County, which has been reverting to secondary growth, has been continued; but, as much of the information required is now available, there will be no need for this work to be conducted in the future on the same extensive scale as has been the case in the past. Arrangements therefore have been made for considerable curtailment.

The demonstration farm conducted by the Lands Department in the Whangamomona County under the provisions of the Deteriorated Lands Act has been carried on, and quite excellent carrying-capacity has been attained with a corresponding result so far as returns are concerned.

Instruction in Agriculture.

This is the most important function of the Division, and requests from the farming community for advice show a steady increase from year to year. This increase has been definitely stimulated by the bad conditions existing at the present time. The curtailment of expenditure in travelling-expenses necessary to keep within the amount appropriated means that the instructors are not able to meet this demand by personal visits, and consequently a great deal has to be done by telephone or letter. While this is very helpful to the farmer, it cannot compare with a personal visit to the farm where the instructor is enabled to discuss the farmer's problems with him on the spot.

Experimental Farms and Areas.

Puwera.—This farm has been conducted during the year as an ordinary dairy-farm, and experimental work has been restricted to investigations regarding the value of nitrogenous fertilizers, observational phosphatic top-dressing plots, and rotational grazing. A separate report will be prepared later for publication in the Department's *Journal*.

Marton.—The majority of the work carried out during the past season on this area has been of an intensive technical nature, and has been conducted by the specialist officers concerned in grassland-research work. The work at Marton has consisted in the main of rye-grass strain trials, manurial trials, and technique connected therewith.

Ashburton.—As in the past seasons a great deal of the work at Ashburton has been in connection with the improvement of the potato crop. During the 1930–31 season, however, the work on this farm was conducted under most trying weather conditions. In connection with certification, 334 lines of potatoes were tried out in the certification trials and 232 lines in the qualifying trials. This is the largest number so far entered in any one year. About 16 acres were under various varieties, and selections of potatoes and seed from these will be available for sale to farmers for sowing in the 1931–32 season.

Gore.—This farm has again during the season been devoted to experimental work, and a wide range of investigations has been dealt with. Of particular importance has been the experimental work in connection with club-root, and the results being obtained are very encouraging.

Galloway.—This area continues to serve, as was originally intended, as a demonstration of the adaptability of irrigated country to dairy-farming. Continued interest is shown by local settlers in the activities of this farm.

Waimaunga.—Dairying has been continued on this farm during the year.

Subsidized Farms.—The subsidized farms at Stratford, Manaia, Dargaville, and Winton have continued to do much useful demonstration work during the season.

Winter Lectures.

The holding of winter lectures as in past years was not so prominent a feature during the 1930 winter. The decrease in the number of lectures given was to some extent due to officers not having sufficient time available to organize and conduct these lectures.

Ruakura Farm Training College.

The Training College established at Ruakura in 1923 continues to meet the popular demand, and for the first term of 1931 all accommodation at the school was occupied. No great difficulty is experienced in securing an adequate number of students to enter Ruakura each term.

Boys' and Girls' Agricultural Clubs.

These clubs are still conducted in various parts of the Dominion, especially in Taranaki, Wellington - West Coast, and the Wairarapa districts, while a considerable extension has taken place in Canterbury and Otago-Southland. As hitherto, the movement embraces the growing of crops, particularly roots, and the rearing of calves. Owing to reduction in available funds it will be necessary to revise the basis on which these clubs are at present conducted.

Land-development Schemes.

The land-settlement policy of the Government has created a considerable amount of extra work for several of the field staff, and particularly for the Fields Superintendent for the Auckland District. Development work on a block called Ngakuru No. 1, a few miles distant from Rotorua, was continued, and the authorized programme of development was completed by the end of March, 1931. One thousand two hundred and thirteen acres were cleared, and 1,160 acres were cultivated and sown in grass and plantations, and much subdivisional fencing carried out. During the year (in November, 1930) work was commenced on a block adjoining and called Ngakuru No. 2. On this block to the end of March, 1931, 1,975 acres were cleared and 400 acres cultivated. Only a comparatively small area was sown in grass in the autumn of 1931, and the remainder of the block, of approximately 3,000 acres, will be sown in grass during the coming spring.

In addition to this development work on the pumice-land near Rotorua, some work has been done on about 50 acres of pakihi soils near Westport.

Deteriorated Lands.

The work carried out under this heading for the Lands Department ceased during the year, and is now carried on by officers of the Lands Department.

Farmers' Field Competitions.

Farmers' field competitions were carried on in various parts of the Dominion, but mainly in Taranaki and Wellington - West Coast districts, on much the same lines as in past years.

Chemical Control of Noxious Weeds.

Quite an appreciable step forward in the control of noxious weeds by chemical means was made during 1930–31 season. On the recommendation of the Department large quantities of sodium chlorate were used to control noxious weeds, particularly ragwort, and the improvement obtained in those districts formerly badly infested with ragwort is most noticeable. A considerable amount of experimental work on other weeds with sodium chlorate, calcium chlorate, Atlacide, Occysol, and other materials, has been conducted during the season, and it is hoped to publish the results secured, with recommendations, in a bulletin so soon as the current season's work has been finalized.

Field Experiments.

The extensive programme of work in field experimentation carried out during the year has dealt with variety, manurial, and other trials on all classes of roots and grains. The total number of experiments conducted was 696, spread over the whole of the Dominion. This work gives the Division a permanent record of the behaviour of the crops under different manures and different systems of manuring, and information of a similar character in other directions. With the careful summarizing of the results most valuable information is obtained, and this information is being disseminated to farmers through the Department's *Journal* and the instructional staff.

Crop Certification.

Crop certification continues to expand, and for the season just ended the following crops have been dealt with under this scheme: Rye-grass, white clover, brown-top, wheat, and potatoes. With rye-grass a total area of 5,642 acres was certified, as against 2,447 acres the previous season. Increases have also been shown in the volume of each of the other crops, but not so great as in the case of rye-grass. The benefit to be derived from using certified seed is being more and more recognized by both the farming community and the seed-merchants, and a still further rapid expansion of this work can be looked for in the near future.

Insect Control of Noxious Weeds.

Working in co-operation with the Cawthron Institute, officers of the Fields Division during the year made numerous distributions in widely scattered centres of the cinnabar moth for ragwort-control. This work has simply followed up that done the previous two years. The moth has now been established over many areas, and full opportunity is afforded of showing whether or not it will be effectively beneficial.

Ironstone Land in North Auckland.

The work in progress on a block of ironstone country at Kapiro, near the Bay of Islands, has been carried on. The establishment and growth on the area sown last autumn have been very poor, and generally results are not promising.

Ensilage.

In my last report I mentioned that a definite ensilage drive had taken place. This was continued during the past year, with the result that most districts in New Zealand have made sufficient ensilage to recognize its value, and the making of silage should now rapidly become a definite farm practice on all farms where material is available. Instructors generally report a considerable improvement in the quality of the silage made.

Radio Lecturettes.

Officers of the Division at regular intervals broadcast lecturettes on numerous subjects of interest to the farmer. These lecturettes, it is understood, are highly appreciated, and the intention is to continue them.

Reports for other Departments.

Other Departments of State, particularly the Lands and Survey Department and the State Forest Service, have made a number of calls on officers of the Division for reports and investigations on land propositions.

The Hemp Industry.

The hemp industry of the Dominion has during the year fallen on very bad times, and a decrease in the amount of fibre submitted for grading as compared with the previous year has been shown to the extent of approximately 66 per cent., the actual figures being 1929–30, 65,813 bales, against, in 1930–31, 23,478 bales of hemp. This decrease is due very largely to slump prices only being obtained for sisal and manila, the other fibres which compete with New Zealand fibre. As indicated previously, the amount of hemp graded for the year ended 31st March, 1931, was 23,478 bales, as compared with 65,813 bales for the previous year, a decrease of 42,335 bales. The quantity of tow graded was 6,938 bales, as compared with 20,070 bales for the previous year, a decrease of 13,132 bales. Of stripper slips 315 bales were graded, as compared with 1,435 for the previous year, a decrease of 1,120. Of the hemp graded 8·47 per cent. was "good fair," 47·06 per cent. "high fair," and 31·25 per cent. was "low fair." The percentage of "good fair" shows an increase when compared with the corresponding figure for 1929–30, but, owing to the much smaller quantity graded in 1930–31 than in the previous season, the comparison is not reasonable.

Show Exhibits.

Officers of this Division have assisted at all centres where exhibits have been staged, and in some cases have taken charge of the complete exhibit.

Departmental Photography.

The photographer attached to this Division has performed excellent service during the year and has carried out, as in the past, photographic work for all branches of the Department and occasionally for other Departments.

Staff.

I desire to place on record my appreciation of the loyal service rendered by the staff, both field and office, during a particularly arduous year.

DAIRY DIVISION.

REPORT OF W. M. SINGLETON, DIRECTOR.

Production.

Despite the more or less unfavourable weather conditions during the past season, an increase in the quantities of butter and cheese has again to be recorded. For the year ended 31st March, 1931, 95,981 tons of butter and 92,527 tons of cheese were received for grading, as compared with 94,054 and 86,962 tons respectively for the previous year. This represents an increase of 1,927 tons of butter, equal to 2·04 per cent., and 5,565 tons of cheese, equal to 6·4 per cent. In terms of butterfat equivalent they represent an increase of 4,305 tons, or 3·89 per cent.

Quality of Creamery Butter.

Butter-factory managers are to be congratulated on the high quality of the bulk of the creamery butter manufactured, the average grade of which during the year was 93·10, as compared with 92·96 for the previous year. Butters scoring finest exceeded last year's figures by 3·9 per cent., the totals being 78·31 and 74·41 per cent. respectively. "Firsts" and "under firsts" were 20·59 and 1·07 per cent. respectively as compared with 24·09 and 1·5 per cent. for the previous year.

During the year a regulation was gazetted and came into force as from 7th August last limiting the quantity of salt in butter from not less than 1½ per cent. to not more than 2 per cent. This has resulted in a more even salt content, which, together with the uniformity of body and texture, even moisture content, and more attention to packing and finish, reflects the greatest credit on butter-factory managers.

Whey Butter.

The production of whey butter shows an increase as compared with the previous year, the figures being 1,358 tons and 1,128 tons respectively, an increase of 229 tons. Although factory-managers have given more attention and care to the manufacture of this class of butter, the infrequent delivery of the whey cream from cheese to butter factories militates against the production of a satisfactory quality article.

It is understood that some New Zealand whey butter is at times supplied by the retail trade in the United Kingdom to customers asking for New Zealand butter. It is recognized that most of the exported whey butter goes into manufacturing channels and that some is used by blenders. The prohibition of export to safeguard creamery butter to a greater extent has been considered. The small percentage which whey butter constitutes of the Dominion's total output, together with the fact that comparatively little is presumed to be retailed, seem reasonable grounds for making no change.

Quality of Cheese.

The quality of cheese manufactured during the year has not been uniformly satisfactory. Cheese-factory managers have experienced a trying year in so far as conditions for the manufacture of good-quality cheese is concerned, and, although an earnest endeavour has been made to improve the quality, this has not been realized to the desired extent, more especially in districts in the North Island where "standardized" cheese has been made. Cheese graded "Finest" for the year amounted to only 17·53 per cent., as compared with 24·16 per cent. for the previous year. Percentages of "firsts" and "under firsts" were 79·80 and 2·65 per cent., as compared with 73·85 and 1·98 per cent. respectively for the previous year.

In the early season makers experienced considerable difficulty in developing sufficient acid in the curds, and in endeavouring to make a better-bodied cheese used an excessive amount of salt, resulting in a sweet and mealy-bodied cheese. Uniformity in acid control, and the development of the required amount in a given time, is most essential. Complaints from Britain have been fairly numerous, and refer principally to lack of maturity in the cheese on arrival, harshness in body, and openness, also some discoloration of coloured cheese. These defects are being closely investigated by the Dairy Research Institute staff, and other scientists, who are working in co-operation with them with a view to finding remedial measures. In the meantime cheesemakers are using every endeavour to improve quality, and it is expected that cheese going forward more recently will give better satisfaction.

More care and attention should be given to the packing of the cheese to ensure sufficient air space between the cheese and crate-ends. Too tight packing has resulted not only in soft crowns, but also in numbers of cheese being batten marked, which has rendered them difficult of disposal at ruling prices. Crate-timber which does not comply in size with the regulations should on no account be accepted by dairy companies in fulfilment of orders.

During the year approximately 75 per cent. of the cheese were made from pasteurized milk and approximately 85 per cent. were wax-coated.

Standardized Cheese.

Regulations for the manufacture of "standardized" cheese which provided for a minimum fat content of 50 per cent. by weight of milk-fats in the dry matter from 1st August to end of February and 52 per cent. from 1st March to 31st July, came into force on the 21st December, 1928, and the legal manufacture of this class of cheese commenced early in January, 1930, and continued up to the 31st December, 1930. Complaints from Britain were numerous concerning the quality of much of this cheese, and, as a result of the apparent prejudice created against this standardized article, the

Government agreed to increase the minimum content of fat in the dry matter in order to distinguish it from the article previously branded "fat 50 per cent. or over," and branded the resultant cheese as "Cheddar." Amended regulations were therefore gazetted on the 22nd December, and came into force as from the 1st January, 1931, providing for the manufacture of cheese with a minimum milk-fat content in the dry matter of 52 per cent. from 1st August to 31st December, 53 per cent. from 1st January to 15th March, and 54 per cent. from 16th March to 31st July. Up to the end of the financial year no reports had been received from Britain as to the quality of this cheese. It is evident, however, that the British public do not look with favour on cheese which has been made from other than whole milk. This question will be fully gone into at the Conference of the National Dairy Association to be held in June, and a final decision will then be arrived at as to whether or not the manufacture of full-cream cheese only should be permitted.

QUANTITIES OF BUTTER AND CHEESE FORWARDED FOR GRADING, YEARS ENDED 31ST MARCH, 1930, AND 31ST MARCH, 1931.

Port.	1931.		1930.	
	Butter.	Cheese.	Butter.	Cheese.
	Cwt.	Cwt.	Cwt.	Cwt.
Auckland	1,298,483	354,252	1,237,739	289,232
Gisborne	29,506	260	29,590	..
Napier	34,781	3,597	43,280	4,365
New Plymouth	156,687	359,368	153,584	338,046
Patea	44,186	397,834	47,221	380,077
Castlecliff	56,394	77,684	59,402	125,024
Wellington	229,760	327,280	224,655	259,429
Lyttelton	42,731	22,543	47,391	28,242
Timaru	8,249	19,275	6,268	17,403
Dunedin	13,521	48,374	24,364	49,164
Bluff	5,337	240,088	7,586	248,259
Totals	1,919,635	1,850,555	1,881,080	1,739,241

VALUE OF EXPORTS.

Although production is in excess of last year's figures, the increase is not nearly sufficient to balance the decline in prices ruling for dairy-produce as compared with those of the previous year. The Customs figures of the declared export values of cheese, butter, dried milk, casein, condensed milk, and milk-sugar totalled £16,935,143, as compared with £18,842,994 for the previous year, a decrease of £1,907,851.

CASEIN.

The quality of casein continues to be of a uniformly high standard. Rennet casein, which amounts to approximately 10 per cent. of the total graded, commands a high market value, being exceedingly low in butterfat content and in keen demand on overseas markets. The quantity graded during the year totalled 1,395 tons, being 645 tons less than for the previous year. The grading of this produce is optional, a grading-fee of 1½d. per cwt. being charged for the service. Some 1,313 tons went forward for shipment ungraded.

TESTING BUTTER FOR MOISTURE AND CHEESE FOR FAT IN THE DRY MATTER.

During the year the number of samples of butter tested for water content was slightly less than for the preceding year, the figures being 151,142 and 156,967 respectively. Buttermakers have maintained a very even water content in their butter during the year. Only 0·4 per cent. of the churnings exceeded the legal limit of 16 per cent., and the usual practice of returning these to the factories to be reworked with drier butter was followed.

The number of vats of "standardized" and "Cheddar" cheese tested in order to prevent the export of any of these classes of cheese containing less than the legal quantity of fat in the dry matter totalled 90,190. To cover the cost involved by this service an additional grading fee of 1d. per crate is charged.

CREAM-GRADING.

The grading of cream in accordance with the regulations has been continued during the year, and the regular supervision of this by the Butter Instructors and special Inspectors has been the means of keeping the grading on a uniform basis. Criticism of an adverse nature concerning this regulation is seldom heard, and it is generally recognized that cream-grading has assisted materially in improving the quality of our creamery butter.

FARM-DAIRY INSTRUCTION.

It is regretted that owing to the lowering trend of prices of dairy-produce during the year a number of dairy companies have deemed it necessary to discontinue this service, which has in consequence reduced the number of Farm-dairy Instructors from thirty-seven to thirty-one. It has become strikingly evident that in districts where Farm-dairy Instructors are employed a far

greater improvement in the quality of the milk and cream supplies has been made than in areas where there are no instructors. Similarly in a number of cases where the services of the Farm-dairy Instructor have been discontinued a falling-off in the quality of the dairy-factory output has been manifest. The need is therefore apparent for the institution of farm-dairy instruction on a Dominion basis as soon as economic conditions will permit.

Inspection of Milking-machines.

In districts where Farm-dairy Instructors are operating these officers give special attention to the inspection of new and renovated milking-plants installed during the year, and elsewhere the inspection was carried out as opportunity offered by the Butter and Cheese Instructors. During the year some 3,125 plants were inspected, the great majority of which were found to comply with the regulations. A few required minor adjustments, and necessitated a further visit before being finally passed.

The reduction in the number of Farm-dairy Instructors must necessarily throw more work on the Dairy Instructors in connection with the inspection of the erection of new milking-machines, and any re-erections of used milking-machines. This is important work, and has been the means of ensuring that these installations are such that they can be kept clean without unnecessary care and attention. Since the amending regulation has placed some responsibility on the vending and erecting firm, fewer erections are found to contravene the regulations, and their assistance is appreciated.

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

The check testing at dairy factories of suppliers' samples of milk and cream for butterfat content has been considerably extended during the year, as, in addition to the two officers specially detailed for this work, the Dairy Instructors have assisted as opportunity offered. In all, 550 visits were made to dairy companies for this purpose.

Dairy companies are keen to carry out the testing accurately and efficiently. Very few samples of milk and cream now come forward to the Division for testing as a check against that of the factory test, which is an indication that suppliers are satisfied that the factory testing is being carried out accurately.

Dairy Bacteriology.

This section of the Division's activities is under the direction of Mr. G. F. V. Morgan, N.D.A., N.D.D., Dairy Bacteriologist, and as the problems investigated by him during the year are of interest and value to the industry a summary of his report is appended. (See General Appendix III.)

Inspection of New Zealand Dairy-produce in Britain.

The divisional officers have had a strenuous year in examining butter and cheese on arrival in Britain, and furnishing detailed reports to the Division on the quality and condition of this produce at time of examination. This information is of great value not only to the Division, but to the dairy companies also, who receive a copy of each report received dealing with their particular produce. Owing to the ever-increasing volume of dairy-produce being exported to Britain, it is evident that the two officers engaged in this work are unable to examine as many lines as is desirable, and it would seem that consideration should be given to the desirability of appointing a further officer to assist Mr. Wright. Mr. A. C. Ross, who had assisted Mr. Wright for some four years, returned to New Zealand in August last, and was replaced by Mr. F. H. Taylor, formerly Dairy Instructor, Invercargill.

Certificate-of-record Testing.

Statistics relating to this branch of the Dairy Division's work are classified in calendar years, the 1930 returns being the latest available. The calendar year 1930 must be written down as one of the good years of the C.O.R. system. First-class certificates were issued to 643 cows as compared with 491 cows in 1929, and despite an increase of 152 in the number of certificates gained, average production rose by over 4 lb. of butterfat, the 1930 figure being 474·02 lb. fat as compared with 469·95 lb. for 1929. Thirty-four second-class certificates were issued during the year under review as compared with twenty-eight for 1929.

Official Herd-testing.

The O.H.T. system experienced a marked revival of support for the season just closing. The largest number of cows tested under this system in any one month during the 1929–30 season was 1,365, while for the peak month of 1930–31 we reached the very encouraging figure of 2,054. Quoted in herds we have had 167 breeders on our list this year as compared with 129 at the height of the preceding twelve months.

Herd-testing.

During 1929–30 some 283,731 ordinary herd cows were under test, as against 259,594 cows for 1928–29. Classified according to the three principal systems the 1929–30 total is divided as follows: Association system, 40,667 cows; group system, 242,688 cows; dairy company system, 376 cows. The Government subsidy to herd-testing has been continued, though decreased from £10,500 for the 1929–30 season to a maximum of £8,000 for the current financial year.

Appreciation.

The season has been a particularly arduous one for the staff, and the cordial co-operation, attention, and enthusiasm of all members is much appreciated.

Thanks are also extended to the Department's Chief Chemist, State Forest Service, Dairy-produce Board, the various cattle-breeders' associations, and freezing companies for their co-operation and assistance during the year.

HORTICULTURE DIVISION.

REPORT OF J. A. CAMPBELL, DIRECTOR.

The Fruitgrowing Industry.

From a horticultural standpoint the season under review has, generally speaking, been a satisfactory one. The crop of apples and pears was above the average, notwithstanding that the previous year's crop was a heavy one. One of the main reasons for this, apart from the favourable weather conditions again experienced during the growing and harvesting period, is no doubt the fact that the greater majority of fruitgrowers are manuring their orchards more liberally than formerly, and are also paying more attention to orchard-cultivation.

In most localities lack of sufficient sunshine retarded the ripening of the tomato crop, the fruit in consequence being smaller than usual, which affected the returns received by growers.

A pest identified as *Phthorimaea melanoplintha* (closely resembling the potato-moth) attacked the tomato crops in the Lower Hutt, Manawatu, Wanganui, and Napier districts, doing serious damage in some cases before it was discovered. The life-history of this moth is being worked out with the view of arriving at the best means of control.

The culture of citrus fruits is still receiving a good deal of attention in the northern districts adapted to the growing of this class of fruit. With more orchards coming into bearing it has become necessary to enlarge a number of curing sheds in order to satisfactorily deal with the extra amount of fruit being handled. Some of the citrus groves in the Auckland District suffered somewhat from the effects of severe frosts in the early spring, a large quantity of fruit being rendered unfit for sale. The bulk of the affected trees, however, made a rapid recovery, and are carrying a good second crop.

Orchard plantings during the year were only on a small scale, and consisted mainly of replacements to existing orchards where the trees had become unprofitable. The total area in commercial orchards for the whole of the Dominion stands at approximately 27,000 acres.

The gradual adoption of up-to-date methods of spraying, &c., which has taken place during recent years has enabled orchard pests and diseases to be more readily kept under control, and a dirty commercial orchard is now rarely met with. Fungoid diseases were less prevalent during the past season, the weather conditions experienced being unfavourable to their development.

Fireblight disease has been kept well under control in the fireblight areas in the North Island, and has caused very little damage to orchards during the year. The disease, however, has now made its appearance in the South Island, having been discovered in an orchard in Christchurch towards the end of the year, and also at Kaikoura. The infection is at present confined to a small area, and steps have been taken to quarantine the infected districts.

The matter of establishing a central Fruit Research Station was finalized during the year, a commercial orchard of some 20 acres of established fruit-trees with adjacent undeveloped land being purchased at Redwood's Valley. Experimental spraying and the laying-down of manurial plots has already been undertaken in connection with the scheme of investigation work which is being carried out by the Department in co-operation with the Department of Scientific and Industrial Research and the Cawthron Institute.

