1929.

NEW ZEALAND.

DEPARTMENT OF AGRICULTURE.

ANNUAL REPORT FOR 1928–29.

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

Wellington, 31st July, 1929.

SIR,—

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

The season of 1928–29 may be recorded as an excellent one for our farming industries generally, as regards both production and market returns. This is reflected in the country's exports for the period, which show material increases in several leading primary products, and for the June year a total value of domestic produce only once before exceeded.

Salient features of the progress of the various branches of agriculture are presented in the respective reports of the Director-General and heads of Divisions. The marked development in agricultural research and education noted last year has gained further impetus, and effective co-ordination of the practical and the scientific sides promises to be of steadily increasing benefit to our primary producers. The growing appreciation of this aid by the producers themselves is a valuable contributing factor.

With increasing competition, and an outlook on the world markets which has lately become rather less assuring at some points, it is essential to still further promote efficiency, lower working-costs, and higher quality in production. The Government fully realizes the position and its requirements, and is making liberal provision, within the country's resources, for building up a good scientific foundation, combined with effective agencies for conveying the best knowledge to all sections of our men on the land. In this work the Department of Agriculture will continue to take a leading part in co-operation with allied bodies.

The Department's report reveals a very wide scope of operations and a great volume of useful service. It is a pleasure to testify from close contact and observation that the varied work is in the hands of a good all-round team, well able to hold its own with similar departmental staffs in other parts of the world.

I have, &c.,
GEO. W. FORBES,
Minister of Agriculture.

His Excellency the Governor-General.

REPORT OF THE DIRECTOR-GENERAL.

THE HON. THE MINISTER OF AGRICULTURE. Wellington, 30th June, 1929.

I beg to submit herewith a report dealing with the work of the Department during the year ended 31st March, 1929, and in doing so to express my sincere appreciation of the manner in which Divisional Directors, Heads of Sections, and all other officers have throughout endeavoured to carry out their duties to the best advantage of the Department's efficiency and of the welfare and progress of the primary industries.

FIELDS AND PASTURES.

The Fields Division has had an extremely busy year, both in its instructional and research activities. Grassland-management instruction and grassland research have developed very considerably, due to the considerable increase in staff that is now available for this work. Methods of surplus-grass utilization and the development of ensilage-making have been a feature of instructional work. A large amount of demonstrational work in intensive grazing and the value of nitrogenous fertilizers for special seasonal growth has occupied much of the attention of the field staff in the North Island. The control of hard or carpet fern with arsenic pentoxide, and methods of better establishment and maintenance of pastures on deteriorated country, have been put to practical test during the year with satisfactory results. The supervision of expenditure under the Deteriorated Lands Act has also been successfully conducted.

The most outstanding work of the year from the grassland viewpoint has been the very clear demonstration over many parts of New Zealand that the greater part of the perennial rye-grass at present sown in New Zealand is perennial only in name. The hundreds of lines that have been grown at Palmerston North have shown that true perennial rye-grass is harvested in certain areas. Its great superiority over what may be termed temporary rye-grass or false perennial rye-grass clearly necessitates a complete change in the rye-grass grown for seed, and a system of certification whereby genuine mother seed can be guaranteed is being put into operation. The substitution of the present temporary rye-grass by true perennial seems destined to effect a very great improvement in pasture establishment, and may relatively prove to be second only in importance to top-dressing itself.

Crop certification, in particular with potatoes and wheat, is developing very rapidly, and can be viewed as work of the first importance, having as its objective the elimination of the "scrub" crops from the farms of New Zealand.

The wheat manurial experiments, now in their fifth year, have yielded most important results, and more important than the results themselves is the fact that they are being made use of by the farmers, as is indicated by the fact that over 65 per cent. of the wheat crop is now manured according to the directions or advice of the Division.

The fields instruction staff is doing good work, and the demand for the services of these officers cannot at the present time be in any way adequately met with the number available, hence additions are highly desirable. The position is, however, that men of the high practical and scientific ability required in this work are extremely difficult to secure. It is hoped that within a few years the two agricultural colleges will be turning out men that are suitable for the requirements of the Division, and in this connection it is perhaps as well to emphasize that the training given should be specifically directed towards making such graduates really efficient from the viewpoint of farming instruction.

THE PLANT RESEARCH STATION.

The Plant Research Station at Palmerston North, under the directorship of Mr. A. H. Cockayne, has now got well into its stride. Research on plant-diseases has been vigorously prosecuted, dry-rot and club-root of swedes and turnips, and cereal, pea, and potato diseases being the main ones under investigation. During the year the staff of the Station was considerably strengthened, both by officers paid for by the Department of Scientific and Industrial Research and by transfer of certain of the specialist officers of the Fields Division to Palmerston North. The centralization of research workers has proved of the very greatest value, enabling efficient team-work to be prosecuted. Dr. G. H. Cunningham is at present absent on a visit to America and Europe, investigating a number of important matters and establishing personal contacts which should prove of great value in connection with the work.

Grassland-farming.

Taking mutton, lamb, wool, beef, butterfat, pork, bacon, and veal as the products sold by the farmer from grassland, carefully prepared estimates show that between 1907 and 1921 the value of these on a standard price basis doubled—from 16 to 32 millions sterling. Between 1921 and the present time the figure has risen to 43 millions. At the rate of progress now being maintained the value of our grassland products is increasing at over double the rate it did in the first two decades of this century. The grassland-farmer is to-day producing over 40 per cent. more products per acre of occupied area than he did eight or nine years ago. Butterfat has doubled during that period, with an increase of only 40 per cent. in the number of cows, and with no increase worth mentioning in the area devoted to dairying. During the past two years well over three million sheep have been added to the flocks of the Dominion, and the potentiality of still greater expansion through the fact that breeding-ewes are now increasing by nearly a million annually becomes sufficiently apparent.

To use an everyday expression, 1928–29 has been our "peak year" for production from grassland. It can now be viewed that the vast majority of New Zealand farmers are fully alive to the great potential production-increase that lies ahead of modern grassland-farming, in which more and better grass represents one phase, and better utilization by sound live-stock husbandry the other. The successful interweaving of these two fundamental principles of grassland-management is destined to make our premier crop—grass—play an even more important role in out national prosperity than could have been thought possible a few years ago.

That this statement has a solid practical foundation is well exemplified by the performance of the New Zealand grassland-farmer during the past ten years. In the five-year period 1920 to 1924 the average annual value of grassland products on a standard-price basis was £33,410,000. During the five years 1924–1929 the average annual value amounted to £39,520,000.

Of even greater significance than these figures are the yearly increases since 1924 over the average of the previous five years, which indicate very clearly the rapid upward movement that is taking place, as follows:—

Year.	Amount of Increase.	Approximate Percentage Increase.
1924–25	£3,550,000	11 per cent.
1925–26	£3,540,000	11 ,,
1926–27	£6,020,000	18 ,,
1927–28	£7,680,000	23 ,,
1928–29	£9,780,000 (estimated)	29 ,,

Top-dressing and related Farm-management Problems.

By far the most outstanding feature in the process of increasing the quantity and quality of our grass crop is the application of artificial fertilizer generalized under the term "top-dressing."

The large increase in acreage top-dressed in 1927 and 1928 has been fully maintained during the past twelve months. A very considerable proportion of our rapidly expanding pastoral production is directly due to this practice, which up to recently has been mainly applied to dairying land, but which during the past three years has increased at even greater rate on sheep-country. The actual acreage top-dressed during the past three years have been (in round figures) as follows:—

	Amount of Fertilizer.	Area Top-dressed.
1926–27	180,000 tons	1,400,000 acres.
1927–28	245,000 ,,	1,850,000 ,,
1928–29	315,000 ,,	2,250,000 ,,

These figures represent an increase of nearly a million acres within two years. Large as is the area now annually top-dressed, it represents only 13 per cent. of the sown grasslands of the Dominion, and it is safe to say that there are not less than 6 million acres of grassland in New Zealand where payable increases due to top-dressing could be secured. At the rate of top-dressing progress of the past two years this acreage would be reached within the next decade, with the fertilizer tonnage reaching the million mark and an annual top-dressing bill of approximately £6,000,000 or more.

Almost the whole of the 315,000 tons of top-dressing fertilizer used last year was of a phosphatic nature. Apart from great expansion in the use of phosphates, the time is rapidly approaching when more consideration will have to be given to nitrogen, potash, and lime in the top-dressing of grass and. This is particularly true of those farms on which the practice is being applied to almost the whole of the pastures, and where saturation-point of high profits from phosphates alone is being

reached. Nitrogenous fertilizers are of special significance in this respect, and with their recent great lowering of price seem likely to play an important part in the future of top-dressing programmes. The Department during the past year has carried out a great deal of experimental work with nitrogenous fertilizers, but it will require the accumulation of several years' data before their exact place in New Zealand top-dressing practice can be accurately defined. One point, however, is certain, and that is that nitrogen will largely increase production on a payable basis on the high-production farm or the one brought up to high production by adequate phosphating, but on the low-production farm it is of comparatively little moment. The use of potash, again—provided it gives a response—on high-production farms appears sound. An expansion in the liming of grassland is also more than warranted—on the one hand to increase phosphate efficiency on phosphate-responsive soils, and on the other to make top-dressing efficient on soils where phosphate alone gives poor results both from the grass-growth and animal-health standpoints.

The future so far as capacity to increase the grass crop by top-dressing is concerned is bright enough, but the successful utilization of this enormously increased grass crop bristles with problems and difficulties. It is clear that stock-management practice, satisfactory enough as it has been in the past, will have to be thoroughly modified and adjusted to the changing conditions largely being brought about by top-dressing. The adequate conversion of the grass crop into animal products, and the avoidance of excessive waste of good grass, together with the important point of maintaining the health and reproductivity of grazing-animals under conditions of far closer stocking than in the past, is essential if the real production increase that can be brought about by general top-dressing is to be reaped by the New Zealand grassland-farmer.

A close study of the whole of the problems involved in what may be termed modern grassland live-stock management is demanded, and until that has been done, and management methods attuned to the new conditions are in operation, top-dressing development will be in danger of serious retardation, with the possibility of monetary loss resulting from inability to efficiently utilize the excess feed, and consequent inadequate returns from the money and labour expended in top-dressing.

Dairying.

As will be noted from the report of the Acting Director of the Dairy Division, the dairy industry has experienced a record season as regards production. This, however, can be regarded as only a step towards a further increase, having regard to the gradually improving methods of dairy-farmers and the better understanding of the utilization of fertilizer top-dressings to the best advantage, together with the improvements resulting from herd-testing.

It is satisfactory to note that the good standard of quality attained by our butter has been maintained. As regards cheese, however, there is an undoubted necessity for improvement in more than one direction, though the most outstanding feature lies in the condition known as openness. This is the subject of intensive research at the Dairy Institute at Massey College, and, apart from this, the instructional staff of the Department has been devoting consistent attention to the manufacturing side in the hope of assisting towards overcoming the trouble, co-operating in this with the research workers. The instructional work being done at Massey College and the Dairy Institute, as well as the research work, is on good lines, and it should prove of benefit to the industry and of aid towards its advancement.

An important feature of the year lies in the decision of a large section of the industry to adopt a system of standardizing the butterfat content of cheese at factories where the milk-supply as a whole possesses a high butterfat content. The standard set is a high one, and it is satisfactory to note, at the time of writing, that cheese manufactured under this system is selling in the overseas market at prices equal to those ruling for our full-cream cheese.

In regard to casein, the output was somewhat less than in the previous year, but the quality continued good. A charge of 1½d. per hundredweight is now made for grading this article.

The system of cream-grading at factories has worked well on the whole, and is of undoubted value as an aid to maintaining a high standard of quality in the butter manufactured. All cream graders are certificated, and their work is under regular supervision by the Instructors of the Division. Suggestions have been made that the Department should take over the control and direction of this service, and also the testing of milk and cream at factories. This is still a matter for discussion by the industry as a whole, and no recommendation regarding it can be made at present. The Dairy Division's two special officers have carried out considerable check testing at dairy factories, and valuable work has been done in the direction of seeing that the regulations pertaining to the testing and grading of milk and cream have been complied with.

The Farm Dairy Instruction service is giving good results. The cost is shared between dairy companies and the Department. The system is not yet in operation throughout the Dominion, but there is a general desire that it should become general, and be systematized in such a manner that each Instructor will carry out his work in a defined area irrespective of what dairy factories are drawing supplies from it. In principle this has much to commend it. The question of cost needs to be gone into thoroughly, seeing that if a Dominion scheme is established, and operated upon present lines, an additional charge upon the Consolidated Fund would be involved in order to provide the Government's share of the expenditure.

Herd-testing continues to progress, the number of cows under test showing an advance, according to the latest available figures. The allocation of the subsidy paid by the Government was placed in the hands of a small committee, which functioned quite satisfactorily. The gentlemen composing it deserve sincere thanks for their voluntary assistance, which was highly appreciated. Nearly the whole of the testing carried out under the more complete system known as the "group" system was done under the voluntarily established Herd Testing Federation. A few independent groups also operated. Further, a considerable number of cows were tested under the original association method, carried out through dairy factories, and in the case of some forty associations by officers of the Dairy Division. With a view to assisting in furthering the interests of the movement, a new central body has just been established, consisting of representatives of the Federation, the Dairy Board, Massey College, and the Department, whose function it is to direct the policy of the Federation and to control the expenditure of Government grants or subsidies.

The Certificate-of-Record Test continues to provide a useful service to breeders of purebred dairy stock, and entries for this test are now again distinctly on the ascendant. The Official Herd-test, also applicable to purebred stock, is progressing and extending.

The bacteriological work at Wallaceville Laboratory, well carried out by Mr. G. F. V. Morgan, has proved of great assistance to the Division, dealing as it does with current difficulties met with in factories by Instructors. It in no way clashes with the deeper research work in progress at Massey College, with which institution harmonious co-operation exists.

The Division's Inspectors in London have been active in carrying out their duties, and the information they provide is of great aid to the New Zealand staff in their work of assisting the industry in maintaining the quality of exported produce.

The Director of the Division, Mr. W. M. Singleton, is now making a visit to the United States, Canada, Great Britain, and the Continent of Europe, in order to gain first-hand information relating to our export trade and manufacturing methods. His keenness and earnestness of purpose will no doubt enable him to return with increased knowledge which will be of marked assistance towards the continued progress of the industry upon the best lines.

Animal Health.

The influence of pasture conditions upon the health of sheep, particularly hoggets, was well illustrated in Canterbury during the 1928 late autumn and winter, when an unusual growth of late autumn feed (not influenced to any extent by top-dressing) occurred, and, as a result of the animals being unable to properly digest it and assimilate its nutritive elements, hoggets lost condition and became an easy prey to internal parasites—a heavy and (for Canterbury) quite unusual mortality occurring. In the present winter, with more normal conditions, very little trouble of this kind is being experienced in the South Island or in Auckland Province, but in Wellington Province, with a plentiful growth of autumn feed and a mild winter, extensive losses among hoggets are occurring where they are grazing on pastures carrying feed of too watery, indigestible, and unsuitable a nature for these young animals.

The top-dressing of pastures on the richer lowlands has an important bearing upon this, and it is evident that, as farming methods advance, live-stock management in the form of sound animal-husbandry methods becomes more and more necessary, especially perhaps with sheep, which thrive best upon short feed that is of not too "watery" a nature, and keep in the soundest health when they have to take plenty of exercise in order to obtain their daily ration. Stockowners not unnaturally in these days are sometimes prone to look to research to find easily applied methods of preventive treatment which will enable their stock to be kept in sound health under unsuitable and unfavourable natural conditions of pasture and climate, but this is expecting too much even of the advanced science of the present day. Science can and does help, but it cannot override the physiological conditions imposed by nature.

Other sheep troubles induced primarily by dietetic causes are ante-partum paralysis (so-called "sleeping-sickness") and extrusion of the vagina in ewes, and pulpy kidney in lambs. Of these the

two first named vary in their incidence according to seasonal climatic and pasture conditions, a mild wet winter with plenty of feed being the most dangerous, especially as regards extrusion of the vagina. Ante-partum paralysis may occur, however, under drier, colder, and more healthy winter conditions if the ewes are in plentiful feed and in a condition in which they have stored up an excess of internal fat.

The whole position as regards these troubles may be summed up by stating that the essential preventive measures consist of so managing the flock that the animals are not kept under conditions of grazing which are unsuitable for the maintenance of sound health and vigour, and that in-lamb ewes are compelled to take a sufficient amount of regular exercise to prevent them getting too lazy and too fat internally.

As regards extrusion of the vagina, there is still a belief in the minds of some sheep-farmers that it is infectious. Of late further observation and investigation has taken place in connection with this trouble, and has included additional experiments upon this particular point of infection. These have entirely failed to produce any evidence that the trouble is capable of being conveyed by infection from ewe to ewe. Pulpy kidney in lambs has been the subject of further research, and, though no new and better method of preventive treatment has been elucidated, our knowledge of the subject is gradually becoming clarified. As the Director of the Live-stock Division points out in his report, checking the development of the lambs would prove beneficial, but this, from an economic standpoint, cannot be looked upon as desirable. Further work, in Otago particularly, is being planned for the coming season, both from the research and the management points of view.

Dairy-cow Diseases.

It is satisfactory to note from the Divisional report that contagious abortion and mammitis have been less in evidence than in previous years. The study of these troublesome diseases, also of temporary sterility (which shows no decrease) has been continued side by side with the giving of advice to farmers as to practical management methods aimed at reducing their incidence. As has been the case for some years past, the investigation work has been carried out by the Wallaceville Laboratory staff in immediate association with two skilled field Veterinarians, selected for their special faculty for research work, the field staff of the Division also co-operating freely.

As regards contagious abortion, increased use is being made of the blood test, which enables disease-carriers to be identified. The Wallaceville Laboratory report (printed with that of the Live-stock Division) states that during the year 2,480 blood samples were tested, many of these being sent in by farmers themselves. Further trials were carried out with abortion vaccine of South African origin, about 800 animals being inoculated, and the latest reports regarding these are rather encouraging, though complete details are not yet available. More extended trials will be carried out during the coming season. The Wallaceville report gives details of the work done in connection with this disease, also regarding mastitis (mammitis), in connection with which our knowledge is increasing. It must here be reiterated that a good proportion of cases of mastitis could be prevented if more care were exercised in the maintenance of cleanliness in milking-sheds and milking-machines, also in the handling of milking-machines and in the general care of dairy cows. Tests were made with vaccines prepared at Wallaceville, but without satisfactory results; research work generally has been actively continued.

Rather serious losses were experienced among dairy cows in some districts last season through a condition known as parturient eclampsia, not entirely unlike milk-fever, but not responding to the usual treatment for milk-fever. It may be in some way related to feeding-conditions, but this is not yet clear. When the calving season arrives special attention will be devoted to this, and further investigation work carried out. The remarks of the Director of Live-stock in connection with this disease are worthy of note.

Temporary Sterility of Dairy Cows.

Temporary sterility of dairy cows is still very troublesome, and research into the problem it presents is being vigorously prosecuted on various lines. These include field observations on herds where the trouble is prevalent, bacteriological and pathological examinations, study of the effect of lime and of phosphatic top-dressing, pasture analyses, the effect of concentrate feeding, carbohydrate feeding, and dietetics generally, the direct administration of drugs, and management matters. A further line of experiment is in preparation, this consisting of adding to the diet a material rich in a vitamin the presence of which in the food is believed to be essential to successful breeding.

Observations in Taranaki suggest a possibility of infection carried by the bull's organ being a factor, and this aspect of the problem is being followed up. Scientific research is often necessarily slow in producing definite successful results which can be practically applied, and while it is in progress it is necessary to do the best possible, with our existing knowledge, to minimize losses. With this in view, advice regarding herd-management and preventive treatment is being freely circulated among farmers by means of lectures, leaflets, and other literature.

The trend of modern dairy practice in the Dominion is to increase the milking-period of the herd by early calving. Two factors, one decreasing in effect, the other increasing as the season progresses, operate against this aim being always successfully realized. These two factors are (1) adequate early spring-feed provision, and (2) the difficulty often experienced of getting cows and heifers to hold to the first or second service of the season. Cows which fail to hold at the proper time will almost invariably get in calf later on, sometimes in February or March. This means that they are thrown out of time for their next conception and calving; these animals, moreover, are often yielding well when the herd is dried off in the ordinary way. There is now a method developing which is economically sound, in the circumstances, if the farmer is prepared to face the labour and inconvenience involved by winter milking. This is to avoid calving too late in the season by making no further effort to get the animal in calf if she fails to hold after the second or third service, but to milk her on continuously for from eighteen to twenty months, making provision for extra good feeding for the May, June, and July period. Such a cow, if a good ordinary producer, might yield up to 500 lb. or more of butterfat during this prolonged milking-period, and could be dry for from four to six months before calving. Experience is showing that cows treated in this way almost invariably hold to their first service, when they become properly timed for the future.

On the other hand, some farmers with experience hold the view that cows which only hold to service after the New Year, and consequently do not calve until the next season is well under way, will yield as great an amount of butterfat during their shortened milking-period as they normally yield during a full season. Taking everything into consideration, however, the practice of giving the cow a year's rest from breeding seems sounder economically, and is more likely to bring about regular conception at the proper period during the future milking-life of the cow.

Tuberculosis.

The returns furnished by Inspectors at meat-export slaughterhouses and abattoirs show that the number of animals found on slaughter to be affected in any degree with tuberculosis was 5·22 per cent., this being an increase of 0·12 per cent. on the preceeding year's figures. An analysis of these returns indicates that this is limited principally to cull cows fattened for beef in the North Island, and it may be a reflection of the closer segregation of animals on pasture areas of dairy-farms the carrying-capacity of which has been increased by top-dressing, combined with the greater protection given by the heavier growth of herbage to tubercle bacilli voided on to the paddocks. On the other hand, the number of tubercular animals condemned on farms and at saleyards by Inspectors decreased by 4 per cent. as compared with the preceding year. Pigs showed a decrease of 0·38 per cent. As regards dairy cows supplying the main centres of population, the position is satisfactory, as is shown by the fact that of 714 composite samples of the mixed milk of individual herds subjected to biological examination only four were found to contain tubercle bacilli.

The Chemical Laboratory.

A large volume of work was done in connection with deficiency diseases by the Chief Chemist, Mr. B. C. Aston, and this is dealt with in his appended report. It was carried out largely in association with the Mineral Content of Pastures Committee of the Research Department, and partly financed by a grant from the Empire Marketing Board. The investigation entails a large amount of analytical work, and this has caused much pressure upon the staff of the Laboratory. More analysts are needed in order to meet requirements for research and for general routine work.

The Veterinary Laboratory.

The Veterinary Laboratory, situated at Wallaceville, has been responsible for a large volume of good work under the direction of the capable Officer in Charge, who furnishes a detailed report which is printed later. This work not only embodies special research into individual diseases, but also a large number of examinations of material sent for identification by field officers of the Live-stock Division, farmers, and others. Additional accommodation is badly needed in order to enable the increasing activities of this institution to be efficiently carried on.

Inspection of Meat for Export.

This important responsibility of the Live-stock Division has been well carried out, only a very few cases having occurred wherein any complaint has been received from overseas countries where our meat is marketed. The Chief Inspector of the Smithfield Market, London, visited the Dominion during the year and personally inspected the work being done at the various meat-export slaughter-houses and abattoirs, expressing appreciation of it generally. He made some suggestions as to certain points of detail, and these are being gone into by correspondence through the medium of the High Commissioner.

An important feature of the meat-export trade during the year lies in the action taken by the British authorities regarding the disease of sheep known as lymph-adenitis. A large number of imported mutton and lamb carcasses from various sources were examined, and as a result restrictions in the form of special inspection in the United Kingdom were imposed upon imports from certain countries. The number of New Zealand carcasses found affected was so small that no action of this kind was taken at the time in connection with our meat. The disease is present here to a relatively small extent, and special precautions in the form of more thorough inspection than usual at the time of slaughter were taken to detect any affected carcasses and prevent their shipment. In addition, information and advice has been freely disseminated among sheep-farmers to enable them to be fully acquainted with the methods necessary for preventing their sheep becoming infected. The characteristic feature of the disease is the formation of abscesses in lymphatic glands. It does not affect the general health of the animals.

The trade in boneless veal has necessitated an extension of meat-inspection work. This has proceeded satisfactorily, thanks to a large extent to the manner in which those engaged in the trade have done their best to assist in meeting the requirements of the Department.

Wool.

Quite a good wool season was experienced, as will be gathered from the report of the Live-stock Division, in which extracts from the sub-report of the Wool Instructor give details.

A considerable amount of attention has been given to the complaints made in Bradford regarding faults in Romney and Romney-cross wool, and in conjunction with the Research Department and the Massey Agricultural College authorities definite research work into this question has been undertaken at Massey College. The Department has naturally interested itself specially in this matter, and is co-operating with advisory and other work in the field. It is hoped that this may be further extended.

The Poultry Industry.

As will be gathered from the report of the Director of Live-stock and that of the Chief Poultry Instructor, this industry is passing through a difficult phase both as regards marketing conditions and the cost of egg-production in the North Island. It is hoped that the earnest endeavours which are being made to bring about improvement will be successful.

In order to assist the industry by providing an outlet for surplus eggs the Government, through the Department, gave a guarantee on export, the rate being based upon market values in London during the previous year. Unfortunately, owing to causes beyond our control, market values during the season were markedly lower than of late years, and the guarantee had to be called upon to the extent of £5,839. The quality of the eggs shipped was good, and a good reputation for New Zealand eggs has been established in the British market. For the coming season it is hoped that a further guarantee will be given, even if it be on a lower basis of value.

The Pig Industry.

Pig-keeping has made some progress, but this has been restricted in the North Island by the cost of foods supplementary to dairy-farm by-products. This question of foodstuffs has become, in fact, more or less of a limiting factor in that portion of New Zealand, and a good deal of thought and of experimental work has been given to the question of how to meet it. There is room for much improvement in the methods of housing and feeding pigs in dairying districts, and a good deal of loss is experienced through sickness and death among young animals as a result of bad methods. The field officers of the Live-stock Division and the special Instructor do their best to aid farmers by advice regarding improved methods. The bonus on export pork has been continued. Many farmers think that this does not operate with full benefit to them, but owing to the nature of the trade it is difficult to see how any other method of payment would be workable in actual practice, seeing that with bacon pigs in particular their ultimate destination, whether for home consumption or for export, cannot be determined at the time of purchase from the grower.

Sheep Returns.

