1950
NEW ZEALAND

DEPARTMENT OF AGRICULTURE

ANNUAL REPORT FOR YEAR 1949–50

Presented to Both Houses of the General Assembly by Command of His Excellency

SIR,—

I have the honour to forward for your Excellency's information the report of the Department of Agriculture for the financial year ended 31st March, 1950.

The Director-General's report reviews some of the systems of price support practised in various producing countries; it discusses the long-term implication of increasing production and the particular interest for New Zealand of international attempts to stabilize farming economy by the control of surpluses.

A summary of the principal farming activities of the year and the work of the various Divisions of the Department in the development of the Dominion's farming industry is contained in the reports of the Divisional Directors.

I have, &c.,
K. J. HOLYOAKE,
Minister of Agriculture.

His Excellency the Governor-General.

REPORT OF DIRECTOR-GENERAL OF AGRICULTURE

There are many indications that the seller's market which has operated since the commencement of the recent war is now changing to a buyer's market more characteristic of pre-war years. It is true that surpluses as experienced in the decade prior to the war have not yet materialized. In many commodities, however, surpluses are being built up, but are being treated in the main as reserve stocks. In many instances these so-called surpluses are the result of disequilibrium in trade and non-convertibility of sterling. Thus we find attention being paid to the necessity of maintaining producer stability. This concern is apparent in international organizations and specialized agencies, and in discussions at the recent Conference of the International Federation of Agricultural Producers particular stress was placed on the dangers which that organization foresaw in the near future. Similarly, the Council of the Food and Agriculture Organization of United Nations devoted most of its ninth session, held at Rome in May of this year, to a discussion of the practicability of FAO sponsoring arrangements which would ensure stability in terms of that organization's constitution. It is appropriate, therefore, to consider at this time some of the systems of price support which are being practised in various producing countries.

Methods of price control to achieve stability in agriculture fall broadly into two categories—those which apply to products consumed entirely or almost entirely in the country of origin and those which apply to products which are economically significant in the export trade. The following examples are typical of these classifications :—

Sweden

Sweden's economy is predominantly dependent on industry and sale of raw materials such as iron, steel, and timber. Agriculture operates under the disadvantage of a long, severe winter, a short growing-season, and a large proportion of small farms, resulting in relatively high costs and low incomes for farmers whose aggregate average income during the past ninety years has seldom reached two-thirds of the national average income.

In Sweden no attempt has been made to base prices on individual costs of production, but the general aim has been to arrive at such prices for farm products as would result in a balance between total farm cost and total farm income in Swedish agriculture as a whole, at the same time ensuring that a reasonably efficient worker in agriculture should obtain an income comparable with that earned by workers in other industries. The scheme was initiated during the war, a broadly constituted committee reviewing the economic position of agriculture in the light of national statistical and price data and reporting to the State Food Commission, which includes representatives of farmer organizations and all political parties. The Government then attempts to balance gross farming revenue against gross expenditure, not by fixing prices over the whole range of farm products, although this was done with some strategic products such as milk, but by using its influence on the market for farm requisites and for farm-produce.

Further refinements were introduced in 1947 involving the rationalization of Swedish agriculture, in particular by increasing the size of holdings, but from the point of view of price-control techniques the most interesting was the substitution of individual data secured by farm book-keeping methods for national data based on statistics.

The important features of the Swedish system are, first, the method of approach through the State Food Commission, which means that at least some aspects of agricultural price determination are lifted out of the political sphere, and secondly, the flexibility of the pricing aspects of the scheme through the elimination of rigidities inherent in any system of basing prices of individual farm products on their estimated unit costs of production.

THE UNITED STATES

The farm lands of the United States have a production potential for most commodities greatly exceeding local requirements. This factor, coupled with the unhindered operation of supply and demand, renders farm incomes extremely elastic. It is generally true of all countries that when produce prices fall mortgage indebtedness remains fixed and prices of farm requisites seldom fall to anything like the same degree as produce prices. Thus producers become extremely vulnerable in time of depression.