In November last Mr. R. G. Hatton, Director of the East Malling Research Station, arrived in New Zealand, and was given every assistance in visiting as many of the commercial fruit areas as was possible in the limited time at his disposal. Mr. Hatton was very favourably impressed with the development made in this country, and his visit should prove of lasting importance and value to the fruitgrowing industry here.

Another visitor of interest was Senor Gonzalez, representing the Commerce Department of the Chilean Government, who was desirous of obtaining an insight into the fruitgrowing and marketing methods adopted in the Dominion. He was provided with all information available on these subjects, and shown round a number of the main fruitgrowing districts by officers of the Division.

Investigations were made during the year by separate parliamentary Committees into the methods of marketing fruit and vegetables in the Dominion, and also regarding the tobacco-growing industry in New Zealand. Evidence in connection with these was given by officers of the Department.

Export of Fruit.

As the result of an abundant harvest the 1930 fruit-export season was a particularly busy one for both fruitgrowers and the inspecting officers attached to the Division, the total quantity exported reaching the record figure of 1,330,891 cases. Of this total 1,093,153 cases apples and 55,972 cases pears were shipped to Great Britain and the Continent; 160,541 cases apples and 3,223 cases pears to South America; and 17,787 cases apples and 215 cases pears to Canada. The bulk of the fruit was exported under the Government guarantee of a gross market price of 11s. per case of "Extra Fancy" and "Fancy" grades, and 7s. for "Good" grade.

Heavy Australian shipments to Great Britain had a somewhat adverse effect on New Zealand fruit prices, but the returns as a whole were fairly satisfactory.

Fruit exports from the Dominion during the last five years are as follows: 1926, 730,308 cases; 1927, 544,233 cases; 1928, 1,026,986 cases; 1929, 992,151 cases; 1930, 1,330,891 cases.

Another good season having been experienced, it is anticipated that the 1931 exports will equal those of the previous year.

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. Reports to hand indicate that the bulk of the produce is of good quality and well packed. There is still a tendency, however, on the part of a number of growers to market small immature fruit, which, besides hardly paying marketing expenses, has the effect of lowering the prices of the higher grades.

Notwithstanding the warnings given during the past year or two by the publicity of Court proceedings, a number of cases of fraudulent packing or "topping," more particularly in regard to vegetables, came under notice during the year, necessitating prosecution of the offenders. The infliction of substantial fines seems to be the only deterrent in such cases.

Fruit Cool Storage.

The many problems connected with the cool storage of fruit have received considerable attention during the year. This has been rendered possible by the appointment of a Cool Storage Officer (Mr. R. Sutherland), who took up his duties at the end of 1929. This officer's time has been fully taken up with investigation work, both in the various cool stores in the Dominion and on board ship.

The loading and stowage of fruit on overseas vessels has been looked into with a view of minimizing the rough handling that frequently takes place. In this connection experiments were carried out at Wellington in transporting fruit from the coastal boats and cool stores and despatching it into the holds by the loaded-tray system. This arrangement was found to give very good results, and is well worthy of general adoption.

The pre-cooling of fruit prior to placing on the overseas vessels and the early reduction of temperatures in the ship's holds are other important features that have been dealt with.

Instructional and Experimental Work.

With a considerably curtailed expenditure, the work of inspection and instruction under field conditions was carried out as well as the altered circumstances would permit, and the usual demonstrations and lectures were attended to by the Instructors in their respective districts as far as was possible. Fruit-packing classes were again conducted in a number of the commercial fruitgrowing centres.

An experimental officer has been made available who will act as a connecting-link between the practical and scientific phases of fruit-culture, in pursuance of a research scheme which is being conducted by the Division in co-operation with the Mycologist and other scientific officers attached to the Plant Research Station, Palmerston North. The support of a number of district fruitgrowers' associations has also been secured through the New Zealand Fruitgrowers' Federation, Ltd., the latter being responsible for all spray-testing material required. The scheme has been actually put into operation, and a large programme of experimental work already commenced, including the control of brown rot, powdery mildew, the elimination of russeting, &c., while a number of new spraying ingredients are being tested and new formulæ tried out with a view to increasing general spraying efficiency. The programme also includes extensive cool-storage investigations, with a view to correlating evidence relative to the fungal rotting of fruit in storage. A number of orchard manurial tests which will run for several years have been established.

The majority of the tung-oil plants raised from imported seed are making fair progress in the different localities in which they have been planted. An acre of these plants has been set out at the Te Kauwhata Horticultural Station, and they are doing fairly well.

Tests with various fruit-tree stocks, including pip, stone, and citrus, are also receiving attention, and in this connection a consignment of root stocks recently came to hand from the East Malling Research Station, Kent, England.

Viticulture and Wine-making.

Cold weather experienced in the majority of the vine-growing districts interfered with the development of the wine-grape crop, and, as a result, the crop, besides being some two to three weeks later than usual in coming to maturity, was a light one. Considerable confidence is being evidenced in the growing of grapes for wine-making, and extensions are being made to existing privately owned vineyards. The light grape crop resulted in a reduced output of wine, the season's production amounting to 75,000 gallons of an estimated wholesale value of £28,125. Outdoor-grown table-grapes yielded a fair average crop of approximately 800 tons, representing a value of £44,800. The acreage planted in table-grapes is gradually increasing. Growers of grapes under glass experienced a somewhat disappointing season through lack of sufficient sunshine, the fruit being late in ripening and lacking in colour, and, as a result, the returns received were not up to the average. The value of hothouse-grown grapes for the season is estimated at £55,000.

Cider-making.

Owing to a short supply of surplus fruit, there was a considerable reduction in the quantity of cider produced during the year. The total made amounted to approximately 30,000 gallons, of an estimated value of £7,500.

Te Kauwhata Horticultural Station (Lower Waikato).

Vineyard and cellar: As the result of unfavourable weather conditions the grape crop was late in ripening, and was considerably lighter than that of the previous year. The total weight of grapes harvested was 38 tons, from which it is estimated 10,500 gallons of wine will be manufactured. Wine sales amounted to 8,769 gallons, which realized £4,268. This shows a considerable falling-off as compared with the previous year's figures, and is no doubt largely due to the financial depression existing throughout the country. The financial position of the Station is, however, satisfactory, receipts exceeding the expenditure for the year by some £2,000.

Sheep: The lambing season was a satisfactory one, 636 lambs being produced, of which 591 were forwarded to the freezing-works. The total receipts for this branch of the farm was £967. This amount includes the returns for fat lambs shipped to Great Britain last year.

Tobacco-culture.

The cultivation of tobacco-leaf is still receiving a good deal of attention in different parts of the Dominion, and the demands for information and advice have been considerable. The total area devoted to tobacco-culture is approximately 1,600 acres. Reports to hand indicate that the bulk of the season's crop is of high quality, especially that grown in the Nelson and Motueka districts. There has been a marked improvement in the growing and curing of tobacco-leaf, the experience gained by growers during the past few years enabling better results to be obtained. Most of the present crop is grown under contract to the manufacturing companies operating in New Zealand—at payable prices to the grower. In the Auckland District considerable areas are being devoted to tobacco-growing, and a number of flue-curing barns erected.

For the purpose of ascertaining its suitability for the requirements of the Home market, a small parcel of Auckland-grown leaf was forwarded to the High Commissioner for New Zealand, London, towards the end of the year, but a report on the matter is not yet to hand. It should be again mentioned that although leaf of good marketable quality can be produced in the Dominion, the success of the industry very largely depends on a satisfactory overseas market being available for the surplus not needed for New Zealand requirements, and intending planters are therefore advised to proceed with due caution.

Numerous laboratory tests with different varieties of locally-grown leaf were conducted during the year.

Hop-culture.

During the past two or three years there has been a steady decline in the quantity of hops produced. This has been largely due to an unstable market, and to the fact that a number of hop-growers have gone over to the cultivation of tobacco as a more reliable means of livelihood. Owing to the dry weather conditions experienced the season's crop was a light one, the hops not weighing out as well as usual. The quantity and value of hops exported from the Dominion during the year ended 31st March, were 1,943 cwt. and £9,108.

New Zealand Institute of Horticulture.

A considerable amount of valuable work has been carried out by the New Zealand Institute of Horticulture during the year in the interests of horticulture generally. Matters connected with nomenclature, improvement of economic plants by selection and hybridization, recording new varieties of plants produced in New Zealand, and the training of young men and women in all branches of horticulture, are some of the main features of the work of the Institute.

Under the New Zealand Institute of Horticulture Act passed in 1927 the Institute has full legal authority to grant diplomas in horticulture to those qualified and passing examinations during the course of a special training. This very important phase of the work is being taken advantage of, and a number of persons have already gained the diploma in question.

Orchard Registration and Orchard-tax.

The number of registered orchards in the Dominion now stands at approximately 6,050, representing some 3,000 taxable and 3,050 non-taxable; £1,400 was collected in orchard-tax, which amount, less cost of collection, has been handed over to the New Zealand Fruitgrowers' Federation, Ltd., for furthering the interests of the fruitgrowing industry generally.

Registration and Inspection of Nurseries.

Reports to hand indicate that the bulk of the nurseries in the Dominion are kept in good condition, and the stock raised is well up to standard and clean and free from disease.

Nurseries registered during the year numbered 662, and £662 was collected in registration fees.

Imported Fruit, Plants, etc.

A careful inspection of all imported fruit, plants, bulbs, &c., has been carried out at the different ports of entry in the Dominion—viz., Auckland, Wellington, Christchurch, Dunedin, and Bluff. Fruit imports show a substantial increase on the previous year's figures, mainly due to large shipments of citrus fruit (oranges and mandarins) from Australia following a light season experienced in 1929. There was a considerable increase in the quantity of bananas imported from Samoa, most of the fruit being of good quality. Later shipments, however, contained an excess of small, immature bananas, which gave cause for much dissatisfaction amongst importers. All lines of citrus fruits were closely examined for fruit-fly infection, and it was found necessary to condemn four consignments from Australia (three of oranges and one of mandarins) on this account.

The Beekeeping Industry.

The weather conditions which prevailed during the past season were not favourable to the production of a normal honey crop. With the exception of the Auckland, Hawke's Bay, and South Canterbury districts, light to poor crops were produced. Otago and Southland suffered a particularly adverse season, the yield of honey in these districts being the lowest obtained for a number of years. Notwithstanding the somewhat unsettled state of the local and export markets, commercial beekeepers are extending operations and installing modern apiary and honey appliances, it being realized that overhead charges must be kept down to a minimum if the business is to be made a payable one.

Following the usual practice, lectures and practical demonstrations connected with the various phases of beekeeping were given as far as it was possible to do so by the Apiary Instructors in their respective districts.

Owing to the poor season there was a very considerable decline in the quantity of honey submitted for export, the total number of cases passed at the different grading stores being 2,269, a decrease of 14,119 cases on the previous year's export. The following shows the quantities and values of honey exported from the Dominion during the last five years ended 31st March :—

	Quantity Cwt.	Value. £
1927	10,590	34,695
1928	8,650	27,784
1929	22,062	82,230
1930	19,234	75,623
1931	1,958	7,845

The number of registered apiaries now stands at 6,523, comprising a total of 102,418 colonies of bees. The majority of beekeepers are now fully aware of the regulations relating to registration, and it is considered the number that have not so far registered are very few.

Staff.

With the increasing demand for information and advice on the many activities coming within the scope of the Division, and the extension made in experimental and other investigational work, I desire to tender my thanks to all officers of the Division for their cordial assistance and co-operation during the year.

CHEMISTRY SECTION.

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

Mineral Content of Pastures Investigation.

This work occupied chief place, and has made considerable advances during the year. Inquiries have been received regarding the composition of licks for supplementing the natural pasture as a ration for stock or to correct various disorders. Probably this method of supplying deficient mineral food constituents will have a greatly extended use in the near future.

Rotorua Pumice or Nearby Volcanic Lands.—Attention has been devoted largely (1) to the carrying-out of large-scale lick and pellet-feeding experiments, with the object of discovering the most economic method of supplying assimilable iron to ruminants, especially sheep; and (2) to the growth and collection of representative samples of pasture plants and mixed pasture free from contamination, for analysis.

Both the feeding of pellets containing meals and citrate of iron and ammonium, and of a lick composed of common salt and finely ground native carbonate of iron (a local product), have succeeded in the case of sheep, which previously it was impossible to keep for any length of time, or rear, on bush-sick land. Probably some of the good effect of the pellets is due to the concentrated food in the form of meals which they contain. As this is an expensive and unessential ingredient it is hoped that suitable licks may be found sufficiently palatable to enable pellets to be dispensed with.

Carbonate of iron added to ensilage during the building of the stack was found to be an effective and economical method of administering iron to cows and calves, widely applicable in the bush-sick areas; analysis shows that the iron is thus rendered more soluble. A prominent settler on bad bush-sick country (Mamaku) has introduced sheep, and intends breeding them on this type of country. He is confident of keeping all stock healthy with the aid of iron-carbonate treatment, which he has succeeded in giving automatically to the whole flock. He carries 1,000 sheep, and has 350 ewes now in lamb at Mamaku. Doubtless, therefore, with little additional expense or trouble, the whole of the lands affected with bush sickness in any degree can be farmed without fear. This opinion, arrived at before with regard to cattle-farming, can now be asserted with regard to sheep-farming, and this certainty of being able to keep both kinds of stock on the same country will make it much easier to farm than if the worst country had to be restricted to cattle. To name only two reasons: a better utilization of pasture is effected in the mixed grazing of sheep and cattle, and the diverse quality of the products gives a better chance of making bush-sick country pay, than if only one class of stock were carried. In making ensilage it is recommended to dissolve 1 lb. of the iron ammonium citrate in water, mix with molasses, and spray on to the layers of ensilage from time to time as the stack is building, 1 lb. of the citrate to 1 ton of ensilage. The option secured over a deposit of spathic ore at Huntly has been kept alive, and the ground material distributed free or at cost price to farmers in bush-sick areas in small quantities for experimental purposes. Results have been very encouraging, and many requests for a supply of the material have been received. The fine grinding of this hard iron ore has been generously undertaken, practically free of charge, by the Challenge Phosphate Co., at Otahuhu, a service much appreciated.

Analysis of the herbage produced by pot experiments with limonite from Whangarei showed that its incorporation with pumice soil did not increase the amount of iron taken up by the plant. Possibly, however, a use will be found for the limonite as an ingredient in stock-licks for providing iron directly to the animals. Stock-feeding experiments with limonite from Whangarei and from Onekaka, Nelson, are now in progress in the Rotorua district.

Green-manuring experiments for the improvement of the pumice soil have been proceeded with in two localities. Good crops of (*a*) red clover and (*b*) lupins have been ploughed in and the areas resown in pasture. The drainage water from the lysimeter has been regularly collected and analysed. Applications of superphosphate made to the surface soil have not led to loss of phosphate in the drainage water.

Ngaroma.—During May, 1930, an inspection was made of experiments which have been in progress for several years at Ngaroma, an isolated block of country where there appears to be more than one deficiency disease. On the whole, the results were distinctly encouraging. In one case a farmer's milk-yield had shown a substantial increase on manuring with superphosphate, while a further increase had followed the addition of sulphate of iron to the superphosphate. Carbonate of iron as a lick was also reported on favourably.

Poverty Bay Back Country.—Experiments have now given indications of the nature of the deficiency effects experienced in sheep in parts of this area. Animals depastured on affected paddocks well top-dressed with superphosphate and basic slag became sick equally with those on untreated areas, thus indicating that deficiency of phosphate could not be responsible, and adding proof that lack of iron is the principal factor. The pastures have an abnormally low iron content.

Two other instances of iron deficiency trouble in sheep on stations between Napier and Gisborne have been investigated. In both cases the trouble has occurred on easy country with a surface-covering of pumice, and soil and pasture analyses and the symptoms point to it being due to iron deficiency. The soils are "sandy silts" similar to those near Rotorua. Steep country, from which the surface-covering of pumice had been denuded, was not affected.

Waitomo County.—Some reorganization of the work in the Mairoa and Kopaki areas has been made as a result of the experience already gained. Carefully controlled experiments have been initiated at Mairoa to compare the effect of various top-dressings on the health of sheep. A large series of replicated enclosed plots with different top-dressings have been established at Kopaki and Mairoa.

Samples of uncontaminated pasture from these plots are being obtained whereby it is hoped to secure exact data concerning the variation in mineral content and composition of the pasture with soil-type and manurial treatment.

The occurrence of "wasting" in cattle reported recently at Kopaki confirms the opinion previously expressed that the trouble affecting sheep in this particular area is similar to that experienced on the pumice soils of the Rotorua district.

Wairarapa.—The results of three seasons' work on this area are embodied in a paper which appeared in the *Journal of Science and Technology* for March, 1931. It is there conclusively shown that—

(1) The phosphoric-acid content of the pasture was highest in the summer with greatest rainfall, lowest in that with least rainfall, and intermediate in that with intermediate rainfall, and that the nitrogen content varied correspondingly. The lime content varied in the reverse order.

(2) The general trend of the phosphoric-acid and nitrogen content of the Wairarapa pastures is to increase rapidly to the maximum in the spring, falling with the summer, and reaching the lowest figure in the autumn. Calcium (lime), on the other hand, is lowest in the winter and increases with the progress of the seasons, giving the maximum figures in the autumn.

Taranaki.—A comprehensive report on the second autumn series of pasture-samples from the Taranaki District was incorporated in the Tenth Quarterly Report to the Empire Marketing Board. The fall in phosphoric acid and nitrogen content in the autumn which has been found to be of widespread occurrence was strongly marked. Lime was somewhat more variable though usually showing a considerable increase from spring to autumn. The analyses of the soil-samples taken in conjunction with the pastures have also been completed and will be of use in recording the soil-types of the province.

Marlborough.—During the late autumn of 1930 an investigation was commenced into the nature and causes of endemic "bentleg" in sheep on certain poor danthonia hill country in the Wairau Valley. A poor all-round composition of the pastures was disclosed, but analyses are required at other seasons before coming to a definite conclusion.

As lime and phosphate were both low in the pastures, feeding experiments were instituted to discover which deficiency, if either, was primarily responsible for the disease. Arrangements were made to feed bone-meal and salt to the flock on one of the affected paddocks, and citrate of calcium (lime) and salt in another. The latter was abandoned owing to the sheep refusing to take it. In the former case a report just to hand states, "It has been ascertained that the percentage of lambs found to be affected by the 'bowie' conditions was only about one-fourth as great as that of the preceding season." It must be said, however, that the disease was this season not so prevalent.

Hunterville District.—It was recently brought under notice that certain areas near Rangiwahia gave disappointing results with breeding-stock, abortion both in ewes and cows being common, and apparently endemic. In the locality it was found that the pastures were poor, having been down forty years with very little top-dressing. Analyses of soils and pastures are expected to throw light on the matter, which appears to be due to phosphate deficiency. Top-dressing with phosphates and lime, together with the feeding of a bonedust lick, is recommended.

Southland.—Investigation has proceeded of a deficiency disease among sheep in the Morton Mains district, near Invercargill. The general symptoms are allied to bush sickness. Analyses of soils, pastures, and animal tissues so far indicate possible deficiencies of phosphate, iron, and iodine. A difficulty in the way of an iron-deficiency hypothesis is that the soils are loams, a texture much finer than anything so far found associated with the recognized bush-sick areas. Further investigation is planned for the coming year.

Iodine Deficiency.

Miss B. W. Simpson, on exchange from the Rowett Research Institute, Aberdeen, investigated during the year the distribution of iodine in New Zealand pastures and the animals grazing thereon. In the districts, Fendalton and Tai Tapu (Christchurch), and Karori (Wellington), the maximum iodine content of the pasture occurs in late autumn and winter and the minimum about midsummer. Analyses of a large number of thyroid glands, some abnormal, taken throughout the season 1929–30, have been published. It is concluded that "the iodine content of the thyroids of lambs born and bred on definite areas seems to give a fair indication of the amount of iodine available on those areas."

It has also been shown that—

1. (*a*) Garden plants assimilate an increased amount of iodine when applied to the soil:
   (*b*) The addition of iodine to food grown in the Wellington area and fed to young rabbits improved their rate of growth:
2. (*a*) Additional lime added to the ration of rabbits on a basal ration low in iodine did not promote the formation of enlarged (goitrous) thyroid glands:
   (*b*) A lick containing Kerol, salt, lime, sulphur, bone-meal, and rock phosphate added to the basal ration promoted increased growth in the rabbits as well as reducing the size of their thyroid glands:
   (*c*) The addition of lime alone to the basal ration had little effect either upon the rate of growth or the size of the glands of rabbits:
   (*d*) Large glands with a very low iodine content were produced by feeding animals with food grown on a goitrous area.

The effect of feeding iodine to laying hens has been studied in districts where iodine is deficient. The method is a convenient one of increasing the amount available for human consumption on account of the concentration of iodine that then occurs in the eggs.

Valuable information may result from the attempt to correlate the iodine content of the thyroid glands of grazing animals with the soils upon which they have been depastured. A circular has been sent out to Stock Inspectors by the Director of the Live-stock Division, requesting them to forward glands for analysis wherever it is possible to obtain a satisfactory history. It is hoped in time to obtain a picture of the normal iodine uptake for the various districts. This may then be used to indicate the probable need of stock for supplementary iodine in the form of licks.

Pulpy-kidney Disease in Sheep.

At Ranfurly an experiment in feeding a lick containing sulphur in the form of gypsum to ewes was carried out to ascertain what effect it might have in preventing the development of pulpy kidney. Other work on pulpy kidney included the analysis of a large number of samples of milk from ewes in the North Island whose lambs were affected.

Soils.

A rapid survey of the soils of the Mohaka district was undertaken and a report furnished to the Progress Association there on the results of analyses. The soils were varied, comprising fine subaerial pumice on the gentler slopes, papa or mudstone on the steeper slopes where the pumice covering had been removed by erosion, and river-terraces of resorted material. The pumice soils varied from sandy silts to sandy loams, being on the whole finer than those of the Rotorua district, and therefore less likely to give rise to deficiency diseases. Iron was found to be low in the pastures, the immunity of ruminants to iron starvation (bush sickness) up to the present being probably due to the natural change of pasture provided by the papa and river-terrace soils.

A report embodying many analyses of soils from various parts of Taupo County, and South Rotorua County, especially Native lands, was furnished to the Native Department. It is confidently anticipated that the knowledge of the physical and chemical characteristics of soils thus made available will be of great value in bringing pumice lands under settlement. Work on the volume weights of pumice soils has been continued. Ultimately this method may afford another clue to the delimitation of bush-sick lands. A report with analyses was also prepared for the Lands Department on certain areas of the Waotu district, Matamata County, and of South Rotorua County, with the object of aiding in opening new lands for settlement.

For the Cook Islands Department analyses were made of a number of taro and other soils from the Cook Islands. Some of these were practically coral sand, others were from volcanic hills. The outstanding deficiency was of phosphate, but nitrogen and potash were also low in some cases. A soil analysed for the Forestry Department from Parengarenga was found to be very poor and acid and to contain a relative excess of magnesia.