The interim returns, to hand at the time of writing, show an increase of 1,877,637 head over the preceding year, bringing the total flocks up to an aggregate of 29,011,447. This is very satisfactory, and suggests that the increased carrying-capacity gained by top-dressing sheep-country, together with the great reduction of the rabbit pest, have been factors in bringing it about. There has also been a marked decrease in the number of sheep slaughtered, when the previous year's increase in the total number of sheep in the country is considered. Also, while lambs show an increase of 254,690 in the number slaughtered, this has to be considered in relation to the fact that the returns at the 30th April, 1928, showed an increase in breeding-ewes amounting to 702,321.

Fruitgrowing and Horticulture.

The past year must be regarded as having been a satisfactory one for the fruit industry. The quantity of apples and pears exported in the 1928 season was greater than in any previous year, and payable market values were obtained for the bulk of the shipments, the call upon the Government guarantee proving very small—namely, £526. Fruitgrowers generally did their best to assist in ensuring that fruit of good quality, conforming to requirements, was sent forward for export, and while there were occasions when unavoidable delay occurred in securing shipment, the fruit, generally speaking, reached overseas markets in good condition. This matter of minimizing as far as possible the time elapsing between harvesting and grading fruit and placing it on board the overseas vessel constitutes an important factor in the success of the export trade. The industry has made a big advance towards establishing itself upon a basis of stability, and, given continued business-like management of its overseas trade, and progressive improvement in local marketing methods, its outlook is distinctly good, provided overproduction is guarded against.

The officers of the Horticulture Division have worked strenuously in carrying on their instructional activities among growers, also in conducting a considerable volume of experimental work, inspecting and grading export fruit, and generally taking their part in furthering the advancement and improvement of the industry. Citrus fruitgrowers have experienced a better year, and are reaping the benefit of improved practice in the curing and marketing of lemons.

An interesting feature of the year lies in the development of tobacco-culture. Already, a proportion of leaf of high quality is being produced, and improvement in the average standard of quality can be anticipated. With a still limited production, a good portion of the crop was purchased for manufacture in the Dominion. The ultimate success of tobacco-growing here, however, must depend mainly upon a stable overseas market being found for the surplus not required for our own internal use.

Grape-growing, both outdoor and under glass, is making steady progress, and where soil and climatic conditions are suitable the production of outdoor crops should be capable of some extension, as the markets in our centres of population appear to give paying returns to growers. The wine-making industry continues to develop satisfactorily, a good article of its type being produced.

Full details of the various activities of the Horticulture Division will be found in the Director's report.

Bee-keeping.

This excellent minor industry has experienced an uneven season, with a total production below the average, but the quantity exported during the period under review (comprising most of the preceding season's heavy crop) constituted a record. That the marketing and advertising methods adopted in Great Britain are good is shown by the satisfactory prices obtained and the evidently high appreciation with which New Zealand honey is regarded there. The industry has been well served by the section of the Horticultural Division dealing with it.

Farm Economics.

The major function of the Farm Economics Section of the Fields Division is the study of farm-management methods and the effect of different factors on production. It has shown quite conclusively that production per acre must be looked upon as the basic principle in dairy-farm management, and that to this end the number of cows milked on a given area is of relatively greater moment than individual cow records. The fact that production per acre is directly correlated with the amount of manure used as top-dressing has been proved; also that by understocking and heavy manuring it is possible to raise herd averages, but that if done deliberately the practice is unsound. Where labour is fully exploited, the amount available is also directly correlated with production. It has been shown that where the farm-labour organization has been upset by the introduction of extra cows into the herd farmers should raise more heifers for sale rather than employ additional labour on milking. The production efficiency of small farms has been clearly demonstrated, and likewise the soundness of expenditure on improvements on farms producing about 200 lb. of butterfat per acre.

A review of live-stock production in New Zealand over the past twenty-six seasons published in the "New Zealand Official Year-book," 1929, and later in the *Journal of Agriculture*, represents the best index of production yet compiled, and serves as an admirable guide in observing the trend of production and in forecasting movement in the future. Two other publications were also completed by the section during the year.

Ruakura State Farm.

This farm has made further good progress, and substantial improvements have been carried out, thus increasing the intrinsic value of the property. For the year the total expenditure, excluding permanent salaries but including all expenditure upon the farm training college and other educational work, was £8,410, while the total receipts were £11,074. Permanent salaries, including instructional services, amounted to £3,149. A period of short rainfall in December, January, and February had the effect of reducing the production per cow over that period, but for the year ending 31st March, the receipts for butterfat exceeded those of the preceding year by £166. The quick response of the pastures later in the season was expected to bring about a longer period of production than usual. A number of cows were under certificate-of-record test, and some very good results were obtained. Sheep did well. The sales of fat lambs totalled up to a value of £1,606. Surplus Southdown sheep brought in £693, while the gross returns for wool amounted to £632. Southdown rams sold topped the local market. Pigs failed to return a profit owing to low prices and a poor demand. A line of thirty bacon pigs of the Large White-Berkshire cross was prepared for the purposes of a special experimental shipment to London. Generally the farm is in very good order, and the Manager is to be commended for a good year's work.

A series of special pasture experiments have been laid down on the farm by the Fields Division, and these should in due course produce results of value to farmers in the district.

Ruakura Farm Training College.

The Training College at Ruakura had forty-five students in residence last year, this being the maximum number which can be comfortably accommodated in the quarters devoted to that purpose. A portion of the homestead building is now in use for lecture-room purposes, and more space is available in the building for a further later development of this educational work. Mr. P. W. Smallfield, who had charge of this work from its inception, and did much to place it upon a good footing, was promoted to a position elsewhere, and his place at Ruakura was satisfactorily filled by Mr. G. K. McPherson, who had previously acted as his assistant. Students entering for the course at Ruakura need to be not less than sixteen years of age, and the fee charged is £36 per annum. The time occupied by the course is equally divided between indoor instruction and practical outdoor work on the farm, the aim being to turn out lads who in due course will become good progressive farmers.

Weraroa State Farm.

A good season was experienced by this farm, so much so that the stock carried proved unable to cope with the luxuriant pasture-growth, and a greater quantity of hay than usual was saved. The dairy herds of Friesian and Red Poll cattle did well, and ended the season in good condition. The sheep flocks gave a satisfactory return, fat lambs selling well. Pigs were unprofitable owing to lack of demand, coupled with low market values. The farm cattle exhibited at the Royal Show were successful in winning the Wilbur Cup, also one second and three first prizes for Friesians, while the Red Polls secured two championships, two reserve championships, eight first and two third prizes, the cup for the best female, the Woodhouse Cup, and the Osmond Trophy for best points.

The financial results of the year's operations were good, the total payments, excluding permanent salaries, being £4,549, while the total receipts were £7,822. Permanent salaries amounted to £1,870. In comparing this with previous years it must be borne in mind that had it been necessary to carry the farm on, some expenditure in the purchase of grazing-stock would have been incurred, and the balance between payments and receipts altered accordingly. The Manager has done good work at the farm since taking charge in 1923.

During the year it was decided to cut up the farm for close-settlement purposes, reserving 140 acres for the purposes of the Education Department. This operation is in hand, and the sections will be balloted for in July, the stock being auctioned at an earlier date.

Rabbits.

As will be gathered from the Live-stock Division report, the rabbit pest has continued to be kept well under control, but at the same time vigilant inspection has been maintained.

A considerable number of tame Angora and Chinchilla rabbits have been imported for the purpose of enabling private persons to keep these animals in captivity and produce rabbit wool

and skins for export. The granting of permits and the maintenance of the necessary supervision over these tame animals has thrown a considerable amount of extra work upon the Live-stock Division staff. It is a matter for regret that the market for Angora wool in the United Kingdom is in a very unsatisfactory state, and the immediate outlook gives cause for concern.

Noxious Weeds.

The officers responsible for the carrying out of noxious-weeds inspection have had a hard time, especially in those districts where ragwort is prevalent. They do their best, and the aggregate result of their efforts doubtless represents the exercise of a considerable amount of control. But, with ragwort and blackberry especially, a full enforcement of the Act would in many cases mean asking settlers to undertake a volume of work entirely beyond the capacity of their financial resources.

From time to time the question is raised of forming local Noxious Weeds Boards to take over the administration of the Act. This suggestion possesses a good deal of merit, in that, if adopted, local knowledge and local effort would be applied to local conditions. If given effect to it would undoubtedly mean that the Government would have to pay a considerable subsidy, though as an offset its own expenditure upon inspection would largely disappear and be limited to some over-seeing responsibilities. At the present time County Councils possess powers enabling them to deal with noxious weeds (and in a few cases, by arrangement with the Department, they are co-operating in noxious weeds control). Hence a County Council could undertake the duties which the advocates of Noxious Weeds Boards consider should be carried out by the Boards.

The control of noxious weeds constitutes a difficult and sometimes unpleasant responsibility, and consequently the undertaking of it can hardly be expected at first sight to appeal favourably to established county authorities, notwithstanding the fact that, having regard to the value of local effort in this direction, it would be a valuable forward step. Failing the establishment of localized control, some system of co-operation between the Department and County Councils, or, alternatively, local Noxious Weeds Boards, would be of distinct advantage, if not involving too great expenditure.

All this may appear to convey the idea that the Department is desirous of getting others to relieve it of an arduous and difficult responsibility, but I trust it will be realized that the expression of these views is actuated only by the genuine desire to endeavour to find the most effective and practicable method of dealing with noxious weeds to the best advantage. As the success of Rabbit Boards has shown, organized local effort is very valuable in work of this kind.

Publicity.

The Publications Service was well maintained during the year, with the *New Zealand Journal of Agriculture* as the Department's chief means of disseminating information and recording its many-sided work. There was also a large output of instructional pamphlets, and a number of miscellaneous departmental publications were issued.

The weekly radio broadcast lecturettes service instituted some eighteen months ago was continued during the year from Station 2YA, Wellington. A wide range of subjects was again covered, all branches of the Department having furnished lecturers. Much appreciation of this service has been expressed. Many ordinary lectures and demonstrations were also given as usual.

Some special publicity work was carried out by the periodical supply to a number of daily newspapers throughout the Dominion of notes on animal-husbandry subjects of a topical nature, an extra means of promptly reaching the farming community with information being thus provided.

Legislation.

During the main 1928 session of Parliament the following legislation connected with the Department was enacted: Rabbit Nuisance Act, 1928; Noxious Weeds Act, 1928; Orchard and Garden Diseases Act, 1928; Canterbury College and Canterbury Agricultural College Amendment Act, 1928; Reserves and other Lands Disposal Act, 1928 (section 12).

Retirement of Assistant Director-General.

At the end of March Mr. F. S. Pope, Assistant Director-General, who had completed over forty years of Government service, retired on superannuation. Mr. Pope had been associated with the Department of Agriculture since 1900, and his assiduous and loyal devotion to the high duties entrusted to him were an important factor in the development of the Department and in the extension of its services to the primary industries. He was a highly valued coadjutor, and it was a matter of great regret to me that circumstances of time necessitated a severance of his association with the Department.

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 ninth year of operations at Nauru and Ocean Islands under Government ownership terminated on 30th June, 1929, with the following results as regards phosphate shipments, compared with the previous year:—

	Eighth Year (1927–28). Tons.	Ninth Year (1928–29). Tons.
Nauru	310,990	342,770
Ocean	190,925	233,820
	501,915	576,590

Bill-of-lading figures are taken in each case. An increase of 74,675 tons in quantity shipped will be noted, but falling short of our previous highest year (seventh year) by 16,750 tons. The latter year was one when particularly favourable conditions were experienced at the islands as regards weather, freedom from epidemics of sickness, labour difficulties, &c. The year just ended was what may be called a normal year, in that bad weather was experienced during the months when it is due, and the usual difficulties with shipping were encountered, though we were fortunate in not having any of the moorings carried away. When the fine season started rapid progress was made, and in May a record month's work was established, viz., Nauru, 44,500 tons; Ocean, 23,825 tons: total, 68,325 tons. The previous best month for Nauru was 41,931 tons, shipped in June, 1928.

As regards phosphate dried and stored ready for shipment, the ninth year constitutes a record, the figures for the last three years being as follows:—

	Seventh Year. Tons.	Eighth Year. Tons.	Ninth Year. Tons.
Nauru	326,695	332,230	346,764
Ocean	255,362	195,900	251,749
	582,057	528,130	598,513

In this connection it may be noted that under present conditions Ocean Island has no chance of an increased output owing to the phosphate-workings becoming more restricted each year through the difficulties in acquiring further lands. There is, however, reason to think the matter will be settled within a few months.

Importations of Nauru/Ocean phosphate and phosphate from outside sources of supply for the last three years are as follows:—

	Seventh Year. Tons.	Eighth Year. Tons.	Ninth Year. Tons.
Nauru/Ocean	139,535	136,718	138,053
Outside	10,415	42,946	29,288
	149,950	179,664	167,341

With regard to the percentage of Nauru/Ocean output coming to New Zealand, figures for the last three years are as follows: Seventh year, 21·95 per cent.; eighth year, 24·76 per cent.; ninth year, 24·66 per cent. We could have supplied a further cargo this year, but it was not convenient for the manufacturers to take it, owing to their storage-bins being practically full, and it was accordingly diverted to Australia.

A statement follows giving particulars of shipments of Nauru and Ocean Islands phosphate during 1928–29, together with the countries of destination.

Shipments of Nauru and Ocean Island Phosphates, 1st July, 1928, to 30th June, 1929.

	Totals.		Australia.		New Zealand.	
	Tons.	Per Cent.	Tons.	Per Cent.	Tons.	Per Cent.
Nauru.						
July-December, 1928	166,792	100	117,170	70·25	49,622	29·75
January–June, 1929	175,978	100	136,950	77·82	39,028	22·18
Full year	342,770	100	254,120	74·14	88,650	25·86
Ocean Island.						
July–December, 1928	127,460	100	97,315	76·35	30,145	23·65
January–June, 1929	106,360	100	82,960	78·00	23,400	22·00
Full year	233,820	100	180,275	77·10	53,545	22·90
Nauru and Ocean Islands.						
July–December, 1928	294,252	100	214,485	72·89	79,767	27·11
January–June, 1929	282,338	100	219,910	77·89	62,428	22·11
Full year	576,590	100	434,395	75·34	142,195	24·66

NOTE.—Eighth year shipments: Australia, 377,645 tons = 75·24 per cent.; New Zealand, 124,270 tons = 24·76 per cent.

LIVE-STOCK DIVISION.

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

Stock Conditions generally.

The season of 1928–29 can be regarded with entire satisfaction by those engaged in the dairy industry. Seasonal conditions were such that there was no lack of food during any part of the season, and catch-crops, grown as a provision against shortage of feed in dry periods, were not required in many cases. These conditions did not give such favourable results in the production of fat lambs. On account of the strong luscious feed which was in evidence on account of the damp season, lambs were very backward in coming to maturity. In many districts the lambs reached the freezing-works later in the season than usual, and of those which did reach the works many were lacking in bloom when seen on the rails. For such produce we would not be justified in looking for the results obtained in previous seasons.

Owing to the mild winter, pastures at time of writing look well and carry a fair amount of feed. Turnip crops are in most districts above the average; hay and ensilage saved has also been above the average. The present position with regard to feed for stock is a very satisfactory one. Unless exceptionally severe conditions are experienced during the remainder of the winter and spring months stock should come through in satisfactory condition.

Speaking generally, pigs have done well, and there has been no serious outbreak of disease calling for special mention. The numbers slaughtered for the season 1928–29 are 516,471, as compared with 498,022 for 1927–28, an increase of 18,449. While the industry is steadily expanding and prices have been fairly satisfactory, I do not feel justified in advising dairy-farmers to make any substantial increase in their output in the present state of the market. If this industry is to further increase we have to look principally to the British market for the consumption of our products; if at any time a shortage occurs, and as a result the market shows an upward tendency, it is not difficult in a short time for producers to meet the demand, and in fact overstep the mark, with the result that there is overproduction and prices fall. This is a frequent occurrence in the history of the industry, and New Zealand producers, on account of being so far from their market, are not able to produce their supplies in time to reap the advantages of any shortage that may occur. Producers in this country should not become unduly optimistic on account of a rising market, as nothing is more detrimental to the industry than to suddenly increase production, and, on account of the unremunerative prices, to get discouraged and more or less cease producing. The aim to be kept in view is a steady increase, not in quantity alone but in quality, which will ensure that there is always a steady demand for our pork and bacon. This can only be accomplished by improved methods of breeding and feeding. At present there are several breeds of pigs in the Dominion any one of which is suitable for the purpose, and which can be improved by proper selection. Regarding feeding and management there is much to be desired. With reference to this the District Superintendent, Auckland, remarks: "The better housing and feeding of swine are subjects which need constant reiteration in order to induce the farmer to pay more attention to these important items of husbandry. In this country we have an abundant cheap source of food—namely, skim-milk—which enables the farmer to produce pork and bacon at a lower cost than many of our competitors. But is the most being made of this by-product? One has only to see how pigs are fed to realize that we are not doing so. If arrangements were made so that this product could be used in a more economical manner, and with the addition of a quantity of grain, so that a better balanced ration is fed, the output could be increased out of all proportion to the cost of the grain supplied. Better housing, bedding, and sanitary conditions are also an absolute necessity." Effective grading is also a matter which requires attention. It is understood that the Meat Producers Board has this matter in hand. The difficulty, however, is to get a grade which will suit all requirements. A fixed standard was drawn up by the Board, but it was found that it did not meet requirements in all cases. The export industry is as yet relatively in its infancy, and there is no doubt that in the near future a standard will be fixed to meet requirements.

At the present time there is a good demand for horses, more particularly of the heavy class for city use. It has been proved that for short journeys and where stoppages are frequent the horse and lorry is a more economical proposition than the motor-lorry. Although prices are high and the supply at present scarcely meets the demand, there is not sufficient indication that the breeding of these animals should be undertaken on an extensive scale. Although there will always be a number of horses required for farm-work, and also for certain classes of work in the cities and towns, I feel satisfied that this branch of farming will never again reach anything like its former proportion, and that the present high price is an indication that fewer horses are being reared, rather than an increased demand for their service. At present the supply is not sufficient to meet the demand, and for those settlers having the facilities for breeding a few good-class draught horses the indications are that there is scope for a limited increase in this direction with profit to themselves.

Health of Stock.

The principal diseases and troubles affecting stock in New Zealand are dealt with under the respective headings as follows:—

Horses.

The health of horses generally has been excellent during the past season, and no trouble has been in evidence which calls for special remark. A few cases of strangles and influenza were seen

in various parts of the country, but these troubles yielded to the treatment applied. In the Auckland District a number of cases of staggers were seen, also in the northern part of the South Island a number of cases of forage poisoning were seen. In both districts the trouble was of dietetic origin, which in a short time yielded to treatment.

Cattle.

Tuberculosis.—The position still remains satisfactory with regard to this disease. The number of cattle slaughtered in the field as the result of clinical examination and the tuberculin test amounted to 4,623, as against 4,839 last year, showing a decrease of 216. Decreases in all districts have to be recorded as follows: Auckland, 115; Wellington, 13; Christchurch, 74; Dunedin, 14. The Auckland District again shows by far the largest percentage of condemnations. In my last year's report I gave the reasons for this, and in the absence of a better system of drainage and better management such high percentages are likely to continue. Taken as a whole, even with full consideration of the slight increase shown in the freezing-works and abattoir returns, the position as regards this disease is satisfactory, and compares more than favourably with the herds of other dairying countries. With the careful elimination of all animals showing any symptoms of the disease, and by testing those which are suspicious, it is to be hoped that in the near future the herds of this country may be in a still better condition. The District Superintendent, Dunedin, remarks that the incidence of the disease is less than in former years, and it would not be a difficult matter to have the disease eliminated from many dairy herds in the district. This is the aim that departmental officers keep steadily in view, and with the co-operation of individual owners this can be accomplished in many districts throughout the Dominion. The number of cattle examined at the various freezing-works and abattoirs was 320,945, a decrease of 60,667 from last year. Of these 16,758, or 5·22 per cent., an increase of 0·12 per cent. over last year, were found affected in varying degrees, a considerable number being only slightly infected. The reasons for this slight increase will be investigated. The total number of swine examined was 490,789, an increase of 17,669 over last year. The total number affected was 49,761, or 10·14 per cent., a decrease of 0·38 per cent. on last year's figures. In my report of last year I drew attention to the fact that tuberculosis was on the increase among swine in New Zealand, and urged the necessity for better feeding and housing, and I again take the opportunity to still further urge these necessities. If we are to increase our output of pig products and become a competitor on the world's markets—and with our climate and conditions there is no solid reason why we should not—then we will have to do away with the present slipshod methods, and see that these animals get the proper care and attention which will enable them to be put on the market with the maximum of profit to the producer.

Actinomycosis.—The animals condemned for this disease and for which compensation was paid show a slight increase over last year's figures. The number condemned is 685, as against 628 the previous year, distributed as follows: Canterbury, 63; Auckland, 380; Wellington, 182; Otago, 60. In addition to those animals slaughtered for the disease a considerable number was treated with potassium iodide with satisfactory results. It is only in open cases or in those which have advanced so far that treatment is useless that slaughter is carried out, and wherever possible owners are advised to seek advice early, in order that the best results may be obtained and that the lives of valuable animals may not be sacrificed.

Malignant Growths.—The number of cattle condemned for malignant growths was 428, a decrease of 52 over last year's figures. In all cases the diagnosis made in the field was confirmed by microscopical examination at Wallaceville Laboratory.

Mammitis.—This is still a serious menace to our dairy industry, and far too many cows have to be culled from the herds on account of this complaint, although, with the exception of one or two districts in Auckland Province, the disease has not been so much in evidence as in previous years. Since my last report the investigations made by the scientific workers of this and other countries have not yielded information as to any new or improved method of control of practical utility, and we have still to depend on methods formerly in use—namely, improved sanitary conditions and management. In this way very much can be accomplished. From observation in the field it has been found that the increase of the disease is greater in those herds which are machine-milked than in those milked by hand. It is well known that any abnormal condition which will weaken the resistant powers of the udder-tissue, thereby rendering it more susceptible to disease, is a factor which cannot be disregarded. Such conditions enable the organism of the disease to gain easy access into the tissue, and set up trouble which could otherwise be avoided. Adverse conditions which pave the way for the disease, although seen in the hand-milked herd, are not nearly as common as when mechanical appliances are used. It frequently happens that such appliances are worked at too high pressure, and are left too long on the teats after the milk has been drawn. Such conditions, as stated, previously lessen the animal's resistant powers, and afford greater facilities for the organism to invade and destroy the udder-tissues. To avoid risk of infection it is also essential to see that the sanitary conditions in and around the shed are in a satisfactory condition, that the milking-machines are kept thoroughly clean, and that they are not used on any infected quarter. If a strict observance of these conditions were adhered to I feel satisfied that the incidence of mammitis among our herds would be considerably reduced.

Genital Diseases.—(*a*) Contagious abortion: This disease, although still widespread, has (with the exception of one or two districts in North Auckland) not been so prevalent as in previous years, and in no case have large outbreaks in any one herd been common. Year by year farmers, either independently or through the field Veterinarians and Stock Inspectors, are taking more advantage of the laboratory test in the diagnosis of this disease. This is a step in the right direction, as it puts

them in the position of knowing which cows are affected and which are not, thus enabling them to take preventive measures which would otherwise be impossible. In this disease the advice of the Division's field officers is always at the disposal of the dairy-farmer, so that he may be able to control and prevent the spread of the disease. While to a great extent a large majority of our farmers put this knowledge into practice, there is still too great a minority who are indifferent and will not take the trouble to segregate their cows at the proper period and take all other methods which will prevent its spread. If a farmer will not take the necessary precautions in as far as they are known to minimize the incidence of this disease, then he must suffer.

Experimental work is being carried out in the field with an attenuated anti-abortion vaccine with a view to the prevention of this disease. Although some farmers are satisfied that a certain amount of benefit has been conferred by the use of this vaccine, the results have so far not been on the whole satisfactory. Further tests are being carried out at the Veterinary Laboratory.

(*b*) Sterility: The failure of many cows to conceive until late can be looked upon as the most serious problem confronting the dairy-farmers and the veterinary service of this country. During the past few years every field officer of the Department has been devoting much of his energies to this complaint, with the view to discovering a remedy. In addition to this two selected veterinary officers give the whole of their time, in conjunction with the staff at Wallaceville, to the elucidation of this problem in conjunction with work on mammitis and abortion. Many experiments—medicinal, dieting, &c.—have been tried, and although considerable knowledge has been gleaned as a result we are not yet in the position when we can approach the farmer with confidence and assure him of a satisfactory preventive treatment. In Southland, Mr. J. Danskin, Veterinarian, has met with very encouraging results from injecting warm iodized saline solution into the vagina, a small enough quantity being used so that it can be retained for some time. Treatment on lines resembling this has not given as good results elsewhere, hence a good deal of further experimentation on the exact lines of Mr. Danskin's method will need to be done before any definite recommendation can be made regarding it.

Paturient Eclampsia.—This disease is still in evidence in a great many dairying districts throughout the country, and considerable loss has been caused thereby. The origin of the disease is somewhat mysterious, and presents a difficult problem to the research workers. Strictly speaking, there is no organic disease. On post-mortem examination nothing abnormal can be observed, and the only assumption that can be arrived at is that the trouble is an absorption of toxins from the intestines or womb, or that it is a lack of some essential element in the system at this particular period. This aspect of the question is being followed up. When making investigation into this complaint one is struck with its similarity to milk-fever. Both these troubles occur in the richer class of country where animals are being well cared for, and many of the symptoms are common to both. So much is this the case that I am satisfied that many cases of milk-fever are mistaken for eclampsia, and on this account treatment is not applied, or, if so, only in a prefunctory manner, as there is a preconceived idea that treatment for the latter trouble is useless, and that fatal results will follow in spite of any treatment that may be applied. In these circumstances I am strongly of opinion that when a cow goes down after calving the customary treatment for milk-fever should be applied in every case. It can do no harm, and in many cases will be the means of restoring the cow to her normal condition. If this treatment is properly carried out (the udder should be inflated until it is tense and hard to the feel), and care is taken to see that the animal is kept in her natural position afterwards, I feel sure that mortality among our dairy stock at this season would be considerably lessened.

Blackleg.—There has been a considerable increase in the number of deaths from this disease in the Auckland District, while in Taranaki the position is much the same as previously. The increased mortality in the Auckland District is in all probability due to the fact that, on account of the discontinuance of general vaccination, the vaccination of many herds has not been carried out early enough in the season. It will be necessary in all cases where blackleg has previously existed to have the herds vaccinated early, and I feel satisfied that when this is put into force it will have the desired effect.