The need for price support of farm commodities led to the organization of the Commodity Credit Corporation (CCC) in 1933. This organization was managed and operated by the Reconstruction Finance Corporation until 1939, when it was transferred to the United States Department of Agriculture. In 1948 Congress provided the CCC with a permanent Federal Charter and wide powers. Its functions of immediate interest are (1) the power to support prices of agricultural commodities through loans, purchases, payments, and other operations; and (2) to purchase and dispose of surplus agricultural commodities. The CCC is capitalized at only $100,000,000, but is authorized in addition to borrow up to $4,750,000,000 on the credit of the United States Government.

A major difficulty in any form of price control, and particularly in agriculture, is that of assessing the cost of production of individual commodities, especially in the mixed farming enterprises generally characteristic of overseas countries. If it is assumed that such costs can be assessed, it must then be determined on what basis prices will be fixed—*i.e.*, average, highest, or lowest costs within the group, &c.

As in Sweden, no attempt is made in the United States to assess costs of production of individual items. The general basis of fixation is a system of farm-prosperity analysis leading to a determination of the purchasing-power of the farming community in relation to that of other sections of the community. This analysis is based on an index calculated for prices for farm requisites in relation to prices received for produce. The base period selected for most commodities is the average 1909–14, a stable period of relative prosperity and reasonable stability during which the prices of farm cost items were considered to be equitable in relation to produce prices.

The index of prices received is divided by the index of prices paid and the result is called the parity ratio. During the base period both indexes equalled 100, and in order to arrive at the prices thought desirable for each individual commodity, the average base-period price of this commodity is multiplied by the index of prices paid and the result is the parity price, which in effect represents a return for the commodity giving it purchasing-power equal to that of the base period.

In practice, there are numerous complications with consequent necessary adjustments. For instance, the relative cost of production of different commodities has changed considerably since 1909–14 (that of wheat has nearly halved relative to that of animal products), and price relationships are calculated on a more recent basis and then reduced to the level of the base period.

To calculate the index of prices paid by farmers, prices of no less than eighty-six commodities covering general living-costs and of eighty-nine items used in production are collected and weighted and interest and taxes are also included. This index is calculated on a monthly and yearly basis.

The parity price thus arrived at is the basis used for determining the vital feature of the system and the levels of support prices, which vary from 60 to 90 per cent. of the parity price, depending on the nature of the product.

For purposes of application, farm crops are divided into two classes, basic and non-basic. The six basic commodities are maize, wheat, cotton, tobacco, rice, and peanuts; and the non-basic include potatoes, eggs, butterfat, and wool. Others may be added to or taken off the list.

The level of support in excess of the minimum level depends on a number of factors, including the supply and importance of the commodity, its degree of perishability, the export position, and the ability and willingness of producers to keep supply in line with demand.

The normal required supply is calculated by the Department of Agriculture from estimates on consumption, export, and allowance for carry-over. It is in this respect that there arises the greatest difficulty in connection with any price-support programme which encourages production in excess of an amount for which there is an effective demand—namely, the problem of surpluses. The Department of Agriculture takes positive action to prevent excessive over-production to obviate the financial and political embarrassment of paying support prices on unused produce.

National acreages or quantity requirements are determined in advance and individual farmers are then asked to restrict their plantings to a certain acreage or, in the case of commodities to which acreage restriction is not applicable, to agree to market only a reduced quantity. Those willing to comply are called "co-operators." At present co-operators are entitled, with a few exceptions, to receive 90 per cent. of the parity price for the six basic commodities. Wool, although not a basic commodity, is being supported at between 60 and 90 per cent. of parity to encourage production, and other non-basic commodities are being supported at between 70 and 90 per cent. of parity as deemed essential by the Secretary of Agriculture to secure an adequate supply.

The United Kingdom

Agricultural price control in Britain is of recent origin and is, in fact, a direct outcome of war conditions. Originally, the objective was to develop as large a measure of self-sufficiency as possible in the period when there was a danger of supplies being cut off through enemy action, particularly in basic commodities such as bread grains and milk. The policy has been continued since the war because of balance-of-trade problems and shortage of dollar exchange. Britain is still dependent on imports for the bulk of her food; hence she has no problems of surpluses.