In certain coastal areas of the Hauraki Plains development of sterile patches in the pasture has given rise to some concern. An investigation and analysis of some of these areas revealed several injurious conditions all traceable to the influx of saline water from the drains and subsoil. The lime in the soil has been largely replaced by magnesium and sodium, which occasioned what is known as a "deflocculated" or "puddled" clay with a slightly alkaline reaction. Manurial treatment can afford only a temporary improvement, and the solution must lie in the provision of adequate drainage and the cultivation of those species of pasture plants and crops which naturally flourish under such conditions—*e.g.*, strawberry-clover and rape.

Constant touch has been maintained with the newly constituted Bureau of Soils, Rothamstead, England, and interchange of useful information has resulted. On account of the difficulty sometimes experienced in the mechanical analysis of pumice soils due to the unusual nature of the particles, an analysed sample was forwarded to the Bureau of Soils for test analysis. The results reported confirmed the conclusions already arrived at in this Laboratory, and indicated the need for certain variations from the standard procedure when dealing with pumice soils.

Limestones.

One hundred and sixty-four samples of limestone were received for analysis during the year. Great variations are shown in the fineness of grinding of some of the commercial ground limestones. Consideration has been given to the possibilty of providing for some means of regulating the quality of ground lime supplied by commercial firms. The field is being explored by the periodical sampling and analysis of the various companies' products.

Fertilizers.

During the year seven official samples were taken under the Fertilizers Act. Numerous samples have been received from farmers for checking. In the case of one special mixture analyses of samples from different parts of the consignment showed marked discrepancies. Representations were made to the firm, who agreed to exercise closer supervision in future mixings. With this exception, no discrepancies materially to the prejudice of the purchaser were found in any of the samples.

The Inspector of Fertilizers has now got the work of registration of brands thoroughly organized and running smoothly. The question of advertising and propaganda matter, some of which was likely to be misleading to the public, has been the subject of a considerable amount of attention and correspondence. The advisability of making some provision in the Act to regulate such matter is now under consideration.

Miscellaneous.

In a case where stock habitually licked the sticky mud round a small spring it was found that the water contained a half per cent. of common salt, this indicating the need for the provision of rock salt.

Another instance where sheep ate an earthy material occurred in Poverty Bay back country. The material was found to contain 6·46 per cent. of iron and alumina besides 1 per cent. of magnesia, and 0·7 per cent. of lime. As this was in the area where bush-sickness occurs, it was suggested that the animals were seeking iron, and that a lick of iron carbonate, bonedust, and salt would be beneficial.

An interesting sample from the Greymouth district proved to be "hair salt" or hydrated aluminium sulphate.

A case of brown stain developing in pulled wool was investigated. Traces of iron and sulphide were found, the latter evidently being derived from the mixed calcium and sodium sulphides used for removing the wool, but the source of the iron was not determined.

Inquiries have been received and instructions issued concerning the precautions to be observed in using sodium chlorate for weed-destruction. It is only in the dry state that it is explosive or promotes vigorous combustion, so that the chief precaution is to immediately wash or burn all inflammable material with which the solution has come into contact.

Work for the Departmental Divisions.

Live-stock Division.—The periodical examination of the public cattle-dips of the Auckland and Taranaki districts has been continued. A number of proprietary remedies for cattle-diseases have been analysed, and confidential reports furnished to the veterinary officers. Analyses have been made of thyroids, bones, and other tissues in connection with the investigation of stock-diseases. Stomach-contents and other toxicological specimens have been examined. A natural deposit contaminating a water-supply and suspected of being the cause of mortality in stock was found to be alum. In another case large amounts of sulphuretted hydrogen were found in a well water. In a case where sodium chlorate was suspected of poisoning a cow no chlorates could be detected in the stomach-contents. Analyses have also been made of meat-meals, stock-licks, &c. A case of suspected bracken poisoning of cattle came under notice, but the investigation of the rather obscure poison of this plant could not be undertaken without special provision. A somewhat mysterious case of sheep-poisoning, apparently due to some native plant occurring near Tokaanu and in some other localities in the central North Island, is under investigation. The symptoms and circumstances indicate the possibility of *Pratia angulata*, a lobeliaceous plant, being responsible. Previously this plant has not been suspected of causing mortality among stock, though a near Australian species is known to possess toxic properties.

For the *Fields Division* soils, fertilizers, limestones, weed-killers, &c., have been analysed. A sample of seaweed from the Auckland Province was found to contain 4 per cent. of potash, which is unusually high. Nevertheless its chief value as a manure probably lies in the organic matter it supplies to the soil. For such purposes it cannot be transported far.

For the *Dairy Division* work has included standardization of apparatus, analyses of butter, cheese, casein, acid-neutralizers, &c. One sample of butter suspected of adulteration was found to have a peculiar composition and reactions, but unfortunately its history was not available. The feeding of certain oily meals was suspected. Various stock-licks and tonics have been reported on. Samples of cheese showing patches of dark discoloration were found to contain traces of lead. Lead was also found in some samples of annatto colouring material used in the factory where the cheese was manufactured. Samples of low-acidity wheys were examined for the presence of rennin. It appeared, however, that the enzyme present, if any, was not rennin, and was rather unstable.

In some bees examined for the *Horticulture Division* traces of arsenic were detected. Owing to the smallness of the sample, it could not be decided, however, whether the amount present was sufficient to have caused the mortality.

Alkaloids of the Pukatea.

In response to a request from Dr. Fogg, who is studying the physiological effects of puketeine, and had intimated that it might be of clinical use, a supply of the substance was prepared. The chemicals necessary were defrayed out of a grant from the New Zealand Institute.

APPENDICES.

I. REPORT OF THE PLANT RESEARCH STATION, PALMERSTON NORTH.

THE activities of the Station have been well maintained during the year (1930-31), and a large amount of valuable work has been performed, as is indicated in the appended reports of the individual Sections.

The work has been carried out partly in co-operation with the Department of Scientific and Industrial Research.

A. H. COCKAYNE, Director.

AGRONOMY SECTION.

J. W. HADFIELD, AGRONOMIST.

1. SEED-PRODUCTION.

The raising of improved lines of seed of the various farm crops had to be carried out at the Ashburton Experimental Farm for another year, and conditions have been anything but satisfactory. The abandonment of the transfer to Lincoln, which was expected to be arranged in time to transfer work there, meant the hurried preparation of land for autumn sowing and the planting of potatoes on land unsuitable to the crop. A rather extensive programme of sowings had to be modified to meet a reduction in the amount of money available for the work. To offset this, some of the selection work in peas, linseed, and onions was transferred to Palmerston North. In addition, the season was unfavourable. The winter was unusually dry and cold. Fair rains were experienced in the spring, but these were followed by a dry summer, with a long spell of "nor'-westers" early in the new year. As a result, yields will be much lower than anticipated and the quality of the grain harvested will not be up to the usual standard.

WHEAT.

The aim of this work is to make available to growers pure and disease-free seed of high-yielding strains of the regularly-grown varieties, so that farmers can build up larger supplies for their own use and for entry into certification. Considerable progress should be made in this way towards controlling such seed-borne diseases as do not lend themselves to preventive treatment. Only varieties of recognized or of possible commercial importance are being dealt with. Breeding and production of new varieties are carried out by the Wheat Research Institute.

Two major problems are met with in this work: (*a*) The relatively large amount of natural crossing. (*b*) The distribution of spores of loose smut. Both these will be mentioned only briefly.

Last season (and also previous seasons) plants were noticed which appeared to be of crossbred origin—*e.g.*, Solid-straw Tuscan plants with Velvet Chaff, and Velvet plants with Red Chaff. Seed of these plants, when saved and planted out this season, segregated in a typical F 2 manner. An attempt was made to eliminate these plants by carefully hand-picking a few sheaves from each plot. In the case of the Red Chaff impurities success was attained, no such plants appearing this season, but Velvet ears were still to be found in the Tuscan.

With regard to the spread of loose smut, it appears that spores can be carried and cause infection from at least 21 chains distant on a south wind. This makes necessary more careful isolation of the seed area and the treatment by hot water of any seed suspected of having been produced anywhere near a smutted crop.

The method employed in this wheat-improvement work is to select a large number of single ears from various sources. These are grown in short adjacent rows, and only the best retained. The next and following seasons these remaining ears are tested in a yield trial. The poorest ones are eliminated year by year until the best remain. With each yield trial corresponding increase plots are grown, so that no seed need be retained from the trials.

The plots this season comprised: Ear to row, 435; first-year-yield trial, 42 lines; second- and third-year-yield trial, 28 lines; small-increase areas, 115 lines; large-increase areas, 28 lines.

The varieties Solid-straw Tuscan, Velvet, and Dreadnought have now been tested four seasons, and one outstanding line of each retained. These will be sown out next season on larger areas to provide seed for distribution. A high-yielding variant in Dreadnought has been isolated. This has outyielded the standard Dreadnought for three consecutive seasons, and promises to be worth testing on a larger scale. White-straw Tuscan and Pearl have been tried out for two seasons, and promising lines of each are on hand. As Solid-straw Velvet is of recent origin, no yield trials have been carried out, but a pure line of seed is being built up. A line of Hunter's is being maintained pending the results of field trials of Bell's Hunter's. Work is being carried out with Major. Great difficulty is being experienced with this variety, as it has a tendency to throw a large range of ear-types. Further selection is being carried out to obtain a fixed line of definite Major type. A pure line of Sensation is being raised for trial against other varieties on a field scale.

In addition to the above, ¼-acre plots of twelve varieties were grown to supply seed for next season's variety trials. Also 3½ acres of hot-water-treated College Tuscan were grown for Lincoln College to provide them with smut-free seed. Areas of pure line Velvet and Dreadnought were grown to provide seed for distribution.

POTATOES.

The objective here is the production of pure lines, as far as possible, free from virus disease. Virus in one form or another is responsible for the majority of poor run-out crops. Since the disease is carried over in the seed and there are no remedial measures the only hope lies in the use of virus-free seed.

The method adopted entails, first, a search for virus-free plants. Tubers taken from such plants are termed "tuber units." Each tuber is cut into four parts, planted out, and carefully observed during growth. Tuber units showing disease are rogued out immediately, and at digging only the best are kept. These are then planted out for increase, and further rogueing and selection goes on over several seasons. When sufficient material is available to plant an area for distribution the line is entered in the certification trial for comparison with commercial lines.

In addition to raising lines as above, nucleus lines were imported from Scotland and Ireland. These carried very little virus and they have given very gratifying results.

The area under potatoes this year comprises some 19 acres made up as follows: Tuber units, 1,992; 1929 selections, 438; 1928 selections, 55; 1927 selections, 8; imported lines, 29.

To prevent, if possible, the spread of virus among the tuber units, the area devoted to this work was divided into squares by belts of oats sown in September. One tuber unit was planted in each square, and was thus sheltered from the neighbouring tuber unit. The oats made splendid growth, but the efficiency of the method cannot be determined till next season. A special trial to test the efficacy of this method, and using diseased and healthy tubers has been laid down.

The 1929 selections have been heavily rogued, and the remaining lines appear very promising. Many show no virus disease whatever, the greatest percentage allowed being 5 per cent. in a few cases. The 1928 lines have also received close attention. Of the fifty-five lines planted thirty have been discarded. The remainder are of high standard, some being practically free from virus. Provided the standard is maintained, the eight 1927 selections will be available for distribution this season from areas varying from ¼ acre to 1 acre.

The imported lines vary from ⅛ acre to 1 acre. Considering the dry season, they are well grown and are very healthy. A comparison between this season's disease counts and those made last season indicated that the rogueing last season has reduced the amount of disease present. In order to determine the merits of some of the lesser-known imported varieties seed has been distributed to twenty different centres for trial under varying conditions. These trials are under the control of the Crop Experimentalist. Forty-eight lines have been received from various sources and are being grown for identification.

Garden Peas.

Seed-production of garden varieties, &c., is an important feature of the arable farming in Marlborough and Canterbury, and as an export trade is one to be fostered. Peas deteriorate very rapidly, and no seed produced on the farm receives such close and critical inspection. No doubt the threshing-mills are responsible for a large proportion of the impurities. Apart from this, however, garden peas persistently revert to recessive types. Probably it is not altogether possible to check this reversion, but a great deal of improvement can be effected. The usual method adopted by merchants is to rogue fields during flowering-time. The system is both expensive and ineffective. It removes only the most obvious impurities.

The work undertaken in garden-pea selection has as its objective the raising of pure lines of the commercial varieties. The 1928 seed was collected from several sources in New Zealand. This was sown and single-plant selections made. When these single-plant selections were grown the following season (1929–30) it was very obvious that a considerable variation in type existed and that merchants had different ideas as to what constituted the characteristics of certain of our well-known varieties.

In the seasons 1929–30 and 1930–31 these selections were grown, and the bulk eliminated on account of variation in type, tendency to revert, disease, and such factors as these. In the latter season the selections were reduced to about two of each variety, and were grown at Palmerston North to relieve the tension at Ashburton farm, where suitable facilities were not available.

This past season a few seeds of each selection have been grown on netting to allow more critical observation, and the balance in increase blocks. An attempt has been made to select a line of each of the thirty varieties that is typical. This has been very difficult in some cases, and it will be interesting to see whether the merchants will accept these types for their trade.

Notes have been taken of all varieties. These will be supplemented next season, and it is hoped that we shall then be in a position to publish type descriptions of varieties and comments on their adaptability for New Zealand conditions.

The present position is that we shall thresh about 10 lb. of each selection. It is hoped to increase this next season and to invite merchants to view the trials. If they are satisfied with the strains, and feel disposed to give orders, we shall then multiply those they have selected and make delivery in due course. If merchants are not disposed to handle these lines, further work is not warranted. There seems to be no purpose served in distributing them to individual farmers, since the great bulk of seed is grown on contract.

Field Peas.

A commencement was made in 1928 when samples were collected from various sources. From this material single-plant selections were made and sown out in 1929–30. This season those selections remaining from the 1929–30 season have been planted on netting at Palmerston North and carefully observed. Increase plots have been grown at Ashburton.

We observed this season: 31 selections of partridge peas; 29 of Harrison's Glory; 14 of Marrowfat; 20 of White Ivory; 20 of Small Blue; and 20 of Large Blue. In addition we grew and observed commercial lines introduced from Tasmania.

Observations have been very greatly hampered by disease. Virus, collar-rot, and fusarium have all tended to upset observation, and it has become exceedingly difficult to be certain whether the early maturity of a selection has been due to genetic or pathologic influence. Moreover, the nomenclature has offered difficulties. The names used are trade terms, and may embrace one or more varieties.

Generally speaking, there is little variation in partridge beyond that of maturity, and about this factor we cannot be certain. Only one variant has been noted, and since this seems to possess many features of interest it will be studied more fully. Partridge is the most important field variety in New Zealand. It overshadows all others, and warrants considerable investigation. The other varieties all show variations. Those that are obviously not true have been discarded this season, so also any showing weakness in other directions. From those remaining it should be possible, during the next few years, to isolate the most productive types and bring these in to replace the mixtures that are grown at present.

The present position is that we have about 6 lb. to 10 lb. of each of the selections, and the bulk of this seed will be held pending further trials and observations.

Linseed.

In 1927 work was commenced in selecting a tall strain of Moose linseed, and one more easily harvested with reaper and binder. Single-plant selections were made from crops then growing in Canterbury, and these were sown out in the season 1928–29; also during that season further single-plant selections were made, so that we have two series—viz., 1928 and 1929 respectively.

From the plots in 1928–29 several lines were selected, but it was found that thickness of sowing had a marked effect upon height. In 1929–30 we were unfortunate enough to lose nearly all the seed through damage by birds, but enough of both the 1928 and 1929 selections remained for trial this past season. These were sown at Palmerston North, and protected from birds by netting. Some seed of each selection was sown, for purposes of comparison, in carefully spaced rows, the seed 1½ in. apart, and a bulk line of Moose in every fourth row as a check. The balance has been used up in increase blocks.

Some very promising selections have been reserved, and appear to be from 6 in. to 9 in. taller than Moose, much more uniform, and to yield more heavily. Determinations of oil content are being made by the Chemist. Next season should see the final trials, and thereafter the line selected will be increased and sooner or later replace the present type that is grown.

Barley.

As a result of work commenced in 1926–27 we have four smut-free selections of each of the standard varieties of malting barleys—Plumage-Archer Spratt, Plumage-Archer, Chevalier, and Goldthorpe-Spratt. These were grown last season in $\frac{1}{10}$ acre plots, and this season they have been on trial to determine whether any differences exist. Selections are also being raised of the "Gisborne" variety of malting-barley.

Clover.

We have now 73 acres of Montgomery Red and 39 acres of Kentish Wild White. In most cases the seed has been grown on virgin land to ensure the minimum of volunteer impurities. The Department has reserved the right to purchase from the growers all or part of the seed harvested from these areas. It is proposed that this seed shall be sold to merchants and growers intending to undertake seed-production, and that eventually there will be sufficient available for export under certification.

2. CROP CERTIFICATION.

Operations in connection with crop certification have been continued during the 1930–31 season. The only new crop to come under the scheme is the French-bean seed crop, while the certification of the following crops was continued from the previous season: (1) Perennial rye-grass, (2) potatoes, (3) brown-top, (4) wheat, (5) white clover.

The certification scheme generally is being well received throughout the country, and inquiries already received from abroad would indicate a decided preference for certified over uncertified seeds.

Rye-grass.

The following figures give the number of crops and the acreage passed in the field this season as compared with last:—

Class of Seed.	1930–31.		1929–30.	
	Number of Areas.	Acreage.	Number of Areas.	Acreage.
Mother	88	1,074	..	..
Permanent pasture (eligible mother)	258	3,092	173	2,383
Permanent pasture only	27	279	..	..
First harvest	89	1,197	2	64
Total passed	462	5,642	175	2,447
Areas rejected	82	720	45	581

It is estimated that this season from 80,000 to 90,000 bushels of field-dressed rye-grass seed will come under certification.

The germination of the various lines this season is showing a great improvement on that of last season, when lines averaged from 60 to 70 per cent. germination. This season, with two exceptions, all lines ranged from 85 per cent. upwards. The most gratifying result from rye-grass certification has been the success following the use of mother seed in the South Island, particularly in Canterbury. Excellent crops of certified seed have been produced, and there is little doubt that the system of certification will rapidly tend to the elimination of the production of the false perennial rye-grass types of seed with very permanent benefit to New Zealand agriculture.

Potatoes.

The quantity of seed for which tags were issued in the 1929–30 season, together with that for the 1928–29 season, is given below:—

	1929–30. Tons.	1928–29. Tons.
Aucklander Short-top	176	85
Dakota	174	96
Aucklander Tall-top	50	14
King Edward	30	2
Iron Duke	23	..
Majestic	16	..
Early Regent	14	..
Epicure	13	..
Up-to-date	6	15
Robin Adair	4	..
Golden Wonder	3	12
Arran Chief	1	18
Bresee's Prolific	1	6
Total	511	248

The current season has seen three main modifications to the certification scheme: (1) The acceptance of entries of only those crops planted with seed from a provisionally certified crop, or seed once grown from a provisionally certified crop. (2) The introduction of qualification trials, carried out under the supervision of the Fields Superintendents. Farmers may now forward fifty tubers of the seed they are planting, and receive a report as to its suitability for entry into certification the following season. (3) The deletion of the second field-inspection from the certification procedure.

The first alteration was introduced primarily with a view to restricting applications, and, secondly, with the idea of doing away with the inspection of a large number of crops which had no possibility of reaching the required standard. This decision was reached following upon such figures as the following, which were obtained in the 1929–30 season: One hundred and seven lines of Dakota were entered in that season: (*a*) Forty-eight of these were from crops provisionally certified the previous season, and 62 per cent. of these forty-eight again reached the required standard. (*b*) Fifty-five were from crops about which nothing was known, and only 20 per cent. of these fifty-five came up to standard. (*c*) Four were from crops rejected the previous season, and none of these passed. So that whereas 62 per cent. of certified lines again passed, only 20 per cent. of those lines passed which had not previously been entered.

As a result of this change in the scheme, applications were received as follows:—

	1930–31.	1929–30.
Manawatu and Hawke's Bay	15	4
Canterbury and Marlborough	320	310
Otago and Southland	28	65
Total	363	380

Thus the number of entries was not materially affected, but when it is considered that in addition to these 363 entries, 262 applications for the qualification trials were received, and that under the old conditions of entry practically all these would be entered into certification, one can readily see the advantage derived from limiting the applications. This is still more noticeable when it is pointed out that whereas 85 per cent. of the crops in certification passed the field inspection, an estimate would reveal that probably not 20 per cent. of the samples in the qualification trial would reach that standard.

Reports on the field inspection for the current season are to hand, and the following figures reveal the difference in the standard of lines entered this season and last. After deducting the crops which have been withdrawn for various reasons (thirty-four withdrawn in 1929–30 and fifteen in 1930–31) we have—

	1930–31.	1929–30.
Crops inspected	331*	341
Crops rejected on account of rogues	22	87
Crops rejected on account of virus	26	88
Crops passed field inspection	283	166
	=86 per cent.	=49 per cent.

* A few crops yet to be inspected.

A slightly higher standard was adopted in the current season, so that these figures show the great improvement in the general standard of lines under certification, and also indirectly the advantage of certified over uncertified seed.

In the 1929–30 season 1,200 acres were inspected in the field. This season a similar acreage has been inspected, equal to about 6 per cent. of the total New Zealand acreage. One would be safe in saying, therefore, that from 10 per cent. to 12 per cent. of the New Zealand acreage was this season planted with seed from provisionally certified crops. It is anticipated that of the 283 crops passed in the field well over two hundred will pass the cropping-power test, and qualify for provisional certificates, thus materially increasing the area in New Zealand to be planted with certified seed.

The work in Canterbury this season (where most of the potato certification is undertaken) has been made difficult by the peculiar weather conditions prevailing. The dry season and the January frosts so affected growth as to make the work of the Inspectors at times extremely difficult.

A feature of potato certification this season is the entry of twenty-five lines of different varieties from the Ashburton Experimental Farm (referred to in Part I). Most of these lines are produced from seed imported from Scotland and Ireland, though some are from local selections. All seem to be comparing favourably with local farmers' lines of the same variety.

White Clover.

The certification of white-clover seed in the 1929–30 season resulted in the sealing and tagging of about 35½ tons of machine-dressed seed, which has been certified to as being the produce of pastures five years of age or over. This current season certification of white clover on an age-basis is again being undertaken. Up to the present most of the lines certified have been dressed out of certified rye-grass seed, and it is impossible at the present juncture to give an estimate of the total amount which will be handled this season. In the meantime as much information as possible regarding samples from known areas is being collected, so that, when classification on a type-basis is introduced, it will be possible to locate immediately areas which will be eligible.

Brown-top.

Records of the 1929–30 season in connection with the certification of brown-top indicate that 170 areas, approximately 22,000 acres, were inspected and declared free from red-top. There were 24 acres rejected as containing red-top. Not all the area passed in the field was harvested, while not all the seed harvested was sealed after machine-dressing; but approximately 76 tons of seed was sealed and certified after machine-dressing.

The United States tariff somewhat upset the organization in that the dressing-plants immediately commenced to work twenty-four hours per day in order to ship as much seed as possible before the tariff came into operation. The result was an unforeseen rush in the dressing-stations of Southland and Otago, and in some cases merchants preferred to ship their seed unsealed rather than to delay shipping and incur the extra tariff.

With the exception of one sample of seed, the origin of which was doubtful, all samples received at the Plant Research Station for trial have proved to be free from red-top, and the areas concerned, together with those which pass the field inspection this year, will again be eligible for certification.