Cattle-tick.—The position in regard to cattle-tick remains much the same as in previous years. Within Area A an increase is reported from some districts, while from others a considerable decrease is observed. In those districts where better farming methods are employed, and the feed kept short, this pest gives very little trouble, whereas the reverse is the case when the feed is allowed to get away. In Area B the pest has appeared on a few farms where it had not been previously seen. Again, in this area, on those farms where it has been seen in previous years no further ticks were noticed after the first infestation, although a strict watch was kept. In Area B when a fresh outbreak occurs a strict watch is kept on the farm and neighbouring properties, and the stock treated. By these methods the pest is kept well in check.

In the quarantine area at Waitara, although all stock in the area were regularly inspected, no ticks were observed this past season. In the Gisborne district a considerable number of ticks were seen in the district north of Tolaga Bay. During the past season amended regulations under the Stock Act for the prevention of the spread of cattle-tick were gazetted, and the district referred to divided into A and B areas. The Uawa County Council erected a cattle-dip and also a sheep-dip, and no stock are allowed to leave the affected area without a permit. It is to be regretted in connection with the control work relating to this pest that a few ticks were found on a farm in the Nelson District. Although exhaustive inquiries were made at the time it was found impossible to get at the source of infection. Strict precautionary measures were taken, and by this means it is hoped that the pest will be eradicated on the farm in question, as has been the case in previous instances when a single outbreak occurred. I would again impress upon settlers in those areas where tick is plentiful the necessity for keeping this pest in check, not only in their own interest but in the interests of those in other districts. To keep cattle clear of ticks during the season is not a difficult matter in milking-herds. Further, if the

pastures are not allowed to get away and thus provide shelter for the eggs and young ticks, and all roughage burned, these measures will go a long way towards freeing this country from ticks. In the interests of all concerned I would ask all farmers in infected areas to do all they possibly can in this direction.

Ragwort Poisoning.—Although the deaths on any given farm from this cause have not been alarming, nevertheless if taken as a whole over the Dominion the total figures would no doubt be considerable. The mortality from this source will in all probability increase among all classes of stock unless individual farmers make a serious effort to keep this weed from spreading and to eradicate it where possible. In many districts this could easily be accomplished. It is not uncommon in many of our dairying districts to see a few plants on various farms, of which no notice is taken until the weed becomes a serious menace, not only to the individual but to the surrounding neighbourhood. Under such conditions farmers have only themselves to blame for the consequences, as the weed could easily have been controlled at that stage. It becomes a difficult matter, however, when the plant is allowed to gain possession. It can then only be controlled by the laborious process of mowing, and much of the owner's time is taken up which could have been more profitably spent on other work. Again, when ragwort is allowed to gain possession in rough country, or among stumps, its control is still more difficult. Its destruction has then to be undertaken by manual labour or by grazing sheep thereon, with possible detrimental effects to these animals. Although this method of control is liable to be detrimental to the sheep and a number may succumb in the process, I am of opinion that it is the most economical method of ragwort-control in rough country. The best results will be obtained by placing the animals on the ragwort country in the late winter and early spring months. I again take this opportunity of impressing upon farmers in those districts where ragwort is not plentiful the necessity of keeping the weed in check when it first makes its appearance. A few hours will accomplish this if taken in time. If neglected, however, it will be an endless source of labour and worry in the years to come.

Dietetic Troubles. — A considerable amount of worry was experienced in various districts throughout the country on account of dietetic troubles such as redwater, Waihi disease, and skin-diseases. In all cases reported the field officers of the Division attended and gave such advice as was necessary in regard to treatment and better management of the stock generally, and this assistance was appreciated by settlers.

Foul-in-the-Foot.—A considerable amount of this trouble was seen in many districts where dairying is carried on. An animal suffering from a severe attack of this complaint is of little further use as a dairy cow for that season. On this account, although fatal results do not follow, the total loss sustained therefrom is considerable when taken over the whole Dominion. This disease in the majority of cases can be prevented, and from this point of view is worthy of serious consideration. The complaint, although it is caused by an organism, is for the most part seen in those herds which are compelled to walk over rough surfaces when going to and from the milking-shed. These rough surfaces injure the tissues between and around the claws, at which points the organism enters and sets up necrosis (foul-in-the-foot). In those districts where scoria is used the complaint assumes almost epidemic propensities after a fresh dressing of this material has been put on the yards. Dairy-farmers should see that an even surface is maintained on their yards, and the approaches thereto. If this were carried out I venture to say that very few cases of this complaint would be seen among our dairy herds.

Bush Sickness or Soil Deficiency.—In my annual reports for the preceding two seasons I discussed this subject very freely from a farming point of view. In the meantime the experimental work carried out in the affected region has not yielded any important new knowledge regarding simple methods of soil-treatment which will render the pastures in themselves in every way fit to maintain cattle and sheep in full health and vigour.

Sheep.

Parasitic Gastritis.—A considerable mortality from this complaint occurred among lambs, more particularly in the Wellington Province, some flocks suffering rather heavily. Owing to the damp eason experienced this was to be expected, and under such circumstances owners should see that their lambs are well cared for, particularly at weaning-time. At this time, if lambs are allowed to fend for themselves without suitable feed being provided, a check in their growth is unavoidable, thus weakening the resisting-power of the young animals, with the result that they become a prey to parasites. Once such a condition becomes established it is almost impossible to avoid heavy mortality, as only those with strong constitutions will be able to survive. In such cases the lambs eat but sparingly, and cannot be induced to take artificial food. At this stage medicinal treatment frequently does more harm than good, for even if the parasites are destroyed the animals have not sufficient recuperative powers to enable them to recover. In those flocks where suitable feeding-conditions are available to enable them to get over the weaning and carry them into the winter without going back in condition, the loss is infinitestimal compared with that in those flocks for which little or no provision is made. Many sheep-farmers now realize that it pays to give their lambs proper attention, and it is to be hoped that the remainder will follow their example. When this condition is general the heavy death-rate among hoggets during the winter months will be reduced considerably.

Liver-fluke.—I have to report a considerable improvement in the Hawke's Bay district in this respect. Much good work in eradicating the water-snail host has been undertaken by the settlers, with satisfactory results. During the year investigations showed that liver-fluke is more prevalent in the Gisborne district than was supposed. Whenever fluke is found, instruction and advice, with a view to prevention, is given in all cases, and by this method it is hoped that the incidence of fluke will be reduced to a minimum.

Lice.—Taking the position right through the Dominion as a whole there has been a slight improvement. However, there are still far too many sheep affected with lice being exposed in the saleyards. In the Auckland District there has been an increase in the number noted. To some extent this may have been caused by the lack of water which was in evidence during the dipping-period. The chief offenders are those on small farms carrying a comparatively small number of sheep as a side-line. I would again draw the attention of all owners to the fact that when sheep affected with lice are found in the saleyards the provisions of the Act will be enforced in all cases.

Renal Congestion in Lambs.—This disease, although confined principally to certain districts in the South Island, has again been in evidence in practically all sheep-farming districts. The experiments carried out during the past season—*e.g.*, flushing the ewes before lambing with medicinal licks, green oats, &c.—have not been generally followed by the results hoped for. In some instances the results were satisfactory, while in the majority no benefit was derived. Taken as a whole the results were disappointing, and from the experience gained it would appear that the complete solution of the trouble cannot be looked for in that direction. From the experience gained so far it would appear that any condition which gives a check to the growing lamb is beneficial, but as this is against all principles of good sheep-farming one hesitates to advocate such methods in a wholesale manner. Further experiments are in progress, and will be carried out during the coming season, and it is to be hoped that a certain amount of benefit will be derived therefrom. This is one of the most difficult propositions the officers of the Department have undertaken. Every experiment that is carried out, even although negative results may follow, is narrowing the issue, and a solution should not be impossible in the not distant future.

Maggot-fly Infestation.—With the exception of Otago, this trouble is in evidence in most districts throughout the country, although in the majority the fly is not troublesome to any serious extent. During the past season the natural enemy to this fly was introduced into a number of districts in both Islands. The results will be observed with interest, and should its introduction prove successful further supplies will be liberated. Meanwhile farmers will have to rely on the methods now in use for keeping the fly in check—namely, keeping the flock as free from dags and dirt as is possible, and careful inspection and dressing when necessary. Seasonal dipping also assists in this direction.

Lymph-adenitis.—This disease, although fairly common in the Canterbury District, is not prevalent to any great extent in other parts of the Dominion. In view of the increased activity of the British authorities in regard to the incidence of this disease in mutton and lamb carcasses landed in Great Britain, it is essential that every care should be taken with reference to inspection in this country. With this end in view the inspection staff was increased during the past season, so as to obviate as far as possible the exportation of affected carcasses. This is a step in the right direction, but at the same time it does not assist the farmers in any way to lessen the disease among their flocks, an object which should be kept in view by all interested parties. The disease is one which is seldom observed by the flockowner; it may be in existence in his flock without his being aware of the fact, and only revealed when the carcass is placed on the hooks. In the circumstances the farmer is not in a position to cope with the trouble. Officers of the Department are, however, keeping a strict watch for the disease, and when it is found in carcasses going through the works the owner is traced, and later he is acquainted with the fact, and advice given regarding the best methods of control. During the season a leaflet was issued by this Division giving the history of the disease and full instructions in prevention, and it is to be hoped that farmers will act upon the instructions and benefit by the advice given.

Extrusion of the Vagina, Ante-partum Paralysis, Stomatitis, Facial Dermatitis.—A number of cases of these troubles were seen in several districts in both Islands, but in no instance were they prevalent. In all cases the advice and assistance of the field officers were available to the settlers.

Pigs.

Pasteurellosis.—Outbreaks of this disease were seen in various localities in the North Island. Advice and assistance as to its control were given in all cases, and every endeavour made to limit the spread of infection.

Necrosis.—A considerable number of cases of this disease were also seen, and advice given as to treatment and prevention. This complaint is always associated with unsanitary conditions, and if owners would only see that the premises are kept clean and occasionally disinfected the disease would be less troublesome than it is at present.

Paralysis.—This trouble has caused considerable loss in a few isolated cases in the Auckland District; otherwise it cannot be said to be prevalent among pigs to any serious extent. A number of experiments are being conducted at Wallaceville with a view to ascertaining the cause of the the trouble. These experiments are dealt with by the Officer in Charge of the Veterinary Laboratory in his report.

Various.—A number of other troubles, chiefly of dietetic origin, have been observed in several districts. In such cases assistance and advice have been given by field officers of this Division.

Live-stock Statistics.

Sheep.—It is satisfactory to record a substantial increase in the numbers of sheep held in the Dominion at 30th April, 1928. The returns show an increase of 1,484,794 in the total sheep, of which increase breeding-ewes claim 702,321, bringing the total number of sheep to 27,133,810 and breeding-ewes to 15,534,051. It is of interest to note that the South Island shows an increase of 900,509 head, as against 524,285 for the North Island. The proportionate increase in the South Island is all the more striking when it is considered that the South Island flocks are approximately 1,800,000 below the North Island figures.

The numbers of lambs slaughtered at freezing-works for the year under review was 6,031,011, an increase of 254,690. For the same period sheep slaughtered showed a decrease of 144,035. These figures do not represent a complete season's slaughtering, the period covered by the official year embracing part of two seasons, but as it closely coincides with the taking of the sheep returns the comparison is of value.

The number of sheep as at 30th April, 1928, is shown in the table hereunder, together with those for the previous four years :—

Year.	Stud and Flock Rams (Two-tooth and over).	Breeding-ewes.	Other Sheep.	Lambs.	Total.
1924	332,814	13,076,097	3,853,482	6,513,386	23,775,776
1925	355,579	13,715,223	3,947,429	6,529,724	24,547,955
1926	370,535	13,948,252	4,292,056	6,294,036	24,904,993
1927	388,274	14,831,730	3,906,665	6,522,347	25,649,016
1928	396,351	15,534,051	3,893,774	7,309,634	27,133,810

Cattle.—Coincident with the substantial increase in the sheep flocks an increase in the total number of cattle in the Dominion was shown in the statistics for 1928. While cattle other than dairy cattle show a decrease, dairy cows show the very satisfactory increase of 49,173 head. The following table shows the position under the respective classes, together with the previous four years' figures :—

Year.	Bulls.	Dairy Cows.	Other Cattle.	Total.
1924	58,934	1,312,589	2,192,074	3,563,497
1925	59,820	1,323,432	2,120,492	3,503,744
1926	58,853	1,303,836	2,089,777	3,452,466
1927	58,842	1,303,225	1,895,662	3,257,729
1928	59,334	1,352,398	1,862,037	3,273,769

Swine.—An increase of 66,755 in swine has taken place, the total number at 31st January, 1928, being 586,898.

Horses.—After showing a steady decrease each year for some years past the 1928 returns show an increase of 3,442 horses, the total number as at 31st January, 1928, being 307,160.

Slaughter of Stock.

A good lambing was experienced and the season promised to be an early one, but subsequent weather conditions, while excellent from a dairy producer's point of view, were not favourable for fat-lamb production, and the numbers of lambs which came forward were not up to expectations. Nevertheless the numbers slaughtered for the twelve months ending 31st March, 1928, are in excess of previous years' killings, as will be seen from the tables given hereunder. The numbers of sheep slaughtered show a decrease, as do also cattle, but swine and calves show increases. Prices to producers have on the whole been favourable.

The following table shows the stock slaughtered during the past year at freezing-works only. The previous year's figures are also shown for comparison :—

Stock.	Year ended 31st March, 1929.	Year ended 31st March, 1928.	Increase.	Decrease.
Cattle	165,643	220,831	..	55,198
Calves	342,582	120,015	222,567	..
Sheep	2,156,034	2,300,069	..	144,035
Lambs	6,031,011	5,776,321	254,690	..
Swine	270,084	259,114	10,970	..

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

Stock.	1925-26.	1926-27.	1927-28.	1928-29.
Sheep	1,654,489	1,729,963	1,580,024	1,421,741
Lambs	3,574,508	3,806,498	4,093,750	4,093,332

These figures show a decrease in slaughtering of sheep of 158,283, and a decrease in slaughtering of lambs of 418, for the period 1st October, 1928, to 31st March, 1929, compared with the same period for the year 1927–28.

Following are the numbers of each class of animal slaughtered under direct inspection during the year ended 31st March, 1929: Cattle, 320,945; calves, 393,039; sheep, 2,740,890; lambs, 6,126,993; swine, 445,534.

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

Stock.	Abattoirs.	Meat-export Slaughterhouses.	Bacon-factories.
Cattle	155,302	165,643	..
Calves	50,457	342,582	..
Sheep	584,856	2,156,034	..
Lambs	95,982	6,031,011	..
Swine	129,641	270,084	45,809

Stock slaughtered at ordinary slaughterhouses during the year ended 31st March, 1929, was as follows: Cattle, 82,385; calves, 1,948; sheep, 239,176; lambs, 22,489; swine, 25,684.

In addition to the stock slaughtered at meat-export slaughterhouses, abattoirs, and ordinary slaughterhouses, 45,253 carcasses of pork killed and dressed by farmers and sent into butchers' shops were examined by departmental officers.

In connection with the animals shown in the above table as slaughtered at meat-export slaughterhouses, the following numbers of the respective classes are returned as having gone into consumption within the Dominion: Cattle, 41,963; calves, 6,157; sheep, 183,631; lambs, 78,814; swine, 20,431.

Compensation paid for Stock and Meat condemned.

Compensation to the amount of £16,138 0s. 6d. was paid out during the year for 5,713 animals condemned in the field for disease under the Stock Act, and £15,085 17s. 11d. for carcasses or parts of carcasses condemned for disease on examination at time of slaughter at abattoirs, meat-export slaughterhouses, &c., under the provisions of the Slaughtering and Inspection Act.

Importation of Stud Stock from Abroad.

Outbreaks of foot-and-mouth disease in England having persisted, the embargo on cattle, sheep, and swine from Great Britain is still in force, and present prospects for the lifting of the embargo are not bright. The only countries from which cattle may be imported into New Zealand at present are Tasmania, Canada, and the United States (with the exception of the State of California); swine may also be introduced from the same countries; all animals are subject to quarantine on arrival. The following animals from abroad entered into quarantine during the year to undergo the required period: Horses, 11; cattle, 29; swine, 33; dogs, 59.

Exportation of Stud Stock.

The following stud stock was exported during the year: Sheep, 2,669; cattle, 164; horses (draught), 10. In addition, the usual shipments of trotting and thoroughbred horses were made to Australia, principally for racing purposes, but the majority of these eventually return again to this Dominion.

Destruction of the Kea.

The subsidy of 5s. per beak paid for the destruction of the kea during the year totalled £748 10s., equal to 2,994 birds.

The Poultry Industry.

The position of the poultry industry in respect to the production of eggs has reached a stage requiring very considerable thought. The production of eggs has steadily grown of recent years, and prospects of a payable market in England for all surplus eggs produced in the flush season, ranging from August to November, were bright in the past season. Several small shipments of eggs shipped to London within recent years realized quite payable prices, but steadily growing production in the United Kingdom, on the Continent of Europe, and in South Africa and Australia, coupled with a mild season in England, resulted in a depressed market, particularly for all cool-stored eggs, with the result that prices realized for New Zealand eggs exported to London were not payable. The condition of the eggs on arrival was reported to be good, as also was the grading and quality. The industry is sorely in need of better organization in order that better control of the system of marketing may be introduced to the advantage of both producer and consumer. The local market is capable of absorbing considerably increased quantities of eggs, and in the absence of payable export prices, this market should be built up, and the present surplus of eggs marketed locally at payable prices, in place of exporting to an unprofitable overseas market. This should be capable of being brought to fruition without Government action, and the matter is commended to those connected with the industry for their careful consideration.

I attach the report of the Chief Poultry Instructor, Mr. F. C. Brown, as follows:—

The production of eggs has shown a considerable increase during the year. Notwithstanding the fact that 7,427 cases of 30 dozen each were exported to the London market (which constituted a record), and that an ample supply of egg-pulp was put down under cool storage for use by large consumers during the winter, it is unfortunate for the producer that this did not have the effect of removing sufficient of the summer surplus

for the maintenance of paying prices on the local market. The result was that during the flush season of supply the consumer in many parts of the Dominion was in the happy position of being able to buy eggs below cost of production. It is only a comparatively few years ago that New Zealand had to import large quantities of eggs and egg-material to satisfy the local demand, but, as before indicated, this position has now changed.

During recent years the London market gave promise of the establishment of a sound trade in New Zealand eggs. It is regrettable, however, to have to report that this market slumped badly last season, and as a result the returns did not reach expectations. According to reports received the drop in prices was due to a combination of circumstances. Chief among these was the mild early winter season which prevailed in Britain, and which encouraged greater production than usual at that period of the year. Another factor was the increased number of eggs exported from several European countries which had been practically off the London market since the outbreak of the war. Although the British market declined last season, or, in other words, reverted to something approaching pre-war level, it is gratifying to know that New Zealand eggs commanded higher prices than did those of all other countries which had to ship their supplies from overseas; including Australia and South Africa.

Indications are that difficulties will present themselves relative to the future welfare of the industry, and the greatest question will be whether New Zealand can export eggs to the overseas market at payable prices to the producer. Judging by the prices realized last year, and in view of the present high cost of foodstuffs, the outlook for the industry from this standpoint is by no means encouraging, except for large-sized eggs of undoubted internal quality. Perhaps the most important lesson conveyed by last season's shipments of eggs was the difference in price realized for large-sized eggs as compared with that for smaller grades. Eggs weighing 17 lb. per 120 ("long hundred") gave the best return, whereas the smaller grades showed a decided loss. Reports from London state that our eggs were of good quality, and well graded and packed.

Probably the greatest factor which will govern the position as to whether or not New Zealand will be able to export eggs at remunerative prices in the future is that of food costs, particularly the cost of wheat. Perhaps the biggest difficulty which many producers have had to contend with of late is in being charged top prices for decidedly inferior grains and adulterated food materials.

In accordance with regulations it will be necessary in the future for all eggs imported into Britain to be stamped with the name of the country of origin. What effect this will have on New Zealand eggs remains to be seen.

While there are indications that a future export trade in eggs to the London market is doubtful, it should not be thought that without export the limit of production has been reached. Excepting during the spring and summer months, when production is at its maximum, fresh eggs command a price on the local market which no export returns can approach. If given a better system of marketing throughout the Dominion and a regular supply of fresh guaranteed stamped eggs, there is no telling to what extent the consumptive demand would increase.

Considerable improvement is necessary before it can be said that the local trade is anything like properly catered for. Eggs for export are carefully graded for size and cleanliness, and tested for internal quality under Government supervision. Little, however, is being done in this direction for the local trade. Generally an egg is an egg and nothing more, whether it be good, bad, or indifferent. Obviously this is not the way to secure the confidence of the consumer, nor is it the way to make eggs a more common article of diet. As in the case of any other new industry there are difficulties to overcome, and to succeed in this direction it would appear that the first step would be the enforcement of regulations whereby eggs must be sold according to their size, and stamped as a guarantee of internal quality. If these and other necessary reforms of the local trade were brought about, the industry would be capable of much greater expansion, not so much as a means of livelihood, but as a side-line for the farmer and small settler. The industry is an important one, as the annual value of poultry products—in other words, New Zealand's egg and poultry bill—is estimated at £3,000,000. In considering the development of the local trade, should there be a surplus at any time beyond local requirements the export of this would be necessary for the maintenance of local paying values, even if they did not reach a paying-point. There will, however, be time enough to consider this when the local market has been properly catered for. A bad mistake is the production of too many eggs below the 2 oz. standard, and these are frequently sold at top prices. This, of course, does not tend towards increasing the local consumptive demand; furthermore, such eggs are unsuitable for export. In England, Canada, Denmark, and other countries the enforcement of regulations governing the sale of eggs according to their sizes and internal quality is having a most desirable effect, not only towards increasing the consumptive demand, but in securing enhanced prices, and if the necessary reforms are to be brought about New Zealand must adopt similar measures. Census returns go to show that there are about four million birds in the Dominion held in flocks averaging about two dozen. Obviously under these conditions voluntary reforms on the part of producers would be almost impossible to achieve. Some practical scheme to ensure better-quality eggs reaching the market appears to be imperative.

The Wallaceville Poultry Station, for breeding and experimental work, continues to make satisfactory progress. As a result of careful breeding and selection the stock have now generally attained a desired standard. The demand for birds and eggs for breeding purposes has shown a considerable increase over the previous year. This station is proving to be of real practical value towards widening the knowledge of the instructional staff, which in turn is being passed on to the producer by visits of instruction and through printed matter published by the Department.

With the increased interest that has taken place in poultry-keeping of late the services of the Poultry Instructors have been in great demand. Every effort has been made to cope with the requests coming to hand, but with the limited staff it has been found impossible to do so as fully as I would have liked.

Wallaceville Veterinary Laboratory.

The interest taken by the farming community in the work carried on by the staff of this Laboratory is becoming greater each succeeding year. To such an extent has this been in evidence from the veterinary side of the work that an addition to the staff became necessary if they were to keep abreast of the work. During the Director-General's visit to Great Britain last year he made arrangements which resulted in the services of Mr. J. Hill Motion, M.R.C.V.S., B.Sc.(Ag.), B.V.Sc., being secured, and his services should be a considerable help to the staff in the future. Before leaving for New Zealand Mr. Hill Motion visited the principal laboratories related to his work in Great Britain and

the Continent, and the knowledge gained by him while visiting these institutions should be of considerable assistance to himself and his co-workers.

A summary of the work carried out at Wallaceville during the year, supplied by the Officer in Charge, Mr. C. S. M. Hopkirk, B.V.Sc., is appended to this report.

Dairy Inspection.

At the present time there are in the vicinity of five thousand registered dairies supplying milk to consumers in municipalities throughout the Dominion, and when one considers the amount of inspectional and advisory work involved to keep these premises in a sanitary condition, so that a satisfactory supply reaches the consumer, it is to the credit of the Dairy Inspectors that steady progress has been made in their improvement. The old-time shed is quickly disappearing throughout the country, and newer up-to-date structures with improved surroundings are being erected, thus enabling a purer supply of this most important food to be produced. In spite of the fact that many new premises are being erected, the individual still plays an important part in the production of a pure milk-supply, which cannot be produced even in apparently clean sheds if he is negligent in other directions. Sediment-testers have been in use for some years, and are a considerable asset to the Inspector in this connection. Samples of the whole milk are frequently taken from individual herds and put through the testers. If the sample is not up to standard the owner is notified and requested to remedy the defect. It is to the supplier's credit that he does this in every case in his desire to produce a clean article.

In regard to the health of the herds, all are clinically examined periodically, and should any individual animal show symptoms of tubercular disease it is destroyed forthwith. Further than this, all suspected animals are set aside and the tuberculin test applied, and the animal is slaughtered on reaction. At the present time a number of owners in their desire to produce a pure milk are having their herds voluntarily tested with tuberculin or by arrangement with the Inspector. In addition to these methods composite samples are taken from various herds, and put through a biological test at the Wallaceville Laboratory, and if disease is found the herd comes under the care of the field Veterinarian, who takes such steps as he considers necessary to free the herd from disease. Special attention is also paid to the condition of the udder, and if any disease is found which would in any way affect the purity of the milk-supply the individual animal is either condemned or isolated. In the latter case the milk is prevented from being mixed with that from the remainder of the herd and used for human consumption until she recovers.

Wool.

The climatic conditions ruling throughout the Dominion were in favour of a good wool-clip, and expectations were fully realized. It was noticeable that some attention was being paid to the question of remedying the position in respect to faulty wool, and the wool was also on the whole better presented. More can be done in regard to removing grounds for complaint regarding faulty wool by attention to breeding, particularly in the class of ram for mating with the ewes. I feel sure that faulty slipshop methods of breeding are largely responsible for the complaints that have been made of faults in New Zealand wool, and that being so it is a matter within the reach of every sheep-owner to do his best to overcome.

The average price obtained for the Dominion clip sold within the Dominion was 14·99d. per pound, this being 1·90d. below last season's average. The price was nevertheless quite a satisfactory one.

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

Sheep throughout the Dominion commenced the winter period of 1928 in good condition, and as the winter was not a severe one this was reflected in the wool when the sheep were brought in to be shorn. The wool opened up clean, bright, and well grown, giving a high, clean yield, the bigger percentage of it being suitable for combing purposes. The wool-sales were well attended by a full bench of buyers, some of the French buyers being very keen after pieces and belly-wool, and German buyers purchasing a large amount of the coarse crossbred wool and at times some of the fine halfbred. The bulk of the wool went to the United Kingdom, but France, Germany, Japan, United States, and Australia took a fair quantity. The woollen-mills within the Dominion secured a fair amount of wool suitable for their purposes, and on several occasions topped the market for choice lines. Competition was fairly keen at the earlier sales, held in November and December, and in January prices rose slightly higher, but the February and March prices dropped about 2d. per pound.