As in the two countries already quoted, the approach to price is a national one, the whole of the farming industry being regarded as one vast national undertaking. Each February negotiations take place between representatives of the Farmers' Union and high officials of the Ministry of Agriculture and Fisheries.

The first stage in the annual review is the discussion of priorities and of production targets, consideration being given to consumption trends and the position of overseas supplies. In the second stage the over-all "global total" estimates of net income and degree of prosperity of the farming industry are discussed on the basis of a profit and loss statement for the whole of United Kingdom agriculture prepared by the Ministry of Agriculture from national statistics of farm input and output. The purpose is to give an idea of the general level of profitability of farming.

The third stage of the review relates to the analysis of incomes from various types of farming and within them of the financial position of the various size groups of farms. Figures are collected by the Government, by the Farmers' Union, and by independent economists from the Universities, all collected on a uniform basis through a common form of primary return; thus, though disputes may arise over the interpretation of the data, there is complete agreement over their basic accuracy.

The fourth stage of the review relates to cost changes in production; that is, the extent to which various expenses such as fertilizers, feeding stuffs, wages, transport, &c., enter into the total production cost of each commodity. These data represent the basis of agreement on individual prices, but in the final analysis the general trend of profitability in farming and the relative profitability of different types and sizes of farms, national production requirements, and matters of general policy are also given due weight.

Australia

Australia has a national system of price stabilization for dairy-produce and wheat. Approximately 50 per cent. of total dairy-production is consumed locally, but wheat is an important export item.

The Commonwealth Government guarantees a price for wheat marketed through approved organizations on the basis of an index of production costs. Exports are included in the guarantee up to a limit of 100,000,000 bushels. A stabilization fund financed by a tax on export wheat protects growers in the event of the average sales price falling below the guaranteed price. This stabilization plan, which was introduced in 1948, will operate for five years and at the end of three years the fund will be reviewed. If it is considered too high in relation to ruling prices, refunds will be made to growers. At present export prices are just ahead of the guaranteed price, the difference being accentuated by depreciated currencies.

The principle of maintaining some measure of price stability in the dairy industry has obtained for a number of years. The local price of butter was held at a level above the export price, the difference being used to increase the over-all return. Since 1943 the Government has accepted the principle that dairy-farmers should receive prices in line with production costs. Periodic cost surveys are made by the Joint Dairying Industry Advisory Committee, consisting of four farmer and four Government representatives. All returns from the sales of butter and cheese, whether internal or exported, are equalized and a subsidy is paid to bring the equalized price up to the guaranteed price. This is necessary at present because, as in New Zealand, the local price of butter is being maintained at a level much below export parity. A Dairying Industry Stabilization Fund is being built up as f.o.b. values permit.

Because of certain clauses in the Constitution of the Commonwealth regarding inter-State trade, it is not possible for any Government body to regulate trade between States. This has been overcome by the voluntary formation of a private company, the Commonwealth Dairy Produce Equalization Committee, Ltd., which administers the equalization of the price and the payment of the subsidy and generally acts as a link between the Australian Dairy Produce Board, which handles all exports of butter and cheese, and the State Boards, which regulate marketing within their own States.

Canada

Canada, in addition to other farm products, exports about 70 per cent. of its wheat crop, a significant proportion of live-stock products, and potatoes. Production and exports are high in relation to the population; hence any price-support programme on a scale comparable to that operating in the United States is impracticable. Realistically, the Canadians have emphasized the necessity for keeping costs and marketing charges as low as possible.

Nevertheless, during the war, an Act aimed at support of agricultural prices was introduced and was to operate until March of this year. The operation of this Act has since been extended and provides that producers of any agricultural commodity, except wheat, can turn for assistance to a Board of three members, consisting of two producer representatives and a Department of Agriculture official acting as chairman. The Board has at its disposal a fund of $200,000,000, maintained at that amount by annual appropriations. The general task of the Board is to endeavour to secure adequate and stable returns for agriculture and to maintain a fair relationship between the returns from agriculture and those from other occupations.