The brown-top harvest for the 1930–31 season has not commenced at time of writing, and there is speculation as to the demand for New Zealand seed from overseas; but it seems almost certain that any seed sealed and certified will be preferred to uncertified seed.

Wheat.

The following quantities of machine-dressed seed wheat were purchased, sealed, and tagged, and sold to merchants in the 1929–30 season, the figures for the 1928–29 season also being given :—

Variety.	1929–30. Bushels.	1928–29. Bushels.
Solid-straw Tuscan	11,006	7,119
Hunter's	4,160	4,563
Velvet	216	..
Dreadnought	220	..
Marquis	400	..
Solid-straw Velvet	213	..
Yeoman	36	..
Totals	16,251	11,682

Alterations in the wheat-certification organization for the current season have been such as to place the scheme on a similar footing to other certification. The Wheat Research Institute will not again purchase seed at a fixed premium over ordinary milling-wheat. Instead merchants will receive samples of farmers' dressed lines which have come up to the standards set, and business will be done by them direct with the growers.

Secondly, fixed standards for the field inspection have been introduced—namely, a minimum of 99·8 per cent. varietal purity, and a minimum of 99·8 per cent. of heads free from loose or stinking smuts. These standards were such as to exclude practically all Solid-straw Tuscan crops, but, in spite of this, it was considered advisable to adhere to the standard rather than to relax and allow more crops through.

The following figures show the number of areas and the acreage entered and passed in the field. (Note.—Figures in parentheses are acreages passed in the 1929–30 season) :—

Variety.	Number of Areas inspected.	Acreage inspected.	Number of Areas passed.	Acreage passed.
Solid-straw Tuscan	76	2,178	9	129 (490)
Hunter's	44	894	8	139 (190)
Velvet	6	85	3	28 (5)
Dreadnought	2	13	2	13 (5)
Marquis	2	36	2	36 (20)
Solid-straw Velvet	1	16	1	16 (5)
Garnet	2	24	1	12 (20)
Yeoman	1	12	1	12 (1)
Purple-straw Tuscan	1	14	..	..
Major	1	17	..	..
Totals	136	3,289	27	385 (736)

Beans.

Following upon a report submitted by the Mycologist drawing attention to the presence of bacterial wilt in the bean crops of Marlborough, arrangements were immediately made for the certification of bean crops grown for seed-production. The scheme operated on the current season's harvest, and the following areas have been inspected in the field :—

Variety.	Passed.		Rejected.	
	Number of Areas.	Acreage.	Number of Areas.	Acreage.
Canadian Wonder	39	126	22	119
Butter	16	56	1	2
Miscellaneous	15	23	1	3
Totals	70	205	24	124

Next season only those crops which have been sown with certified seed will be eligible for entry into certification.

3. MISCELLANEOUS TRIALS.

Rape.

Nothing very much is known regarding the strains of rape used in New Zealand. That variations exist is evident from reports received from growers regarding the variable palatability and fattening qualities of rape. A preliminary trial was laid down this season with a view to studying the types and to determine whether further investigation was warranted. Seed was collected from merchants throughout New Zealand and thirty-three lines placed under trial. Seed was sown in the nursery and forty-four plants from each line transplanted 30 in. apart each way. Thus each plant had ample opportunity for full development. Subsequent investigation revealed the fact that ten of the thirty-three lines were of mixed types, and were eliminated. The remaining twenty-three lines could be classified into three as follows :—

Type 1 : Giant form or French rape represented by seven lines.
Type 2 : Dense-crowned Dutch rape represented by twelve lines.
Type 3 : Open-crowned procumbent and blue-green leaf, represented by four lines.

The trial was divided laterally into four blocks—A, B, C, and D. Block A was cut back hard representing a severe grazing. Block B was cut back lightly representing a light grazing. Block C missed the first cutting and represented a light grazing taken when the plants were well past the stage at which they might have been utilized. Block D has been left for observation. Interesting evidence is being secured as to the behaviour of these types, but results are not yet completed and will form the subject of a later report. There are, however, distinct differences in recovery and general behaviour.

With regard to the rape investigations, certain plants from the most homozygous lines have been marked for seed production.

Lucerne.

Samples of seed that were collected by the late Mr. C. W. Purdie, and others obtained from various sources, have formed the material for study during the past summer. The seed was sown in the nursery and from twenty to one hundred plants of each line transplanted 30 in. apart each way for single-plant studies. There are under observation about 3,600 plants, one-half of which have originated from old stands in Marlborough.

The preliminary work this past summer, and in the coming winter and spring, is to observe type, leaf-density, flowering, recovery after cutting, and winter and early spring growth. Already some 360 plants have been located which are showing promise, but no doubt the number will be materially reduced during the coming winter and early spring. There are two objectives. Firstly, the production of a high-producing, persistent, and leafy strain for hay-production; secondly, the production of a type having the same features, but adapted to stand grazing. In general, the Marlborough types are showing no wide variations; but varieties such as Ladak show every possible extreme, and many prostrate, dense-leaved types are to be found. So also this variation is found in strains which have obviously been crossed with *Medicago falcata*.

Barley for Green Feed.

A small preliminary trial was conducted this past season to determine the value of malting-barleys as against the Cape and Skinless varieties for green feed. The trial was not sown in the spring, but it indicated that Cape and Skinless give a far greater bulk in the first two feedings, and that the malting-barleys in general give feed over a more prolonged period and stand cutting more readily. A more extensive trial in which actual weights will be taken has now been sown, and this should give more reliable data.

Recognition is here accorded to the valuable services rendered by Messrs. R. Thomson and J. H. Claridge, Assistants in Agronomy. The former is specializing in seed-production, and the latter is responsible for the bulk of the work connected with the organization of seed-certification.

AGROSTOLOGY SECTION.

E. Bruce Levy, Agrostologist.

The work of the past year has definitely opened up a new avenue for advancement in grassland-production. A milestone on the road of progress has been set up that bids to mark an epoch as important if not more so than that which marks the introduction of top-dressing. The concept of strain and pedigree in herbage plants has given new stimulus and afforded greater vision into the possibilities of permanent pasture. Good strains of herbage plants will cheapen as well as increase production, and will tend to level out and spread better the total yearly grass crop.

As a result of our trials, for New Zealand conditions at least, the best of world types are to be found in New Zealand itself. Supplies of seed of specially valuable strains exist at the moment, and these can be used as a nucleus for the production of our total Dominion requirement, and will serve better than any other strain yet tested as a basis for pedigree-strain building. I refer particularly to the permanent strains of rye-grass, particularly exemplified by the Hawke's Bay type, New Zealand Wild White clover, New Zealand cocksfoot, and New Zealand brown-top (for lawns).

The Hawke's Bay type of rye-grass is the only rye-grass yet tested that conforms definitely to the certification requirements as being fit for mother seed. There is only one white clover that the Department should certify to at the earliest possible date, and that is the New Zealand Wild White clover. The cocksfoot position represents a clear demarcation between New Zealand cocksfoot and Danish. There is no significant difference between Akaroa, Plains, Southland, or any other New Zealand type, and the best selections from plant-breeding stations overseas are essentially of the New Zealand type. With regard to red clover for temporary and short-rotation pasture, nothing has been found to equal the New Zealand Broad Red type. There is in the Montgomery Red clover type distinct hope of working up supplies of a truly permanent red clover, and there is a possibility of our growing Montgomery Red clover seed for export to Great Britain. In New Zealand brown-top the type in general is good and free of red-top. There are from our single-plant studies great possibilities of working up elite strains for playing-greens and in greatly improving the type for hill-country sowings in New Zealand itself.

The year's work at the Plant Research Station has been almost entirely given over to the study of the foregoing species, together with trials of lines of these that enter as a routine in certification. I would again like to affirm my opinion that the application of certification to the sale of seeds of herbage plants is a boon from the research point of view, and it makes the locating and isolating of strain a live potential factor that gives security of continuity for work that otherwise must go for naught in the ordinary channels of trade.

Strain-isolation and pedigree-strain building and the certification of the resultant crops of these must of necessity revolutionize the potentialities of grassland farming.

Perennial Rye-grass.

(*a*) *Certification Trials.*—Approximately one thousand lots of rye-grass 1930 crops were sown out in connection with certification, and duly reported on to the Agronomist in charge of this project. These represented the major portion of the Hawke's Bay and Poverty Bay crop, and certain lines from the South Island sent in with a view to entering certification. Of all lines tested from overseas, none were up to certification standard. The 1931 crop has now in the main been received and the majority of these have been sown out. Approximately one thousand lines of the 1931 crop are under trial.

A difficulty arose in regard to ground for the sowing of these, and as no further ground was available two thirds of each of last year's plots was ploughed up and prepared as well as was possible. This left one-third of each plot still down of last season's crop, and it is hoped from these to get some information regarding any variations in the type of the certified crops themselves. I consider this testing-on for a few years of all lines certified to as necessary, as affording valuable data upon which to harden up on the standard for certification. Differences at the moment are apparent, and it is hoped to use certain of the better lines for breeding of improved strains as early as possible.

(*b*) *Single-plant Study.*—Two thousand two hundred single plants drawn from twenty-two of the best commercial Hawke's Bay lines previously tested were planted out for detailed study. These have been heavily culled during the year for rust and other constitutional weaknesses. The best of those left will be lifted and split up into tillers and subjected to a further trial under a triple system of mowing—lot 1 under cultivation as single plants; lots 2 and 3 will be planted out and, when established, sown about with a mixture of cocksfoot and white clover; lot 2 will be mown at seven to ten day intervals; and lot 3 will be cut at ensilage or hay stage. Those then that show best general production under all conditions will be further split up and propagated as an improved strain. Five hundred plants that have been tested under intercultivation and mowing for two years are showing marked differences in behaviour, and the intention is to propagate the best of these and plant out for seed-production.

(*c*) *Growth-form Experiment.*—Nine hundred single plants, representing sixty clones of fifteen plants each, and eight different growth-forms have been set out and placed under the triple system of cutting as outlined in (*b*) above.

(*d*) *Elite-strain Work.*—Two acres and a half of rye-grass (21,000 tillers) were planted out at Flock House, Bulls. These were secured by splitting up some 50 plants selected out of approximately three thousand Hawke's Bay single plants. A mistake was made in not cutting or grazing these back prior to shutting up for seed. The crop went into the spring and summer heavy in leaf and, owing to overmaturity of the leaf, rust attack was so severe that the majority of the area was cut and the crop removed prior to ripening. A somewhat later-maturing, erect, dark-coloured leafy type, however, resisted rust, and some 2 bushels of seed was secured from this lot. This seed is at present under trial and if it proves a superior type a larger area will be sown out in the spring. All the rye-grass plants that rusted have been ploughed in and a selection made from the rust-resistant type. These will be further split up into tillers and the 2½ acres replanted with these during the coming winter.

Half an acre of an elite strain of rye-grass from Aberystwyth was sown out this autumn in rows 18 in. apart. This is to be grown on behalf of the Welsh Plant Breeding Station in pursuance of their policy of once growing in New Zealand elite strains from that station. A seed crop should be secured during the 1931–32 season.

White Clover.

(*a*) *Certification Trials.*—One hundred and sixty-five lines for determination of type and for certification purposes were sown out in the spring. An additional two hundred and ten lines were sown out this autumn. An interim report on the spring-sown lines has been submitted to the Agronomist.

(*b*) *Single-plant Study.*—Four thousand single plants put out in November, 1929, have been studied in detail, and careful records of the performance of each made. The New Zealand Wild White lines have been outstanding. Kentish and ordinary New Zealand have made moderate growth only, while the New Zealand Dutch types and ordinary imported lines have done very poorly indeed.

(*c*) *Broadcast Trials.*—Those sown in 1928 have been ploughed up. Up to the time of ploughing in, the New Zealand Wild White was easily the best, and had spread and swamped out adjacent poorer types.

Eight hundred lines under trial sown in 1929 have been carefully recorded. Total production, speed of recovery after cutting, and persistency of the various lines were most marked. The New Zealand Wild White is again outstanding, and plots sown with this type are improving rather than deteriorating. Ladino White has put up a very poor showing during the past autumn, and the Kentish, although dense, is far below the New Zealand Wild White type in production at any period of the year. The imported Dutch types have virtually gone right out.

(*d*) *Elite-strain Work.*—Fourteen thousand eight hundred plants were set out at Flock House, Bulls. These made excellent growth during early autumn, but no payable seed crop was produced, but a few pounds were hand-collected for trial prior to taking a full crop next season. The 4,400 single plants at the Station representing the best New Zealand Wild White have been heavily culled, and some of the more outstanding plants have been marked for propagation by cuttings and further testing during the coming year.

Red Clover.

(*a*) *Certification Work.*—A few lines only of red clover are under trial for determination of type, and none yet are actually under certification. Some Montgomery Red has been imported and sown out in New Zealand for seed-production purposes. It is highly probable that the Department will be asked to certify to these crops, and samples of the seed sown have been submitted by growers to enable this to be done.

(*b*) *Single-plant Study.*—One thousand single plants of Montgomery Red planted in 1929 were allowed to run to a heavy crop this summer. A heavy death-rate has occurred which would indicate that a good deal of work yet is required before we can definitely offer a truly permanent red clover.

Three thousand five hundred single plants were put out during the year. These were in the main Montgomery Red lines and a number of other types from overseas research stations. Several Aberystwyth-bred lines are included in this trial. It is extraordinary the marked variation that exists in red clover even of the station-bred lines, and much preliminary testing of growth-form is necessary before we can determine just what is the best type to work for. It would appear certain that the intermediate late red clover as represented by Altaswede and Hersnap strains is useless for New Zealand conditions. It would appear that Aberystwyth had spent a good deal of time on this type. The two types of most value to New Zealand are the Broad Red type and the Montgomery type, the former of particular value for temporary and short-rotation grassland and the latter (after severe culling and much work in getting a uniform type) may be very suitable for permanent pasture. Montgomery Red will not replace Broad Red in New Zealand, but it could well be added as an additional clover, as it were, for permanent-pasture work.

(*c*) *Growth-form Experiments.*—In order to test growth-form particularly among the Montgomery Reds six plants each of six different growth-forms were selected and from each plant were propagated by cuttings clones of fifteen plants each. These have been planted, and two of the three rows of each sown about with cocksfoot and white clover. These will be differentially cut, as in the case of rye-grass growth-form experiments.

(*d*) *Broadcast Trials.*—Those sown in 1928 have been ploughed up. The European Broad Reds—Lombardy, French, and Italian—had almost completely disappeared in both hay and mown sections. New Zealand Broad Reds stood the test extremely well, particularly in the hay section. The Montgomery Reds never at any time beat the Broad Reds in production, but certainly were persisting much better under constant mowing. Forty-one lines sown in the spring, 1930, are being differentially cut under triple-mowing system. The Broad Reds have outyielded all other types since growth commenced. Under regular cutting, however, the Montgomery Red is swarding well.

(*e*) *Elite-strain Work.*—No progress apart from testing growth-form.

Cocksfoot.

(*a*) *Type-determination and Certification Trials.*—One hundred and fifteen lots sown last autumn in rows and twenty-seven lots sown broadcast last spring. These have been noted and an interim report as to type submitted to Agronomist. The Danish lines and most European lines from various plant-breeding stations showed marked winter dormancy and much leaf-burn. The New Zealand type is outstanding, and the best selections of research stations in Great Britain are definitely of the New Zealand type. No district in New Zealand appears to produce a superior type to any other, but there is undoubted scope for selection and improvement in any one line from any one district. The presence of rye-grass of a poor type in some Plains lines of cocksfoot reduces the real value per pound of those lines.

(*b*) *Broadcast Trials.*—Those sown in spring, 1928, have been ploughed up. In these trials cocksfoot stood mowing better than rye-grass but grew best under haying. The New Zealand cocksfoot persisted infinitely better than Danish, and made more late autumn and winter growth. Neither of the two lines from the Welsh Plant Breeding Station, Bc. 1629 and Bc. 1163, proved superior to New Zealand cocksfoot. Possibly in these the foliage was finer-leaved and somewhat denser at the crown, but production was low compared with ordinary New Zealand. A sample of cocksfoot from Lincoln College, C. 23, has been tried out in comparison with New Zealand ordinary and Danish. C. 23 is slightly superior to ordinary New Zealand.

(*c*) *Elite-strain Work.*—Two acres and a half of cocksfoot ex Aberystwyth Plant Breeding Station (Bc. 1163, Aber.) were sown in the spring at Flock House, Bulls, for seed-production on behalf of Aberystwyth Station. No crop was produced this autumn, but there is a good take and the area looks well. The area has been twice grazed off with sheep.

Brown-top.

Type-determination and Certification Trials.—Two hundred and twenty-nine lines were sown out and reported on in connection with certification as to type and whether these were free of red-top.

Single-plant Study.—Two thousand single plants, representing sixty lines, have been under careful observation and extraordinary varieties in type are shown. Two very distinct types of brown-top are harvested commercially: No. 1, the normal type from the wetter and colder second-class country of Southland, Waipu, and foothills of Canterbury: No. 2, a type from the poorer and drier arable areas of Canterbury particularly. Dr. Allan has this type under study. It is obviously of species rank. For hill-country work this type, No. 2, is of no value, and clearly should not enter certification as genuine brown-top (*Agrostis tenuis*). As a lawn-grass the merits of type No. 2 against genuine brown-top have not been sufficiently studied. The broadcast trials now under lawn conditions should give good information on this point.

Broadcast Trials.—Those sown in 1928 have been ploughed up. Competition of white clover and Yorkshire fog on this country (which is above the fertility scale for brown-top) almost completely wiped the brown-top out in a two and a half years' duration of this trial. Red-top, creeping-bent, Cocoos bent, true brown-top, and No. 2 type were included in this trial. Creeping-bent and Cocoos bent are one and the same—*Agrostis stolonifera*. Neither formed a good lawn-sward. Red-top went out in twelve months and at no time produced a lawn-sward. Both forms of brown-top produced good lawn-swards, but the true brown-top was the better colour. There is, however, to date insufficient evidence to show that we should exclude the No. 2 type from certification for export purposes, but recommendations in the meantime have gone to the trade to blend Canterbury lines rather than send straight lines, particularly from the drier and arable belt.

The 229 lines now sown out in field 8 are on a poor and drier soil-type. These are being treated as lawns and are being differentially manured as for lawns, and the weed and clover competition is being destroyed by spraying with arsenic pentoxide. The trial includes red-top, creeping-bent, true brown-top, and No. 2 type. To my mind determination of good lawn forms is important for the building-up of a sound export in fine lawn-seeds. The value of a good herbage-type of true brown-top for the wetter hill country throughout New Zealand is considerable. Steps should be taken to prevent the No. 2 type from being sold as brown-top for regrassing of hill country.

Yorkshire Fog.

One thousand single plants and ninety-seven lines collected from all over New Zealand are under trial. There is sufficient evidence to warrant going further into Yorkshire fog from a herbage-type point of view. A good deal of preliminary testing-out of growth-form, freedom from woolliness, and dead bottom, palatability, rust-resistance, persistency, &c., is necessary.

Timothy.

Twenty-six lines under trial sown autumn, 1930, from Germany, Scotland, Sweden, Norway, Russia, United States of America, Aberystwyth, and New Zealand. There is some fairly marked variation, but the grass as a whole has given very disappointing results in our trial grounds. For New Zealand conditions, excepting perhaps in country too wet for rye-grass, I am of the opinion that the value of Timothy is overrated.

Elite-strain Work.—Three-quarters of an acre for seed-production ex Aberystwyth pedigree-stock seed has been sown at Flock House, Bulls, for seed-production on behalf of Aberystwyth. Good establishment wat secured, but here, again, compared with cocksfoot alongside, Timothy is making a poor showing. The broadcass trials sown 1928 have been ploughed up.

Fine-leaved Fescue.

Sixteen lines under trial sown autumn, 1930, from Germany, Aberystwyth, Scotland, Norway, Austria, and Southland: The German forms are all fairly coarse-leaved of *Festuca duriascula* type (hard fescue). Aberystwyth line is a fine leaved *Festuca rubra* (red fescue) type, and has in this trial, and under broadcast trial sown in 1928, proved superior to New Zealand *Festuca rubra* var. *fallax* (Chewings fescue).

Elite-strain Work.—Three-quarters of an acre for seed-production ex Aberystwyth pedigree stock has been sown at Flock House, Bulls, for seed-production. This has established well and made good growth, but no seed was produced this year.

Growing-on of Elite Strains.

It will be noted that any work so far attempted in this has been done at Flock House, Bulls. This was made possible through an offer to donate ground and to provide certain labour by the managing trustee (Mr. T. R. Lees) and through the co-operation of the Principal (Colonel Powles). Our thanks are due to both these gentlemen. A suitable growing-on station equipped with suitable harvesting and threshing machinery is essential to the satisfactory prosecution of elite-strain building.

Field-work in Strain.

Field-work in connection with strain and species is now in progress at the following places: Puwera, Dargaville, Ngakuru, Katere, Stratford, Manaia, Marton, Feilding, Oroua Downs, Irwell, Amberley, Dunsandel, Winchmore, Hororata, Waimate, Caterhope, Gore, Waikaka, Tapanui, Winton, and Wanaka. Trials are also being conducted at several overseas stations.

Reports on these by the instruction staff of the Fields Division have been submitted regularly, and the outstanding feature is the marked superiority of the true perennial (Hawke's Bay rye-grass type) on all soil-types against the false perennial South Island and imported rye-grass types. Akaroa and Plains cocksfoot in all cases are superior to Danish. Montgomery Red is reported on in certain instances to be lasting better than Broad Red, but these red-clover trials, also the white-clover trials, are inconclusive to date.

The rye-grass trials laid down at Lincoln Agricultural College were ploughed up owing to poor take throughout due to late autumn drought.

Suppression of Annuals in Hawke's Bay and Poverty Bay Pastures.

Manurial experiments on fourteen places in Hawke's Bay and on six in Poverty Bay were laid down last autumn to see if autumn recovery of rye-grass could be made sufficiently rapid to control re-establishment of annuals, particularly goose-grass, burr clover, suckling clover, and clustered clover. The prolonged drought experienced by these two districts nullified any results as far as rye-grass stimulation was concerned, and the pastures remained sufficiently open to permit of free re-establishment of seed of annuals shed. It would appear the only hope of elimination of annuals by building up fertility will be during periods of normal rainfall so as to carry into a drought period a sward containing no annuals.

Regrassing Secondary-growth Country, Whangamomona.

This work has been continued, and marked progress has been shown. Swards of brown-top, *Danthonia pilosa*, and *Lotus major*, as the dominant species, are helping considerably to hold that country and to bring it back. Hard fern still proves aggressive, however, but is slowed up greatly in spread by competition of the above grass and clover species. Spraying with arsenic pentoxide is effective in complete eradication and control, but the economics and practicability of control by this method are doubtful. A sufficiently large area has now been cleaned up by spraying and burning to work out with a fair degree of accuracy the amount of work entailed in keeping this area clean of hard fern by spraying. The seed mixtures recommended as a result of regrassing trials are now adopted by practically all the settlers in the district, and have become part of the stock-in-trade of the Fields Instruction Service. It now remains to be seen how big a part strain will play in the major species now used—*i.e.*, brown-top, *Danthonia pilosa*, *Lotus major*, white clover, rye-grass, &c.