Approximately £12,000,000 was received from the sale of wool at the Dominion wool-sale extending from 16th November, 1928, to 18th April, 1929. During this period 589,388 bales were offered for sale, and 553,809 bales were sold, averaging £21 8s. 9d. per bale, or 14·99d. per pound. These figures show a decrease from those of the previous year of £2 16s. 3d. per bale or 1·90d. per pound.

The highest-priced wool was sold at Dunedin, the top price being 26½d. per pound. Wool from the same station the previous year realized 28½d. per pound. The carry-over this year is approximately 45,000 bales, most of which no doubt will be shipped direct to London before next shearing season commences. There has been (as usual in other years) a fair quantity of wool shipped without having been offered for local sale.

The following table shows the difference in price per bale between the 1927–28 selling season, and the 1928–29 season:—

	1927–28. £ s. d.	1928–29. £ s. d.
Auckland	22 6 3	20 4 3
Napier	23 9 1	22 6 0
Wanganui	23 12 4	21 1 5
Wellington	24 10 5	22 2 5
Christchurch	25 0 7	21 14 0
Timaru	26 1 5	21 10 9
Dunedin	26 6 10	21 3 11
Invercargill	21 7 0	18 16 9

The following table also shows the total value received at each centre where the wool was sold during the present selling season :—

	£		£
Auckland	1,024,722	Christchurch ..	1,620,507
Napier	2,225,361	Timaru	728,426
Wanganui	1,277,089	Dunedin	1,791,211
Wellington	2,544,269	Invercargill	662,908

During the past year practical demonstrations have been given on live sheep showing desirable and undesirable features, and also in various shearing-sheds on handling the wool-clip for the market. A number of lantern lectures, aided by slides, have been delivered, which were well attended by the farmers.

Microscopic examination of ram's wool: A large amount of this work has been carried out, and a keen interest is shown by farmers who forward samples of wool for examination. In a number of cases where rams have been adversely reported on the owners have not used them for breeding purposes, but have followed the advice given and discarded them. As a result of this work I am pleased to say that during the past seven or eight years there has been a slow but gradual diminution in the number of fleeces with hairy wool, and this fact which is confirmed by both wool-brokers and manufacturers, indicates that the work being done by the Department is having a beneficial effect.

Tufts of grey and black hairs in fleece wool: Complaints regarding this trouble were made by some of the wool-buyers, who sent samples of wool showing the trouble. All the samples sent were from cotton wool, and in most instances had been shorn off old ewes. Some of the farmers whose wool had been mentioned in the complaint were visited and advice given them.

The following table, covering the period from 1st April, 1928, to 31st March, 1929, shows the number of bales of wool and value of same exported from the Dominion :—

Destination.	Greasy.	Sliped.	Scoured.	Washed.	Total.	Value.
	Bales.	Bales.	Bales.	Bales.	Bales.	£
United Kingdom	325,541	69,080	32,712	1,080	428,413	10,573,472
France	65,163	100	131	..	65,394	1,477,529
Germany	45,342	..	1,022	..	46,344	1,138,276
United States	23,846	4,953	49	..	28,848	806,071
Japan	20,608	..	58	..	20,666	487,765
Australia	15,191	738	1,759	10	17,698	432,188
Canada	8,233	811	1,589	50	10,683	263,286
Belgium	6,290	..	..	..	6,290	142,089
Italy	4,946	..	..	..	4,946	114,631
Netherlands	3,206	..	..	..	3,206	79,108
South African Union	1,383	..	..	..	1,383	22,626
India	1,220	..	..	..	1,220	31,195
Denmark	361	..	68	..	429	8,863
Sweden	164	..	..	..	164	3,457
China	..	..	5	..	5	145
Totals	521,494	75,682	37,373	1,140	635,689	15,580,701

Rabbit Nuisance.

The improved conditions in regard to the rabbit pest have been maintained, and taken as a whole a further reduction has taken place. Constant vigilance on the part of settlers, Rabbit Boards, and Inspectors has been necessary to attain to this position, and owing to the capacity of the rabbit to rapidly increase its numbers, any slackening of effort would be quickly reflected in an increase of the pest.

The number of rabbit-skins exported for the year ended 31st December, 1928, was 12,104,072, valued at £582,148, being a reduction of 824,597 skins on the previous year's figures. For the year 1924 20,444,390 skins of a value of £740,975 were exported.

The large increases which have taken place within recent years in the sheep population of the South Island, particularly in Otago and Southland districts, are to a considerable extent due to the increased carrying-capacity of the country through the reduction of the rabbits.

A consolidation of the Rabbit Nuisance Act, with certain necessary amendments, was passed during the parliamentary session of 1928, and came into force on 1st January last. The amendments made pertain more especially to the provisions relating to the formation and administration of Rabbit Boards.

Noxious Weeds.

During the parliamentary session of 1928 there was passed the Noxious Weeds Act, 1928. This Act made no change in the law, but merely consolidated the existing legislation as contained in the Noxious Weeds Act, 1908, and the various amendments thereunder, which ceased to operate when the new Act came into force on 1st January, 1929.

The question of the most economic and effective method of dealing with noxious weeds is a problem confronting a great many of the agricultural and pastoral community, particularly those settled in sparsely populated areas, and even many in the more closely settled districts. Each locality has its particular menace in this respect, for while some communities are fighting against an invasion of sweetbrier, Californian thistle, &c., others are battling against the still more troublesome ragwort and blackberry.

The season under review, with its frequent warm rains, was particularly conducive to the growth of vegetation; consequently the rank growth of weeds, where uncontrolled, was very noticeable. Ragwort especially achieved renewed notoriety, and it is regrettable to record that serious headway

has been made by this noxious weed in recent years, particularly in the dairying districts of the North Island, notwithstanding the advice and warnings given by this Department over the last quarter of a century. It is recognized, of course, that much good work is done by many settlers, but there are others who, in spite of the risk of legal proceedings, will not do as much as they might, and not only themselves but their neighbours and the country as a whole suffer, while the blame is often placed on the Department.

Shearers' Accommodation.

In the course of the year the Inspectors of Stock have satisfactorily administered the provisions of the Shearers' Accommodation Act in their respective districts. This work is carried out on behalf of the Department of Labour. Speaking generally, it may be said that the accommodation provided for shearers is fairly good. The few complaints that came to hand were not of a serious nature, but were given immediate attention. No prosecutions under this Act were found necessary, as in most cases where shortcomings existed the employers were quite agreeable to give effect to the requirements of the Inspectors, while in other cases an extension of time was given in which to carry out the terms of the notice. The result is that the living-accommodation for shearers is being gradually improved.

Staff.

In closing this report I desire to again express to the Divisional staff, one and all, my appreciation of the loyal service rendered by them during the year.

REPORT ON WALLACEVILLE LABORATORY BY C. S. M. HOPKIRK, B.V.Sc., OFFICER IN CHARGE.

During the past year each officer has had his time fully occupied, and the full working-capacity of the staff has been reached. It is felt that very little more can be done without further assistance, which has now been arranged for. The sympathy of the Department's administrative officers, as well as the better feeling of camaraderie between field and laboratory officers, is helping to produce a much better service for the farming community. The staff of the Laboratory wish it realized that every reasonable effort is made to diagnose and report on material received, so far as it is in the knowledge and power of the officers to do the work. When this point is thoroughly appreciated we can expect to be of even greater service.

The staff has been augmented by the addition of an office assistant and by the appointment of a Dairy Bacteriologist and a cadet for the Dairy Laboratory. With increase of work more space is required, and with the increasing necessity for help on the chemical side provision requires to be made for the full-time employment at Wallaceville of a biochemist and a dairy chemist. In the near future the necessity of a worker in parasitology will be realized, and the advantages of qualified research officers giving full attention to single subjects can best be felt by those who have the care and burden of numerous disease problems on their shoulders.

The work of the Laboratory farm has progressed very satisfactorily. Sufficient winter food is grown for the large number of small experimental animals, the guinea-pigs amounting at one time to nearly 1,000 head. 26 tons of hay and 6 tons of oaten sheaves have been grown and stored for the coming winter. Top-dressing with superphosphate and lime has been again carried out, and the carrying-capacity of the farm is being markedly increased.

The total number of samples and specimens received during the year has increased by almost 100 per cent., due to the very great increase of blood-samples and milk-samples from experimental herds throughout the Waikato and Taranaki, where Messrs. Dayus and Webster, Veterinarians, are stationed. Total this year, 9,347; last year, 4,685. Pathological specimens, not represented by bloods, and milk-samples of mastitis or tuberculosis were 681 in number, and it is this side of the Laboratory work which could be increased with advantage to all.

Receipt of specimens from diseased conditions in any one district draws attention to the presence of such a trouble in the area, and emphasizes the necessity for further investigation. There are so many diseases, particularly those of dietetic origin, which will shortly of necessity have to be reinvestigated. The obvious method is by feeding-experiments with analytical and biochemical aid. More work, too, requires to be done on the poisonous plants of New Zealand. They do not figure as largely as in Australia, but rusts and ergot probably might explain many deaths or symptoms which we are doubtful of at present.

Streptococcic Mastitis (Mammitis).

Mastitis samples have been received in large numbers this year from the field veterinary officers engaged in research in the subject, and also from farmers anxious to gain further knowledge on the disease. A total of 5,473 samples were received, 2,536 being positive by microscopical examination and 2,925 normal. Other forms of mastitis which appeared definite were staphylococcic, 1; *B. lactis aerogenes*, 7; B. *pyogenes bovis*, 2; slimy milk, 2.

(1) *Diagnosis.*—Experimental work on diagnostic methods has been attempted as follows:—

(*a*) An intradermal test with filtrate from infected quarters proved negative—no swelling resulting.

(*b*) Indicators soaked up by filter papers have been used to find whether any one indicator would give a result sufficiently delicate to show up quarters affected chronically. Unfortunately, only one indicator (Brom. Cresol Purple) gives any results at all, and that in a few subacute, all acute, but no chronic cases. The

alkalinity resulting from the inflammation gives a purple tinge in mastitis. It was hoped to make an attempt in the field to produce mastitis in cows with long-continued use of milking-machines, and to watch the lactic-acid content of the milk and the reaction during the process, but this so far has not yet been possible.

(*c*) Microscopical examination of samples has been a feature of the year's work. Observation consisted mainly in monthly examination of milk-samples from individual cows of the herds selected. Samples were composite from four quarters. The results have been tabulated for each herd, and they show that many cows with a very small leucocytic content are actually carriers of the streptococcus of mastitis, and that such cows show acerbation of inflammation in the affected quarter from time to time until the quarter so changes that it finally becomes dry. The direct inference is that once cows become infected they usually remain carriers, or, more properly, remain affected in a chronic or subacute state for months or years. It has been noted, too, in the herd examinations that there is a tendency for the percentage of mastitis to drop considerably towards the end of the milking season—*i.e.*, there is a greater incidence of mastitis during the flush of milk than later when the milk-yield subsides.

A large number of cultural examinations for country herds has not yet been attempted, but that work is slowly progressing. It is required to be learned definitely that the streptococcus is not saprophytic. All cultural work has pointed to this up to the present; also that the many cases of chronic mastitis in heifers are due to the streptococcus. Insufficient progress in cultural work on this point has been carried out to be definite. It would appear, however, that there is a precursory stage to be found in heifers which may be due to injury, but which finally becomes infected with the streptococcus. Cultural work does show a large number of staphylococci in such cases, but as these cocci quickly disappear as inflammation becomes more acute they cannot be looked upon as causative of inflammation in the first place. It is a point frequently noted that as leucocytosis of the milk becomes more apparent, so do the cocci decrease, and finally at the most acute stage of the inflammation one gets a pure or almost pure culture of the causative organism. This is so in true staphylococcic or true abortion mastitis as well as in the less frequent mastitis due to *B. pyogenes bovis* or *B. lactis aerogenes*.

Experimental work has shown definitely that a severe transient form of inflammation of a quarter can be set up by *B. abortus* from culture, but examination of combinations of milk and blood from numbers of herds has shown the lack of correlation between mastitis and abortion in the herd quite definitely. That there is mastitis due to abortion is believed, but it is difficult to demonstrate. Such cases, however, do not seem to have a streptococcic infection also.

(2) *Experimental Work.*—Following work last year, a theory was formed that mastitis was due to the action of a streptococcus following a primary non-infectious inflammation. The inflammation could be caused by any means whatever, from diet to actual trauma, but the essential point was the formation of sarco-lactic acid in the quarters, which made the quarter particularly vulnerable to attack by the streptococcus and also increased the virulence of that organism.

No experimental evidence is yet forthcoming to show exactly how the streptococcus gains entrance to a quarter. It is not, as far as can be found by culture, a normal inhabitant of the udder. It does not gain entrance via the lymphatics or blood-stream, so it must get through the teat-duct; but why the streptococcus should be the most favoured organism remains to be demonstrated. One reason suggests itself, and that is that *Streptococcus lactis* has become pathogenic. But not only do cultures of streptococci of mastitis differ from streptococci of sour milk, but also it is impossible to make *Streptococcus lactis* assume pathogenicity under experimental inoculation of the streptococci into the udder. This has been repeated on several occasions, but unless *Streptococcus lactis* has time to produce acid it is not able to set up an inflammation, as it apparently produces no toxins whatever.

Streptococcus mastitidis, on the other hand, produces a toxic product which can be found by injecting filtrate (of a normal pH) from acute cases of the disease into the udder of a normal cow. Transient inflammation will result. Experimental injection of solution of saline on the acid side of neutrality is able to make a chronic case of mastitis flare up into an acute case, and yet the normal quarter remains unaffected. Theoretically this results from the production of a "smooth" type of streptococcus from a "rough" resistant alkaline-loving type, but the point has not yet been proved in cultural practice. It has not been possible in this laboratory to grow a known smooth type of streptococcus which will not flocculate out in glucose broth, though efforts have been made in media of various PH. If the statement made by Andrews is correct, that rough-type streptococci are specific, then *Streptococcus mastitidis* is certainly the specific organism for mastitis.

An attempt has been made by application of alkaline solution to the udder to cure acute mastitis, but with no success. An attempt to set up acute mastitis from chronic by drenching repeatedly with ammonium chloride was not conclusive. Treatment with Selectan, a German proprietary preparation, was likewise unsuccessful.

Treatment prophylactically with vaccines has not been a success. A number of herds in Taranaki, Waikato, Manawatu, and Wairarapa were treated with vaccine, using half the herd for controls and vaccinating half. Results fluctuated considerably, but failed to show that the vaccine had conferred any benefit on the herd. Figures can be produced if required, but would take up much space.

Tuberculosis.

A big effort was made to test biologically a large number of composite milk-samples from dairies supplying towns in all parts of the country. The junior staff were exceptionally busy for three months receiving and despatching the cases and bottles used, and in centrifuging the numbers of samples which came in. Altogether 714 samples were received; of these 710 were negative and 4 positive. All herds supplying towns are under inspection, and the results speak well for the system.

Contagious Abortion due to Bacillus Abortus.

Blood-samples to the total of 2,480 were tested throughout the year, of which 842 were positive and 1,638 negative. Very frequently two tests were applied—the macroscopic 24-hour test, and the rapid slide method as a confirmatory test. The rapid method has proved quite reliable, but does not give the titre required in many of the samples examined for experimental purposes. Agglutination reactions occur in about 30 per cent. of cows in New Zealand where whole herds are the subject of test. This figure is computed from only a small range of herds and may not be quite correct, but appears to be the average for Taranaki, where average abortion in cows is 4 per cent, and in heifers 9·6 per cent.

Preventive vaccination has again been tried in Taranaki and Waikato with Bevan's vaccine; some 800 are being done with appropriate controls; results will not be known for some time. Last season's vaccination results did not suggest that any good had been done, but several owners were so convinced that their stock had benefited that the results of a further trial are awaited with much interest.

The figures were as follows: Vaccinated heifers, 205; slipped, 23 = 11·2 per cent. abortion rate. Controls 442; slipped, 38 = 8·6 per cent. abortion rate.

There is, however, a definite reaction to an abortion vaccination as represented by agglutination tests, so that one hesitates to state that no good whatever has been done. It is the final result, however, upon which the efficacy of a preventive depends. The double intradermal test described by Holtum has been tried on the Laboratory herd, and results were satisfactory, so much so that the test is to be tried under field conditions. Such a test may not come into direct practical use in the field, but is a valuable aid in cases of doubt where a positive opinion is required.

An acute form of mastitis has been set up on one occasion with *B. abortus*. Inflammation does not last for very long, and the quarter returns to a chronic state of induration in some ten days. The titre of the blood in such cases is only very weak at six days, but at ten days is strongly positive. It remains strongly positive for two months and commences to decline, but in this case did not work completely out in six months, when the cow was killed. No sign of *B. abortus* could be found in the uterus or in the membrane round the calf, nor did inoculation of milk into guinea-pigs give a positive reaction. Cultures of the milk showed cocci only, and no streptococcus gained entrance to the quarter. Where streptococci were entered with the *B. abortus*, no streptococcus could later be cultured; apparently *B. abortus* had not allowed the streptococci to remain in the udder. The whole experiment is already being repeated on two other in-calf cows, and results will be of interest, for the question arises as to the possibility of passing on abortion by means of milking-machines. It is very probable that if conditions, either in the cow or in the culture of the organism, are favourable, abortion will result.

A further means of passing on the disease was tried with the aid of the bull. A two-year-old Ayrshire bull born on the farm was given an intravenous injection of 10 c.c. of virulent first subculture of *B. abortus*. Five days later the agglutination reaction was strongly positive, and it remained so for two months, when the animal was used on six heifers known to be clean over a period of three years. Since that time the blood titre diminished a little, but rose again and was strongly positive six months after inoculating. At no time has *B. abortus* been obtained in culture from samples of semen, nor does palpation reveal abnormality, but for the first six weeks after inoculation the bull did not appear thrifty. Of the heifers served, four have shown a reaction to the agglutination test, and this test has remained positive for three months, though it appears to be weakening in one of the animals. Results will not be known till later, and experimental work of a similar nature is under way for the new year.

Segregation of animals has been found to be quite possible in our hands as a means of control of contagious abortion. An effort is being made to test out the possibility in the field, and two owners now keep their herds clean by means of the agglutination test with fairly good results. It is desired to get more pedigree owners interested.

Temporary Sterility, or Return to the Bull.

This disease has received much attention by laboratory and field officers, but no decision has yet been arrived at as to the etiology.

The first year's team-work has been devoted to gathering data on definite herds, and in watching results in such herds over a number of seasons. Two points of interest have been brought to light: (1) That cows calving a few days earlier than the stated period are liable to return to the bull; (2) that cows coming into œstrum a short while after calving will not hold on that occasion, and may, following such services, not return to œstrum for six weeks, although empty.

The first point has also been borne out in the Laboratory farm heifers, six in number. Three calved at 271, 276, and 278 days respectively, while three others calved at 283, 282, and 285 days. Sex of calves was mixed, and heifers were all much alike in condition. The first set returned to the bull more than once; the second set held at first service. Such figures suggest an ovarian or uterine trouble before calving. Arrangements have been made to subsidize certain farmers this coming season in Taranaki, where trouble is occurring, to watch carefully such herds by daily palpation of individual cows. By watching those cows which calve a little early it is hoped to find whether abnormalities occur in fœtal membranes, endometrium, &c., at birth of the calf.

In a number of specimens examined during the year there was no one organism in particular isolated as occurring regularly in affected cows. Different herds had a tendency towards a herd flora of the vagina and cervix.

Analysis of pasture carried out by the Chief Chemist from farms where sterility did and did not occur in the Wairarapa demonstrated the known fact that aphosphorosis tended to inhabit œstrum, but when sufficient phosphorus was present it had no result one way or the other in the genital health of the cow. Further analysis from the Waikato tended to indicate more sterility on pastures of higher nitrogen content. This phase is being watched carefully in repeat analyses over a wider field.

Feeding cattle on iodine or calcium phosphate ($CaPO_4$) and liming of the water-troughs has not had beneficial results apparently, while it is yet too early to decide whether the four farms divided up into halves and limed a second time during this year are in any way giving better results in health of cows on the limed over the unlimed areas.

Examination of semen of bulls has not generally implicated the bull, yet many histories of commencement of disease tend to implicate the sire, and in a few cases the bull was found to be semi- or altogether impotent.

Treatment of the condition was tried to a limited extent only this past season. The field officers encountered less of the disease, and where treatment could be tried Neilson's method of uterine douching was attempted, but this was unsuccessful. Also, injections were made with follicle-fluid and with anterior pituitary lobe on a number of cows, but with equal lack of success.

The milk-yield of cows has been shown to have very little if anything to do with this form of sterility.

Tumours from Stock.

Eighty-one tumours were received during the year from various animals, and these were classified, the majority being epitheliomata.

Blackleg.

A total of 31,800 doses of single-dose vaccine made from dried muscle was distributed on requisition during the year, but this would by no means represent the number of calves vaccinated. An attempt was made to make an aggressin to replace the present vaccine, but the non-arrival of Seitz filters which were on order foiled the project. It is hoped now that the new apparatus has arrived to prepare aggressin this coming winter.

Lamb Mortality Investigation.

This work was continued and a report submitted. Mr. Gill's efforts were again aimed at determining the exact cause of the condition. A small number of blood-samples from affected lambs showed no abnormality in the amount of serum calcium present, nor was evidence obtained of a disturbance in the acid-base balance of the blood. The amount of work done on this latter point was, however, insufficient, and the samples were not, in Mr. Gill's opinion, sufficiently fresh when the estimates were made. Urines were also tested, but showed nothing significant. The tests made were albumen, sugar, and the diazo reaction. The latter was negative in all cases; small amounts of albumen were frequently present, and some sugar was found in certain cases, but these findings are of no real consequence.

Bacteriological work was aimed at as follows: (1) The detection of any number of the Colityphoid group in the blood, organs, or intestines. The findings were negative in all cases. (2) To discover evidence in support of *B. welchii* as the cause. Details of the work done are given in the report already mentioned, and it suffices to say here that, while this possible cause has not been definitely ruled out, no evidence could be found to support it with the limited facilities available in a field investigation. A highly toxic strain of *B. welchii* was isolated from a lamb dead of the disease, and is being maintained at Wallaceville for future work.

A very large range of experiments in the prevention of the condition by the use of various mineral licks was conducted by the field staffs in Canterbury and Otago. Judging by the reports submitted there was no definite benefit so far as the actual mortality was concerned.

Everything points to the condition being brought about by the sudden flooding of the system with a toxin or toxins produced in the alimentary tract, and a scheme for next season's work has been submitted largely based on this view.

Caseous Lymph-adenitis.

Experimental work for the year is here set out in detail, but is by no means finished. The outstanding feature is the ease with which small punctures are infected, and this leads possibly to a need for parasitic control.

(1) Two sheep, one cut with shears and infected with cultures, und the other pricked with a needle infected from cultures. Cuts became infected but after some time healed. Pricks showed subcutaneous abscess formation. Three months later post-mortem showed in cut sheep an abscess in right prescapular containing the Preisz Nocard organism. In pricked sheep abscesses were found in the right retropharyngeal, right parotid, and left maxillary, and subcutaneous abscess on back also. A few small foci in mediastinal glands. Subcutaneous abscesses in left axilla and left groin were associated with the cuts. Sheep became emaciated, toxæmia being therefore suggested.

(2) One sheep was insufflated with culture, but with no results.

(3) Six sheep were fed with 10 c.c. emulsion of cultures on five occasions at three-day intervals. No results were noted when killed fat seven months later.

(4) A sheep was cut with scissors to resemble shears, and pus rubbed in. There were no results, except some pus-formation in cuts for a few days. Post-mortem later revealed the animal to be clean.

(5) A sheep was pricked with a needle infected with a minute quantity of pus. A subcutaneous abscess formed in one site, and the pus seems to be spreading along lymphatics. This animal is still alive.

(6) Sheep-ticks (*Melophagus ovinus*) were allowed to run over pus from infected glands for one hour, and then placed on two sheep. Further sheep had their necks smeared with pus and ticks liberated over this area. The sheep were previously clean. As pricks apparently cause the severest lesions there is a possibility of tick-infection becoming important. This experiment is still in progress.

Glands from affected sheep usually show pure cultures of Preisz Nocard organism. Colour was only demonstrated in culture in serum from cows with sufficient carotin content of serum. Contrary to reports from Smithfield Market concerning pigs found suffering from Preisz Nocard infection, we have found other diphtheroids responsible. Agglutination tests have not proved reliable.

Arthritis in Lambs.

Following on the previous year's work it was decided to spray cultures of the organism found to be specific on to the cut surface of the tails, and on to the cut scrotum of a few of the lambs of the flock. Two wether lambs had cut scrotums sprayed with a mixture of cultures of specific diphtheroid; three ewe lambs had cut tails sprayed; one wether and three ewes left as controls. Lameness appeared in all wether lambs and in two ewe lambs by the fifth day, but did not appear in the lambs of the flock which were operated upon in a different yard. One ewe lamb was particularly bad at the end of three weeks, and was then killed. Three joints were affected, and the specific organism was recovered from one, while other organisms were recovered from the two remaining swollen joints. The remainder of the lambs got over their lameness, but did not do well for some months, remaining culls till late in the season—February. One wether was killed three months after spraying and found to show an enlarged joint; but although the specific organism was not recovered, the joint had every appearance of having been infected by the organism under experiment. A second wether lamb became deformed in the back, the latter appearing arched in the lumbar region. Nothing abnormal could be demonstrated in post-mortem. The other lambs all appeared normal.

Points of interest in the experiment are: That both ewe and wether lambs become lame and develop arthritis by infection of tail or scrotum; that wethers appear more susceptible than ewes; that the lameness leaves in its wake a slightly toxic condition of the lambs which stops their quick fattening.

Extrusion of the Vagina in Ewes.

Further observations and experiments in connection with this trouble have been carried out. In view of the idea held by some that this trouble is infectious, bacteriological examinations were made, but no organisms capable or suspected of being capable of causing it could be determined. In addition, attempts to set up the trouble by the introduction of material from affected ewes proved entirely abortive.

Lice on Sheep.

A small experiment with sheep-lice showed that the maximum time a louse would live off a sheep under optimum conditions was ten days. If kept dry and warm 50 per cent. will last five days, but in the open, exposed to night and day temperatures, they will live three days only.

Distemper in Dogs.

Experimental work on immunization during the year was aimed at obtaining a virus from affected dogs and introducing this virus into ferrets and pups. Unfortunately, however, it was found most difficult to obtain suitable affected animals. Dogs which were dying of broncho-pneumonia, which frequently follows distemper, were found to be useless for obtaining reliable material. Subsequently an arrangement was made to have the live virus and a small amount of prepared vaccine brought out by a new appointee, Mr. Hill Motion, who was, at the time, visiting various laboratories and institutions in England and the Continent to obtain the latest information for the Department in New Zealand. Mr. Hill Motion visited the Mill Hill Distemper Laboratory and was provided with material, and also given the exact technique by the originators of the vaccine, Messrs. Dunkin and Laidlaw. This will be of great use in the coming year, but experimental pups and ferrets will still be required.