Representatives of producers of a particular commodity or commodity group make representations to the Board, which studies the situation and either rejects the application or recommends to the Government that assistance be given. In the latter case it will also recommend a prescribed price and the amount of assistance as well as the

method of support it considers most appropriate to the particular case. This may take the form either of outright purchase or underwriting through guarantees or deficiency payments. In 1949 butter, cheese, skim-milk powder, and apples were assisted by the price-support programme.

International Attempts at Price Regulation

As New Zealand is more dependent on exports of foodstuffs than any other country in the world, we are naturally more interested in price control in countries where exports are important than in self-sufficient countries such as Sweden and importing countries such as Britain. Nevertheless, pricing systems for locally-consumed products such as wheat, eggs, food grains, and potatoes have always presented serious difficulties. Although considered separately such products appear of minor importance, their collective place in the national economy is great, and they must therefore be given careful consideration. Our main concern, however, must continue to be with export products and their prices.

The only products to which a system of price stability with legislative backing apply are butter and cheese. The system is effected through a guaranteed price under provisions of the Act establishing the Dairy Products Marketing Commission. That body, in fixing the guaranteed price, "shall have due regard to the economic stability of the country." Prices paid to producers for other export commodities are determined by agreement between the Government and producer representatives and with a general background of support made possible by long-term bulk contracts with limited f.o.b. price variations.

Reserves built up in industry pool accounts during recent years are of national importance, as they constitute a first line of defence against a possible fall in f.o.b. values below production costs. To the extent that they may be used as a buffer pending cost adjustments, they will assist in maintaining equilibrium between urban and rural incomes. These funds are not inexhaustible, however, and it must be envisaged that the national income might at some stage be called upon to assist in maintaining stability in primary industries.

Although we are not likely to face a severe crisis in the immediate future, the long-term implication of increasing production causes us to be particularly interested in international attempts to stabilize farming economy by the control of surpluses if and when they occur. In the international field the Social and Economic Council of United Nations, together with its specialized agency, the Food and Agriculture Organization, has been most concerned that action be taken at an international level. The constitution of the Food and Agriculture Organization is based on a philosophy of improving the nutritional standards of all the peoples of the world, but recognizes that producers of raw materials and foodstuffs must be assured of stability if they are to work towards this end. In 1946 Sir John Boyd Orr (now Lord Boyd Orr) presented plans for a World Food Board to the annual Conference of the Food and Agriculture Organization. His proposals envisaged an international body backed by international funds with power to buy and sell at its discretion. Although the principles underlying his proposals were generally supported by delegates at the conference, they were subsequently discarded by an interim commission set up to study them. The interim commission recommended an individual commodity approach through inter-governmental commodity agreements. This concept was carried forward to discussions on the establishment of an international trade organization, and as an outcome of meetings in New York, London, Geneva, and Havana, the Trade Charter included a chapter on the conditions under which inter-governmental commodity agreements might function and provided machinery for their establishment. Although the International Trade Organization has not yet materialized, there have been discussions on commodity agreements in various fields. These dis-

cussions have been sponsored by FAO or by individual Governments. The only agreement so far completed is that dealing with wheat. This agreement, in the main, follows the principles laid down in the Havana Charter, and it is hoped that when it comes up for review in four years it may be renewed on a broader basis.

Conferences have taken place in relation to other commodities such as sugar, rice, coffee, and tin. Some countries of the British Commonwealth have had experience in a co-operative marketing procedure for wool, and as a result of recent discussions in London it is possible that this commodity might be the subject of discussions at study-group level and later at international conferences. It is apparent, however, that the individual commodity approach is likely to be a slow one, and it is increasingly obvious that great difficulties must be faced in an endeavour to convince both producer and consumer Governments of the desirability of compromise in agreeing to mutually satisfactory prices on a long-term basis.