Hawke's Bay rye-grass has been used in the last two years' sowings, and this season trials of strains of white clover have been make on a fairly large scale. New Zealand Wild White, New Zealand ordinary White, and Kentish Wild White have been used. Selection work in brown-top, *Lotus major*, *Danthonia pilosa*, and possibly Yorkshire fog, may have a big influence on the successful regrassing of this type of country.

Field Certification Work in Grasses and Clovers.

Field inspections of rye-grass crops—first harvest and permanent-pasture seed ex Hawke's Bay—under the certification scheme were made in Marlborough, Canterbury, Otago, and Southland; also small number of crops in the Sandon district. The Hawke's Bay and Poverty Bay crops were inspected by the Instructors in charge of this work in the respective districts.

Ecological Work.

Detailed analyses in connection with field trials to determine composition of sward and changes that occur under differential treatment were carried out in Hawke's Bay and Poverty Bay and at Marton. Some sward analytical work was also done at Marton on behalf of Crop Experimentalist. Work on pasture analysis technique has been attempted, particularly in the case of the point quadrat method, for determining composition of pasture association.

Lawns.

Several experiments have been conducted in regard to control of weeds in lawns. The lawn-sward consists of the desirable fine-leaved grasses and a ground-floor assemblage of weeds. The ecological conditions set up in a lawn favour weeds rather than grass. As a result, a strong ground-floor competition of weeds arises and prevents effectively the tillering and spread of the grass. The object of these experiments is to destroy by weed poison this ground-floor competition and then to give to the sward as near as possible optimum conditions for the two major lawn-grass—brown-top and Chewings fescue—to thrive. Considerable success in control of weeds has resulted by the use of arsenic pentoxide. An article setting out details of this treatment is in course of preparation for the *Journal of Agriculture*.

Mr. William Davies, on loan from Aberystwyth, proved a tower of strength in the initiation and carrying-on of the strain work of the Station. His extended term in New Zealand expired at the end of January, when he returned to Aberystwyth, with the good will of all associated with him. His place as a strain ecologist will be difficult to fill. During his stay in New Zealand no pure genetical work was attempted, due largely to the more immediate practical needs of the strain-ecological side.

FIELD EXPERIMENTS SECTION.

A. W. Hudson, Crop Experimentalist.

The total number of experiments being carried out is 650. The number for the corresponding date in 1930 was 750. The reduction in number is chiefly due to the following: (*a*) A reduction in the number of observational pasture top-dressing experiments in Canterbury. These experiments have served their chief purpose, which was to carry out a manure-response survey, and only a limited number will be continued with the chief object of observing the duration of lime effect. (*b*) A reduction in the number of experiments on annual crops in the South Island. The present financial position has caused a reduction in this work. (*c*) The reduction in the number of grazing trials to determine the effect of applying nitrogen to dairying pastures. Most of these have served their purpose, but a limited number are being continued to determine the effect of the more or less continued use of nitrogen.

CLASSIFICATION OF EXPERIMENTS.

A. Research into fundamental grassland problems being carried out at—
(1) Experimental Farm, Marton.
(2) Farm of Instruction, Ruakura.
(3) Technical College, Christchurch (co-operation with).
B. Grassland investigations and demonstrations carried out by field officers of the Fields Division.
C. Experiments on annual crops being carried out by field officers.
D. Experiments on the manuring of fruit-trees.

A. RESEARCH INTO FUNDAMENTAL GRASSLAND PROBLEMS.

(1) MARTON EXPERIMENTAL FARM.

MEASUREMENT OF PASTURE PRODUCTION THROUGHOUT THE YEAR BY MOWING WITH A LAWN MOWER.

The six lines of investigation reported on last year have been continued. Slight modifications have been made in the technique. These have resulted in a more accurate measurement of total production of herbage. A Dennis motor-mower donated by Imperial Chemical Industries was received in March. The use of this machine will ensure greater accuracy of results and more satisfactory work generally. It is anticipated that a report covering work up till August, 1931, will be completed for publication about September next.

(*a*) *Trial of Effect of applying Super and Slag as Winter, Spring, Summer, and Autumn Applications respectively.*—The main features of this trial are: (1) Super continues to show a consistent superiority over slag, especially during low-production periods; (2) the summer and autumn applications of superphosphate are most effective in increasing production during low-production periods; (3) the total production from each treatment for a period of over two years has been worked out, and shows that the summer and autumn applications of super have caused the greatest production of herbage. The difference between these and the winter and spring applications is not very great, but combined with their superiority during the low-production periods a very excellent argument in favour of summer and autumn applications can be advanced.

(*b*) *Trial to determine Effect of Three Distributed Applications per Annum of Super, Super plus Sulphate of Ammonia, and Super plus Sulphate of Ammonia plus Potash, and to compare Ammonium Phosphate and Nitrophoska with the appropriate Mixtures above.*—This experiment is proceeding satisfactorily, but there is nothing to report at the moment beyond what was reported last year.

(*c*) *Trial to determine whether a Heavy Application of Super at Infrequent Intervals is as effective as smaller Applications at more Frequent Intervals.*—This trial was commenced in August, 1929. The treatments are arranged so as to apply 4 cwt. of super per acre per annum in the following ways: (1) 8 cwt. once in two years; (2) 4 cwt. once a year; (3) 2 cwt. twice a year; (4) 1⅓ cwt. three times a year; (5) initial 4 cwt., plus 1⅓ cwt., three times a year. This experiment has arrived at an interesting stage. Up to November, 1930, the experiment had been in progress for sixteen months, and the initial 8 cwt. dressing had maintained superiority. Since November, 1930, all other treatments are markedly superior to the 8 cwt. one, and up to the end of two years, when all plots except (5) will have had an equal amount of superphosphate, the superiority of the more frequently applied dressings is likely to be quite marked.

(*d*) *Study of Effect of applying Sulphate of Ammonia at Intervals of Two Months on Different Plots.*

(*e*) *Trial to determine the Effect on Production of utilizing Herbage at 2 in. to 3 in. Stage and 4 in. to 5 in. Stage.*

(*f*) *Trial to determine whether any Loss of Nitrogen occurs when Sulphate of Ammonia is mixed with Carbonate of Lime.*

The above trials are being conducted with much the same results as indicated in the last annual report. These trials, unlike (*a*), (*b*), and (*c*) above, are under a system of mowing only, with the result that considerable changes in the botanical make-up of the sward are evident. It is obvious that mowing only is not a satisfactory method of treatment of pasture if carried out over an extended period.

CHEMICAL ANALYSIS OF HERBAGE.

Dry matter determinations are being made on all grass cut. As much chemical analysis as possible is being carried out, this work being done by Mr. Doak, Analytical Chemist, attached to this Station.

EXTENSION OF WORK UNDER SYSTEM OF MOWING.

As indicated in the last annual report, the mowing technique adopted is undoubtedly highly satisfactory for investigating certain problems. It is highly desirable to have this work extended, but until a special assistant to take full charge of the work at Marton is appointed it is inadvisable to proceed further.

Further extension of this work to five or six stations, representative of different grassland districts of New Zealand, is highly desirable considering the importance of the grass crop to New Zealand. An area of about 10 acres at each centre should suffice for a start, but a special officer would require to be stationed at each centre.

SHEEP-GRAZING TRIAL.

This trial, which was commenced in August, 1928, has been continued, and should be carried on for another year. Very satisfactory control and utilization of pasture has been carried out during the past year, and the sheep have done extremely well under the system of intensive stocking. Sheep, which have been carried continuously for eighteen months under the system, produced at last shearing an average of 13·6 lb. of wool per head, and, judging by the appearance of the sheep at the present time, the wool-production at next shearing should be as good. During the calendar year 1929 the carrying-capacity over the year worked out at a little over ten sheep per acre. During 1930 the carrying-capacity worked out at 9·8 sheep per acre. Under a system of farming involving the raising and fattening of lambs this should allow for the carrying of seven to eight ewes per acre, the fattening of the lambs, and the conservation of hay and ensilage to meet stock requirements during low-production periods. As indicated in the last annual report, the information provided by this trial points to the desirability of acquiring farms specifically for the trial of a really intensive system of management accompanied by conservation of hay and ensilage. It should be pointed out that the pasture on which this trial has been conducted cannot be regarded as a really good one. The results are therefore more significant, as it is certain that even better results would obtain on good pasture.

TRIALS TO OBSERVE THE EFFECTS OF DIFFERENT FORMS OF NITROGEN.

These trials are being maintained at the present time, the chief feature is the inferiority of sulphate of ammonia on unlimed ground. It would appear that the continued heavy applications are increasing soil acidity to a marked extent.

(2) MEASUREMENT OF PASTURE-PRODUCTION THROUGHOUT THE YEAR BY MOWING WITH A LAWN-MOWER: RUAKURA FARM OF INSTRUCTION.

This trial was commenced in June, 1929, and is an extension of (1) above. It aims at a determination of the effect of winter, spring, summer, and autumn applications of superphosphate. Applications of nitrogen in autumn and winter are also included. In 1929 the spring nitrogen had a marked effect on production in this trial. The second and third applications of nitrogen in the autumn of 1930 and the spring of 1930 respectively had very small effects only. This trial will be reported on along with those being conducted at Marton.

(3) MOWING TRIAL IN CO-OPERATION WITH THE CHRISTCHURCH TECHNICAL COLLEGE.

On account of an unsatisfactory strike of the seed sown in this trial it has had to be abandoned. Work such as this must be under full control of the Department as it is too detailed and exacting to be worked on a co-operative basis.

B. GRASSLAND INVESTIGATION AND DEMONSTRATIONS BEING CARRIED OUT BY FIELD OFFICERS OF THE FIELDS DIVISION.

(1) GRAZING TRIALS ON DAIRY-FARMS.

During the season under review these trials were reduced to forty-three. Of these, thirty-three were carried out in the North Island and ten in Otago-Southland district. The results of the second season were in fairly close agreement with those of the first season, and indicate that the use of nitrogen is profitable, generally speaking, on good pastures only. A full report covering the two seasons was published in the *Journal of Agriculture* for February, 1931.

(2) GRAZING TRIALS TO DETERMINE THE RELATIVE MERITS OF HAWKE'S BAY RYE-GRASS AND SO-CALLED PERENNIAL RYE-GRASS IN CANTERBURY.

Six trials on carefully selected farms were laid down during the past year. The management up to date has been satisfactory in the main. No marked differences occurred in the carrying-capacity of the two types of rye-grass up to the late summer. The superiority of the true perennial appears to be establishing itself at the present time.

Experiments of different types of rye-grass were laid down in conjunction with these trials by the Agrostologist. They are already providing convincing evidence in Canterbury of the superiority of the good perennial types.

(3) OBSERVATIONAL TOP-DRESSING EXPERIMENTS.

A series of reports on about two hundred of these experiments conducted in Canterbury were published in the *Journal of Agriculture* for October, November, and December last. These trials very clearly demonstrate the importance of lime in conjunction with superphosphate on grasslands in Canterbury. In 1929–30 80 per cent. more lime was used in Canterbury than in the previous year. In 1930–31 133 per cent. more lime was used than in 1928–29, in spite of a general reduction in the use of lime over the South Island as a whole. It is fairly certain that this increase is largely due to the demonstrations provided by the experiments mentioned.

The extension of this type of experiment, which aims at securing a fertilizer-response survey of New Zealand, has not been pushed ahead as rapidly as was hoped, on account of financial stringency. About one hundred new trials in other parts of New Zealand were laid down during the year. The total under way at the present time is about four hundred. Approximately one hundred of the Canterbury trials have been given up, as in most cases the fields on which they were laid down have been ploughed up. The desirability of extending these trials as rapidly as possible is evidenced by the fact that in quite a number of places potash is having a marked effect on production where its deficiency was hitherto unsuspected.

(4) HAYING TRIALS.

Most of these trials have served the purpose for which they were laid down, and, consequently, are no longer carried on. At the present time only ten of these trials are being proceeded with.

C. EXPERIMENTS ON ANNUAL CROPS CARRIED OUT BY FIELD OFFICERS.

WHEAT MANURING.

A programme of wheat-manuring experiments was maintained during the past year. Twenty-four trials were laid down in the Canterbury-Marlborough district, and eight in North Otago. The experiments for the previous year were reported on in the *Journal of Agriculture* for July, 1930.

The 1930–31 season has not been as favourable to manure response as previous seasons. This applies particularly to nitrogen. The general average increase from 1 cwt. nitrate of soda was 2·6 bushels per acre. This represents the lowest seasonal average for some years, and shows a loss from the use of nitrogen, although superphosphate has maintained a good paying increase. Increasing the quantity of superphosphate to 2 cwt. per acre has not been productive of good results in the main, and it would appear as though 1 cwt. per acre just about meets the requirements of the wheat crop. The spring top-dressing of extra phosphate along with nitrogen was carried out by using ammonium phosphate. The results from this treatment were not as good as when nitrogen alone was used.

Trial of Different Forms of Nitrogen at Different Times of Application.—A report on this trial carried out in the season 1929–30 was published in the *Journal of Agriculture* for March, 1931. The results indicate that nitrate of soda gave best results when applied in September or October rather than in August. In the case of sulphate of ammonia better results were obtained from the dressing in August than from dressings in

September and October. Other forms of nitrogen were also reported on, but were not of outstanding merit. In the 1930–31 season three trials in which nitrate of soda and sulphate of ammonia were applied at different times were laid down. The differences between different times of application were not so marked as in the previous year, nor were the increases from the nitrogen as great. These experiments will be the subject of a special report to be published in the *Journal*.

Rate-of-seeding Trials with Wheat.

Three trials were carried out with rates of seeding ranging from 80 lb. to 130 lb. per acre with each of three varieties. The results confirm those of the previous year, and point to the conclusion that a sowing of 20 lb. or 30 lb. of seed in excess of the optimum will not affect the yield. If, however, the rate of seeding is 10 lb. or 20 lb. below the optimum a considerable reduction in yield will result. The results of these trials have an extremely important bearing on variety-trial work and also on farmers' practice. There is a tendency for the rate of seeding of wheat to be decreased below that formerly practised. While this practice may result in an improved sample, it is not likely that the grower will get a price for such wheat commensurate with the lowered yield which is likely to result. The tendency should be for a little more rather than a little less seed to be sown. These trials are being repeated in the coming season, and no results will be published until the results of the coming season's trials are available.

Wheat Variety Trials.

Twelve variety trials were laid down in collaboration with and on behalf of the Wheat Research Institute. With very few exceptions, Solid-straw Tuscan has proved to be the best-yielding variety under trial. Its yield, combined with its wind-resisting properties, will make it a difficult wheat to displace, and unless growers receive a considerably higher premium for quality than they have done in the past it is not likely that quality wheats will become very popular. The programme of variety trial work is being maintained as far as finances will permit.

Effect of Hot-water Treatment for Control of Disease on Yield of Wheat. (Trials conducted on behalf of Mycologist.)

Three trials were laid down in continuation of the programme of the two previous years. The hot-water treatment had rather a severe adverse effect on germination, and did not increase the yield. Seed once removed from treatment yielded the same as untreated wheat in all cases, although the treatments of the previous year from which this seed was derived did have a considerable effect on yield.

Oats.

One manuring trial was conducted at the Gore Experimental Farm; the results are not yet to hand. One hot-water-treatment trial was conducted; the hot-water treatment had no effect on yield.

Barley.

One manuring experiment was conducted in Canterbury; 1 cwt. of superphosphate increased the yield by approximately 9 bushels per acre; muriate of potash depressed the yield; nitrate of soda had no effect.

One hot-water-treatment trial was conducted, but the treatment was ineffective.

Note.—Hot-water-treatment trials on wheat, oats, and barley were carried out on the Canterbury Seed Co.'s Farm by courtesy of Mr. Hewlett, Manager of the Canterbury Seed Co.

Potatoes.

Four manuring trials on early potatoes were conducted in the Pukekohe district; the results of the 1929 experiments were published in the *Journal* for April, 1930.

Only ten South Island manuring experiments on main-crop potatoes were sown in 1930, as compared with twenty in the previous season, the rduction in the number of trials being occasioned by lack of finance. It is intended to summarize the results of four years' experiments about August next. A brief summary, including recommendations to growers, was published in the *Journal* for September, 1930.

Eight trials conducted in 1929–30 on behalf of the Agronomist revealed marked superiority of certified over non-certified seed potatoes. The increases in yields of the following four varieties, Epicure, Aucklander Short-top, Dakota, and Up-to-date were 148 per cent., 9 per cent., 84 per cent., and 112 per cent. respectively. These increases refer to the yields of table potatoes only.

Eight trials laid down in 1929 in collaboration with the Mycologist, Entomologist, and Agronomist, with the object of determining what districts least favoured the spread of virus disease and produced the most vigorous seed are being continued. In 1930 seed from eight different sources was put under trial at Rangiora. The results are not yet available.

Swedes and Turnips.

During the year two reports were published on manuring of turnips in Canterbury. Results of a large number of trials are awaiting publication and will be attended to this year. The average of nine experiments conducted in 1929–30 shows a superiority of superphosphate plus lime over superphosphate by 47 per cent. in germination and 30 per cent. in yield. Only thirteen experiments were laid down in 1930 as compared with twenty-four in the previous year.

An experiment on behalf of the Mycologist was laid down at Gore Experimental Area in 1930 to determine the effect of lime combined with the manuring of slag on the control of club-root. Reports to date indicate that the combination of lime and slag had a very striking effect on club-root control. This experiment is being continued to determine the effect of lime application in the second season.

Miscellaneous.

Other experiments being conducted include onion variety trials, lucerne inoculation trial, lucerne manuring, control of bidi bidi, control of manuka-scrub, lupins for sheep-feed, maize variety and selection trials.

D. MANURING OF FRUIT-TREES.

The Director of the Horticulture Division has handed over the control of experiments on the manuring of fruit-trees to the Plant Research Station, and is placing the services of Orchard Instructors at the station's disposal for the carrying-out of the trials. Mr. Dallas, now on the staff of the station, is acting as liaison officer between myself, the Instructors, and the Director of the Horticulture Division, and is personally responsible for the conducting of the trials. Unfortunately, the Orchard Instructors' busy season coincides with the time when most attention will be required for the picking and weighing of fruit. Consequently, the amount of work attempted is strictly limited.

The following experiments have been laid down: Pip fruits: Auckland, 1; Hawke's Bay, 1; Otago, 1. Stone fruits: Auckland, 1. Citrus fruits: Tauranga, 2.

Many points require investigation, but as very little accurate information regarding responses to manure is available it was deemed advisable to determine the fundamental points, viz.: "To what extent are phosphate, potash, and nitrogen limiting production in the districts under trial?" The natural sequel to these trials will be determination of such factors as the effect of quantity, time of application, &c., regarding those treatments which prove beneficial. Dr. Cunningham is watching the trials from the point of view of the effect of treatments on resistance to fungus diseases.

As far as possible five replications in the form of a "Latin square" have been laid down. The arrangement of trees in orchards has necessitated modification of the arrangement of plots in some cases, but five to eight replications of treatments is the general rule.

It is proposed to continue the experiments for from four to five years at least. At the end of that time the question of extension of time of trials will be considered. Up to date of writing results are available only from experiments on lemons and peaches. No differences occurred in the first season, although there are indications already that manuring is having an effect on the production in the case of the lemon-manuring experiments.

MYCOLOGY SECTION.

G. H. CUNNINGHAM, Mycologist.

A large volume of work has been undertaken during the past twelve months, despite financial considerations causing curtailment of travelling, special field-work, and of labour at the experimental area at Tiritea. The activities of the laboratory during the year have been extended to cover forest mycology and orchard experimental investigations.

BRASSICA DISEASES.

(*a*) *Club-root.*—Extensive tests have been conducted to determine effects of nitrogenous, potassic, and phosphatic manures alone or in mixtures, and of differing quantities and types of lime on the persistence of the club-root organism in the soil. Results as yet are inconclusive concerning the effects of manures, save with superphosphate and basic slag, for there is definite evidence on the experimental area at Tiritea and other types of soils showing that the former increases and the latter decreases infection under field experimental conditions. With lime quite definite results have been secured, burnt lime in particular having been proved to have a marked effect in reducing the disease. This is enhanced if the seed is sown with basic slag, but if super is used the controlling effect of the lime has been almost entirely lost. The evidence that has come forward indicating the effect that acid fertilizers may play on reducing the controlling effect of lime is of great practical importance and explains many of the poor results experienced by farmers where lime has been used in large amounts to counteract the disease.

Many tests have been made in order to isolate resistant strains of rape, swede, and turnip. Selections of swedes from Canada have been tested and found to be almost or completely resistant. These have been seeded and are now being bulked for further field tests. A special study is being made of resistance within the variety superlative, and strains have been isolated that promise to be as resistant as was that variety when first introduced into New Zealand. A selection of rape practically immune has recently been isolated, so that there is a probability, provided these lines remain resistant, that club-root may shortly be a disease controllable to the extent of being of little economic significance. Tests have been conducted to determine whether biologic strains are present in the organism, but so far results have proved negative. The host range of the disease has been further examined, and it is now believed our knowledge on this point is fairly complete.

Work on the longevity of spores under both laboratory and field conditions has been continued, and on the effects of soil-types on the persistence of the disease. Transmission studies have been continued, but so far only negative results have been secured in tests designed to determine whether the organism is carried with seed. Positive results, however, have been secured with animal-dissemination studies, for it has been proved that spores will pass unaffected through the alimentary tracts of sheep and cattle fed on club-root-infected swedes.

(*b*) *Dry-rot* (Phoma lingam).—Work during the year has been concentrated on the following points:—

(1) Studies on commercial production of swede seed. For this experiment 1 acre of swedes were grown on the area, half being sown *in situ*, half being transplanted, to enable comparisons to be made between the two common British methods. Over 1,000 lb. of seed has been harvested, showing that swede-seed growing should be a practical proposition in the Dominion. During the experiment studies were made on the spread of dry-rot in the seed crop.

(2) Investigations designed to show whether the disease was transmitted in the soil from a previously infected crop gave negative results, thus supporting the work of previous years that the disease is not carried in this manner.

(3) Seed-disinfection studies of previous years have proved inconclusive, for although clean seed could be secured under laboratory conditions, we frequently failed to secure clean crops in the field. As this work was conducted with commercial lines of seed, containing about 0·2 per cent. of infected seed, it was considered inconclusive, results which were secured as a result of the small percentage of diseased seeds rendering the test unsatisfactory. Consequently, methods were elaborated to secure artificially infected lines, showing a high degree of infection. As a result, by special inoculation, a line of seed with 16 per cent. of infected seed has been produced. And when disinfection of this line was tried, it failed to give complete control. As a result, further disinfection studies have been undertaken, and a different process evolved, which, under laboratory tests, has given complete control. This method, however, is only applicable for the cleaning of nucleus mother lines, and could not be applied satisfactorily on a general scale.

(4) Tests of the viability of spores of the organism under wet and dry conditions were made, and, as a result, it was found that exposure of spores to dry conditions resulted in a rapid decrease in spore viability,

whereas when kept moist the spores were found to remain viable for a considerable period. This would tend to explain, in part, why the disease is more prevalent in wet seasons.

(*c*) *Fusarium Root-rot* (Fusarium elegans *var.*).—Laboratory tests have demonstrated that a Fusarium isolated from roots of soft turnips is responsible for considerable losses in the field, since it attacks and destroys the tap root of this plant. Hitherto this disease has been attributed to grass-grub.

Cereal Diseases.