Specimens and Experimental Work on Swine.

Eighty-three specimens from pigs were received for a variety of reasons. Pasteurellosis alone and combined with otitis is fairly common. Abscess formation from *B. pyogenes suis* is also common, and so simulates caseous lymphadenitis that it is occasionally mistaken for that disease of sheep.

A number of ulcerative conditions from pigs have recently been examined. They were generally supposed to be due to *B. necrophorus*, but Mr. Gill has been able to find *Treponema suilla* in all cases. No lesions have been transmitted to other pigs, so that the presence of *Treponema* is probably secondary, but as the organism exists in large numbers at the line of demarcation between ulceration and normal tissue one must assume that it is certainly damaging. Treatment of this ulceration is being attempted.

Feeding experiments: An effort is being made to produce stiffness or paraplegia in pigs by feeding on different diets with milk as a base. Pigs were placed on a short ration of skim-milk with pollard, a large ration of skim-milk and pollard, a ration of whole milk, and a ration of milk and cod-liver oil. No change was seen in such pigs till they were over 100 lb. in weight, when one animal on quantity of whole milk showed a stilty action in the fore quarters after being caught and transferred to a grass-pen at finish of experiment. A feeding trial is under way with rice as a base to find whether vitamin B may have a bearing on stiffness.

Specimens from Horses.

These included Strathmore-weed poisoning, tetanus, botriomycosis, intestinal ulceration, &c. None required further experimental work. A total of twenty-three was examined.

Specimens from Dogs.

These were very few, mainly parasites, though one of lymphatic leukæmia was of interest. Blood smears from dogs of the Byrd Antarctic Expedition were examined for larvæ of *Dirofilaria immitis*, with negative results in all cases.

Specimens from Poultry.

Eighty-six specimens were received and dealt with, a number being from the Poultry Station on the Laboratory farm. Two were found to be definite cases of calcium deficiency. A test for bacillary white diarrhœa was carried out in a number of chicks to find the cause of deaths in brooders, but a negative result was recorded in all cases. Parasites and dietetic errors account for most of the poultryman's troubles.

An example of parasitism of a fowl with the nymph stage of *Haemaphysalis bispinosa* (cattle-tick) was received from North Auckland.

Miscellaneous Specimens.

Stores Control Board: Twenty-eight disinfectants were put through the necessary tests for phenol coefficient.
Chemistry Section: Feeding of tutu pollen to rats, with negative results.
Horticulture Division: Feeding of suspected poisonous honey to rats; negative results.
Dairy Division: Examination of water-samples.

Identification of Parasites.

The following parasites, in addition to those mentioned in previous reports, were received and identified:—
Sheep and Cattle: *Cooperia oneophora.*
Pigs: *Oesophagostomum dentatum; Ascaris suis.*
Horses: *Cylicocercus alveatum; Cyclichnostomum tetracanthum; Gastrophilus equi larvae.*
Dogs: *Taenia marginata; Sarcoptes scabiei* var. *canis.*
Poultry: *Choanotaenia infundibuliformis; Heterakis vesiculosa; Heterakis perspicillum; Haemaphysalis bispinosa* (nymph form).
Miscellaneous: *Tyroglyphus* on *Stomoxys calcitrans.*

DAIRY DIVISION.

REPORT OF W. E. GWILLIM, ACTING-DIRECTOR (IN ABSENCE ABROAD OF W. M. SINGLETON, DIRECTOR).

The Season.

From a dairying standpoint the year under review has been an exceptionally favourable one. A mild winter in most districts, with pastures in great heart, enabled dairy-farmers to conserve supplementary feed until the early spring, so that as cows came to profit they were in excellent condition to commence their lactation period. With a few exceptions favourable seasonal conditions prevailed up to the end of the year, and although for a time pastures were inclined to be rank, the production of butterfat has never previously been exceeded. Hay and ensilage crops are good, and provided the incoming winter is normal dairy cows should commence their next lactation period in the best of condition.

Production.

During the year under review 80,932 tons of butter and 84,627 tons of cheese were forwarded to the various grading-ports throughout the Dominion. These figures represent an increase of 7·58 per cent. in butter and 12·36 per cent. in cheese, and are the highest yet recorded. In terms of butterfat they represent an increase of 8,359 tons, or equivalent to 9·09 per cent.

The beneficial results from the use of fertilizers in the top-dressing of pastures, and a general desire to increase the productive capacity of dairy herds, together with the favourable weather conditions which prevailed, have contributed largely towards this further record production.

Quality of Butter.

The quality of butter has been fully maintained during the season by most of the dairy companies, and a number have shown a marked improvement. It is a pleasing feature of the year's work that the quantity of "Finest" creamery butter is 1·58 per cent. in excess of the total for the previous year, the figures being 69·91 and 68·33 per cent. respectively. The percentage of "First" grade was 27·82 as compared with 28·71 for the previous year, and under "First" 2·27 and 2·95 respectively.

There is a tendency by some dairy companies to too heavily salt their butter, and if this is persisted in it is likely to prejudice consumption. Reports from the Division's officers in London indicate that some of our saltless butter after defrosting rapidly deteriorates in quality. This matter is being investigated by the Division's Dairy Bacteriologist, and it is hoped that a means of over coming the defect will soon be available.

Whey Butter.

The production of this class of butter shows an increase of 7,421 boxes over last year's figures, equal to 16 per cent. Little improvement, however, is being shown in the quality. Too little care is given to the whey cream between the time of separation and churning, and in many instances the operator in charge of the manufacture is lacking in experience. Provided the cream is treated and handled carefully and intelligently, whey butter of good quality can be made.

Weighing and Packing of Butter.

Recent advices from London indicate the need for more care by factory staffs in the weighing and packing of some butters. Naturally it is the irregularities to which the Division's attention is drawn, and little is heard of the great quantity which gives satisfaction. Traders in Britain do not appear to be expecting much overweight, but are getting more insistent on each package being up to good weight. An excess in one box is not accepted as offsetting a discrepancy in another box, factories being penalized for all deficiencies.

Traders have now arranged to accept a standard net weight, excluding parchment paper, of 56 lb. 2 oz.—the 2 oz. being allowed for shrinkage in transit—and this has the approval of the London Provision Exchange. As from 1st April last the practice previously in vogue of marking on the grade-notes the net weight including paper has been discontinued, and in future grade-notes will show the net weight, excluding paper, as checked by Grader.

The better packing of much of our butter should also be given more attention. A well-packed block of butter when displayed on the retailer's counter adds to its attractiveness, and, from the viewpoint of those firms which pat butter and use wire cutters to cut the pats from the block, saves much time and labour.

Quality of Cheese.

The quality of cheese manufactured during the year has not been fully maintained in some districts. The general averages as indicated by the grades show that 29·57 per cent. was "Finest," 69·10 per cent. "First," and 1·33 per cent. under "First" as compared with 34·15 per cent., 63·19 per cent., and 2·66 per cent. respectively for the previous year. This shows a falling-off in "Finest" quality of 4·58 per cent., as compared with the previous year, and no less than 20·59 per cent. below 1926–27, that being the year in which the Dairy Produce Board advanced a premium over and above "First" grade for cheese grading "Finest." It would seem, therefore, that lacking an incentive many dairy companies are at present satisfied provided their cheese is not graded "Under First."

The most prominent defect noticeable was openness in body. Mottled colour in coloured cheese has been more in evidence, and has caused some monetary loss to manufacturers. This appears to be a hot-weather complaint, and is traceable in a number of instances to lack of care of utensils on the farm, and is accentuated by the return of whey in the milk-cans.

The finish of cheese has improved considerably, and less cracked rinds are noticeable. The production of a rimless cheese, or a cheese with a "minimum" rim, is now fairly general. (As from 1st August, 1929, it will not be lawful to export any cheese which is not either rimless or with a minimum rim exceeding $\frac{3}{8}$ in. in depth.)

The manufacture of pasteurized cheese has further increased, this class representing 93 per cent. of the output. During the year a large number of factories installed plant for the paraffin-waxing of their cheese.

Standardized Cheese.

One of the most important departures in the cheese industry during the year was the introduction of a new class for cheese. The introduction followed a series of resolutions passed at a fully representative meeting of cheese-producers held in Wellington on 7th December last to discuss what action might be taken to meet the position brought about by the large and constantly increasing employment of high-testing milk for cheesemaking. For many years the question of the yield of cheese per pound of butterfat from high-resting milk has placed owners of Jersey cows at a disadvantage, owing to the ratio of casein to butterfat in the milk being lower than in the milk of cows usually used for the manufacture of Cheddar cheese.

A large proportion of dairy cows in New Zealand are of the Jersey strain, and a fairly high percentage of our cheese is made in dual-plant factories, most of which are in districts where the Jersey strain predominates. Moreover, without successful cheesemaking in those districts the cheese industry would not flourish and producers would ultimately have to resort to buttermaking, which could result in an overproduction in butter and relatively an underproduction in cheese.

It was recognized that the addition of casein per medium of skim-milk was a practical way to meet the position, but as cheese made from other than whole milk could not be branded "Full Cream" the new class became necessary. Regulations were therefore gazetted on 21st December, 1928, making it legal as from that date to manufacture a standardized cheese containing a minimum of 50 per cent. fat in the dry matter, to be branded "New Zealand Produce: Factory Cheese—Fat 50 % or Over," and to include the national brand for "Finest" and "First" grades similar to full-cream cheese.

These amendments to the General Regulations under the Dairy Industry Act, in addition to providing for the manufacture of standardized milk cheese, also provide additional safeguards for the manufacture of full-cream cheese. Standardized cheese may only be made in factories registered for the purpose, and by certificated standardized-factory managers. Full-cream cheese must be made from whole milk only, including starter milk, if any, and be made in registered whole-milk factories.

Standardized cheese will, we believe, compare very favourably with other cheese on the markets in Britain. The standard of fat it contains has to be recognized as a minimum which is higher than that required for whole-milk Cheddar cheese produced in Britain, or in such cheese-producing countries as Canada and Holland. The cheese will contain no fats other than milk-fats, and from March to July inclusive the minimum fat content in the dry matter will be as high as 52 per cent. Up to date thirty-five dairy companies represented by seventy-eight factories have registered their premises as standardized-cheese factories, the total output from these during the previous season having been upwards of 27,000 tons of whole-milk cheese. To the end of March, 1929, a period of approximately three months since the amended regulations were gazetted, 3,153 tons of standardized cheese have been forwarded to grading-stores for export.

Storage of Butter and Cheese.

The method of storing and handling butter and cheese intended for export continues on a satisfactory basis. Pending shipment, butter is held at suitable temperatures, and all cheese is precooled, and the transhipment from cool stores to overseas vessels is carefully supervised by the graders as well as the shipping companies. Exceptionally good work is also being done by the Dairy Produce Board's Shipping Supervisor towards ensuring still more suitable conditions for the carriage of dairy-produce on steamers for the overseas markets.

Quantities of Butter and Cheese forwarded to Grading Stores for Years ended 31st March, 1929 and 1928.

Port.	1929.		1928.	
	Butter.	Cheese.	Butter.	Cheese.
	Cwt.	Cwt.	Cwt.	Cwt.
Auckland	1,054,009	259,499	956,523	229,173
Gisborne	27,277	..	22,298	..
Napier	40,940	5,723	32,497	4,686
New Plymouth	116,422	337,579	119,519	301,281
Patea	28,003	383,074	35,318	344,306
Wanganui	71,873	134,058	65,719	106,424
Wellington	195,808	261,410	186,001	229,658
Lyttelton	44,481	28,543	37,982	26,313
Timaru	7,350	18,495	7,336	14,174
Dunedin	25,552	46,556	29,528	41,061
Bluff	6,944	217,609	11,743	209,222
Totals	1,618,659	1,692,546	1,504,464	1,506,298

Value of Exports.

Prices for dairy-products for the year under review have been on a higher level than for the previous year. Including butter, cheese, dried milk, casein, condensed milk, and milk-sugar, as indicated by the Customs statistics of values, a total of £20,862,700 was reached, as compared with £18,590,866 for the previous year, an increase of £2,271,834.

Casein.

The quantity of casein graded during the year was slightly less than for the preceding period, the figures being 1,890 tons and 2,233 tons respectively. Approximately 80 per cent. of this total consisted of lactic casein, the balance of 20 per cent. being of the rennet variety.

Quality was of a very high standard, and this produce finds a ready market overseas. During the year a plant for drying casein was established at Midhirst, in Taranaki, the finished article being graded and shipped at New Plymouth. In addition the grading of casein is carried out at Castlecliff and Auckland.

The grading of casein is optional, but at the request of manufacturers it has been the practice to grade all lines offering for shipment, no fee being charged in the past for this service. It has since been decided, in order to bring the grading into line with butter and cheese, to charge a grading fee of 1½d. per hundredweight, and this came into operation as from 1st February, 1929.

Testing Butter for Water Content.

The testing of butter for moisture content has been continued as in the past, with very satisfactory results. During the year 142,934 churnings were tested, the average water content being 15·29 per cent., as against 15·19 for the preceding season. The number of churnings over the legal limit have been much less this season, the percentage of excess having been reduced from 0·873 to 0·059. The usual practice of returning these overmoisture churnings to the factories to be reworked with drier butter has been given effect to. These figures reflect credit on factory staffs, and are evidence of the good team-work existing in our butter-factories.

Branding Dairy-produce with National Brand.

The branding of containers of "First" and "Finest" grades of butter and cheese with a national brand continues in operation. The use of a brand of this nature is well justified, as, apart from being attractive in appearance and ensuring uniformity of style in the branding of New Zealand dairy-produce, it is also a hall mark of quality. The impressing of the national brand on the top of the butter in each box, as previously suggested, has now been given effect to, and has added to the generally pleasing appearance of the butter when marketed.

Cream-grading.

The system of cream-grading on a compulsory basis, and the payment of a differential price for "Finest," "First," and "Second" grade cream, is now proceeding on fairly sound and uniform lines, and the general quality has shown some improvement during the year. On the whole cream-graders are doing consistent work. Few complaints have been received, the majority of suppliers recognizing that the old system of payment for cream irrespective of quality was unbusinesslike and not in the best interests of the industry.

Farm-dairy Instruction.

Although those dairy companies who are co-operating with the Department in the employment of Farm Dairy Instructors—whose principal duties are along the line of assisting suppliers to produce and deliver to the factory a high-quality milk or cream—have improved the quality of their produce the scheme requires to be on a wider basis in order to effect the desired result throughout the whole Dominion. Combined with cream-grading, universal dairy instruction is the desideratum to be aimed at, and dairy companies are again urged to give this matter their serious consideration during the coming winter.

The efficient manner in which the officers at present engaged in this work have carried out their duties is freely commented on, and most of the companies employing them have experienced an improvement in the grade of their products. During the year forty Farm Dairy Instructors were employed by dairy companies, as against thirty-one during the previous year, thirty-six being in the North and four in the South Island.

Inspection of New Zealand Dairy-produce in Britain.

Messrs. W. Wright and A. C. Ross, the officers engaged on this work, have had an exceptionally busy year. A very large number of detailed reports on the quality and general condition of butter and cheese at time of examination in Britain are received here regularly by mail, and these are distributed to the dairy companies concerned. This particular work, which links up the quality of the produce at time of grading in New Zealand and on arrival in Britain, is of the greatest value in checking the grading at this end. A survey of these reports received during the present season discloses the fact that over 90 per cent. agree with the grade-notes at time of grading.

The two officers mentioned keep in close touch with all phases of the industry, and also report fully on all matters of value to our producers.

Non-use of Preservatives in Butter.

The non-use of preservatives in the manufacture of butter, in order to comply with the British Ministry of Health's requirements, has been in operation during the whole of the year, and has been duly complied with by all dairy companies in New Zealand. Tests for preservatives in butter intended for export have been carried out by the Graders at intervals, and in no instance was it found that preservatives had been used, neither have any complaints been received from Britain in this connection.

Check Testing Milk and Cream Samples for Butterfat at Dairy Factories.

The reports of Messrs. G. R. B. Boswell and W. G. Batt, the two officers engaged on this work, evidence the need for such checking. At many of the factories various irregularities were noted, due mostly to either lack of experience or poor equipment, but in most cases these have since been corrected. Check testing has now been carried out at the majority of the factories, and visits of inspection paid to a greater number, and it is pleasing to record that at most factories the testing is now carried out carefully and efficiently.

Dairy Bacteriology Section.

The year's work in dairy bacteriology carried out at the Wallaceville Laboratory by Mr. G. F. V. Morgan, N.D.A., N.D.D., has included many points of interest, and as this work develops it will undoubtedly be of great value to the Division and to the dairy industry generally. Investigational work carried out by this officer includes the bacteriological condition of unsalted butter, and mould and yeast contamination in butters of this class; factory water-supplies; butter parchments; bacteria in brands of commercial salt; washing and scalding of cream-separators; mould contamination from factory atmosphere; condition of commercial dry-culture starters; "peanut" flavour in butter; and non-acid milk in cheesemaking.

In addition to the usual laboratory equipment, a small plant is being installed for the manufacture of experimental lots of butter and cheese which may be required in connection with the investigational work being carried out.

Certificate-of-record Testing.

Some 465 certificates were issued under this system in the calendar year 1928, as compared with 529 certificates issued during the preceding twelvemonth. It is pleasing, however, to be able to record increased support for the season 1928–29. For the flush month of this season 660 cows were on C.O.R. test, these being in the hands of 226 breeders; the corresponding figures for last season were 622 cows and 214 breeders.

Official Herd-testing.

The Official Herd-test has now entered upon its second year, and there is every indication that the scheme is meeting with the approval of our C.O.R. breeders of registered purebred dairy cattle. For the first year 109 breeders availed themselves of the O.H.T., to the extent of some 1,500 cows. This year, in the flush, we had 128 breeders participating, the total number of cows being 1,666.

Herd-testing.

The season 1927–28 saw considerable extension of the herd-testing movement in New Zealand. During 1926–27 some 170,150 cows were tested, and in 1927-28 the total rose to 224,130, which represents 16½ per cent. of the total of the Dominion's dairy cows in milk and dry. The number 224,130 comprises 164,610 cows tested under the group method and 59,520 tested under the association system. Figures pertaining to the extent of herd-testing in New Zealand for the current season, 1928–29, are not yet available, but a further increase is anticipated. The Government subsidy to herd-testing has been continued, and a sum not exceeding £10,500 made available for distribution to dairy-herd owners.

Staff.

The staff of the Division as a whole has had a strenuous year, and their loyal and willing services are acknowledged with thanks.

Appreciation.

The Department's Chief Chemist and the Bacteriologist have given the Division valuable help during the year, and this is gratefully acknowledged. Thanks are also extended to the State Forest Service, the various cattle-breed associations, and to the freezing companies controlling the dairy-produce cool stores, for their co-operation with and assistance to the Division.

FIELDS DIVISION.

REPORT OF A. H. COCKAYNE, DIRECTOR.

Grassland Farming.

In any review on crop-production in New Zealand it is customary to give special prominence to those crops that are produced annually on ploughed and cultivated ground, and relegate to a quite minor position any consideration of the greatest and most important crop of all—namely, that produced on grassland.

Increased production is admittedly the key factor in developing and stabilizing our prosperity. So far as our great land heritage is concerned, by far the greatest potentiality towards increasing production lies along the lines of better production and better utilization of our grass crop. In other words, it is on the expansion of grassland products, primarily elaborated from grass by the ewe and the cow, to which New Zealand farming should be mainly directed. That this is correct can be readily seen when one considers the increase that is rapidly taking place in grassland products. Based on standard values, the increase in production derived from grassland between 1901 and 1921 (a period of twenty years) amounted to £15,000,000; while during the past eight years the further increase has amounted to £13,000,000. Thus at the present time increase of grassland products is developing at over double the rate it did in the first two decades of the century. The increase is even more significant than the figures indicate, inasmuch as during the first twenty years of this century 8,000,000 acres were added to our area under occupation, while in the last eight years the amount has remained comparatively stationary. From these figures it is clearly evident that future farming progress is largely concerned with grassland and its better management, or, in other words, with the development of sound grassland-farming practice.

In this aim of better production and better utilization of our grass crop one of the most potent factors leading to a bigger and better crop is the top-dressing of pastures. This practice, excellent as it is wherever top-dressing responses are obtainable, has brought with it a whole train of problems of grassland management, which, when surmounted, will so vastly increase the per-acre production of grassland products that New Zealand will become the model grassland-management area of the Empire. It is towards some of these problems of grassland management that the instructional and research work of this Division is becoming more and more primarily directed. "Better production and better utilization of our grass crop" is New Zealand's slogan towards increased production.

Increase in Manuring.—A very large increase in the tonnage of artificial fertilizers has again to be recorded. In 1914 the New Zealand farmer was using about 100,000 tons of artificial fertilizers, of which 40,000 tons were employed for top-dressing grassland and 60,000 tons for other crop production. During the past twelve months over 400,000 tons were used, of which 300,000 tons were devoted to top-dressing grassland and 100,000 tons for other purposes. The tonnage of artificial manures carried on the railways during the past three years shows rather vividly the great strides that are being made in the use of fertilizers—1926–27, 445,000 tons; 1927–28, 580,000 tons; 1928–29, 710,000 tons.

These figures, including as they do railage into works and other double railages, do not represent the actual amount used by the farmer, and when the necessary deductions have been made the actual amounts used were as follows: 1926–27, 265,000 tons; 1927–28, 345,000 tons; 1928–29, 415,000 tons. These figures represent an increase of 150,000 tons within two years, or an increase greater than the total tonnage used nine or ten years ago.

Increase in Top-dressing.—The increase in the amount of top-dressing with artificial fertilizers, almost wholly of a phosphatic nature, is by far the most significant feature in agricultural progress in New Zealand at the present time. As recently as eight years ago less than 750,000 acres of grassland were being top-dressed annually, with a consumption of considerably less than 100,000 tons. During the past twelve months 2,250,000 acres were top-dressed, and the top-dressing tonnage rose to 315,000 tons. The figures for the amounts used and acreages top-dressed during the past three years are as follows:—

	Amount. Tons.	Area Top-dressed. Acres.
1926–27	180,000	1,400,000
1927–28	245,000	1,850,000
1928–29	315,000	2,250,000

This represents an increase of nearly 1,000,000 acres within the past two years.

The total area of sown grasslands in New Zealand is just on 17 million acres, so that the amount top-dressed last year represented just over 13 per cent. When it is considered that in the Auckland Land District over 40 per cent. of the total grassland was top-dressed during the past twelve months, the scope for tonnage increases even more sensational than those of the past two years on the 15 million acres of sown grassland outside Auckland Province, of which only 8 per cent. has been top-dressed, can be readily realized.

It would appear sound to top-dress regularly all grassland that can be practically dealt with and which shows an appreciable response. There are at least 6 million acres in New Zealand that come within this category, and if the present rate of increase of nearly half a million acres a year were maintained, that total would be reached within the next decade. Unfortunately, however, there are certain limiting factors against top-dressing expansion that are rapidly coming into operation,

and unless eliminated they must rapidly slow up the development that is taking place. These factors are the urgent necessity for more stock, more fencing and watering, more conservation of surplus summer grass, and more provision of better strains of grasses and clovers suitable for intensive grazing.

Increase of Stock required.—With every added ton of fertilizer being used an increase in stock becomes necessary, and in order that anything like the present top-dressing expansion may be maintained a great increase in breeding-stock must be provided by the farmer. On farms where only a limited amount of top-dressing is as yet being carried out stock increase is not essential to make top-dressing handsomely profitable, as the general improvement in condition and production of the stock carried amply repays for the expenditure. Where, however, a considerable proportion of the farm becomes top-dressed the capability for increased carrying-capacity brought about must be made full use of to realize in any way the full benefits of the use of manure. Both the dairy-farmer and the sheep-farmer are equally involved in increasing their breeding-stock, and unless such increase can be made to keep pace with top-dressing it will be necessary, except so far as the farmer who has not yet become a top-dresser is concerned, to restrict rather than extend the area top-dressed.

Increase in Fencing required.—The fact that leaves pay and that stems do not must always be in the mind of the progressive grassland-farmer. This merely emphasizes the fact that young vigorously-growing grass, consumed as such, is far more nutritive than older herbage, and as large a proportion as possible of the grass produced should be consumed in a young stage. In order to carry this out some system of rotational or modified rotational grazing, whereby heavy intermittent stocking is possible, must be provided for on every top-dressed farm. This is particularly true in dairying, where farmers are faced with a fencing and watering bill running into millions if full efficiency from top-dressing is to be in any way realized. The rotational grazing experiments carried out on a large number of farms this past season by the Fields Division clearly indicate that rotational or controlled grazing is of the highest value in raising the profits from intensive top-dressing, a yield of as high as 530 lb. of butterfat per acre being secured. When one considers that the present average butterfat production per acre is somewhere about 65 lb. to 70 lb., the possibilities in front of intensively top-dressed dairy-farms where the grass crop is really made full use of in its most nutritive stage are very large.

Increase in Conservation of surplus Summer Grass required.—The inherent weakness of grassland-farming, both top-dressed and non-top-dressed, is the large wastage of summer-produced herbage that is likely to take place due to the stock-carrying capacity during the early summer months being far in excess of what it is in the winter. Some adequate conservation of this surplus summer feed is essential to enable top-dressing to expand, and in this direction ensilage-making, both on top-dressed dairy and sheep country, must become regular and general on every farm. Ensilage-making in the scheme of modern grassland management is at the present time one of the weakest links in the chain of practice, and it must become one of the strongest. It is satisfactory to note that the efforts of the Division to encourage ensilage-making by means of lectures, demonstrations, and general advice are bearing good fruit. The objective in this connection is an ensilage stack, pit, or trench on every dairy-farm in New Zealand. Ensilage-making fulfils in grassland management several very important functions that haymaking — useful as it is in the conservation of summer grass for winter feeding — does not cover. The production of ensilage means a longer growth-period of young grass during mid or late summer; it means a succulent and nutritious supplement to grazing in the late summer when grassland is at its lowest point of production; and it means excellent winter feed when pastures again fail. Until such time as adequate conservation of surplus summer grass is carried out by the grassland-farmer, the actual mowing of pastures without any reference to conservation must be extensively carried out during the flush of growth, so as to enable fresh young grass to be developed; but the final aim should be conservation rather than any actual waste in the herbage produced during the year.