Following upon unbalance in international trade and non-convertibility of sterling the Food and Agriculture Organization studied a plan for an international commodity clearing house at its Conference held in Washington last year. This plan envisaged an international control organization financed by participating countries for the purpose of arranging the purchase and sale of commodities in surplus supply due to lack of hard-currency exchange. Because of this limitation and the considered opinion that it would aggravate the existing blocked currency position, the plan was discarded and we are now faced with the prospect of increasing surpluses of this type. The existence of such surpluses might well precipitate similar conditions in so-called soft-currency-producing countries also.

The International Federation of Agricultural Producers has given further consideration to these matters at its recent Conference in Stockholm, and it is to be expected that as a result of their deliberations producers themselves may bring forward some further plans for consideration on an international level. In the meantime the short-term problem in New Zealand is essentially an internal one, but we would be failing in our responsibilities if we did not make every effort to establish machinery which in terms of Government policy will offer reasonable stability to those producers catering for the local market only. Ultimately the objective should be co-ordination of producer interests of all staple products in order that a maximum degree of stability may be assured to primary industries and a maximum degree of equality preserved between rural and urban workers.

E. J. FAWCETT,
Director-General.

EXTENSION DIVISION

REPORT OF P. W. SMALLFIELD, DIRECTOR

During the past year all officers of the Division have had to work at high pressure to meet increasing demands for instructional, investigational, certification, and testing services. The results and methods of extension work are being reviewed and the Division has initiated a number of land-utilization and farm-management studies so that extension methods for raising farm production and efficiency on a district basis may be investigated and compared with the Division's traditional system of general instruction. Malvern County has been surveyed to investigate problems involved in a wider use of subterranean clover on light land in Canterbury; Akitio County farms have been studied to define methods and costs involved in North Island hill-country improvement; and in Franklin and Manukau Counties surveys have been carried out to review the problems of securing increased production on hill-country and ploughable land. On the initiative of (and in co-operation with) Federated Farmers the Division is investigating a plan for organized farm improvement in the Waikato. The plan aims to help selected groups of farmers to put into operation as quickly and economically as possible the latest knowledge on dairy-farm management.

These projects in land utilization, land improvement, and farm management have the object of confining extension work to limited areas and limited objects and should give tangible results fairly quickly in the areas chosen for the initial work. This approach to extension work has much to commend it, but it demands the services of specially trained men and can be extended only as staff becomes available.

The 1949–50 Season

Weather

Auckland Province.—The autumn and winter of 1949 were mild and were followed by a very favourable spring. Good weather continued until mid-December, when dry conditions set in, especially in North Auckland, where a major drought was experienced.

Wellington.—Throughout the southern half of the North Island climatic conditions were exceptionally favourable for all types of farming. The late autumn and winter were mild with no severe storms. The spring was early with good growth, except in coastal Hawke's Bay, where the rainfall was below average. The summer generally was very favourable to pastures and crops, with a plentiful rainfall and good harvest conditions, apart from districts in southern Hawke's Bay, where dry conditions continued from spring until late summer.

Canterbury.—The winter was mild and dry in most parts of Canterbury. North Canterbury experienced a dry spring and summer with some late frosts followed by good autumn rains. In Mid-Canterbury and South Canterbury dry conditions were alleviated by good rains from late November onwards, resulting in showery harvest conditions.

In Westland the season was wet and cold until January; since then it has been dry. Nelson had an excellent season with a high total of sunshine and good rainfall until late summer. Marlborough after a good winter experienced a severe drought.

Otago-Southland.—The winter was generally mild and dry except in Western Southland, where the rainfall was fairly high, and in South Otago, which experienced a very severe snowstorm, causing stock losses, in September. Cold weather prevailed in early spring with some late frosts. The early summer was dry, especially in North Otago and parts of Central Otago; late frosts in November in some districts caused damage to crops and retarded pasture growth. Good rains in December brought much relief to most districts and since that period rains were generally ample for crops and pastures.

Pastures

In the North Island pasture growth was exceptionally good during autumn and early winter.

Because the very mild winter in the Auckland Province resulted in excellent winter and early-spring growth, dairy herds did not suffer from the usual September feed shortage and there was a considerable increase in the practice of using winter-saved grass for spring feed.