(*a*) *Loose Smut of Wheat* (Ustilago tritici).—Numerous pedigree lines of wheat have been treated by the hot-water method, with a view to distributing smut-free nucleus lines for future certification. Experiments run to test the alleged immunity of Hunter's wheat to loose smut resulted in a small percentage infection being secured, principally in plants "breaking" from the original type. Artificial inoculation experiments demonstrated the presence of more than one biotype of this smut to be present in the Dominion.

(*b*) *Stinking Smut of Wheat* (Tilletia tritici *and* T. levis).—Field reports of continued success of the copper-carbonate-dust treatment, introduced by the laboratory some years ago, have shown further experiments on the control of this smut to be unnecessary at present.

(*c*) *Wheat Rusts and Mildew* (Puccinia elymi, P. graminis, *and* Erysiphe graminis).—Tests were made with sulphur dusts to determine whether under our conditions these diseases could be combated, and to ascertain if possible the probable losses they cause. Twelve applications were made on eight wheat varieties. In the untreated check plots appeared heavy infections of leaf-rust, moderately heavy infection of stem-rust, and in the centre of the plots, moderate infections of mildew; whereas in the treated plots a scant trace of these diseases was apparent. The difference in weight of grain between treated and untreated plots showed an increase in yield of 100 per cent. in most varieties. These results show that were it not for these rusts, wheat-growing could be made profitable in the North Island even in unfavourable seasons, but indicate quite clearly that rust-resistant varieties would be essential. As a preliminary to this work the rust biotypes present in New Zealand are being studied.

(*d*) *Black End.*—Seed showing 9 per cent. of this condition was sown at the area, but infection was not obtained. Heads apparently free from this disease were sprayed with spore suspensions of the fungus, but no increase in percentage infection was obtained over normal check lines. These results would tend to demonstrate that the fungus isolated is probably not responsible for the black-end disease.

(*e*) *Stripe Disease of Barley* (Helminthosporium sativum).—Twelve plots of various infected lines of malting and feed barleys were sown at the area, after treatment with hot water or various organic mercury preparations. But little stripe developed in the check plots, and merely a trace in all treated lines. The disease is apparently controlled by the hot-water process, since in the malting-barley crops of the Dominion, grown principally from seed treated by this process, but a trace is to be found, whereas it is prevalent in crops of green-feed barleys grown from untreated seed, and is common in barley imported from overseas.

Potato Diseases.

(*a*) *Corticium Disease* (Corticium solani).—Definite evidence has been secured showing that this disease spreads in the rows through the soil from diseased to healthy plants. Likewise it has been found in the persistence experiments that the disease may remain in the soil from one infected crop, to infect a second planted twelve months later. Rotation appears to have no effect upon the time over which the fungus remains in the soil, heavy infections being secured following swedes, peas, or cereals. On the other hand, grass appears to have a slight depressing effect on the persistence of the disease.

Attempts to increase the penetration of the acidulated mercuric chloride dip by the addition of alcohol failed when tested under laboratory conditions. A series of tests run with a view to lessening the injury caused by the dip if used late in the season failed owing to damage caused to the sprouts, late dipping killing these, and thus causing the crop to develop more slowly than the normal. In a series of yield-trial experiments, designed to ascertain the effects of different treatments on yield, significant increases were secured with a modified formula, both with seed and cut table tubers. Increased strengths of solution failed to give increased yields, possibly because of the damage caused to the tubers.

(*b*) *Wilt Diseases.*—A special investigation has been conducted in order to determine the causes of wilts so prevalent in our New Zealand potato crops. Isolations made from a considerable number of tubers, from different localities and from different varieties, yielded about twenty-one species of fungi. Inoculations showed that of these only species of *Venticillium* produced typical wilt symptoms. Seed similar to that from which these fungi were isolated was planted in the field and yielded 29 per cent. wilted plants.

(*c*) *Potato Dry-rot* (Fusarium spp.) A study was made of the organisms causing dry-rot. Four species of Fusarium were isolated from numerous tubers. Inoculations showed that of these three species were responsible, and *F. caeruleum* proving to be the species mainly concerned. Negative results were secured with numerous other fungi isolated from decaying tubers.

(*d*) *Black-dot* (Colletotrichum atramentarium).—This has proved to be a common disease of the potato in the Dominion, upwards of 30 per cent. infection being noted in certain lines. Inoculation experiments showed the fungus to be parasitic, twenty-one out of forty plants being infected in one test. Experiments conducted with mercuric chloride have failed to control this disease.

(*e*) *Silver Scurf* (Spondylocladium atrovirens).—This disease has proved to be very common on tubers throughout the Dominion, in one line 98 per cent. being observed. Treatment with mercuric chloride failed to reduce infection in the line tested.

(*f*) *Virus Diseases.*—All plants from supposed virus-free potatoes produced last season have been indexed, and all diseased ones discarded. Clean seed thus secured has been planted in isolated areas at Tangimoana, Marton, and Waituna West, and the crops rogued from time to time.

Certain lines of the variety Dakota show a curly-top condition. Investigation of this has shown it to be due to a virus disease, and this has been verified by graft inoculations.

The connection between net necrosis and spindle sprout has been confirmed. Experiments with grafts and needle inoculations have been undertaken, but results are not available as the crops are not harvested. These diseases are responsible for a considerable lowering of yield, as upwards of a 50-per-cent. decrease has been recorded in trials undertaken at the Area.

Numerous transmission experiments have been conducted in the glasshouse with the various virus diseases of potato (in collaboration with the Entomological Section); several hundreds of tubers have been indexed during the winter months, for freedom from virus. In the course of this work it was found that certain potatoes carried a masked virus, for the juice of certain apparently healthy plants, when inoculated into Datura and Tobacco seedlings produced definite mosaic symptoms in these hosts.

Legume Diseases.

(*a*) *Collar-rot of Peas.*—Investigations during the year have shown that this disease is caused by two related fungi, and transmitted from one season to another by means of infected seed. It is spread in the field by means of insects, and can persist in the soil for nine months (one season) but not for twenty-one months (two seasons). In addition to garden and field peas, the disease has been found to infect red clover, alsike, white clover, spotted-burr clover, and bokhara clover, but will not infect lucerne, lupins, beans, or vetches. These results have been obtained by artificial inoculation, for the fungi responsible have only been found under natural conditions on peas. Despite very numerous experiments, no practical method of complete disinfection of the seed has been secured, probably owing to the fact that treatments which kill the fungi so damage the seed as to reduce germination to a small percentage figure. Consequently, the producing, under isolated conditions, of quantities of disease-free seed is being undertaken as a preliminary to bulking up large lines for commercial distribution.

(*b*) *Bacterial Wilt of Beans.*—This disease has recently appeared in New Zealand, and is being made the subject of a special investigation. Cultural studies have shown that the organism is apparently an undescribed one, and not particularly closely related to those recorded as causing a similar disease in other countries. At present the production of nucleus lines of French beans free from the disease is being concentrated on as a preliminary to bulking up quantities for commercial distribution. The bacterium responsible has been demonstrated to be parasitic upon Canadian Wonder and Butter beans, and a strain has been isolated from garden peas.

(*c*) *Lucerne Nodule Organism* (Bacillus radicicola).—During the year cultures sufficient to inoculate 29,000 lb. of lucerne seed have been forwarded free of charge to farmers throughout the Dominion, showing an increase of 11,000 lb. over the previous season. Cultures for inoculating red and white clover (a new departure) are also being supplied on request; and initial work in the production of cultures suitable for lupins is being undertaken. The success of this work has been outstanding, as since the introduction of cultures some hundreds of acres of lucerne have been established on areas which hitherto have failed to grow this crop successfully.

(*d*) *Sore Shin (cause unknown).*—A serious disease of blue lupin, named "sore shin," is apparently the cause of land becoming lupin-sick where successive crops are grown. Preliminary work has shown that a species of Fusarium, and an Ascochyta are associated with the disease. As yet all preliminary disinfection experiments have failed to control the disease.

Mangold Diseases.

Work is in progress on disinfection of mangold seed against seed-borne diseases, several organic mercury preparations being tested, but as yet results are inconclusive.

Sclerotial Diseases.

Sclerotinia Disease (Sclerotinia sclerotiorum).—This disease has in recent years proved a serious problem to those growing vegetables, small fruits, and flowering-plants, being especially severe on tomatoes, blue lupins, sunflowers, and potatoes. Investigation showed that its spread has been partly due to the use of blue lupin as a green cover crop in market gardens and the like, for of the twenty-two samples tested, seven were found to carry the disease. Disinfection tests have failed to render seed free from the disease; but some success has been secured with a flotation process, by which all diseased seed can be separated from healthy seed. Lines treated by this process are being grown at the station, with a view to producing nucleus lines of clean lupin seed, preparatory to bulking up for commercial distribution.

Tobacco Diseases.

Preliminary investigations into the cause and control of tobacco-leaf spots are in progress, and a series of experiments on disinfection of seed by the hot-water process has been conducted. As yet these experiments have not progressed sufficiently far to indicate whether any measure of success has been obtained.

Fruit-tree Diseases.

(*a*) *Fire-blight* (Bacillus amylovorus).—An intensive cultural study of this organism has been made, and its distribution fully worked out.

(*b*) *Tests of Fungicides and Insecticides.*—During the year a section was added to the laboratory with a view to dealing with experimental work on horticulture, an officer of the Horticulture Division being seconded for the purpose. A commencement has been made on a comprehensive series of experiments designed to improve the insecticides and fungicides in commercial use, a three-years programme of work being laid down in Auckland, Hawke's Bay, Nelson, Canterbury, and Otago. Chemical analyses have been conducted with most of the sulphurs, lime-sulphurs, spreaders, and of certain proprietary compounds, with a view to securing information enabling improvements to be introduced into practical disease-control, and to formulating standards for insecticides and fungicides.

(*c*) *Cool-store Fruit-rots.*—Investigations were conducted into the fungi responsible and the conditions leading to fruit-rots in cool store. Preliminary investigations have shown that most of these losses are due to faulty handling of the fruit prior to storing, and to the running of stores at unsuitable temperatures and relative humidities.

(*d*) *Lemon-bark Blotch.*—Inoculations conducted have shown this disease to be due to the fungus *Ascochyta corticola*, typical cankers being produced on stems, branches, and orange-stocks. Control measures recommended have proved successful under field conditions both in Tauranga and Gisborne, localities in which the disease is prevalent.

Forest-tree Diseases.

During the latter part of the year a section was established at the laboratory to investigate diseases of exotic trees in nursery and field, timber-rots, sap-stain fungi, and the like. For this purpose a laboratory has been fitted, and an officer seconded from the State Forest Service. Preliminary investigations have been undertaken with a view to determining the part played in forest-establishment by mycorrhizal fungi, and the cause of the dying of *Pinus radiata* throughout the Dominion.

ENTOMOLOGY SECTION.

J. MUGGERIDGE, Entomologist.

The past year's activities are dealt with under the three headings—Routine, Investigational, and Research.

ROUTINE.

This includes—

(1) Identification of various insects sent in (approximately two hundred species in past year); and supplying all available information as to their economic significance and methods of control where known.
(2) Dealing with correspondence relating to entomological matters, apart from identification.
(3) Advice on ornithological matters.
(4) Attention to and care of entomological collection and literature.

A considerable amount of work is entailed under this heading, and during the past year over one thousand insect specimens were despatched to the Imperial Institute of Entomology, London, for identification purposes. Some of this material has already been identified and returned, but a considerable amount yet remains to be done.

(5) Investigation of minor problems in the field as they are brought under notice from time to time.

INVESTIGATIONAL.

Spray Experiments.—During the past year Mr. W. K. Dallas was seconded to the Plant Research Station as liaison officer between the various specialists and the Horticulture Division. As a result of this appointment, over forty spraying experiments relating to entomological pests were carried out during the year by the different Orchard Instructors. The experiments at the outset were initiated by Mr. Dallas, but a full account of all the work on entomological problems is kept at this office. Most of the material recorded has now been analysed by this Section, and a condensed report has been prepared.

Effect of Dry Heat on all Stages of the Flour and Grain Moth (Ephestia kühniella) *damaging Walnuts.*—This investigation is now under way, but owing to pressure of other work some time yet must elapse before it can be concluded.

Greenhouse White-fly (Trialeurodes vaporariorum).—This insect is a serious pest to the tomato-growers of the Dominion, and in order to cope with it as economically as possible it was proposed that its parasites (*Encarsia formosa*) be introduced from abroad. As practically no work had been done on the "white-fly" of New Zealand, and little was known regarding it, it was necessary at the outset to forward specimens to the Imperial Institute of Entomology for specific identification. (Specimens sent were identified by the Institute as *T. vaporariorum.*) Following on the identification of the pest, a request was made to the Institute for a supply of parasites. Three boxes of parasites were despatched from England, and this material was received here on 8th January. It was immediately placed in emergence boxes, but, unfortunately, no parasites emerged. Owing to the lateness of the season no further parasites were received, but it is hoped to continue this work in the coming season.

RESEARCH.

Diamond-back Moth (Plutella maculipennis).—The necessary preliminary studies on this insect in New Zealand preparatory to the introduction of parasites have been completed, and a full account of this matter appears in the October issue of the *Journal of Agriculture*, page 253. Regarding the biological control of this pest, word was received from the Imperial Institute of Entomology stating that they were at present unable to procure suitable parasites. Investigations, however, are to be continued as soon as weather in the Northern Hemisphere permits, and it is hoped that the Institute's investigations will be sufficiently advanced to enable us to receive consignments of parasites during the next season.

Tomato-stem Borer (Phthorimaea melanophintha).—This insect, which was first described in 1926 by Meyrick, is, as far as has been ascertained at present, a native species of New Zealand. During the last few years it has become a serious pest to the tomato-growers of the Dominion. The adult moth lays its eggs presumably in the axils of the leaves of the young tomato-plant, and the grubs when hatched bore into the stems of the plant. A study of this insect and of a closely allied species—namely, the "potato-tuber moth" (*P. operculella*) is now being undertaken. It appears, however, fairly obvious that effective control could be brought about by arsenical spraying when the plants are comparatively small; and ascertaining at what stage control can best be carried out will be specially studied during the coming season.

Insect Transmission of Dry-rot (Phoma lingam) *of Swedes.*—An account of preliminary work on this subject was published in the *Journal* for September, 1930. Preliminary experiments were conducted to determine whether a Drosophilid and a Staphylinid are responsible for transmission of dry-rot from infected to healthy swedes. These insects characteristically occur in dry-rot lesions. The sources of infection used were diseased roots taken from the field, artificially infected roots and cultures. The adult insects were taken from infected material and placed on a healthy root in a special receptacle. Only a small percentage of the roots developed the disease, but it is considered that the evidence is sufficient to incriminate both the beetle and the fly. Further work on this problem is being continued to determine (*a*) the characteristic insects present in dry-rot-affected swede crops; (*b*) whether they are responsible for producing the characteristic circles of infection round an initially infected swede-bulb; (*c*) whether from a study of the habits of selected insects in the field this incidence can be correlated with the spread of dry-rot.

Virus Diseases of Potato.—The first portion of this work is completed, and is being prepared for publication. It includes an account and description of the characteristic piercing, sucking, and chewing insects found on the potato-foliage in the commercial growing areas of New Zealand; also an account of their distribution and relative numbers. A second portion of the work dealing with the transmission of the virus "leaf-roll" by these characteristic insects is also completed, and is now in course of preparation for publication. A third and final portion of the investigation is under way, and deals with the transmission of the virus "mosaic."

Grass-grub (Odontria zealandica).—The experiments conducted and in progress on the control of grass-grub relate to the control of the grub in lawns, bowling-greens, nurseries, &c., and would not be economically useful in the treatment of large areas. The insecticides used consist of arsenate of lead, carbon bisulphide, White Island product, and Restar. Of these, arsenate of lead and Restar appear to give most promise. The former may prove useful for grub-proofing lawns if used at the rate of 2 lb. per 100 square feet of surface. For immediate results Restar is most promising, and it has been found that the application of a quarter pint of this material in three gallons of water applied to a square yard of lawn and washed in with a further three gallons of water is quite effective. Carbon bisulphide, it was found, cannot be applied to the surface as it burns the grass, but an injection of this material at the rate of 21 c.c. every foot gives 90 per cent. control. White Island product at the rate of 1,200 lb. per acre appears to give quite inadequate control. Further experiments on this subject are being conducted, and it is not expected that these can be finalized before next November.

BOTANY SECTION.

H. H. Allan, Systematic Botanist.

During the greater part of the year I was absent from headquarters, Mr. V. D. Zotov zealously and ably carrying on the work of the Section. A report on my activities abroad has been furnished. Since my return considerable progress has been made in preparing the results of my studies for publication.

Taxonomy.

From the information gained abroad, especially at the Herbarium of the Royal Botanic Gardens, Kew, and at the British Museum Herbarium, South Kensington, I am in a position to effect a much-needed revision of many groups of the indigenous flora. This will be done by publication in various scientific journals. I also paid much attention to the taxonomy of the alien flora of New Zealand, and am now revising the manuscript of my proposed "Flora of the Alien Plants of New Zealand."

Arrangements were made with various workers for co-operative effort, especially with Mr. Summerhays of Kew (New Zealand flora in general, revision of *Agrostis* and *Juncus*), and with Mr. Wilmott of South Kensington (critical studies in the alien flora). A commencement has already been made with these projects. Especially have I commenced that closer association with the British Museum of Natural History that is greatly desired by Mr. Ramsbottom, Keeper for Botany.

Mr. Zotov made studies on *Agrostis* and *Danthonia*, and systematic work on all grasses, indigenous and exotic, is being conducted, with a view to the publication of a comprehensive work on the "Grasses of New Zealand."

Identification of Specimens.

Some five hundred specimens were received and reported on, mainly by Mr. Zotov. A number of previously unreported species have been received, among which may be mentioned the buffalo burr (*Solanum rostratum*), and saffron thistle (*Carthamus lanatus*), both likely to become serious pests if allowed to spread. The advantage of early report in such cases is obvious. In this connection I should like to express my appreciation of the work of Field Instructors and Stock Inspectors in keeping a lookout for such undesirable incomers. An instance of the value of their work is the evidence afforded from specimens received that corn sowthistle (*Sonchus arvensis*) and hoary cress (*Lepidium draba*) are extending their areas in the North Island. Another example of the need for survey work is that of species of *Erica*, which are well established over many acres in the Volcanic Plateau area, but which have not before been recorded. As some time must elapse before a complete flora of alien plants is ready for the press, it is suggested that a preliminary bulletin be published of an annotated list of all the species so far recorded. A similar up-to-date list of the species of the indigenous flora is also a great desideratum. As the information is to hand the preparation of these lists would not occupy a great deal of time.

Herbarium.

Some five hundred sheets have been added to the herbarium of indigenous species, which is rapidly becoming properly representative of the flora. Dr. Cockayne has generously offered to allow me to incorporate in our herbarium such material as I may desire from his private herbarium. By this means a number of very important specimens will be added. Our stock of duplicate material is enlarged on every opportunity, and has enabled us to effect valuable exchanges with the chief botanical institutions of the world. We now have some four thousand sheets of foreign material. As this has been largely selected for its bearing on the introduced plants of New Zealand, the collection is proving of great value for identification and critical work, and will be further increased during the coming year. We have also received several seed-collections and have added one hundred sheets from specimens grown at the station. The herbarium of introduced plants now contains almost a complete set of recorded species.

Research.

General researches into the taxonomy and ecology of both the indigenous and the alien flora have been continued. Mr. Zotov has continued his detailed studies of *Juncus*, and the danthonias of the semi-annularis-pilosa group, and his results will shortly be ready for publication. The latter, especially, is of considerable economic significance. He has also greatly assisted me in the study of *Agrostis*. We expect to have the fundamental taxonomic work on *Agrostis* completed shortly, when a commencement of selection work may be successfully undertaken.

Further work on ragwort, gorse, blackberry, and piripiri has been accomplished. Specimens of late-flowering gorse have been marked for the purpose of obtaining seed, in co-operation with the insect-control-weed work of the Scientific and Industrial Research Department. For the successful completion of these projects it will be necessary for us to be able to make field studies in various parts of their areas.

A revision of the indigenous grasses of New Zealand is under way, with a view to a publication replacing the now out-of-date volume of Buchanan. For this, also, a reasonable amount of field-work is essential. But by careful selection of the areas these projects can be carried on co-jointly, and the total amount of travelling required will not be excessive. Preliminary work for a general book on grasses is continuing.

CHEMICAL SECTION.

B. W. Doak, Chemist.

CHEMICAL WORK ON MARTON MOWING TRIALS.

Chemical work on samples of mowings from various trials have been carried out during the year, and are being continued. It has not been found possible to carry out chemical work on samples from all the trials, but dry-matter determinations are being carried out on samples from all the mowing trials. Chemical analysis has had to be confined to three trials, but, owing to the amount of time involved in carrying out dry-matter determinations, it has not been possible to keep up to date with the chemical work. However, it is hoped that this work will be completed before next season's samples start. Dry-matter determinations were made on herbage from every cut. In the case of the trials from which samples are taken for analysis, it was decided to bulk samples in pairs if the mowings were made at less than a twenty days' interval. If the interval between

successive mowings was greater than twenty days, the samples were analysed singly. Where bulking of two samples was resorted to the final samples were made up from the original samples mixed in proportion to the plot yields.

The work on pasture samples from Marton has involved the chemical analyses of some two hundred samples and dry-matter determinations on about four hundred and fifty samples.

Mowing Trial A. (Experiment No. 16/2/8.)

Dry-matter determinations were carried out on the herbage from the various treatments. The variation in the percentages of dry matter of the herbage from the various plots when cut on the same date was not great, the extreme range representing about 2·3 per cent. of dry matter, or a variation of approximately 10 per cent. The variation in the percentages of dry matter at different times of cutting was much greater, the extreme values for the percentage of dry matter being 15 per cent. and 25·2 per cent. This difference tends to be seasonal in nature, but is variable, depending on the local weather conditions. This is shown in the following table :—

Date of cutting.	Average Percentage of Dry Matter.	Range of Percentage of Dry Matter.
12th May, 1930	24·5	22·9–25·2
28th August, 1930	15·8	15·1–17·0
23rd September, 1930	19·4	18·9–20·2
17th October, 1930	17·1	16·3–18·2
6th November, 1930	16·5	15·9–17·3
17th November, 1930	16·5	16·2–16·9
28th November, 1930	18·4	17·9–18·8
11th December, 1930	17·8	17·6–18·6
29th December, 1930	21·9	21·4–22·5
16th January, 1931	21·6	20·4–22·1
30th January, 1931	17·5	17·0–18·1
27th February, 1931	20·3	19·8–21·0

Similar differences have been observed in the dry-matter percentages in the case of the other trials. This shows the necessity for making dry-matter determinations on samples from every mowing.

The differences in dry-matter contents due to the applications of phosphatic manures (super or basic slag in winter, spring, summer, and autumn applications) are small, but there is a tendency for the slag applications to reduce the dry-matter content—relative to the control—less than do super applications.

Mowing Trial B. (Experiment No. 16/2/72.)

Dry-matter determinations on samples of herbage from this trial show similar variations to those noted in the case of mowing trial A above. It has not been possible to carry out chemical analyses on samples from this trial yet, but samples are being stored until the coming winter, when it is hoped that it will be possible to carry out the analyses.

Mowing Trial C. (Experiment No. 16/2/74.)