Need for better Strains of Grasses and Clovers.—This Division has for some years past emphasized the higher profits that can be realized by top-dressing good rather than bad pasture. This does not mean that in high-response top-dressing districts poor pasture may not be enormously improved by top-dressing; but the improvement is comparatively slow in comparison with that obtained in the top-dressing of pastures of good botanical composition. In this respect the work of the Agrostology unit of the Division is of far-reaching importance in its recent work on persistence and strain in rye-grass, cocksfoot, white clover, and red clover. It has clearly shown that much of the rye-grass sown in New Zealand is extremely short-lived, and that unless ample opportunities are given for re-establishment such rye-grasses disappear rapidly from the pasture. It has also shown that there are strains—particularly certain ones harvested in the North Island—which are highly persistent and high-yielding, even when heavily grazed and opportunities not given for re-establishment. As full utilization of all the herbage produced is the end aim in modern grassland management, it is clear that strains that do not require re-establishment by reseeding become more and more essential the nearer this ideal is reached. The system of certification of really persistent and high-yielding types of rye-grass, cocksfoot, and red and white clover seed crops which is being initiated this season can be viewed as the first definite step that has been taken to secure strains that will increase the efficiency of top-dressing and tend towards its definite expansion.

Changes in Top-dressing Practice.—Several factors are tending to considerable alteration in the main time of application of phosphatic fertilizers for top-dressing, and the main change is the definite swing that has taken place in favour of autumn rather than spring application. This change, which to an extent is a perfectly sound one, is largely based on the theory of increasing very considerably the normally quite appreciable natural growth of the autumn, thereby enabling far more stock to be satisfactorily wintered, and in this way making better provision for the utilization of the summer herbage. On sheep-country the advice of this Division is clear and definite — namely, that all top-dressing should be completed by the end of April, or earlier if it can be done. In dairying-country the

position is a little different. On farms of extremely high production, and where subdivision is adequate for controlled grazing, the grassland should all be top-dressed twice, once in the early autumn and again the late winter or spring. Where butterfat-production per acre is not really high a certain amount of both autumn and spring application should be made on different paddocks. Comparatively recently much attention has been focused on the probable high value of nitrogen in increasing grass-growth, and a large amount of co-operative experimental work is being carried out in this connection. It is yet too early to make any definite pronouncement as to what position nitrogen should occupy in any top-dressing programme, but certain generalizations (which may later have to be amended) can be given.

(1) Winter application of nitrogen in amounts larger than advocated in European literature—namely, 2 cwt.—are likely to be of considerable value in hastening early spring growth.

(2) Far and away the most payable responses have taken place where the grassland has been definitely of a dominant rye-grass type.

(3) On good rye-grass country autumn application of nitrogen is likely to be payable.

(4) Summer applications of nitrogen, as advised in England and the Continent, have here given very disappointing results.

(5) Apart from response, the question of profit from nitrogen depends very largely on whether any additional growth produced can be made full use of.

There seems little doubt that nitrogen will finally take its place as a supplement to phosphate, but the very clear indication that dominant rye-grass grassland is far the most responsive rather indicates that improvement of pastures by improved leafy strains is connected up with any extensive development of nitrogen top-dressing in New Zealand.

Liming.—The tonnage of lime used in New Zealand shows a distinct upward tendency, the increase during the past year being 25,000 tons. Apart from Southland and southern Otago, liming cannot, however, be viewed as in any way becoming generally a farm practice. In many districts the application of lime alone does not appear to give any visible response on grassland that has not been top-dressed, and for this reason phosphate of some kind, where the response can be readily seen in vigorous clover-increase and better growth generally, would appear to be a sounder policy than any lime applications. The experimental plot work carried out this year in Canterbury, however, shows some astonishing results with lime, indicating that there is a wide belt of country there corresponding more or less to the main brown-top area that is sufficiently lime-responsive to warrant both phosphate and lime being applied in the initial top-dressing that the farmer may carry out. It has also been abundantly shown in many parts of New Zealand that superphosphate, together with lime or on limed ground, gives better results that does superphosphate alone; but where superphosphate by itself is giving huge responses, liming may be profitably delayed until such time as the farmer has reached the stage in top-dressing of phosphating the greater portion of his grassland each year.

It is to my mind sufficiently clear that far more extensive liming is yearly becoming more advantageous where the phosphate top-dressing by the farmer has reached the point of yearly applications over the greater part of his holding. The attitude of this Division with regard to liming grassland which has had few or no phosphate applications is that if no distinct and visible response has followed liming, and if phosphate responds readily, then all available money that the farmer may have for top-dressing should be used in the purchase of phosphate. Later on, some of the profits derived from phosphate top-dressing can and should be profitably used for the purchase of lime, nitrogen, and potash generally, in the order named. On land, however, where no phosphate response can be secured and a high one is obtainable from phosphate and lime, then the initial top-dressing must consist of both these materials. Over most of New Zealand where the rainfall is moderately high, grassland non-responsive to phosphate is luckily the exception rather than the rule. There is little doubt that finally liming grassland in combination with other forms of top-dressing should speed up rapidly, but these phases of grassland management offer no difficulties, as phosphate profits can be made to provide, in the majority of instances, all the necessary finance.

The actual tonnage of lime carried on the railways during the past five years is as under:—

	1924–25. Tons.	1925–26. Tons.	1926–27. Tons.	1927–28. Tons.	1928–29. Tons.
North Island	24,000	27,000	30,000	30,000	42,000
South Island	70,000	78,000	73,000	85,000	100,000
Dominion	94,000	105,000	103,000	115,000	142,000

Arable Crops.

The season's cereal harvest has proved to be quite a good one so far as actual threshings to date of writing have disclosed. Actual figures are not yet available, but it is estimated that 255,000 acres of wheat were sown, as against an actual sowing of 262,799 acres in the previous season. Of this latter amount 260,987 acres were actually harvested for threshing, and yielded a total of 9,541,444 bushels, or 36·56 bushels per acre. The estimated Dominion average yield per acre for 1928–29 is 33·06 bushels per acre, or approximately 8,400,000 bushels total yield. Actual threshings so far show that the yield per acre is 35·28 bushels, which is approximately 2·22 bushels above the estimated yield. At 35·28 bushels per acre, 7,006,628 bushels have been secured up to the present. There is no reason to suppose that the crop still remaining in stack will yield much less than that which has already been dealt with, and it may be confidently expected that the total estimated yield of wheat will be appreciably exceeded.

So far as the oat crop is concerned, it was estimated that for 1928–29 303,000 acres were sown, as compared with 289,660 acres actually harvested in 1927–28. Threshings so far average 40·38 bushels per acre. This is approximately 3 bushels per acre less than last season's actual yield, but is slightly above the Dominion's average for the five years ending 1926–27.

In respect of barley the percentage threshed for the five seasons ending with 1927–28 was 98·03 of the total area under that crop. The estimated area sown in 1928–29 was 22,000 acres; and, assuming that a similar proportion is threshed this year, the total yield of grain, based on the average estimated yield, should be approximately 750,000 bushels, as against an actual yield of 861,985 bushels for the season 1927–28.

The area in potatoes in 1928–29 was estimated at 21,100 acres, as against an actual area of 21,693 acres in 1927–28. Basing the yield on the average yield per acre for the last five years, the total yield from the estimated area sown for 1928–29 should approximate 112,674 tons, as against 121,402 tons last season. It should be noted, however, that in the above figures only holdings of 1 acre and over outside borough boundaries are dealt with. It is undoubtedly safe to say that a fair amount of potatoes are grown on the smaller holdings and on holdings situated within boroughs.

Second-growth Country.

The comprehensive experimental work on hill country—particularly in Whangamomona County—which has been reverting to secondary growth, has been keenly carried on, and reports published in the Department's *Journal* as information became available.

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 notwithstanding that it is being run partly on experimental lines the good work done by those responsible on the place has resulted in the carrying-capacity being more than doubled during the year. The instructional officers of this Division continue to co-operate with the officers of the Lands Department in the work necessitated in connection with advances under the Deteriorated Land Act, particularly in the King-country and in the back-country of Taranaki.

Instruction in Agriculture.

The instructional staff was strengthened during the year by the appointment of several Instructors; but the demands for instruction and advice, coupled with the experimental work in progress, are now even more than the increased staff can satisfactorily cope with, and it is evident that the staff will have to be further strengthened from time to time as suitable men offer for appointment.

Experimental Farms and Areas.

Puwera.—During the past year this farm has been run as an ordinary dairy-farm, and experimental work has been restricted to investigations regarding the value of nitrogenous top-dressing of grassland and rotational grazing. It is intended to extend the scope of these experiments in the coming season.

Marton.—This area has been used as a grass-farm during the year, various trials with fertilizers, clovers, and grasses being carried out, chiefly under the direction of the Crop Experimentalist and the Agrostologist.

Ashburton.—The work carried out on this farm in former years has been continued. It consists mainly of wheat-variety trials and work in the selection of pure lines of seed potatoes.

Gore.—In conjunction with the Crop Experimentalist the layout of this area was completely altered, the small blocks which previously existed being replaced by larger blocks ranging from 4 to 5 acres in size, thus permitting of experiments the results of which could be statistically examined being carried out. The work for the past season embraced a thorough trial of manurial effects on oats, swedes, turnips, mangels, and potatoes.

Galloway.—The Galloway Irrigation Area still continues to be purely a dairy-farm of the commercial type where farming operations are being carried out under irrigation.

Waimaunga.—Dairying has been continued on this farm during the year. Detailed reports on this and the other experimental areas and farms will be made after the close of the season.

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

Farm Schools.

The holding of farm schools was continued during the winter of 1928, but not nearly to the same extent as during the previous two or three winters. The decrease in the number of schools held was to a certain extent due to the organization of the Division (then in progress) not enabling the officers to be spared at the time required. The attendance at all the schools was gratifying, and it is apparent that these schools, limited to, say, one day in each place, will have to become quite a feature of the Division's operations.

Ruakura Farm Training College.

The Training College established at Ruakura some years ago continues to meet the popular demand, and about forty-three students are at present in residence. 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 Wairarapa districts. They are doing good work, but the basis on which they are conducted needs revision. The whole question is at present being carefully gone into, and I anticipate being able to submit concrete proposals on the matter to you before long.

Farmers' Field Competitions.

These were carried out in various parts of the Dominion, but mainly in Taranaki and Wanganui districts, on much the same lines as last year, with the exception that haystack competitions were introduced and ensilage competitions extended.

The Hemp Industry.

A decrease in hemp-production of approximately 6,000 tons for the year has to be recorded. Low prices were offering during the early autumn and winter months. In the early spring there were indications of better prices, but before these materialized industrial trouble in the main flax-milling areas caused the mills to be closed down. After negotiations between the millers and the employees had reached finality and preparations had been made for a fresh start in hemp-milling a heavy flood in the Manawatu district (one of the largest hemp-milling areas in the Dominion) caused a further delay of nearly a month, with the result that milling was not in full swing until after the Christmas and New Year holidays.

Generally speaking, the leaf available for milling throughout the Dominion was of fairly good average quality.

During the year Mr. W. H. Ferris, Hemp Grader, continued to carry on instructional duties among the numerous flax-mills in the North Island, and Mr. J. R. Hynes was appointed to carry on similar work among the millers in the South Island. Both these officers have done extremely good work, and many millers have expressed their appreciation of the Department's action in placing Instructors of the calibre of the men mentioned at their disposal. One very apparent result is a considerable improvement in the quality of hemp coming forward for grading.

The quantity of hemp graded for the year ended 31st March, 1929, was 58,622 bales, as compared with 89,130 bales for the previous year, a decrease of 30,508 bales. The quantity of tow graded was 17,534 bales as compared with 26,557 for the previous year, a decrease of 9,023 bales. Of stripper-tow 928 bales were graded, as compared with 1,548 for the previous year, a decrease of 620 bales. The number of bales of stripper-slips graded was 1,344, as against 2,373, a decrease of 1,029.

Of the hemp graded, 8·25 per cent. was good-fair, 44·05 per cent. high-fair, and 33·62 per cent. low-fair grade. These percentages for good-fair and high-fair show an appreciable increase as compared with corresponding figures for the 1927–28 season. Of the tow 12·84 was first grade, 53·12 per cent. second grade, and 29·22 per cent. third garde. Stripper-tow was 39·33 per cent. first grade, 55·92 per cent. second grade, and 4·09 per cent. third grade. Of stripper-slips none graded in the first grade; 14·28 per cent. were second grade, while 80·72 per cent. (which was below first and second grade) was allowed to be exported for use mainly in the manufacture of cheap lashings for which it has been found suitable.

Reorganization of Division and Establishment of Plant Research Station.

During the year an important event in the history of the Division was its reorganization and the transfer of its headquarters staff to Palmerston North, simultaneously with the establishment of the Plant Research Station in co-operation with the Department of Scientific and Industrial Research. The new organization, whereby all senior specialist officers operate from Palmerston North, and the actual instructional and experimental work in the field is carried out by the instructional staff under the jurisdiction of the Fields Superintendents, operates quite well. The present organization has led to all experimental work throughout the Dominion being placed on a uniform basis. Already quite excellent work in all branches has been performed, and I am confident the transfer to Palmerston North and the establishment of the Plant Research Station was a move in the right direction, and will have far-reaching beneficial effects on the primary industries of the Dominion.

Farm Economics.

During the year three groups of dairy-farms have been surveyed—namely, at Whangarei, Dargaville, and Ruawai. A total of approximately 280 farms has been covered in these districts. An attempt is being made to survey a large group of Waikato farms through the co-operation of the New Zealand Co-operative Herd-testing Association. This is meeting with fair success, and if it can be done satisfactorily will be a very inexpensive method of collecting required data. Twenty-two mixed Canterbury farms have been completely surveyed, and in addition a certain amount of data relative to machinery has been collected. A small group of farms in the Middlemarch area, Otago, has been completed also.

The publications actually available for distribution are (1) Bulletin No. 138, "Dairy-farm Management"; (2) Bulletin No. 143, "Dairy-farm Labour and its Relation to Butterfat-production"; (3) "Live-stock Production." Other publications are approaching completion.

During the year the Council of Scientific and Industrial Research set up a Rural Economics Committee to act as an advisory and co-ordinating body on matters pertaining to economics research. Up to the present this committee has held two meetings.

The ensuing year is likely to show considerable development in the scope of work undertaken. A complete investigation into the poultry industry is being carried out, and later a similar survey of the fruit industry will be made.

Field-crop Experiments.

A considerable extension of field experiments has taken place in the past season. In the North Island the main extension has been along the lines of grazing trials on dairy-farms. In the South Island a large number of pasture observations trials have been laid down, and a considerable increase in the investigations on manuring of wheat, potatoes, turnips, and swedes, and lucerne has taken place. Some particulars follow:—

Pasture Investigations.—Grazing trials: About eighty dairy-farms were selected in the North Island with a view to determining the effect of intensive utilization of grass under phosphate in comparison with phosphate plus nitrogen. On each farm a uniform paddock was selected and divided into two equal parts. The treatments mentioned were used, the nitrogen being applied in three and sometimes four applications, at 1 cwt. per acre each time of application. Co-operating farmers are keeping records of grazing-days, and a very good idea of the relative merits of the treatments is being gained. In some cases nitrogen has been an unqualified success, while in others no apparent differences in grazing-capacity can be determined. The results cannot be finalized for the year until the autumn grazing results are completed. The results to date show that with subdivision and intensive grazing, combined with top-dressing, it is possible to increase carrying-capacity and consequently production of butterfat per acre. Some of the trial paddocks have produced over 500 lb. per acre during the milking season. This is very high, and could not be expected were the whole of the farm subdivided and intensively grazed. The trial areas in each case consist of two paddocks only. It is therefore probable that the test areas have been grazed longer than they should have been, in order to secure this result. Hard conditions for the last day of grazing-periods would not affect the cows materially, as they are immediately moved on to fresh feed. If all the farm were subdivided and sufficient stock carried to consume the whole of the grass produced, overgrazing of paddocks would affect butterfat-yield. However, taking into consideration the error likely to be introduced through using small test areas within a farm, the increase in production under intensive grazing is still considerable.

Farm under intensive system: The intensive system of pasture management was commenced on Mr. J. Ward's farm, at Manawaru, in the 1927–28 season, and is being continued with certain extensions and modifications in the present season. Half the paddocks of the farm are under phosphate treatment, and half under phosphate and nitrogen. In spite of a heavy flood over the farm in September the yield of butterfat will be higher than in the previous season.

Sheep-grazing trial, Marton: A grazing trial with sheep has been started on the Marton Experimental Area. The trial aims at a determination of the stock-carrying capacity at various seasons of the year when immediate and full utilization of grass by stock is observed. Two treatments are under trial, but nothing conclusive regarding their relative merits is likely to be available for at least another year.

Mowing trial: This aims at the measurement of growth throughout the year from application of super and slag applied at quarterly intervals. Valuable information is being gained regarding growth-rate of grass, response rate of phosphates, and incidence of growth relative to time of application of manures. It is highly desirable that dry matter produced and chemical consideration should be investigated as soon as possible in this trial.

Haying trials: Five investigations into the effect of fertilizers have been conducted in the North Island, four in Canterbury, and fifty in Otago and Southland. Most of these trials show a marked increase as a result of using phosphatic fertilizers—super as a general rule, especially in the South Island, proving a very satisfactory form.

Observation trials: About twenty observation and demonstration plots have been laid down or are being continued from the previous season in the North Island. In Canterbury about 180 small experiments have been distributed over as many soil-types as possible. Lime, phosphate, potash, and nitrogen are being used alone and in varying combinations. The object in laying down these trials was to get a rapid survey of as much land as possible, with the idea of determining what factors are mainly limiting production. The results more than justify the work at the present time, and, carried on for a few years, should be of great value. The striking feature of the trials is the comparatively widespread effect from lime. Phosphate response is often limited by the requirement of lime, and when used in conjunction with it is usually highly beneficial. Potash does not appear to be of any consequence, except in one or two isolated cases. Nitrogen has almost invariably increased grass-growth, and where lime, phosphate, and nitrogen are used together the most marked improvement has taken place. Results indicate that nitrogen is highly important in the establishment and maintenance of rye-grass and cocksfoot, which grasses almost always show a marked response. Grazing trials to test the economic value of response in a few places are being started this season. The arrangements of the plots is such as to demonstrate the effect of controlled grazing. Only a small proportion of farmers are carrying out good management utilization of the grass produced, and in these cases improvement of the grass sward, apart from applied manure, is greatly evident. In Otago about twelve areas are being used solely for observation. In the vicinity of Edendale good response to potash is occurring.

Cereals.—Wheat-manuring: A considerable extension of experiments in the manuring of wheat took place in the past season. This was rendered possible by the better threshing facilities provided by the up-to-date thresher mounted on a motor-lorry. In all thirty-two trials were laid down, of which twenty-six were harvested. The remainder in North Otago were destroyed by hail. Superphosphate has established a definite superiority over slower-acting phosphates. The spring dressing with soluble nitrogen again proved to be highly beneficial in the main, the use of 1 cwt. of nitrate of soda causing an average increase of about 4½ bushels per acre. About 200 small plots were laid down on roadside paddocks to focus farmers' attention on nitrogen and to get more general information

regarding it. About sixty of these were harvested, and the general result was more or less in agreement with the results from the more carefully conducted trials mentioned above. Potash has not displayed any general advantageous results from its use.

Wheat variety trials: Three of these were sown in Canterbury. The results indicate a superiority of Tuscan so far as yield is concerned. Some fundamental work on rate of seeding is being done this year, which, it is expected, will greatly simplify and increase the accuracy of these trials.

Effect of disease-control measures on yields: Four experiments on wheat, two on barley, and one on oats were carried out to test the effect on yield of using disease-control measures. The results are not regarded as sufficiently conclusive this season, and the trials are being repeated for the 1929-30 season.

Oat-manuring: Four trials conducted in Southland demonstrated the advantages of super over less soluble phosphates, and a considerable increase in yield resulted from the use of nitrogen as an adjunct to phosphate.

Potato-manuring.—The number of trials in Canterbury was increased to twelve in the past season, and three have been laid down in Otago and Southland, and one in Auckland. At time of writing, these trials are not harvested. The general and highly paying response from superphosphate leaves no doubt as to its advantages. Potash and nitrogen are both inconsistent in response; in some cases both have given increases where used singly with phosphate, but when used together the result is no better than where either is used as a single addition.

Swedes and Turnips Manuring.—Seventeen trials in the South Island and two in the North are under way. They aim at the determination of the effect of various manures in relation to germination and yield. The results of the previous season pointed very strongly to the advantages of super and lime in overcoming germination-injury and in still maintaining the advantages of a readily available phosphate. Although theoretically the mixing of super and lime is a wrong practice, the results in practice are highly promising.

Lucerne.—Experiments to test the effects of manure have been carried out in the North Island and Otago. While phosphates give good results almost invariably, the use of White Island material containing sulphur has been very beneficial to crops in Otago. In collaboration with the Mycology Section various methods of applying soil and culture inoculations are under trial in an experiment in Canterbury, and in various places throughout New Zealand the use of the culture prepared at the Mycological Laboratory is giving excellent results. In some cases inoculation is so important as to cause the crop to fail entirely if it is not applied.

Rape-manuring.—The work on rape has proceeded along the lines of previous seasons, and six trials were undertaken. Super, or a mixture of super and Ephos phosphate, are about equally effective. The top-dressing of nitrate of soda, at 1 cwt. per acre, increases yield by about 15 cwt. to 1 ton, and may be considered just about paying. Farmers usually grow a superabundance of rape, so there does not appear to be any particular advantage in further stimulating yield, except where a shortage is likely to be experienced.

Peas.—Work on peas has been conducted in two trials for the Field Mycologist. The object of the trials was to determine whether the reduction in incidence of collar-rot by using Semesan would materially affect the yield. Results are not yet to hand.

General Remarks.—The energetic and careful way in which experiments have been conducted is greatly to the credit of the individual instructors concerned. Labouring under the difficulty of insufficient technical assistance, many of these officers have had to devote long hours outside those ordinarily required of them to the work of experiments.

Mycology.

In April last the establishment at Palmerston North of the Plant Research Station and transference of the Mycological Section to this organization permitted a considerable expansion of investigational work into the diseases of agricultural crops. With available land and glasshouse accommodation the following work has been undertaken during this period:—

Cereal Diseases.—Further bulk treatments have led to practically the whole of the malting-barley of Canterbury being rendered smut-free; promising results have likewise been secured with smut-control of oats and wheat. An extensive series of treatments has been undertaken with a view to providing nucleus lines of wheat-seed free from wheat-scab, and barley free from barley-stripe, but as yet no successful treatment has been evolved. Attempts at procuring take-all infection in the field, with a view to conducting persistence experiments, have not been successful, this being the third season in succession that negative results have been secured. A commencement has been made with studies of biologic specialization of the cereal rusts, together with their methods of perpetuation, as a preparatory step to working out methods of control.

Potato-diseases.—Selections made by the Agronomist of most commercial lines of potatoes have been grown on the Station farm, so that by the practice of rogueing they could be rendered free from certain diseases, such as virus diseases, wilts, and early blight. All lines were treated before planting so as to render them free from corticium disease. Many high-yielding lines were secured, but it is not possible to determine whether they are disease-free until they have been grown a second season. In addition, lines of commercially disease-free tubers have been secured from Scotland, England, and Ireland, and are at present being grown on the farm. A commencement has been made with persistence studies on corticium-disease, approximately 1 acre being sown with infected tubers with a view to infecting the soil. Further experiments will be conducted in successive seasons to ascertain the period this organism remains in the soil, and, if so, whether any soil-treatment will tend to lessen this period or eradicate the disease.

Pea-diseases.—Selections made by the Agronomist of all varieties of garden-peas cultivated in the Dominion have been grown on the farm. These were treated for collar-rot before being sown, and subsequently have been rogued repeatedly for this disease. Collar-rot was not eliminated by this method, however, so that a second sowing was made with selected seed. This second lot, if free from the disease and if it remains so, will supply sufficient clean seed for bulking.

Brassica-diseases.—Further work has been carried out with dry-rot, the objects being (1) to improve the technique of testing for the disease in seed; (2) to prove that the disease is seed-borne (for this purpose a special insect-proof series of cages has been erected); (3) to improve the method of treatment whereby diseased seed could be rendered dry-rot free; (4) to determine whether the disease carries over in the soil from one season to the next. All attempts at perfecting a seed-treatment have so far failed, so that work is now being concentrated on the production of disease-free lines of seed.

Club-root experiments have been designed to extend over a period of seven years. This work consists of (1) experiments to determine the period the disease persists in the soil; (2) whether any manurial, rotational, or cultural practice will lesson this period of persistence; (3) whether any brassicas are resistant or immune; (4) whether brassica weeds are hosts of the organism (and thus to tend to carry the disease over indefinitely); (5) evolution of a technique for certain detection of club-root in the soil; (6) experiments to determine whether club-root is carried with the seed.

Lucerne Nodule Organism.—Considerable attention has been paid to the improvement of methods whereby lucerne seed may be efficiently inoculated with the lucerne nodule organism prior to sowing. Work conducted on the effects of manures on the organism has led to considerable modifications in the practice of establishing lucerne stands.

Fireblight.—Owing to the outbreak of fireblight in the South Island, considerable additional work has had to be carried out with this disease, leading incidentally to the establishment of several previously unrecorded hosts.

Pine-disease.—The cause of the dying of *Pinus radiata* (*insignis*) throughout the Dominion has been under investigation, leading to the isolation of an organism common to all diseased trees. Experiments are at present under way to determine whether such is parasitic, and, if so, its method of dissemination.

Linseed-rust Control.—Experiments—unfortunately unsuccessful—were conducted during the year to procure a treatment for the elimination of rust of linseed, which has been proved elsewhere to be carried with the seed. Further work is in progress.

Routine Work.—Owing to the transfer to new quarters and to the establishment of the Research Station farm the year has been a busy one. Routine work, fortunately, has not been as heavy as in former years, a large falling-off being noted in orchard-disease identification, doubtless due to the publication of the book "Fungous Diseases of Fruit-trees in New Zealand and their Control."

Agronomy.

This work has for its object crop and pasture improvement by the use of better seeds. The term "better seed" is used to cover freedom from disease, varietal purity, improved strains, and strains suited for particular purposes or environment. The organization falls into two closely associated divisions. On the one hand is the raising of improved seed for distribution, and on the other the organization for wider distribution from farm to farm and the certification of the seeds of those crops conforming to certain standards.

Production of improved Seed.—Seed of all the main farm crops is being raised by adopting pure line selection. The work is carried out in close co-operation with the Mycologist, who undertakes the elimination of those diseases amenable to control and the reduction of others by rogueing and the selection of disease-free lines. Nothing in the way of crossbreeding is being undertaken in the initial stages of this work, the view being held that there is ample scope for improvement in the standard varieties of proved value for local conditions.