As a result of dry summer conditions, especially in North Auckland, pasture production suffered considerably towards the close of the season.

All districts in the southern half of the North Island experienced early spring growth, and though growth was checked in September and October, good rains in November resulted in prolific growth with ample surpluses for hay and silage.

Pasture renewal by ploughing and resowing has increased considerably throughout the North Island. The use of giant disks on steeper country is developing satisfactorily, and there is also much activity in the breaking-in of coastal sand country and in the development of river-flats.

In Canterbury pasture growth was poor in spring and early summer, but there was a timely recovery following rains in November and December and autumn growth was particularly good.

In Westland pasture growth was poor throughout the season; Nelson experienced good growth; in Marlborough good winter growth was followed by drought conditions in summer, and pastures dried up until late autumn.

Mild conditions during winter and early spring favoured pasture growth in Otago. Dry weather followed and summer growth was poor especially in North Otago, where the feed position became critical. Pastures in all districts recovered after rain in December.

In Southland no usual flush of growth was experienced in November and December. Dry conditions continued during January and February and it was only in March that pasture growth became normal.

Supplementary Fodder

Hay and Silage.—The favourable spring weather caused a general increase in the amounts of hay and silage made in the North Island. A large proportion of the hay crop is now baled with the use of the pick-up baler, and contract haymaking is increasing. Weather conditions were favourable for haymaking in the north, resulting in good-quality hay being made. There was also a noticeable increase in the amount of silage made in most dairying districts. In the South Island the quantities of hay and silage saved varied from district to district.

Lucerne.—The area in lucerne continues to increase in the South Island, especially in Canterbury and Marlborough, although established stands in those districts did not contribute their usual quantities last season. In Central Otago, on the other hand, large crops of lucerne hay were harvested.

Swedes and Turnips.—There has been a slight increase in the acreage of swedes and turnips in the North Island, where crops were fairly normal, except in North Auckland. Crops generally in that district suffered from dry conditions. In the South Island average crops were reported, except in Mid-Canterbury, where insect damage, particularly from diamond-backed moth, was severe, and in Otago and Southland, where club root and dry rot reduced yields.

Rape and Chou Moellier.—Rape is a fairly important crop in Central Hawke's Bay and parts of Wairarapa where pastures dry out early and this season the crop has done well. The Canterbury rape crops were affected by insect damage, except in South Canterbury, where the yields were normal. In Otago and Southland rape continues to be the most important lamb-fattening feed; fairly large crops were sown, and yields were good.

The chou-moellier crop continues to increase in the Wellington district, being used on dairy farms for autumn and winter feed, and in some cases as a folded summer milk-producing crop. On fat-lamb farms it is used both as a lamb- and ewe-fattening crop and as a winter feed crop. Crops last season were favourably reported upon.

Cereal, Pulse, and Food Crops

The acreage in cereal crops showed a general decrease over the previous season, the wheat and oat acreages in particular being at very low levels. The very dry autumn and early winter in Canterbury caused dry-soil conditions not conducive to autumn cultivation for cereal crops. Details of estimated crop acreages and the comparative figures for 1948-49 season are as follows :—

	1948–49. Acres.	1949–50. Acres (Estimated).
Wheat (all purposes)	148,653	130,000
Oats (all purposes)	194,850	170,000
Barley (all purposes)	70,807	70,000
Peas	49,152	43,000
Potatoes	18,940	18,000
Onions	1,175	*
Maize (for grain)	6,588	*

* Not available.

Wheat.—The area sown showed a decline in most districts. Autumn-sown crops grew well throughout the winter, but those on the lighter land in Canterbury and North Otago were affected by the very dry spring. In most districts of the South Island late frosts during November caused much damage to some crops and hail damage was also reported in some districts of South and North Canterbury. At harvest wheat crops yielded fairly satisfactorily and the quality of grain was better than average.

Oats.—Yields and grain samples were generally poor in North and Mid-Canterbury, but good in South Canterbury. The oat crops in Southland yielded well and in contrast to the previous year there was little lodging. There is still a fairly substantial carry-over of low-grade oats in store from the previous year's crop and there is little demand by the trade for new season's oats.