Chemical analyses of samples from treatments 1 (control), 2 (8 cwt. super every second year), 3 (4 cwt. super annually), and 6 (three applications each of 1⅓ cwt. of super yearly). Work on this trial has not been carried on sufficiently long to enable definite conclusions to be drawn, but the indications are that the more frequently the phosphate applications are made the more nutritious is the herbage obtained. Thus treatment 6, receiving 4 cwt. super per acre per annum in three applications each of 1⅓ cwt., produces, in general, herbage that is highest in lime, phosphate, protein, and ether extract and lower in fibre and carbohydrates than the other treatments, while treatment 3 (4 cwt. super per acre per annum in one application) yields herbage that is next highest in nutritive value. All treatments in this trial show a marked improvement over the control so far as chemical composition is concerned. It would appear that on land which shows a fairly marked phosphate response applications of super may be expected to improve considerably the chemical composition of the herbage.

The following table shows a typical set of analyses. The analyses were made on a sample prepared by bulking samples from mowings of 23rd January, 1931, and 2nd February, 1931, the bulking being in proportion to the yields. Results are expressed as percentages of moisture-freed material.

Laboratory No.	234	235	236	237
Treatment No.	1 Control.	2 8 cwt. Super biennally, One Application.	3 4 cwt. Super annually, One Application.	6 4 cwt. Super annually, Three Applications.
Lime, CaO	1·26	1·26	1·27	1·31
Phosphoric acid, P_2O_5	0·63	0·71	0·79	0·81
Potash, K_2O	2·82	2·70	2·59	2·68
Soda, Na_2O	0·44	0·57	0·57	0·57
Nitrogen, N	4·61	4·98	5·08	5·12
Total ash	9·47	9·60	9·75	9·79
Soluble ash	7·47	7·77	7·97	8·12
Insoluble ash	2·00	1·83	1·78	1·68
Ether extract	3·68	3·69	3·97	4·14
Crude fibre	16·21	16·08	15·72	15·74
Crude protein	28·81	31·10	31·74	32·00
Nitrogen-free extractives	41·82	39·53	38·83	38·33

MOWING TRIAL D. (EXPERIMENT NO. 16/2/75); AND MOWING TRIAL F. (EXPERIMENT NO. 16/2/89).

A large amount of analytical work has been carried out on samples from these trials, which deal with the effect of applications of sulphate of ammonia on the herbage. The most noticeable effect of sulphate-of-ammonia applications on the mown herbage has been the reduction in the percentage of lime as compared with herbage from the control plots. The duration of this effect is being investigated, and has been found to last for some considerable time after the effect on the yield has disappeared. For example, herbage from treatment 6, which received 2 cwt. of sulphate of ammonia per acre early in April, 1930, still showed a reduction in the lime content in February, 1931. This depression in the lime content is the more interesting, since all the plots received liberal applications of lime just prior to the commencement of the experiment. Also, in the case of trial F, one treatment (treatment 3) received additional amounts of lime at the time of the applications of the sulphate of ammonia (4 cwt. carbonate of lime plus 2 cwt. sulphate of ammonia). The lime content of the herbage from this treatment was almost exactly the same as that of the herbage from treatment 2, receiving applications of 2 cwt. of sulphate of ammonia only. In order to investigate the cause of this lime depression separations of the clover and grass from control and sulphate of ammonia plots were made. Unfortunately, owing to the great amount of work involved in the separations, it was only possible to separate enough to do lime determinations, though it would have been very interesting to study the effect of the nitrogen treatment on the other minerals. As a result of this work, it was found that the depressing influence of the nitrogen treatments on the lime content was due almost entirely to the change in the botanical composition of the sward (*i.e.*, due to a lowering of the percentage of clover). The lime contents of the individual species (white clover and perennial rye-grass) were only slightly depressed by the nitrogen treatments. This aspect is the subject of a paper to be published shortly.

The effect of the nitrogen applications on the other minerals or on the protein content is not very marked. A small increase in the protein content usually follows the nitrogen application, but this effect does not last long, and is often followed by an actual lowering of the protein content. This effect is due to increased growth of grass in comparison with clover. The potash content of the herbage varies considerably—varying inversely with the lime content.

ANALYSES OF STRAINS (ON BEHALF OF AGROSTOLOGIST).

Perennial Rye-grass.—Nineteen samples of perennial rye-grass, representing five distinct types, were analysed. The differences in chemical composition were small, and the variations within the type were almost as great as the differences between the various types—the only exception being in the case of type 5 (bad false-perennial type). This type produces herbage which appears to be superior in lime, phosphate, ether extract, and protein. However, the number of samples of each type analysed was not sufficient to justify any definite conclusions being drawn.

Red Clover.—Analyses of samples of nine types of red clover were made. The analyses showed considerable variations and indicate that definite strain variations exist. For example, the lime content of the complete plants varied from 1·5 per cent. to 3·2 per cent., while the variation in the lime content of the leaves alone was 2 per cent. to 4·3 per cent. The number of samples analysed does not justify any further conclusions.

SEED-TESTING SECTION.

N. R. FOY, Seed Analyst.

For the calendar year ending December, 1930, 10,461 seed samples were received at the seed-testing station, representing an increase of 1,308 on the number received during the previous year, this increase being almost wholly accounted for by commercial samples.

The distribution of the samples received was as follows:—

Senders, &c.	Number of Samples. 1930.	1929.
Seed-merchants	8,856	7,827
Farmers and growers	190	138
Government Departments (other than Agriculture)	130	67
Massey College	247	..
Agriculture Department—		
Fields Division	141	99
Plant Research Station	642	879
Retests	255	143
Totals	10,461	9,153

The samples shown for Government Departments and Fields Division represent mainly check samples on departmental seed purchases, while those for the Plant Research Station consist of special seed station tests, together with samples from the Mycological Laboratory, Agrostologist, Agronomist, &c., in connection with their various investigational activities.

Tests were required on the samples received as shown in the following:—

	Number. 1930.	1929.	Per Cent. Increase.
Samples for purity and germination	3,889	3,101	25
Samples for purity only	133	89	49
Samples for germination only	6,439	5,953	8
Totals	10,461	9,153	14
Purity tests made	4,022	3,190	26
Germination tests made	10,328	9,054	14
Total tests	14,350	12,244	17

Included in the total number of samples are over one thousand tested according to the International rules, this representing more than a reasonably workable maximum under the present conditions of the laboratory.

During the year inquiries relative to the station's testing methods have been received from seed-testing stations and merchants in Europe, Great Britain, United States of America, and Canada, and in every case reference was made to disputes consequent to this station's method of estimating purity. A number of New Zealand merchants have also been communicated with by overseas buyers on the same lines.

Up to the end of December, 1930, 119 certificates of analysis were issued for officially drawn samples of certified rye-grass, 83 of certified white clover, and 70 of brown-top—a total of 272 samples. The germination of the rye-grass was comparatively low, and many lines represented very poor value at the high prices paid. This season (1931) certified rye-grass, with the exception of certain southern-grown seed, is of excellent quality. A most unfavourable rye-grass season was experienced in Southland this year, and once-grown certified seed has failed to produce in certain cases a marketable crop owing to its low germination.

Last year's certified brown-top was of excellent quality, and all stocks were cleared. Certified white clover was of good quality, but there is a carry-over into this year.

Chewings fescue experienced an abnormal season, and one of the poorest crops for some years resulted. As was anticipated, the seed did not ship well, and a number of complaints have been received from foreign buyers as to quality, fears being expressed as to the return of the fescue trouble of some years back. It is considered, however, that 1930 must be regarded as an off-season, and that given normal climatic conditions and reasonable care in production, this seed will ship as satisfactorily as it did for some years prior to 1930.

An investigation into the factors causing hard-seededness in legumes was commenced this year, the material for the preliminary studies being provided by crops of different lines of *Lupinus pilosus* at the Plant Research Station area. The work is planned to cover (*a*) physiological studies as to nature and causes, (*b*) influence of harvesting procedure, (*c*) influence of storage conditions, (*d*) seed-treatment.

Mr. E. O. Hyde has continued his research into danthonia, and special attention has been devoted to the study of morphological variation in floral parts, and it has been shown how these characters may be used for the purpose of indentification of varieties so far as the seed trade is concerned.

A large amount of statistical matter has been prepared and tabulated for issue to the seed trade and to overseas institutions, and it is found that this feature of the station's work is appreciated and highly valued not only in New Zealand but in other countries.

FARM ECONOMICS SECTION.

E. J. Fawcett, Farm Economist.

The following projects undertaken during the past year are completed or are now under way:—

Statistical and Graphical Presentation of Rural Industries.—At the request of His Excellency the Governor-General, this work was undertaken to provide him with a full but compact reference to the position of all branches of the primary industries of New Zealand.

Economic Survey of Production and Capital in the Dairy Industry.—This survey was undertaken to establish the position of the industry as a whole, under varying standards of price for butterfat. The data from some 1,654 farms were used, the salient points standing out in the survey being—

(1) The average per-acre production of butterfat is 80 lb.

(2) The total area of land devoted to dairying approximates 4,000,000 acres.

(3) High per-acre production is definitely associated with small farms, heavy production per cow, and high intensity of stocking, but the number of effective cows milked per given area has the greatest effect on per-acre production.

(4) Labour efficiency varies directly with production. Whereas farms averaging 80 lb. per acre have a labour efficiency of 4,000 lb. per unit, farms producing 190 lb. per acre have a labour efficiency of 5,800 lb. per unit.

(5) Maintenance costs per pound of butterfat increase by 100 per cent. between farms producing 190 lb. and 50 lb. per acre, whereas labour costs (assuming a uniform annual return per unit irrespective of production) increase by 67 per cent. for the same groups of farms.

(6) Of the total area of 4,000,000 acres devoted to dairying, approximately 2,800,000 acres are producing between 40 lb. and 120 lb. of fat per acre.

(7) On the basis of maintenance costs incurred in normal price years, and allowing £100 per year per male unit of labour, the dairy industry earns 6 per cent. interest on £170,218,654 at 17d. per pound for butterfat, on £59,148,284 at 12d. per pound for butterfat, on £36,934,501 at 11d. per pound for butterfat, on £14,715,274 at 10d. per pound for butterfat.

(8) Every extra penny per pound, whether as payout or by exploitation of subsidiary industries such as pigs, represents interest at 6 per cent. on an additional £22,200,000.

(9) Raising the average per-acre production from 80 lb. to 100 lb. of butterfat represents interest at 6 per cent. on an additional £35,661,372 capital on the basis of 12d. per pound for butterfat.

Incidence of Disease in Dairy Herds.—During the year two groups of data have been under analysis to establish the scope of statistical treatment in narrowing down the factors surrounding irregularity in calving experienced in dairy herds. In the first group, cows which have been milked through, calving twice in three seasons, have been studied, whereas in the other group the data from some 2,500 farms are under analysis. From the progress to date it is apparent that trends in breeding irregularities will be established which will be of great assistance in clarifying the position. It is intended that this subject be dealt with for publication in the near future.

Fruit Industry.—The collection of statistical data relative to fruit-farms has been continued. Some five hundred farm records pertaining to last season's production are in course of analysis, and will form the basis of district averages for crop forecasting work next season. Important points, such as yield of different varieties in different districts and rate of maturity of different varieties in different districts are also being studied.

Descriptive Article on Dairy Industry.—At the request of the Empire Marketing Board, a descriptive article dealing with the dairy industry has been compiled. This will be published by the Empire Marketing Board.

II. WALLACEVILLE VETERINARY LABORATORY.

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

During the past year appreciable progress has been made in the investigation of the various animal-disease problems. The full benefit of the additions to the building has been very apparent throughout the year. The institution of a biochemical section for analyses of blood and urine has been most useful, particularly in work on sheep diseases where upset of metabolism is the chief source of trouble. This report will deal with the activities of the staff not only in routine examination of specimens, but in the more specialized work on problems in animal ill health. It is mainly due to shortage of senior officers that feeding-trials and much other work cannot be attempted. The Hamilton Branch has done particularly good work in the examination of large numbers of routine samples of milk and blood and also in the assistance given to the officer dealing with dairy-cow diseases for that district.

The Laboratory lost the services of Mr. J. H. Motion, B.Sc. (Agric.), B.Sc. (Vet. Sc.), M.R.C.V.S., D.V.S.M., Animal Bacteriologist, in September, when Mr. Motion entered practice at New Plymouth. No appointment has yet been made in his place, but it is hoped that this will soon be brought about. However, the appointment of Mr. Peddie as Bacteriological Assistant relieved the situation, more especially as Mr. Peddie has had considerable bacteriological training in hospitals and also has his science degree. Routine work now largely falls on the shoulders of this officer. As far as is possible the staff is specializing each in some particular branch. At the same time each officer is expected to become conversant with all lines of work.

Routine Specimens.

The following is a short summary of routine and experimental specimens for the year examined at Wallaceville, Hamilton, and New Plymouth Laboratories:—

	Milk-samples.		Blood-samples, Contagious Abortion.		Composite Milk-supply for Bovine Tuberculosis.	
	Positive.	Negative.	Positive.	Negative.	Positive.	Negative.
Hamilton	1,917	2,791	260	452	..	..
Wallaceville	686	760	751	1,631	..	121
	2,603	3,551	1,011	2,083	..	..

Hamilton.—Cattle specimens: Sterility, 130.

New Plymouth.—Cattle specimens: Sterility, 736.

Wallaceville.—Cattle specimens: Sterility, 71; blackleg, 77; actinomycosis and tuberculosis, 19; others, 232. Sheep, 231. Pigs, 40. Horses, 11. Poultry, 63. Odds and ends, 252.

Wallaceville.—Biochemical: Cattle-blood, 104; sheep-blood, 408; urine, 58; others, 82: total, 642, Tumours: Epitheliomata, 100; endothelioma, 2; adenocarcinoma, 4; sarcoma, 3; leiomyoma, 4; osteoma, 1; chondroma, 5; papilloma, 4; fibroma, 10: total, 133.

Totals for Year.—Hamilton, 5,550; New Plymouth, 736; Wallaceville, 5,720: grand total, 12,006.

Sterility in Dairy Cows.

There have been very encouraging developments in the work on sterility for the year. Messrs. Webster and Blake have given considerable time to the examination of bulls known to be normal and those from infected herds, and have demonstrated without doubt that the bull is a factor in the high percentage of temporary failure to conceive in certain herds. The seminal fluid is found to be infected usually in the early stages of trouble, mainly with a streptococcus of the viridans type. Later the morphology of the sperm head alters considerably, and these malformations have been found directly associated with breeding inefficiency; later still, histological work has revealed changes mainly in the testes, but occasionally in the accessory glands as well, which have reduced spermatogenesis and motility of spermatozoa. Considerable work has also been done on the pH of male and female genital secretions, showing that the alkalinity of the female is more conducive to continuous and increased motility than are the various secretions of the genital tract of the male.

Re-examination of the cervices and uteri of cows in affected herds has shown that there is an inflammatory condition of the cervix and that a streptococcus similar in its cultural and morphological characteristics is found in the cervix. Forceful treatment of the cervix with holding fluids has overcome the infection to a very large extent, and this line of treatment will be repeated in the coming season to find just how efficient it may be in controlling an outbreak.

Abortion in Dairy Cows.

Mr. Gill, on his return from his study travels, brought back an excellent technique for examination of milk for *B. abortus*. This technique has been used since by the staff on composite supplies from herds where the milk is sold to the public, and in work on individual quarters to find what percentage of quarters are affected, the position of the agglutination test of wheys as against the *B. abortus* content, and the position of leucocytosis of milk as it may be affected by *B. abortus*. Some of this work is also being carried out at Hamilton. Where herds are suspected of having been responsible for cases of undulant fever, the routine examination of blood and milk has now been established to find just what percentage of abortion may occur in the suspected herd. It is as yet impossible to give any detailed information on the subject, but the work is proving interesting and of value. Where owners are willing to eradicate abortion from the herd blood-samples are being repeatedly examined from the cows, and the results are most encouraging. It is hoped to extend this service considerably.

Two hundred heifers in Taranaki have been used as an experiment to find whether intradermal vaccination is of any use as a preventative of abortion. Results will come to hand in due course, but other forms of vaccination with variously killed organisms have been useless in our hands.

Streptococcic Mastitis.

Work in mastitis has been largely bound up with that of *B. abortus* in the Laboratory. Field-work mainly undertaken by Mr. Blake in the Waikato, and aided by the Hamilton Branch Laboratory, has been undertaken to show that basing mastitis on the diagnosis by means of leucocytes it is possible considerably to prevent the spread of mastitis in herds by milking those cows diagnosed microscopically as normal first, and all others afterwards—*i.e.*, by grading the cows for milking purposes. Mr. Blake's work has already tended to show that normal cows do not contract mastitis nearly as readily where such precautions are taken, and that there is less of wastage of cows through culling at the end of the season. An endeavour is also being made in such herds for the general introduction of disinfection of teats after milking of each cow in order to curb the numbers of deleterious organisms lodging in the teat sphincter between milkings.

Milk-fever in Cows.

An extensive trial of calcium chloride intravenously and per mouth and calcium gluconate subcutaneously was carried out by Mr. Blake in the Waikato district. The incidence of this disturbance was particularly high, and on some farms a very large percentage of cows became affected. The paralytic type, without loss of consciousness, was very much in evidence, and was treated in the same way as the typical milk-fever.

Results were particularly good, and undoubtedly many cows, upon which inflation of the udder appeared to be having little or no effect, were saved. Cases occurred, too, where the preventive method of dosing drinking-water with CaO appears to have been a factor in stopping a run of milk-fever on certain farms.

So-called Parturient Eclampsia of Cows.

A very much lessened amount of this condition was noted, and it was not possible to carry out the investigational work, mainly of a biochemical nature, which had been decided upon. In the few cases seen the blood calcium level was lower than normal. The introduction of calcium chloride ($CaCl_2$) and of formalin, intravenously, did not prove beneficial. As in the previous year, treatment by chloral hydrate per rectum in the early stages was the only method which gave success at all, and that not regularly.

Jöhne's Disease.

Jöhne's disease appeared on three farms during the year, and several suspicious specimens were received for diagnosis. "Johnin" was used successfully to a very limited extent as an intradermal test. The fact that this disease has recently been scheduled has given more power for dealing with it, and it is hoped to test all herds from which cases are diagnosed in order to prevent further spread.

Blackleg.

A large number of specimens were received this year from calves to determine whether the cases cropping up throughout affected areas and occasionally in clean areas were or were not blackleg. As a result, it was found that the majority of cases in affected districts were due to *B. chauvoei*, although some were definitely due to the *Vibrion septique*. In clean areas, however, the cases were all due to *Vibrion septique* without exception. Owing possibly to good feed conditions there was a higher mortality than usual.

For some time it has been the aim of the Laboratory to put a more scientific vaccine into the hands of the officers for controlling this disease, and this year instead of the powder vaccine the new formalinized liquid vaccine was used. Very few deaths have been noticed—fewer than with the powder vaccine. Those officers using the vaccine have expressed their appreciation of the change.

SHEEP-DISEASES.

Caseous Lymphadenitis.

Serious attention has been paid to caseous lymphadenitis during the year, both to the incidence of the disease throughout the country as found during palpation and incision in the meat-works and also to the method of infection.

Laboratory experimental work was carried out as follows:—

(*a*) Six hoggets lightly affected with parasitic gastro-enteritis were fed cultures of a Cambridge strain and a New Zealand strain, three hoggets to each. Cultures were washed off Loeffler's blood serum and fed in 10 c.c. amounts on eight occasions at intervals of a fortnight. The first hogget was killed in June—weeks after commencement of feeding, and showed a lesion in the retropharyngeal gland. A second was killed in July and also showed a retropharyngeal gland affected only. A third hogget killed three months after commencement of feeding showed a similar lesion. The fourth hogget killed eight months after feeding commenced showed not only the retropharyngeal gland but also two other lymph glands, one in the region of the pancreas and the other over the rumen. Two remain and are in excellent condition without palpable lesions.

(*b*) Ten affected old ewes were obtained from a farm in the Wairarapa for observation over a long period at Wallaceville. They have been examined at least every fortnight and a record of their lesions, lambing dates, shearing experiences, &c., kept over the year. Three of the ten have abscesses, chronic in character, which have not ruptured, the remainder have ruptured at least once. Two ruptured a second time, two have died or been killed, and four now feel normal in the original glands, but may or may not have developed infection in other glands following shearing, when blades infected with pus were in some cases used.

(*c*) Eight of these ewes lambed, but none of the lambs developed infection with the Preisz Nocard organism as far as could be noted in those slaughtered.

(*d*) At shearing, ewes were shorn alternately with lambs and clean hoggets. Several of the hoggets were shorn with shears smeared with pus from caseous lymphadenitis abscesses obtained from natural cases, and four of these were sprayed with a dip fluid directly after shearing. Where cuts with an overlapping portion of skin were left, sores developed showing a characteristic green pus, later in two such hoggets definite typical lesions developed and were found on slaughter. In another not yet slaughtered there is a growing abscess. Although infection did not occur in more than three out of the seven, two of these were in the sprayed animals, tending to show the fallacy of expecting a dip following shearing to protect the sheep from caseous lymphadenitis where the cuts are of an overlapping nature.

(*e*) A sheep killed some months after rupture of an abscess was found to be quite clean, though the gland had been broken up into shot-like pieces. Another ewe was incised and pus evacuated readily, leaving a clean gland which healed well. Arrangements were therefore put in hand for field officers to try out incision of glands in a number of sheep on the affected farms, in sheep being prepared for meat-works, in order to see the results of incision.

(*f*) Curative trials were made on four affected sheep, two with potassium iodide ½ gr. per day and two with mercuric iodide 5 gr. per day. One of the former two was killed accidentally during drenching. Both ewes receiving mercury developed badly ulcerated lips, but abscesses were unchanged in all cases.

(*g*) Some toxicity work on guinea-pigs and sheep was tried, but toxin-production from strains used was not of a high order. A single experiment to find whether the New Zealand strain would induce icterus in sheep was tried on a hogget. A culture of organisms was given intravenously. Arthritis developed, and later the pus was taken from the joint and reinoculated intravenously. The sheep was killed a week later but showed no signs of jaundice nor were tests of blood indicative of hæmolysis. The differential polymorphonuclear count was raised to 84 per cent. and abscesses were found in the kidney.

(*h*) Many abscesses from lambs have been examined from both the Waingawa and the Gear Co. meat-works during the lamb-slaughtering season. Green-pus abscesses are commonly found in the region of the scrotum, but not actually affecting the inguinal gland. Such abscesses are invariably due to mixed organisms of a pyogenic nature or to B. pyogenes alone, not to the Preisz Nocard bacillus. A few cases where the inguinal gland has been invaded have been true cases of Preisz Nocard infection while the prescapular and precrural glands very frequently are infected with the Preisz Nocard bacillus, but they are exceedingly few in number per cent. The majority of the scrotal infections are due to faulty castration.

(*i*) A definitely abortive attempt was made during the year to test sheep affected and unaffected for caseous lymphadenitis by (1) a precipitin test; (2) intradermal testing with an antigen; (3) rapid agglutination test with an antigen made as smooth as possible.

Pulpy Kidney Investigation.

This was continued at Ranfurly in the spring. The season's work ruled out the theory that cholesterol in the blood-stream might be responsible for the trouble, and from this point of view considerable information was gained as to the normal cholesterol values of the blood of ewes and lambs.