Potatoes: Commencing with tuber units of the more important varieties, there is now available sufficient seed for the planting of several acres. These selections will be multiplied as rapidly as possible and distributed to selected growers, who in turn will pass the seed into commerce, and be followed up by certification. Each year a fresh series of tuber units is being selected to replace the lines going into commerce, so that there will be a steady output annually of pure and healthy seed. Of the original selections made, the stage has now been reached when the produce of next season's crop will be passed on to selected growers for increase and introduction into general commerce after the season 1932–33.

Wheat: Pure lines have been raised of all standard varieties. The original selections are in the process of multiplication, and further selections are being made annually to replace those going into the hands of growers. It will be two or three years before sufficient seed will be available for distribution of any one pure line, and in the meantime some of the varieties in commerce are badly mixed and others are heavily infected with loose smut. To fill this immediate want, those pure lines which are not required for further selection but which possess no serious defect have been bulked. Sufficient seed of these bulked lines is now available for the sowing of nearly 100 acres, and tentative arrangements have been made with the Canterbury Seed Co. to grow these lines.

All seed distributed is smut-free, and the following varieties are represented: Solid-straw Tuscan, Hunters', Velvet Chaff, Velvet Ear, Dreadnought, Marquis, Major, Red Fife.

Peas: Precisely similar methods are being adopted in the improvement of garden and field peas. Several hundred selections are being multiplied, and it is anticipated that the selection work in field peas will be of considerable value.

Malting-barley: Pure lines of all the standard varieties of malting-barley have been raised, and sufficient seed, bulked from single-plant selections, is now available for the sowing out of about

1 acre of each. It will be a couple of years before pure-line seed is available. All lines produced are smut-free, and the work is being undertaken in co-operation with the Canterbury Seed Co.

Linseed: In co-operation with the New Zealand Cattle Cake and Oil Co., selection work is being undertaken in the Bull Moose variety of linseed. This variety yields heavily on the better-class land, and the percentage of oil extracted is considerably higher than that obtained from the common variety. The shortness of straw, however, renders harvesting difficult, and the objective is to remedy this defect without sacrificing the other qualities. The work done so far would indicate ample scope for selection.

Onions: A very large proportion of the New Zealand onion crop is grown in the vicinity of Christchurch. The keeping-qualities of the varieties used leave much to be desired, although there are one or two notable exceptions. Selections from these long-keeping types have been seeded this season. In addition to this, the best-keeping English and American varieties are under trial, and seed will be raised from any which show promise. It is the practice of onion-growers to raise their own requirements in seed, so that if a superior type is produced its rapid distribution is assured.

Oats: A commencement is being made this season in the production of pure lines of oats.

Facilities: The facilities for undertaking this seed-improvement work are quite inadequate. Very little land of a suitable type is available at the Ashburton Experimental Farm, and there are no buildings of any kind on the area. The lack of suitable land and the total absence of shelter of any kind has been a serious handicap in the past, and will prevent development in the future unless the matter of providing adequate facilities for carrying out this work receives early attention.

Certification.—It is essential that the production of pure lines should be closely interwoven with an organization for supervised distribution. This supervision is being effected by means of certification. Seed distributed is followed up by inspections, and while it remains pure and healthy the produce is hall-marked for seed purposes.

Potato-certification: This has met with considerable support from both growers and merchants. Moreover, some very interesting and valuable evidence has been obtained, and a great deal of instructional work undertaken by officers inspecting crops. There has been a very active decline in the number of crops rejected during this, the second year, and a considerable increase in the area under certification. Approximately 1,000 acres have been entered in Canterbury; this represents about 7 per cent. of the potato-growing area of that province and about 4 per cent. of the total area under potatoes in New Zealand. Potato-certification is to be extended to the North Island next season, and it will then be possible to set Dominion standards for certified seed in respect to purity, disease, and grading.

Wheat-certification: This is undertaken in co-operation with the Wheat Research Institute, and is now in its second year of operation. Virtually all the improved seed wheat has in the past been produced by Lincoln College, and probably all that accepted under certification has originated from that institution. Solid-straw Tuscan and College Hunter's were the only varieties found sufficiently pure for acceptance under certification. Of the others nothing approaching pure seed is available in any quantity, but the selection work now under way by the Department should remedy this deficiency, and in a year or two seed of all the main varieties of sufficient purity for certification will be in distribution. Growers whose seed wheat is accepted are granted a bonus of 6d. per bushel above the ruling market price for milling-wheat on 31st March. This amount (and all expenses entailed in transport, dressing, commission, &c.) is charged forward. The bonus granted to growers is in the nature of a prize for efficient farm-management. Mr. Veitch, Government Grader, Christchurch, has been responsible for the grading and distribution of seed wheat, and most of the success must be attributed to his painstaking work.

White clover: A commencement has been made this season in the certification of old-pasture white-clover seed, mainly with a view to stimulating the export trade. A few areas have been accepted as a preliminary trial, the produce of which will be sealed and exported as certified New Zealand old-pasture white clover. Samples from each line will be tested at various stations in Britain and also in this country, with a view to determining the relative value of white clover from pastures of different ages. It is hoped to extend this phase of the work in the near future.

Other pasture-plants: Work recently conducted by the Agrostologist has demonstrated very clearly the necessity for correct categorization of the various grass and clover seeds used for our pastures or exported overseas. Preliminary work is being undertaken with a view to future certification work, a certain amount of which will be inaugurated next season. It seems possible that certification of grass and clover seeds will develop into the most important phase of the work in its effect upon the export trade and the economic establishment of the pastures of the Dominion.

Entomology.

A certain amount of dislocation in connection with entomological work was inevitable consequent on Dr. D. Miller's resignation at the commencement of the year and the transfer of this section to Palmerston North. Apart from this, however, the work for the past year, though necessarily curtailed, has proceeded as usual. For convenience the past year's activities are dealt with under two heads—routine and research.

Routine.—This involves (1) the identification of numerous insects sent in and supplying all available information as to their economic significance and methods of control where known; (2) the investigation of minor problems in the field as they are brought under notice from time to time; (3) attention to and care of departmental collections, and indexing and classification of certain classes of literature.

Research.—The amount of work necessary under this head is to all intents and purposes unlimited, but necessarily only problems of immediate or major importance received consideration. These are briefly outlined and dealt with under their respective headings.

Diamond-backed moth (*Plutella maculipennis*): The larvæ of this moth are particularly destructive in the numerous cruciferous crops grown throughout the country. With a view to the biological control of this pest it was deemed essential to ascertain the different species of parasites and hyper-parasites (if any) already here. This phase of the work is now well advanced, and specimens of the parasites obtained have already been forwarded to the Imperial Bureau of Entomology, London, for specific identification. The life-history of the moth is also being studied.

Biological control of the pear-midge (*Perrisia pyri*): The work under this head has consisted mainly in rearing to the adult stage midges and their parasites from material sent in from various orchardists.

Virus diseases of potatoes: This apparently, though primarily a question for the Mycological Section, also involves entomology, inasmuch as insects are vectors in the dissemination of the disease. A survey of the potato-growing areas representative of the South Island was accordingly undertaken. Various species of insects infesting the potatoes were collected and are being classified, while preparations to ascertain what part these insects play in the transference of the disease are in train.

Eelworm: A brief field survey in regard to the incidence of eelworm as it affects the potato-grower, and experiments to determine broadly the types of soil most conducive or otherwise to the welfare of this pest, have been undertaken, but much remains to be done.

Food habits of the pukeko: Numerous pukeko-stomachs are sent in from time to time from variously selected localities. These stomachs are analysed and the food contents noted.

Aphis-control: Though admittedly a question of primary importance, comparatively little work has yet been done on this—mainly, perhaps, because the subject is involved and difficult, and its successful undertaking no light consideration. Parasites of this pest have been reared and identified, however, while some still remain for identification.

Seed-testing.

In the calendar year 1928 10,149 samples were received for testing purposes, representing a decrease of 619 on the number received the previous year. The reduction in the total is almost wholly accounted for by the lesser number of rye-grass, white clover, and red clover samples submitted. Two hundred and six samples were received from sixty-five farmers and seed-growers. It is of interest to note that the greater number of samples submitted by farmers represented purchases made under the vendor's guarantee of purity and germination, which figure approximately 20 per cent. of the samples failed to reach.

The distribution of the samples received was as follows: Southland, 2,950; Wellington, 2,221; Auckland, 1,191; Canterbury, 1,189; Otago, 732; Taranaki, 328; Hawke's Bay, 238; Marlborough, 174; Gisborne, 23; Nelson, 13; (North Auckland and Westland, nil). The remainder of the total number was made up as follows: Seed-merchants, 8,509; Government Departments, 365; laboratory tests, 890; retests, 115. The whole necessitated the making of 10,060 duplicate germination tests and 2,594 purity tests.

With the exception of rye-grass, the standard of purity and germination shown was very satisfactory. The depression in the germination of rye-grass has been marked for several seasons. Although in 1928 an improvement was shown in Southern and Sandon seed, this improvement, in the general average, was offset by the depressions in Hawke's Bay and Canterbury seeds. Sandon rye-grass has in most cases for several seasons failed to germinate up to a merchantable standard, and some attention has been given to seed-production in this district. The 1929 seed has, in about 60 per cent. of the crops, shown a decided improvement in growth, and where inquiries have been made it has been found that the higher-quality seed has been the result of a delayed cutting. This survey of all the areas harvested this year is being continued, and, with the data collected covering crops harvested in previous years, it is thought that it will be shown that in the majority of cases the unsatisfactory germination is due primarily to immaturity at times of harvest—that is, under average climatic conditions.

During 1928 2,511 tons of grass and clover seeds were exported, a reduction of 2,000 tons on the quantity for the previous year, which, on account of the heavy exportation of rye-grass, was a record year. Taking the export figures over the four years 1925–28, substantial decreases for 1928 were shown in rye-grass, red clover, and white clover; while the quantity of brown-top shipped has been more than doubled.

The experiments commenced in 1928 in dusting Chewings fescue with Semesan to overcome loss in vitality are being continued, six parcels having been sent to Washington and Cambridge during the twelvemonth. Tests made at those places and at the New Zealand Station have shown that, to date, the treatment has in no way checked losses in vitality. A number of white-clover samples collected from the various seed-production districts have been examined, and indices of dominance, frequency, and constancy of occurrence of the individual species of impurities tabulated. Laboratory experiments designed to test the effect of atmospheres of different degrees of humidity, the rates of absorption and loss of moisture on stored seeds are being carried out. With the present organization and accommodation, research work bearing on seeds and seed-production is necessarily limited.

From the commencement of the year 1929 all brown-top samples have been tested under the proposed International testing system, as also were all samples of seed certified under the recently introduced system of seed-certification. It has been repeatedly shown during the year that the retention of the almost obsolete testing system in New Zealand has been the direct cause of many disputes in the seed trade, both import and export seeds being involved. It was mainly for this reason that the Continental system was adopted for brown-top. It is to be hoped that in the interests of the seed trade and of the New Zealand Station itself opportunity will in the near future be provided for the complete reorganization of the Station, so that it may give the full services required of it. It may be added that the adherence of the New Zealand Station to the Irish system was a subject of discussion at the conference of the International Seed Traders' Association and the International Seed Testing Association, held at Bologna and Rome respectively during 1928.

The tabulation and issue to the seed trade of periodic reports covering average purity and germination percentages has been continued, for which general appreciation has been shown. The Station has acted in an advisory capacity in connection with trade disputes, quality standards, seed-production, identification of seeds, seed storage and shipment, &c.

A large number of tests (approximately 600) have been made on behalf of the Mycology Section in connection with its investigation into the control of seed-borne diseases, and approximately 200 for the Agrostology Section.

AGROSTOLOGY.

The transference of the Agrostology Section from Wellington and its establishment as a member of the Plant Research Station at Palmerston North took place during the year. Linked up intimately with the Fields Division extension and instructional service, conveniently placed in regard to the land, and facilitated enormously by motor-car transport, the outlook for extensive, sustained, and well co-ordinated grassland research work is bright. Two additional specialist officers have been added to the staff, and in addition to these Mr. William Davies, M.Sc., arrived on loan for two years from the Welsh Plant Breeding Station at Aberystwyth.

Broadly speaking, the threefold aim of the Section in research is as follows :—

(1) To know our grassland species and the exact niche into which each fits. Knowing the behaviour of each species and the requirements of each species, change in pasture-composition may be correctly interpreted. In other words, each grass and each clover is an indication of its sum environmental conditions. Species vary in habitat requirement and rearrange themselves in definite large or small association types, each association a contributor to a great mosaic grassland complex, the outcome of variation in conditions of the habitat.

(2) To know type or strain within the species. While we are apt to visualize the species as stable or fixed, and to assert replacement and displacement, and rise and fall of association types in response to the environment, yet there is unquestionably a species variation, possibly a product of the environment. Danish cocksfoot differs in colour and form and in persistency from Akaroa cocksfoot ; Kentish wild white differs from Lodino or commercial Dutch white ; Hawke's Bay rye-grass differs in growth-form, palatability, and persistency from Southland rye-grass ; broad red clover differs greatly in form, persistency, and time of flowering from Cornish Marl or Montgomery red clover. Are these variants exploitable ? Can we, as it were, by type or strain selection, widen the habitat range of a species ? Strain-selection has unconsciously gone on in all arable-land-farming communities in New Zealand for the last four or five decades. Quick-maturing and free-seeding types of rye-grass, for example, have been harvested and sown over and over again. The slower-maturing, tardy seed-producing leafy strains have figured in lesser and lesser amounts, until to-day a free-seeding, rapidly maturing, more or less annual rye-grass type has been developed—the outcome of unconscious strain-selection. On the other hand, areas have remained in permanent grass for decades. These have been subjected to an entirely different set of environmental conditions, and survival of the sward components has been determined by one of two things—the ability to reseed, or the ability to persist by vegetative spread as by tillering.

(3) The third aim is to know how best to modify or change existing conditions on the farm, so that the very best species and the very best strains of those species may be provided, and the wherewithal for their optimum growth and maximum development. No consideration of species or strain is of value apart from determination of the conditions necessary for maximum production by those species or strains.

This threefold aim constitutes the fundamental grassland research work of the Station.

Fundamental Grassland Research Areas.—Nine areas on widely different soil types, situated respectively at Weraroa, Marton, Manaia, Katere, Stratford, Tutira, Pembroke, Gore, and Balclutha, have now been sown. On each area fifty-four different grasses and clovers (or strains of these) have been included in the trials, and differential top-dressing of these is being carried on to determine the reactions of each under the varying degrees of fertility-upkeep.

Strain Investigation.—The research work on hand has for its objective the testing out of strain or type, and the reinstatement and perpetuation on the market of the persistent, leafy, and truly permanent strains of herbage-plants. The main species at present under trial are (1) perennial rye-grass, (2) cocksfoot, (3) brown-top, (4) red clover, (5) white clover.

Perennial rye-grass : Over nine hundred commercial lots are now under trial at the Plant Research Station, and field-grazing trials of the more outstanding types are being conducted at Marton, Manaia, and Katere. Over two thousand plots of rye-grass alone have been laid down during the year. The trials up to the present indicate the necessity for differentiation between (1) those lots that are mixed with or are dominantly Italian rye-grass, (2) those lots that are what may be called pseudo or false perennial, and (3) those that approximate to the true perennial, leafy, and persistent types. The main projects are (1) to eliminate the Italian rye-grass lots ; (2) to differentiate out as rapidly as possible the false perennial lots from the true perennial lots ; and (3) to locate throughout New Zealand and get on to the market as rapidly as possible pedigree true perennial rye-grass strains. It is extremely gratifying to report that certain firms in the seed trade are taking the matter up in earnest, and are growing approved genuine perennial types drawn largely from Hawke's Bay. Next year it is hoped there will appear on the market seed certified by the Department as being the true perennial type.

White clover : Approximately 150 lines of white clover are now under test, and more are being secured for planting in the spring. There are probably numerous types of white clover in New Zealand, and much work is contemplated in classifying those white-clover crops which are harvested from districts that differ markedly in the type of agriculture practised. There are those crops harvested from permanent grassland, and those harvested from volunteer white that comes away in the wheat stubble or after the laying-down of some temporary crop—no white-clover seed having been sown. It is not known at the present time how we should regard these volunteer and stubble whites,

and it is felt that the time is ripe for a full investigation into those different New Zealand white-clover crops, in order to nip in the bud any tendency to production and perpetuation of short-lived white-clover strains in this country.

Red clover: 104 lots of red clover are now under test, belonging to four major red-clover groups: (1) Broad red, (2) late red, (3) later late red, and (4) wild red. The work to date has demonstrated that all New Zealand red clover belongs to the broad-red group. English experience has shown this group to be the least permanent of all the red-clover types, and there is a big possibility of introducing from one or other of the late red or later late red groups a type of red clover that will confrom more to the grazing-pasture type than do those reds of the broad-red group.

Cocksfoot: Some 117 lots of cocksfoot are under trial, and these fall into two major types—The New Zealand and the Danish. There is a very marked difference in these types. The Danish is broader in shoot and leaf, and the crown is comparatively few-tillered. In the true Akaroa type the shoots are not so broad or coarse, and the crown tends to being multi-tillered. The dense, finer-leaved, multi-tillered crown types confrom more to the grazing-pasture type, and there is a big danger that unless care is taken the excellent New Zealand type may lose its identity, particularly as cocksfoot-seed production increases on the plains country and diminishes on the hills.

Brown-top: 104 lots of brown-top are under trial, the main project here being to ascertain freedom or otherwise from red-top. All the lines sown are red-top-free, but there exists a distinct type of brown-top which recent field-work has shown to be a type segregated out and confined to the poorer and drier soil type of the Canterbury Plains. The specific identity of this type and its behaviour under lawn conditions are being studied.

Other species from different sources of origin under trial are crested dogstail, timothy, meadow-fescue, Chewings fescue, Danthonia pilosa, Italian rye-grass, Western Wolths rye-grass, and Phalaris bulbosa.

Regrassing Experiments on Secondary-growth Country.—The experiments on regrassing secondary-growth country have been continued, and some additional 30 acres have been sown. It is very gratifying to report that the species and mixtures recommended for these sowings are now being widely adopted by the hill-country farmers, and the work is really progressing of its own momentum. During the year our attention has been focused on the menace of hard-fern (*Paesia scaberula*). This troublesome secondary growth defies the ordinary methods of control. Firing is not entirely effective, owing to the green edge that will not burn unless the area has reverted to one entire mass of this fern. Crushing with cattle and hard grazing with sheep increases rather than decreases the amount of hard-fern; mens' hands, wielding slashhook or grubber, are impotent against its spread. During the past three years spraying tests with arsenical compounds, mainly arsenic pentoxide (AS_2O_5), have been thoroughly tried out, and it is very gratifying to report a marked degree of success. In 1926 approximately ¼ acre was sprayed; in 1927–28 approximately 26 acres were successfully dealt with, and in 1928–29 over 100 acres have been treated. Experiments are now afoot to clean up some 200 acres in all, and to find out over a period of years the amount of spraying and cost to keep this area entirely free of hard-fern. Control of hard-fern will put quite a different complexion on the control of other secondary growths—throughout the Taranaki back-country at least. Crushing is absolutely essential to control bracken-fern, and the menace of hard-fern induced as a result of hard crushing has been a big influence towards lighter stocking, and consequently has prolonged enormously the struggle against bracken. Hard-fern control assured, more confidence will be inspired in the regrassing of the country, and effective bracken-control methods may be vigorously applied.

Land for Experimental Purposes.—All available land on the Plant Research Station farm has been sown, and this autumn it was necessary to acquire a small block apart from the Station. This area will be all sown down next spring, and it is imperative that more land be acquired as early as possible. It is desirable that a 50-acre block be secured, essentially handy to Palmerston North and definitely devoted to grassland research work of the more technical nature, with particular reference to strain and type selection, production of pedigree grass and clover-seed lots, growth phenomena, stimuli reactions, competition and succession, and for botanical analytical work on charting of vegetation.

Agricultural Botany.

Owing to the ill health of the officer who formerly attended to the agricultural botany side of the Division, this work unfortunately got rather neglected. However, with the appointment by the Department of Scientific and Industrial Research of Dr. H. H. Allan to the staff of the Plant Research Station as Systematic Botanist, the work has since been given every attention, and a considerable increase in the numbers of weeds, grasses, and other plants received for identification from all parts of the Dominion has taken place. The plant herbarium has been carefully overhauled and put into order. It has further been considerably added to, and at the same time duplicate material is held for exchange purposes.

Departmental Photography.

A considerable amount of photographic work has been carried out for all branches of the Department. Visits were made to several districts by the Photographer. The demand for lantern-slides for instructional purposes continues, and 1,095 slides were prepared during the year. The routine work includes 5,097 prints, 1,564 photographs, 347 enlargements, and 12 transparencies.

The photographic work is too heavy for one officer to cope with, and assistance in the near future is imperative. A recommendation on this matter will be submitted at an early date.

Staff.

All members of the staffs of the Fields Division and of the Plant Research Station have rendered loyal assistance during a particularly busy year, and their cordial co-operation is much appreciated.

HORTICULTURE DIVISION.

REPORT OF J. A. CAMPBELL, DIRECTOR.

The Fruitgrowing Industry.

The past season, taken as a whole, has been a satisfactory one to the fruitgrower. Orchardists generally are showing an increased interest in orchard management, due largely no doubt to the satisfactory prices realized for New-Zealand-grown fruit on the Home markets during the last two or three years.

Although not as heavy as that of the previous year, the crop of pip-fruits (apples and pears) was a good average one in the majority of the commercial fruitgrowing districts. Other varieties of fruit yielded fair average crops. Unfortunately, considerable damage was done to orchards in several localities by a hailstorm which occurred in the early part of the season, and as a result a large quantity of fruit was rendered unfit for export.

In the districts where lemon-growing is receiving attention good crops have been secured. The bulk of the fruit produced, when properly cured, is quite equal to the imported article. The citrus-growers in the Bay of Plenty have just completed the most successful year hitherto experienced, heavy crops of good-quality fruit being general throughout the district. The co-operative packing and curing shed established at Tauranga in 1928 has given a considerable impetus to the industry in that locality. Almost all lemon-growers in the vicinity of Tauranga are supporting the enterprise, with the result that it has been found necessary to enlarge the building in order to cope with the increased quantity of fruit coming to hand. A considerable area has recently been planted in citrus-trees in the North Auckland district, many parts of which are well adapted for this purpose. It is estimated there are 1,100 acres planted in citrus-trees in the Dominion, the bulk of which is in the Auckland District.

There have been no serious outbreaks of orchard pests and diseases during the year. Ordinary diseases, such as powdery mildew, San Jose scale, red mite, codlin-moth, bronze-beetle, &c., have been more or less prevalent, but where proper spraying methods were carried out they have been kept under control. Fungoid diseases—black-spot and brown-rot—which in some years take considerable toll, were less in evidence. It was found necessary to take proceedings against a number of careless growers who neglected to keep their orchards clean.

Fireblight disease has been confined to the North Island, and no serious headway has taken place. Energetic measures are being taken to keep the disease under control, and fruitgrowers generally are co-operating with the Department in this direction. A slight outbreak was located in the North Canterbury district, but this was confined to a hawthorn hedge, which was promptly destroyed by the owner.

The Orchard-tax Act, 1927, gives power for the setting up of Fireblight Committees, and the collection of a fireblight tax in commercial fruitgrowing districts declared as such under the provisions of the Fireblight Act, 1922. The tax is collected by the Department, and is handed over, less cost of collection, to the respective committees, to be expended for such purposes in connection with the control of fireblight as may be approved in accordance with the regulations under the Act. Fireblight Committees have already been set up in the Thames and Hawke's Bay commercial fruit areas, and similar committees in other districts are in the course of formation.

Reports to hand indicate that good work continues to be effected by *Aphelinus mali*, the natural enemy of the woolly aphis, a pest difficult to control by spraying methods. Orchards in a number of districts have been kept entirely free of the aphis by the operations of this natural enemy. Requests for parasitized insects continue to be received from various parts of the Dominion, and the necessary material is being supplied.

The total area in commercial orchards for the whole of the Dominion is approximately 30,000 acres. During the 1928 season some 496 acres were planted for commercial purposes, the largest extensions being in the Auckland and Hawke's Bay Districts.

Considerable progress is noticeable in orchard management generally, orchardists showing a keen desire to keep abreast of the times by the installation of up-to-date appliances, both in the orchard and packing-shed. Stationary spraying plants, already installed in a number of commercial orchards, are reported to be giving every satisfaction, and it is anticipated that it will not be long before they are in general use in the main commercial fruitgrowing localities. One of the main features of the stationary outfit is that it enables the grower to carry out his spraying operations at the proper time, irrespective of the state of the soil. With the portable plant much valuable time is frequently lost when the land is in too wet a condition for haulage purposes.

During the year I paid a brief visit to Australia for the purpose of discussing with the authorities in the different States matters affecting horticultural interests of the Commonwealth and the Dominion. In May last Mr. W. T. Goodwin, Assistant Director, proceeded to South America on behalf of the New Zealand Fruit-export Control Board. The object of his visit was to investigate the market conditions there in respect to New-Zealand-grown fruit. Information of a valuable nature was obtained, which has since been made available for the guidance of growers in New Zealand.

Export of Fruit.

The 1928 export season was a particularly busy one for all concerned, the quantity of fruit shipped overseas constituting a record for New Zealand, with a total of 1,026,986 cases. Of this total 867,710 cases of apples and 53,090 packages of pears were shipped to Great Britain; 87,157 cases

apples and 300 packages pears to South America; 10,921 cases apples to Canada; and 7,808 cases apples to Honolulu and Pacific islands. The prices realized were, generally speaking, considered to be satisfactory, and very little call was made on the Government guarantee.

The following figures show the total quantities of fruit exported from the Dominion during the last five years: 1924, 243,429 cases; 1925, 236,870 cases; 1926, 730,308 cases; 1927, 544,233 cases; 1928, 1,026,986 cases.

The Government has again renewed the guarantee on apples and pears exported during the 1929 season, the grower being guaranteed a gross market price of 11s. per case for "Extra Fancy" and "Fancy" grades, and 7s. for "Good" grade.

It is anticipated some 900,000 cases of apples and 50,000 cases of pears will be exported during the 1929 season.

Local Markets for Fruit and Vegetables.

The inspection of locally-grown fruit, vegetables, &c., at the main marketing centres received regular attention during the year. The markets have been well supplied, and satisfactory prices received by the growers for all stuff of good quality.

Reports to hand indicate that as a whole the requirements of the regulations relating to the sale of New-Zealand-grown fruit for local consumption are being satisfactorily complied with. Diseased lines are now only occasionally met with, growers realizing that it does not pay to place such fruit on the market. Although it was again found necessary to take proceedings in the earlier part of the year against a few growers for "topping" consignments of vegetables forwarded to the auction-rooms for sale, this practice of defrauding the public by placing good specimens at the top of a package and inferior stuff below has become much less frequent. The action taken by the Department in this matter has no doubt had a salutary effect.