The main work centred round an effort to establish the presence or absence of abnormal toxins in the small gut of affected lambs. It was greatly hampered by the small number of suitable cases for working on that occurred this year. Nevertheless what was accomplished pointed strongly to the presence of such toxins in the gut, and their inoculation into healthy lambs produced a condition that was indistinguishable from the naturally occurring disease. It is felt that this has given a more definite clue than we have previously had, though there is still a very long way to go. Further biochemical and histological examinations confirmed the previous findings.

Valuable epidemiological evidence was forthcoming from the fact that following the extremely bad winter and spring feed conditions the losses were very much less on most farms, the exceptions being almost confined to those on which the owner had been in a position to do his ewes as well as in other years. This confirms the view, previously expressed, that the condition of the lamb is a powerful predisposing factor.

A further large series of ewe-milk analyses were arranged for, and these showed that yarding for twenty-four hours, which is the only method which so far has been shown to check the losses, reduces the ewes milk-yield temporarily by about 50 per cent. Very few samples from ewes whose lambs died were obtainable, but such as were analysed showed that such ewes tend to give a greater amount of milk than the control normals and of slightly richer quality.

Circling-disease of Sheep.

A disease which occurs in many parts of New Zealand in the late summer and autumn was investigated, and found to be due to an encephalitis. The disease had previously been attributed by the farmers to either nasal-bot larvæ or else the cysts of Cœnurus cerebralis, but the investigation made it clear that neither of these is responsible. It appears to be a bacterial disease which results in the formation of microscopic purulent foci in parts of the brain. An attempt to transmit the disease to a healthy sheep by inoculating into its spinal canal an organism obtained from the cerebro-spinal fluid of an affected sheep was apparently successful. Further work that had been planned for this autumn has not been carried out as yet, as there seems to be much less of the disease reported this season. The work will, however, be continued as opportunity occurs, and will be aimed at establishing definitely the bacterial origin of the disease and the path of infection, with a view to formulating sound preventive measures.

Epizootic Jaundice.

Jaundice has been noticed in sheep on two farms widely separated, deaths occurring in January and March. Considerable section work undertaken on organs from killed sheep, and biochemical analysis of blood from affected sheep has shown the condition to be one known in South Africa, Australia, and America. A survey of the paddocks and swamps of the two farms rules out several weeds such as ragwort and subsequent sodium-chlorate poisoning, bracken-fern poisoning, and poisoning with *Praetia angulata*, and also disease conditions such as caseous lymphadenitis. There is still the suspicion of two things—one a weed producing photosensitization, and the other a badly balanced diet, from the fact that the land grows excessive clover in each case. Feeding experiments are under way to determine whether plant poisoning with several varieties of plants can be implicated. *Praetia angulata* has already been fed to sheep and rabbits with negative results, except in the case of a sheep, which showed gastritis.

Biochemical analysis of blood gives a picture of fairly high calcium, low phosphate, leucocytosis, hæmolysis, suggestive of a hæmolytic bacterial invasion. Histology reveals in the liver the large phagocytic cells spoken of by De Koch.

Ergot-feeding to Sheep.

Ergot was obtained as screenings from the season's grass seed, mainly rye, the amount of ergot averaging 5 grammes per ounce of seed. Four sheep were tried, but refused to eat screenings in oats, chaff, with treacle, &c. Finally each was drenched with 2 oz. of screenings = 10 grammes *Ergot sclerotia*. This seed was later ground so as to run out of a bottle more easily. After five days one sheep showing severe gastritis, having had 40 grammes ergot, died next day, showing ulceration of the abomasum. A second sheep commenced salivating on the sixth day after receiving 60 grammes ergot. This sheep was turned out, but died ten days later with ulceration of the tip of the tongue and enteritis. The remaining two sheep were reduced on the ninth day to 5 grammes of ergot and after a month to 4 grammes daily. A fortnight later they were further reduced to

2 grammes per day. After four months at this dosage one sheep lambed normally and the second was found to be empty, and turned out. No ill effects were noted in these two sheep. This experiment was conducted to see whether ergot produced—

(*a*) Deformed lambs as seen frequently on fescue in Otago.
(*b*) Nervous symptoms seen in dry seasons on bare paddocks in certain North Island centres. The sheep were fed on hay only, to try as nearly as possible to simulate the conditions seen where rye-grass staggers occurs.

Arthritis in Lambs.

In view of the close relationship of the organism causing arthritis in sheep in New Zealand with that of swine erysipelas, an attempt was made with work on mice and pigs to find whether the strains were identical or whether the arthritis strain might prove dangerous to pigs.

The effect on mice of the two strains was found to be identical, and typical of swine erysipelas. Pigs inoculated, subcutaneously with cultures of organisms of arthritis and swine erysipelas which had had virulence raised by mice passage, did not react in any way, and were found to be quite free at *post-mortem* examination from lesions of any description.

Deformity in Lambs.

A condition described last year in which the lower jaw of the fœtus is missing. Two ewes thyroidectomized, one before tupping, and one after tupping, both lambed normal lambs. One of the ewes had a difficult parturition, and the lamb died after birth. Thyroids sent in for analysis showed no abnormality as regards iodine content.

As a result of a popular belief that deformity is the result of inbreeding or from the use of certain strains of rams, a belief which could readily be shown wrong by attention to histories of outbreaks, twenty ewes and one ram of known breeding were forwarded to a property where deformity occurs and placed on a paddock of Chewings fescue. Owing to shortage of feed and a cold season, the fescue was, this season, kept particularly short, whereas, when deformity occurs, it is long and dry. All ewes lambed, but one lamb was born prematurely, eight lambs died from exposure, and one ewe had twin lambs. None showed deformity. This breeding experiment is to be repeated next breeding-season on a longer and more representative type of pasture.

Coccidiosis.

A case of coccidiosis was found in a lamb at a Hawke's Bay freezing-works and identified at Wallaceville. This is the first case reported in New Zealand, and occurred in a small line of lambs, but without producing harmful symptoms. The lesions appeared as small pedunculated tumours attached to the mucosa of the intestine.

Deficiency Conditions in Sheep.

(*a*) *Morton Mains.*—Blood specimens from this area have shown that there is a deficiency of calcium, phosphate, and magnesium in the blood. The shortage of phosphate and magnesium may very well be the result of the anæmic condition of the animals, but the lowered calcium is rather suggestive of a deficient intake of that mineral, more especially as bones from their brittle and thin appearance are also deficient. Analyses of bones is at present under way.

(*b*) *Te Pohui.*—Investigation showed nothing in the way of lime and phosphate deficiency, but tended to point to iron deficiency.

Ante-partum Paralysis.

It was decided, because of the installation of the Biochemical Section, to carry out, if opportunity permitted, a considerable amount of blood and urine chemistry on this disease of the pregnant ewe. The results obtained through the season's work are conflicting, and now more work is required to clear up the position.

The use of glucose was repeated, but again found ineffective. Theoretically glucose should prove useful; actually it does not do so in many cases. The best method of control in the past season was transfer of the flock to a more luscious pasture, young grass, green oats, &c. Histories verified the fact that it was the fat animal placed on short rations which was the sufferer, and not the ewe which was kept up in condition or which had gradually improved from tupping. Several of the cases of supposed ante-partum paralysis were found on analysis to be actually calcium-deficient animals suffering from milk-fever, and these cases responded to Ca treatment intravenously. Formalin and $CaCl_2$ used intravenously, glucose, and saline were all failures.

A point of interest in the blood-analysis was the almost consistent high cholesterol content. This, together with one theory held regarding pulpy kidney, caused a considerable amount of experimental work with cholesterol, intravenously and by mouth. It was found that yarding of ewes for twenty-four hours resulted in an appreciable drop in the cholesterol content of the blood. Cholesterol given intravenously dissolved in chloroform is deposited in the lungs and kills the experimental animal very quickly with very small doses. Fed to animals it does not appear to increase the quantity in the blood, but may cause hæmorrhage through the mucosa of the abomasum. More work is contemplated on this condition, and it is hoped to publish full results after the coming season's work on the whole subject.

POULTRY-DISEASES.

No very great amount of poultry-work has been possible in the Laboratory, more having been carried out at the Poultry Station itself. However, two interesting conditions have been investigated: coccidiosis in pullets, and bleeding in pullets and hens.

Coccidiosis in chickens of ten days to eight weeks old is of fairly common occurrence, but coccidiosis in pullets of four to eight months is comparatively new. For the past two years, however, a number of flocks have shown this condition in their young birds, and, what is of importance, have been selling affected pullets round the country, so that poultry-farmers must be prepared for a great deal more of this parasitic condition. The new milk-iodine treatment was applied in one field outbreak, but apparently has not been entirely successful according to reports. What is required is that some power be given Poultry Instructors to stop the sale of affected birds until such time as the parent flocks have been cleaned up. This presents considerable difficulties.

Bleeding was mentioned last year as hæmangioma. A number of flocks in the South Island have been found to get several birds a year affected. It has not been possible to trace the strains of affected birds, although an effort has been made to do so; but it is strongly suspected that there is an hereditary tendency in the form of bleeding described. A young pullet or older hen may be noticed to be bleeding from a scale in the

leg, the wing, the head, or even from a wing-feather follicle. When bleeding commences it is kept going by pecking of the area either by the bird affected or by others in the flock until the affected bird is so weak that it naturally stops bleeding, or may even die. The coagulation time of the blood is not interfered with, calcium in the blood is normal, and blood platelets are not lacking. On several occasions blood-effusions beneath a scale of the leg have been seen and have been opened. If treated in this way the bird has not taken much notice of the wound. As the condition is comparatively new, and could not be ascribed to parasites, to food, or to blood chemical deficiencies, an experiment in breeding is in progress.

BIOCHEMICAL WORK.

Mr. S. W. Josland, who is in charge of this section of the work, reports as follows:—

"Up till 1930 no organized biochemical work had been carried out on the blood and urine of normal sheep and cattle in New Zealand. The first problem, therefore, to be attempted following the institution of the biochemical laboratory was the determination of normal values or limits for the purpose of standards which may be considered as a groundwork upon which future biochemical investigations may be based. This task has formed the basis of the past year's work. In addition, biochemical work has been directed towards several diseases of sheep and cattle. This aspect was discussed briefly when the diseases concerned were being considered.

"*Source of Material.*—Blood and urine samples were collected from the Laboratory farm animals and also from the Gear Meat-works at Petone. The samples were taken from the jugular vein by means of a wide-bored hypodermic needle (internal diameter 1 mm.) and collected in plain bottles and bottles containing potassium oxalate as an anticoagulant. The samples thus taken were examined both chemically and histologically.

"*Chemical Methods.*—Estimations have been made of the following blood-constituents: Serum Ca, serum P_2O_5, serum Mg., serum K., T.N.P.N., urea N., amino acid N., creatinine, uric acid, cholesterol, and sugar.

"Particulars of the methods adopted are given below:—

"Calcium: Kromer and Tisdall, Clark and Collip. *Journ. Biological Chemistry*, 56, 439. 1923.
"Inorganic Phosphate: Fiske and Subbarrow. *Journ. Biological Chemistry*, 66, 375. 1925.
"Magnesium: Denis. *Journ. Biological Chemistry*, 52, 411. 1922.
"Potassium: Kromer and Tisdall. *Journ. Biological Chemistry*, 46, 339. 1921.
"Cholesterol: Myers and Wardell, modified. *Journ. Biological Chemistry*, 26, 147. 1918.
"The remaining constituents were estimated on a protein-free filtrate prepared according to the method of Folin and Wu, but using increased volumes of sod. tungstate and sulphuric acid, with a corresponding decrease in the volume of distilled water.
"Blood sugar: Benedict's modification of Folin and Wu. *Journ. Biological Chemistry*, 68, 759. 1926.
"T.N.P.N.: Micro Kjeldahl.
"Urea N.: Karr's direct nesslerization. Karr. *Journ. Lab. Clin. Med.*, 93. 1924.
"Amino acid N.: Folin and Wu. *Journ. Biological Chemistry*, 51, 377. 1922.
"Creatinine: Picric acid method. Hawk. *Practical Phys. Chem*, 375. 1929.
"Uric acid: Folin's isolation procedure. *Journ. Biological Chemistry*, 54, 153. 1922.

"*Normal Limits for Blood (Values in Millegrammes* 100 *per c.c.).*

	Sheep.	Dogs.	Cattle.
Calcium	10–11·5	10·5–11·5	10–11·5
Inorganic phosphate	4·5–5·5	..	4·5–5·5
Magnesium*	1·5–2·5	2·5	..
Potassium*	17–26	20–25	..
T.N.P.N.	28–38	30–35	28–38
Urea N.	14–20	12–17	12–17
Creatinine	1–2	1–2	1–2
Amino acid N.*	5–8	..	..
Uric acid*	2·5–3·5	2·5	..
Chlorides	450–550	..	450–500
Sugar	0·050–0·065%	0·060%	0·050–0·060%
Cholesterol	90–110	..	90–130
Hb	70–80%	85–95%	Approx. 60%
Erythrocytes	10–11 mils. per c.mm.	5½–6½ mils.	7½–8½ mils.
Leucocytes	6,000–8,000	8,000–12,000	5,000–7,000
Polymorphs	Approx. 30%	Approx. 60%	Approx. 35%
Lymphocytes	,, 65·5%	,, 37%	,, 58%
Eosinophiles	,, 4%	,, 3%	,, 7%
Basophils	,, 0·5%	..	..

* Owing to the delay in obtaining the necessary reagents, a limited number of these estimations were made. These values must be regarded as provisional.

"It will be pointed out that certain blood-constituents undergo marked changes in certain physiological processes such as pregnancy and œstrus. An endeavour is being made for the forthcoming year to trace these changes in a detailed manner.

"*Urine Analyses.*

	Sheep.	Cattle.
"Sp.G.	1,010–1,030	1,010–1,030
"pH	Approx. 7·5	Approx. 7·5
"Albumen	Nil.*	Nil.*
"Sugar	Nil.	Nil.
"Acetone	,,	,,
"Diacetic acid	,,	,,
"Urobilin	,,	,,
"Urea	Approx. 2·0%	Approx. 2·0%
"Ammonia nitrogen	4·20 mgm. per 100 c.c.	..
"Total nitrogen	1,000–1,500	1,000–1,500

* Traces of albumen are occasionally found in urines from apparently normal cattle. Such traces are generally considered to be of a transitional nature.

"Deposits: Usually nil. Occasionally unorganized sediments are present depending on variation of reaction. There is an absence of organized sediments such as pus, blood, and epithelial cells and casts."

III. DAIRY BACTERIOLOGY.

Report of G. F. C. Morgan, Dairy Bacteriologist, Wallaceville Laboratory.

Serious problems have arisen in the past year, the most important of these being the discoloration of annatto-coloured cheese. The groundwork of this investigation has been successfully covered, and the problem will now be further investigated in co-operation with the Dairy Research Institute, Palmerston North.

In addition to this, very comprehensive work has been carried out on methods at present practicable for the examining of cheese-factory suppliers' milks as regards suitability for cheese-manufacture, and also on the various types of milk received at cheese-factories. This work has included the testing of nearly 1,000 samples of cheese-factory suppliers' milks from the Wairarapa, by the following methods:—

(*a*) Plate count.
(*b*) Gelatine count.
Count of putrefactive types.
(*c*) Reductase test.
(*d*) Curd test.
(*e*) Acidity-development—
(1) By direct titration of samples at two-hour periods holding at 98 degree F.
(2) By pH development in broth, watched at one-hour periods.

Considerable variation has been noticed in the behaviour of suppliers' milks, and, where possible, the bacteriological causes have been investigated in detail.

Examination of Cheese-colouring.

A new branch of work was undertaken in the past year in the examination of samples of cheese-colour for the presence of lead. The decision to carry out this work resulted from the discovery of lead in samples of cheese showing black-spot discoloration, and the finding of lead in appreciable quantities in the colouring used in the manufacture of this cheese. This work was confirmed, where possible, by the Department's Chemistry Section at the Dominion Laboratory, Wellington.

Experimental Work in the Dairy.

In connection with the work carried out in the experimental dairy thirty-two cheeses were manufactured by Messrs. J. B. Sawers and M. Syron, Dairy Instructors.

The experiments included the introduction of cultures of organisms isolated from discolored cheeses, the addition of iron oxide, and the effect on cheese of milk produced by cows grazed on paddocks recently top-dressed with sulphate of ammonia.

Investigation of Discoloration in Annatto-coloured Cheeses.

The following types of discoloration in cheese have been brought to the notice of the Laboratory during the past year: Bleaching; muddy discoloration through the body of the cheese; black-spot; red spots; a faint pink and purple discoloration.

Bleaching.—The investigational work into this defect was commenced in the early part of 1930 with the reception of a number of samples of bleached cheese which were examined in a number of ways, and from which a number of organisms apparently predominant in bleached portions were isolated. These included mould cultures of penicillium and aspergilli, also cultures of yeasts (not lactose fermenters), together with various types of bacteria. A number of cheese-samples showing a very marked muddy or dark discoloration were also received.

Cultures were isolated from both bleached and dark discolored cheeses, and introduced into experimental cheese as washed cultures at the time of hooping.

Cultures of as many representative types as possible from bleached portions of cheese were added to tubes of sterile milk containing annatto. It was found that several cultures were capable of reducing the colour of annatto, but never to the extent to which it is reduced in a bleached portion of cheese.

Again, cultures were tried out on annattoed milk-agar. In this case a yeast found present in a bleached area was found to cause a possible bleaching, but to no depth. It was noticed that where certain moulds and yeasts had been able to develop under the wax a marked bleaching had developed in inoculated proprietary cheese. At this time cultures of penicillium mould were introduced into the cut surfaces of experimental cheeses about three weeks old. Mould-growths developed from these cultures which were kept at room-temperature and in the dark. Cutting and examination of these sections at the end of one month after inoculation showed a very marked bleaching to a considerable depth.

At the same time that the investigations on bleaching were being carried out specimen samples of cheese showing dark discoloration were received.

Black-spot Discoloration.—In one case, that of a sample of cheese received from . . . . Factory, a definite small local area of dark discoloration was seen, having a darker nucleus at its centre and not associated with slits or openness in the body. References were made at this time to Professor Leitch's (Kilmarnock) work on dark discoloration in cheese, and, after cultural work had been completed, examination by Fairhall's analytical method was carried out on the ash of the discolored local area for lead. After thorough trial of the test against blank controls and also tests for the purity of the reagents used, a definite positive result for lead was obtained, and a further portion of the sample was taken to Wellington and examined at the Department's Chemical Laboratory, where the presence of lead was confirmed.

Together with this sample of cheese, a sample of annatto was received from the dregs of the drum in use at the same factory when the cheese was made. An examination of this annatto was made by Fairhall's method, and showed the presence of lead in considerable quantities, which could also be determined by a qualitative chemical examination of the ash.

Bacteriolical plate cultures from the cheese showed that there was a considerable number of organisms belonging to the proteus group present. This group has the ability to cause blackening in any medium containing lead. Shake cultures were then made introducing this organism into annattoed milk-agar containing

a weak solution of lead acetate. This gave a plate showing a very definite dark discoloration. An account of this work was published in the *New Zealand Journal of Agriculture*, August, 1930, Vol. 41, No. 2.

Muddy Discoloration.—Soon after this the general question of muddy discoloration was judged to be a long-time problem and handed over to the Dairy Research Institute, Palmerston North. Meanwhile cultures isolated from cheese showing muddy discoloration had already been added to the curds of experimental cheese made in the Division's experimental dairy. These cheeses were cured in a cool, dark room for a period of four months, at the end of which period they were graded and examined for discoloration. No discoloration either muddy or bleached was seen. These cheeses were then held for another three weeks and re-examined. Re-examination showed that one cheese gave a very definite indication of muddy discoloration. This one cheese was a control of an experimental cheese made in connection with the trial carried out on the addition of a suitable quantity of iron rust to cheese-milk. Moreover, the sister cheese from the same vat showed no discoloration. Cutting and cross section of the cheese showed that the discoloration had commenced from the trier-hole and had spread through the body of the cheese by means of openness and slits.

This cheese had been made under practically sterile conditions from milk of excellent quality, and all other materials were identical with those used in the remaining experimental cheese. In this way the cheese showing discoloration was perfectly controlled by all the remainder, even the sister cheese from its own vat. The one point in which it differed from the other cheese was in the fact that mould had entered the neck of the trier-hole, and by cultural methods and the cutting of fine sections of discolored cheese it was seen that mould mycelia had spread through all the discoloured area.

Subsequent examination of discolored cheeses have shown that where the plugs have been closely fitting and well sealed, no discoloration has been seen. Further experimental work has been carried out on these lines in co-operation with the Dairy Research Institute.

Examination of Methods proposed for the Grading of Milk for Cheesemaking.

This experiment was commenced early in September, 1930. Arrangements were made for Mr. Syron, Dairy Instructor in the Wairarapa district, to obtain thirty suppliers' samples from cheese-factories selected by himself, and to forward them in boxes specially constructed to the Laboratory for examination. These samples are packed in ice and arrive at 5.30 p.m. An extensive examination of them is carried out throughout the night.

The experiment has brought to light a type of milk common at certain times of the year about which little has hitherto been heard, but which may be of considerable interest to the industry. A type of milk that clots at from 16 to 25 degrees acidity without souring or developing an acid flavour, producing a clot that does not incorporate any of the lime salts of the milk. This type of milk is still under investigation.

The reductase test alone is not likely to be sufficient for the grading of milk for differential payments. The soundest criterion of the factory milk for cheesemaking appears to be the curd test.

Examination of Water-supplies of Butter-factories.

During the first half of 1930 a bacteriological survey was made of three hundred dairy-factory water-supplies with a view to creating some bacteriological standard that might be applied, and also with a view to noting the types of contamination that might be introduced through an impure supply. The results of this survey showed that the bacterial counts agar incubated at 37 degrees C. varied very considerably, some cultures giving only four colonies per c.c. of water and some having counts so high as to be uncountable in a 1 c.c. plate. The coliform content was in many cases far too high.

Count of Agar.	Number of Samples.	Number of Samples showing Equivalent Count on Gelatine.	Count of Agar.	Number of Samples.	Number of Samples showing Equivalent Count on Gelatine.
1–50	31	3	300–400 ..	9	5
50–100	5	3	400–500 ..	8	5
100–200	14	6	500–1,000 ..	24	5
200–300	7	4	1,000–10,000 ..	202	269

Mould counts: One hundred samples showed mould contamination.

One hundred and fifty-seven samples showed the presence of *B. coli* in 1 c.c.

Examination of Samples of Annatto for the Presence of Lead.

Out of the forty-six samples submitted for analysis nineteen showed the presence of lead by Fairhall's micro-analytical method. In most of these cases the quantity was so small as to be considered harmless.

Unsalted Butters.

Far fewer samples of unsalted butter have been received in 1931 as compared with 1930, most of those received coming from Auckland.

An experiment was tried out in which gelatine cultures were made of unsalted butters instead of agar cultures, and were subsequently incubated at 3–4 degrees C. This gave an indication of butters containing a high percentage of organisms capable of working at a low temperature, and therefore liable to deteriorate butter in cold storage.

Starters.

A mother culture of a very fine starter has been kept going at the Laboratory for the last eight months, and has given satisfaction to all those who have used it. Several requests have been made by Instructors for cultures, and all have done extremely well.

Starter-samples have been examined when forwarded from factories. Most of these show gross contamination, and in many cases the presence of *B. coli communis*.

Approximate Cost of Paper.—Preparation, not given; printing (750 copies), £70.

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