Fruit Cool Storage.

As a result of a prolific harvest the cool-storage accommodation of the various stores established in the chief commercial fruitgrowing centres was fully taxed. The bulk of cool-stored fruit opened up in good condition, very little evidence being found of flesh-collapse in apples—an affection developed under cool-storage conditions, and which has caused considerable loss in the past.

Work of an experimental nature in connection with the cool storage of fruit, both on overseas boats and ashore, is being continued in conjunction with the Low Temperature Research Station, Cambridge, England, an officer of this Division being specially detailed to carry out the investigations. The carriage of fruit by rail within the Dominion is also receiving attention.

Instructional and Experimental Work.

In addition to their other duties, practical demonstrations and lectures on matters relative to orchard management generally, pruning, spraying, &c., have been continued during the winter months by the Orchard Instructors in their respective districts. Considerable interest is taken in these matters by fruitgrowers and others, the demonstrations as a rule being well attended.

In addition, apple-grading and packing classes have been conducted in the main commercial centres in co-operation with the fruitgrowers' associations, and have afforded a number of candidates the opportunity of gaining the Department's certificate of competency in these subjects.

Experimental work of a miscellaneous character has been continued in the field. Some of the main features are: Tests with various fruit-tree stocks, including pip, stone, and citrus fruits, a matter of vital concern to commercial fruitgrowers; control of the more troublesome diseases affecting fruit-trees; trying out of new proprietary spraying-compounds; control of the earwig pest, which is becoming a serious menace to the stone-fruit grower and others, particularly in the Otago Central district; orchard manurial trials for the purpose of increasing production; introduction of suitable species of mulberry for the raising of silkworms, and tests with olive-trees in the Nelson District; growing of subtropical fruits, such as avocados and persimmons.

The establishment of the tung-oil tree in New Zealand is also receiving attention. A quantity of seed has been received, and arrangements made for the raising of plants in the Auckland District, where it is considered the trees should do well on the gum-lands of the North. The oil is in demand by the paint and varnish trade, and as supplies from China are limited and irregular it is desired to have a more reliable source of supply.

Viticulture and Winemaking.

The growing of outdoor grapes is carried on to a considerable extent in the warmer portions of the North Island. In the Hawke's Bay and Poverty Bay districts the crop of wine grapes was considerably reduced by late frosts, hail, and the effects of downy-mildew disease. Good average crops were secured in other localities where the climatic conditions were more favourable. The returns from outdoor-grown table grapes were satisfactory, the Albany Surprise variety in particular yielding heavy crops, and good prices were realized by the growers.

The estimated yield of outdoor table grapes is 791 tons, which at 6d. per pound represents a value of £44,296. An approximate estimate of the quantity of wine produced from the year's vintage is 80,000 gallons, which at a conservative estimate is valued at £32,000.

A number of new varieties of grape-vines were recently imported by the Department for testing out under New Zealand conditions, and a further consignment is expected to arrive at an early date.

An increase is noticeable in the number of vineries in the Dominion, the extension taking place in the vicinity of the larger towns, where there is a ready demand for hothouse-grown grapes at payable prices to the grower. The value of the grapes produced under glass is estimated at £75,450.

Cidermaking.

While in some districts the quantity of cider produced was below that of the previous year, other localities show an increased output. The total quantity manufactured was approximately the same as that of last season—namely, 50,000 gallons, representing a value of £12,500. The making of good-quality cider is a profitable means of utilizing large quantities of otherwise unsaleable fruit.

Te Kauwhata Horticultural Station (Lower Waikato).

Good headway was made during the year with the various operations dealt with at this Station. The main features of the work consist of the carrying out of tests with fruit and other trees, vines, grape-growing for winemaking, testing spray compounds, &c.

A good supply of feed was available for stock during the winter and early spring. Twenty acres were prepared and sown in permanent grass and 18 acres in rape. A further 4 acres of wattle plantation were brought into cultivation and sown in oats.

Sheep: The stock kept for utilizing the surplus feed did well. Owing to a large number of the ewes purchased not proving to be in lamb the lambing percentage was considerably lower than usual. The total receipts from this branch of the farm was £1,076.

Plantations: Owing to a decrease in wattle-bark available, very little was stripped during the year. A quantity of timber was cut on a royalty basis, and waste timber sold for firewood. The revenue received from this source amounted to £811.

Vineyard and cellar: The weather proved favourable for the development of the grape crop, and this, with the better cultivation methods adopted in the vineyard during the past two or three years, resulted in a heavy crop of wine grapes. As a result the vintage was a record one for the Station, over 16,000 gallons of wine being obtained. The three new fermenting-tanks installed during the year have proved invaluable in dealing with the year's crop. Wine sales have been well maintained, 11,310 gallons being sold, which realized £5,585.

The financial position of the Station is quite satisfactory, receipts exceeding the expenditure for the year by £2,707.

Orchard Registration and Orchard-tax.

Regulations under the Orchard and Garden Diseases Act, 1908, provide for the registration, during the month of January in each year, of all orchards from which fruit is sold or those planted for the purpose of eventually selling fruit therefrom. Under the Orchard-tax Act, which was renewed in 1927, tax is payable at the rate of 1s. per acre with a minimum tax of 5s. Orchards consisting of less than 120 trees are exempt from tax. The total number of orchards registered during the year was 3,906 taxable and 3,670 non-taxable. The amount payable in tax is approximately £1,352. The frequent changing of orchard properties often entails a considerable amount of detail work in tracing the responsible persons. A number of prosecutions for non-registration, and also for non-payment of tax, took place during the year. The tax collected is paid over to the New Zealand Fruitgrowers' Federation, Wellington (less cost of collection), to be utilized in furthering the interests of the fruitgrowing industry of the Dominion in accordance with the requirements of the regulations under the Orchard-tax Act.

Registration and Inspection of Nurseries.

This work is proceeding satisfactorily, the bulk of the nurseries in the Dominion being kept in good condition and comparatively free from disease. A slight increase is noticeable in the number of nurseries registered, the total being 704 as against 695 for the previous year. £704 was collected in registration fees. Nurserymen have in the past contributed very materially to the development of our fruit industry by introducing and raising new varieties of fruit, thereby improving their standard of production, and they are still contributing valuable service in this connection.

New Zealand Institute of Horticulture.

Good progress has been made by the New Zealand Institute of Horticulture. Matters connected with nomenclature, improvement of economic plants by selection and hybridization, and training of young men and women in all branches of horticulture are some of the main features of the work of the Institute. The Institute has full legal authority under the New Zealand Institute of Horticulture Act, 1927, to grant diplomas in horticulture to those qualified and passing examinations during the course of a special training. A number of persons have already received the diploma in question.

A cup known as the Loder Cup has been presented by Mr. Gerald Loder, England, for competition throughout the Dominion in a class dealing specially with New Zealand native plants. This will no doubt be highly appreciated not only by horticultural bodies in New Zealand, but also by keen individual horticulturists — amateur and professional — within the Dominion, particularly those interested in our New Zealand native plants.

Imported Fruit, Plants, etc.

All imported fruit, plants, bulbs, &c., are examined at the gazetted ports of inspection—Auckland, Wellington, Lyttelton, Dunedin, and Bluff—prior to being allowed entry into the Dominion. The Inspectors report an increase in importations as compared with the previous year's figures. The majority of the consignments arrived in good condition, and the quantity condemned for disease

infection was comparatively small. It was found necessary to condemn and destroy a few lines of citrus-fruit from Australia on account of fruit-fly infection. A quantity of shelled walnuts and almonds was found to be affected with the larvæ of the Indian meal-moth, and was condemned as being unfit for human consumption. There was an increase in the quantity of fruit imported from the Cook Islands, especially oranges and tomatoes, the quality, grading, and packing showing considerable improvement. The fruit from Fiji was also of better quality.

Hop-culture.

Hop-growing on a commercial basis is carried on mainly in Nelson Province. The season's crop was a fair average one, the bulk of the hops being of good quality.

The following figures show the quantities and values of hops exported from the Dominion during the last five years ended 31st March: 1925, 4,469 cwt., £31,112; 1926, 3,608 cwt., £21,780; 1927, 2,937 cwt., £15,203; 1928, 4,980 cwt., £29,539; 1929, 3,334 cwt., £21,719.

Tobacco-culture.

In view of the fact that tobacco-leaf of high quality, both for pipe and cigarette purposes, can be produced in the Dominion, extensive inquiries have been received during the year for advice and information on the growing and manufacture of tobacco. Besides the Nelson District considerable headway has been made in the North Auckland and Rotorua districts, the Natives in these parts being particularly interested in the growing of tobacco as a means of livelihood. Practical instruction in all phases of tobacco-culture, from the sowing of the seed to the curing of the mature leaf, has been given in the different localities by the Department's Instructor in Tobacco-culture.

It is estimated there are now some 1,000 acres devoted to tobacco-growing in the Dominion. Of this approximately 150 acres are in the Auckland District, 30 acres in Marlborough, and the balance in the Nelson and Motueka districts. The bulk of the crop at the present time is grown under contract to tobacco-manufacturers in New Zealand. The future of the industry in this country, however, depends very largely on a satisfactory overseas market being available for the surplus not needed for New Zealand requirements, and until this is definitely assured the planting of tobacco on an extensive scale requires to be carefully considered.

The Beekeeping Industry.

Unsettled weather conditions experienced during the summer months resulted in the 1928–29 honey crop being below normal in several important producing districts, but in Canterbury and Auckland the returns were generally above the average. There is evidence in all districts that the beekeeping industry is expanding; established beekeepers are extending operations, and quite a number have started in a commercial way.

Applications continue to be received from persons desirous of taking a course of training in apiculture, but owing to this work having been discontinued at the Ruakura Apiary some other means of dealing with these requests is of urgent necessity. The usual practice of affording information to beekeepers generally by means of practical demonstrations and lectures has been carried out in the respective Instructors' districts, and keen interest manifested in the proceedings.

The inspection of apiaries for disease has been well maintained in most districts. The increased powers given to Inspectors under the Apiaries Act, 1927, have helped considerably in controlling disease. Satisfactory work was again carried out by the part-time Inspectors engaged during the past season in the Auckland, Wellington, Canterbury, Otago, and Southland districts. The assistance thus given the Apiary Instructors in the control of disease is much appreciated. There are, however, still a number of beekeepers, mostly in a small way, who neglect to keep their apiaries clean, and it was found necessary to take proceedings against a number of such during the year.

In connection with the alleged honey-poisoning cases which occurred at Morrinsville in March of last year arrangements were made to place a test hive in the district. Honey taken from this hive at intervals during the season was submitted to tests at the Wallaceville Laboratory, but all the tests proved negative.

The total quantity of honey graded for export at the various grading-stores amounted to 20,370 cases. As is the rule in a good year—the 1927–28 season being an exceptionally good one—the honey for the most part was of high quality, white honey being in larger proportion than usual.

The following figures show the quantities and values of honey exported from the Dominion during the last five years ended 31st March: 1925, 10,836 cwt., £30,549; 1926, 15,770 cwt., £51,733; 1927, 10,590 cwt., £34,695: 1928, 8,650 cwt., £27,784; 1929, 22,062 cwt., £82,230.

The regulations under the Apiaries Act, 1927, provide that no person shall keep bees after 31st March, 1928, except in an apiary registered under the Act. The total number of apiaries registered to date is 5,872, comprising 93,675 colonies of bees.

Staff.

With the many and varied matters coming within the scope of the Division, together with the increasing demands for advice and information covering a wide field of operations, a busy year has been experienced. I have to thank the staff as a whole for the loyal and efficient service rendered during the year.

CHEMISTRY SECTION.

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

Mineral Content of Pastures.

The investigation of the mineral content of pastures, under the Empire Marketing Board's scheme of research, as outlined in my last annual report, has occupied the greater part of the time of this Section during the past year. The work has necessitated the employment of several temporary analysts and assistants, and increased accommodation became essential. The transference of the soil work to the Fairlie Terrace Laboratory, and the fitting-up of an extra room in the Public Works Department's building, Sydney Street, has relieved the congestion in the main laboratory, and permitted the pasture work to proceed without undue delay. Special equipment for drying and grinding pasture-samples for analysis has been installed.

Dr. Orr, Director of the Rowett Research Institute, visited the Dominion in May, 1928, and was accompanied by me during his North Island tour. Various aspects of the pasture research work were discussed with Dr. Orr, and an exchange of workers between the Rowett Institute and this Laboratory was arranged. This has since been carried out.

A large number (331) of pasture-samples, in addition to soil and animal specimens, has been collected during the year from the various areas under investigation, and these have been analysed or are in process of analysis.

The principal areas at present being investigated in accordance with the scheme of research are as follows:—

Rotorua pumice lands: The investigation of iron starvation or "bush sickness" is still in progress. A grass-garden has been established on the Kaharoa coarse pumice soil for the purpose of studying the composition of the various grass species under known conditions. Experiments with pellets containing iron-ammonium citrate have been commenced with sheep, with encouraging results, while a lick containing spathic iron-ore, or siderite (ferrous carbonate), and salt has given excellent results with cattle. The experiments are being extended. The demand for iron-ammonium citrate by settlers in the affected areas continues, and the Department has been able to reduce the price of the crystals to 2s. 6d. per pound. Articles embodying the experiences of users of this remedy for iron starvation appeared in the *New Zealand Journal of Agriculture* for May and June, 1928.

Waitomo County: Two distinct types of malnutrition in sheep are in course of investigation. At Mairoa, near Te Kuiti, on a volcanic loam soil, exists an area of country on which sheep fail to thrive, and on which the usual remedy of phosphatic manuring alone has not cured the trouble. Analyses of the soils and pastures are in progress, and on the results so far obtained has been based a series of field experiments with sheep on pasture top-dressed with lime (both as carbonate and sulphate) and phosphate. Trials of the pellet method of administering mineral supplements to the natural ration are also being carried out. A preliminary article on the Mairoa soils and pastures appeared in the *Journal* for September, 1928. At Kopaki, south of Te Kuiti, on a pumice sandy silt, the occurrence of a malnutrition disease in sheep, resembling iron starvation, is under investigation, and a series of top dressing and pellet-feeding experiments is in progress. The use of pellets containing iron-ammonium citrate has given very encouraging results with sheep on this area. The experimental sheep are weighed at monthly intervals, to determine the exact influence of the treatment as shown by the live weights.

Wairarapa: In the upper Wairarapa district inquiries into the existence of several deficiency diseases in stock, and the collection of samples for analysis, resulted in the discovery that the soils and pastures on certain areas were deficient to a previously unsuspected degree in phosphoric acid, some of the pastures containing less phosphate than any New Zealand samples previously examined. A low nitrogen content was also an indication of poor nutritive value of the pasture. The investigation is being continued, and an interim report, embodying suggestions for top-dressing, was published in the *Journal* for October, 1928.

Canterbury: Inquiry was made into a considerable mortality in lambs and hoggets in various parts of the Canterbury Plains. It was found that mortality was greatest in sheep brought down from the higher country for the winter, and that due to an abnormally warm wet season, there had been a rank autumn growth of grass, which was dry and innutritious when the sheep were put on to it. Analysis of the pasture showed that the dry growth was low in protein and mineral matter, and specially deficient in phosphorus and chlorine.

Other stock troubles attributable to malnutrition are being studied, including one in sheep on certain parts of the back country of Poverty Bay, and the occurrence of temporary sterility and eclampsia in dairy cows in relation to the protein content of the pasture (see *Journal*, February, 1929).

Reference has been made to the use of feeding pellets for correcting deficiencies in the diet of animals. Several varieties of pellets are being made, using a phosphorized pollard mixing-machine for the preparation. A full account of the methods of manufacture and use appeared in the *Journal* for January, 1929.

Soils.

The soil investigational work of the Section has now been transferred to the laboratory at Fairlie Terrace, lately occupied by the biological sections of the Fields Division, and the building has been renovated and equipped for the chemical and physical examination of soils.

The reconnaissance soil survey of Rotorua County has been completed, and the subsoil maps are in hand for publication at an early date. Further samples have been collected in areas where only a few samples had previously been taken, and the survey will next be extended to the adjacent Taupo pumice lands.

In connection with the investigation of malnutrition in stock at Mairoa, Waitomo County, further samples of soil have been collected and are now being analysed. A preliminary report appeared in the *Journal* for September, 1928.

Other soil work undertaken during the year has included the analysis of samples in connection with the investigation of malnutrition in stock in the districts of Poverty Bay, Waikato, Wairarapa, Canterbury, and Central Otago, besides special analyses of soils for Divisional Directors, and determinations of lime-requirement in samples sent in by Fields instructional officers.

Limestones and Limes.

Following are brief descriptions of some of the more useful of the 103 samples of limestones submitted for analysis :—

X/1277 was a soft white carbonate of lime from Mount Gladstone, Marlborough. Though containing only 58·5 per cent. carbonate of lime, its soft texture would render it a useful source of lime for local application. X/1278, from Kamo, Auckland, was a white semicrystalline stone containing 96·5 per cent. carbonate of lime. This would be a very suitable stone for production of quicklime. Y/150 was a soft, easily ground shell deposit from Napier district. It contained 93 per cent. carbonate of lime. Y/153, from Waipara, Canterbury, was from a deposit occurring in the form of a fairly fine powder, containing 66 per cent. carbonate of lime. Y/158–160, from Hastings district, Hawke's Bay, were calcareous sinters ranging from 79 to 86·4 per cent. carbonate of lime. Y/215 was a useful coarse shelly grit from Onehunga, Auckland, containing 80·1 per cent. carbonate of lime. Y/216, a hard shell limestone (80·5 per cent. carbonate) was from Hedgehope, Southland. Y/263–68, a series of six hard, semicrystalline limestones from Te Akau, Ngaruawahia, ranged from 80 to 97 per cent. in content of carbonate of lime. The higher-grade material would produce an excellent quicklime. Y/270 was a specimen of calcite (pure crystalline carbonate of lime) from Kopua, Hawke's Bay. Y/303–10 were a series of hard, semicrystalline limestones of high grade, from Tinui, Wairarapa. Their carbonate-of-lime content varied from 89 per cent. to 97 per cent. Y/572 was a moderately hard stone from the Cricklewood locality, Canterbury ; it contained 94·5 per cent. carbonate of lime. Y/583, from Albury, North Canterbury, was a hard limestone of excellent quality, containing 96·25 per cent. carbonate. Y/631 was a friable calcareous sinter from the Greymouth district. It was stated that this substance, which contained 89 per cent. carbonate of lime, could be dug out with a shovel, and it would therefore require no treatment beyond air-drying to make it suitable for application to the land. Unfortunately, such deposits as this are usually of very limited extent. Y/503, from Wairoa, Hawke's Bay, was a shell limestone of high grade (91 per cent. carbonate). Y/851, from a shell deposit at Onewhero, Auckland, contained 85·5 per cent. carbonate of lime. Y/837 was a friable sandy limestone from Albury, South Canterbury, containing 77 per cent. carbonate of lime. Y/1083, from Hawke's Bay, was a shelly conglomerate, containing 91 per cent. carbonate of lime. Y/1087 was a friable white carbonate of lime, 97·5 per cent. pure, from Ngapaenga, South Auckland. Y/1107, from Martinborough, Wairarapa, was also a friable calcareous deposit, containing 76 per cent. carbonate of lime. Y/839, a calcareous sinter from Wainui beach, near Gisborne, contained 94 per cent. carbonate of lime.

A number of commercial ground limestones were also examined for quality and fineness of grinding. Y/299, from Gore district, was a fairly well ground limestone containing 81 per cent. carbonate of lime. Y/338, from Westport, was a high-grade limestone (94·25 per cent. carbonate) of moderate fineness. Y/149, from Kakahu, Canterbury, was well ground, and contained 85 per cent. carbonate of lime. Y/669 was a finely ground stone, containing 89 per cent. carbonate of lime, from Dunback, Otago. Y/734, from Oamaru, was 97·5 per cent. pure, and was a well-ground sample. Y/574–76 were from Southland ; Y/574 and 575 contained 60 per cent. and 76·5 per cent. carbonate of lime respectively ; Y/576 was of much greater purity—91·5 per cent.—and was very finely ground. Y/557, from Limehills, Southland, was ground to a satisfactory fineness, and contained 90 per cent. carbonate of lime. Y/1073, from Toko, Taranaki, contained 86 per cent. carbonate, and might with advantage have been more finely ground. Y/1076 was a fairly well ground stone of low grade from the North Auckland district ; it contained 64·1 per cent. carbonate of lime. Y/838, from Silverdale, Auckland, was a well-ground stone containing 74 per cent. carbonate of lime. The prices charged for these commercial ground limestones (where stated) varied from 12s. to 18s. per ton, bags extra.

Several samples of quicklime and slaked lime were also analysed. These were all found to be well " burnt " from good-quality limestones.

Investigation of Wheat and its Products.

The formation of the New Zealand Wheat Research Institute has now been completed, and research laboratories have been established at Christchurch. Difficulty was encountered in securing a suitable experimental mill, and it was ultimately arranged to transfer to the Institute the Allis-Chalmers mill belonging to this Laboratory, the Scientific and Industrial Research Department agreeing that any milling-work required by this Department would be carried out by the Institute.

The investigation of the milling and baking qualities of New-Zealand-grown wheat and flour, which has been a feature of the work of this Section during the past seven years, and which has evoked many expressions of appreciation, will now be discontinued so far as this Laboratory is concerned, and will be carried on by the Wheat Research Institute.

The question of setting up standards of quality for wheat offals (bran and pollard) has received further consideration, and a recommendation has been made with a view to reaching a decision that will be satisfactory to millers and consumers.

Toxicological.

No positive results were obtained from the ten specimens of organs and ingesta submitted by veterinary and stock officers in connection with cases of suspected poisoning of stock. The difficulty of obtaining adequate material for examination in these cases continues, notwithstanding the explicit instructions issued to all officers concerned with the health of stock.

Fertilizers.

Forty-one unofficial samples of commercial fertilizers were received and examined during the year; all were found to comply with the vendors' invoice certificates where these were sent for comparison. No official samples were taken under the Fertilizers Act, 1927, which came into force on 1st June, 1928. In the past there has been a certain amount of difficulty in securing formal samples, owing to the fact that the Inspectors under the Act were officers of the Department whose time was fully occupied with other duties. An appointment has now been made of a full-time Inspector, whose duties will include the work of registration of vendors, as well as the taking of all official samples required.

The arrangement by which all samples of shipments of basic slag from Great Britain and the Continent to New Zealand were analysed by the Imperial Institute, London, has been terminated after being in operation for over twelve months. This systematic examination has shown that the basic slag imported is of high grade, and in general is up to the standard of quality guaranteed by the manufacturers. No low-phosphate slag (less than 15 per cent. phosphoric acid) has been imported, and such deficiencies as were observed were in nearly all cases within the limits of error allowed.

Regulations under the Fertilizers Act, 1927, were drafted, and, after consideration of the representations of manufacturers and traders concerned, were formally gazetted on 1st October, 1928. The regulations prescribe the methods of sampling and of analysis, the limits of error allowed, standards of quality, &c., forms of declaration, and other matters necessary to the enforcement of the Act.

The returns of importation of fertilizers have been compiled and published in the *Journal*, as in previous years.

Samples of a number of shipments of meat-works manure have been analysed and reported on at the request of the manufacturers to enable them to comply with the overseas purchasers' requirement of a Government analyst's certificate.

Reputed Fertilizers, Phosphate Rocks, etc.

Nineteen samples were submitted for examination during the year. None were found to be of any commercial value. Several samples of diatomaceous and fine siliceous deposits occurring on farmers' lands were also received. These substances are used in the arts for a wide variety of purposes—as heat and sound insulators, for filtering colloidal liquids, as abrasive and polishing materials, &c. Unless the deposits occur in considerable quantities, however, and are handy to cheap transport facilities, they are of little or no commercial value.

Work for the Departmental Divisions.

In addition to advising the various Divisional officers on chemical aspects of their work, a large number of samples has been analysed for the Divisions during the year.

For the Live-stock Division the periodical examination of the public cattle-dips of the Auckland and Taranaki Districts has been continued, 163 samples having been received and reported on. Additional outfits and supplies for testing dips in the field have been supplied as required. Some further samples of wool-branding fluids have been examined, no tarry matter or other harmful ingredients being detected. Various proprietary stock-licks and veterinary preparations have also been examined and reported on, and several cases of water-supplies suspected of being detrimental to the health of stock have been investigated.

Officers of the Dairy Division have submitted samples of dairy-products in connection with the routine instructional or special investigational work of the Division. Samples of water for dairy-factory use, and of dairy salt, cattle-licks, and other preparations used in the industry, have also been reported on. This Section has also co-operated with the Dairy Division in testing the accuracy of Babcock ware and dairy thermometers.

For the Horticulture Division samples of honey, soil, fungicides, and insecticides have been analysed. The variation of specific gravity in honey, and its relation to the volume weight of standardized cartons, has been investigated. As the result of examination of samples from all the principal honey-producing centres it was found that the variation in specific gravity was equivalent to a variation of not more than $\frac{1}{10}$ oz. in the contents of a 1 lb. carton. The specific gravity in fifteen samples varied from 1·422 to 1·435, with an average of 1·426.

Officers of the Fields Division forwarded samples of soils (for determination of lime-requirement and for special analysis), fertilizers, limestones, pastures, root crops, &c., mainly in connection with the experimental work of the Division.

The eminent British agricultural chemist, Sir John Russell, Director of the Rothamsted Experimental Station, paid a brief visit to New Zealand in August, 1928, and was accompanied by the writer on his tour of the northern districts. Unfortunately, his time in New Zealand was limited to a period of eighteen days, and Sir John was unable to see much that would have interested him, but he expressed himself as being very favourably impressed by the agricultural research work in progress in the Dominion, and in particular with the work on soil-deficiency problems and on the mineral content of pastures. (See his paper in "Agricultural Research in 1927," Royal Ag. Soc., London, 1929.)

Summary of Samples received during the Year.

Soils collected by officers of Chemistry Section, 152; soils sent by Instructors in Agriculture, 8; soils, miscellaneous, 41; lime and limestones, 103; reputed fertilizers and rock phosphates, 19; fertilizers, miscellaneous, 41; pasture samples, 331; dipping-fluids, 163; milks, 17; butters, 5; cheese, 31; honeys, 24; stock licks and medicines, 8; waters, 25; sugar-beet and turnips, 7: toxicological specimens, 10; wools, 28; caseins, 10; Babcock ware, 198; miscellaneous samples, 55: total, 1,276.

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