Barley.—Although there has been a decrease in the quantity of feed barley grown, the malting-barley acreage continues to hold at a high level. Yields were generally good, although in parts of Otago crops suffered from dry conditions in spring.

Potatoes.—The acreage of potatoes was estimated to be almost equal to the previous season's crop, but indications are that yields will be greater. Early crops in the North Island were not heavy, but second earlies yielded better than average, and, with a scarcity caused by low yields from the previous season, they found a ready market.

The yields of main crops in South Canterbury and Otago are expected to be better than last season, but only fair to average in North Canterbury.

Peas.—In Nelson and Marlborough the season for canning and garden peas was good, but field-pea crop yields were below average in those districts and also in North Canterbury. In Mid-Canterbury and South Canterbury yields were fairly good : further south pea crops suffered as a result of dry weather.

Onions.—The acreage of onions is considered to be almost equal to that of the previous season and the yields are fairly satisfactory.

Maize.—Except on the flats, where yields will be fair, the crops of maize will be very much poorer in the Auckland Province. In Poverty Bay the crop has made excellent growth and promises well. The Pfister hybrid No. 360 is now being grown on more than half the acreage of maize sown for grain production.

Linseed and Linen-flax.—In North Canterbury linseed crops suffered on account of dry weather, but further south crops were generally good. Linen-flax growing is now confined to one district in South Canterbury and one in Southland and from both these areas high yielding crops of fairly good quality were obtained.

Extension Services

The Division still has vacancies for instructional and research staff which require filling before it can provide a full extension service to the farming community. The recruitment of sufficient men suitably trained in the science and practice of farming has long been a difficulty for the Division, but the training and recruitment plans outlined in last year's report should eventually supply the staff required. Unfortunately, last year no suitable applicants offered themselves for the bursaries in agricultural science leading to service in the Extension Division.

During the year close attention has been paid to improving the efficiency of extension officers, and short courses have been arranged for selected officers for special instruction in farm machinery, drainage, soil testing, plant diseases, seed certification, and experimental work. With increased mechanization of tillage, drainage, and harvesting operations the need has arisen for more Instructors with special knowledge in these fields, and courses for Farm Machinery Instructors have been arranged with Canterbury Agricultural College, Lincoln, and in drainage with Massey College.

The Division's plans for widening extension work for hill country and other marginal-land improvement have been advanced and Instructors have been giving increased attention to hill-country top-dressing, oversowing of clovers, and grazing-management methods. Instructors have nearly completed a broad survey of the potential increases in carrying-capacity in the North Island which might be expected from the general adoption of proved land-improvement practices.

Lectures, Field-Days, and Farm Schools

The Division carried out its usual programme of lectures, field-days, and farm schools and was assisted in the farm-school work by officers of other Divisions and Departments and by lecturers from the agricultural colleges. Sixty-five farm schools were held, the Division organized 262 field-days, and Instructors delivered 547 special lectures. Weekly radio talks were continued from Auckland, sessions were inaugurated from Dunedin, and divisional officers assisted with the broadcasts from Palmerston North, Wellington, Christchurch, and Invercargill.

A special travelling farm school based on the Department's show exhibit was conducted in North Auckland during February and March. Lectures were provided for country women as well as for farmers and the attendances at these schools, which were confined to small centres, were very good.

The Division's Visual Aids Section has now been provided with permanent workroom accommodation and facilities are available to allow of the adequate provision of slides and film-strips for extension lectures. During the year the Visual Aids Officer took 800 photographs of farming subjects for use in illustrating departmental publications, for the preparation of lantern-slides, and for general publicity.

Flock House Farm of Instruction

The scope of the farm-training course for youths at Flock House was considerably expanded during the past year. More up-to-date accommodation and facilities have been provided for the 45 trainees in residence, while practical training has been supplemented by lectures from staff and departmental specialist officers as well as by demonstrations and visits to various farms in the district. The trainees have been active in the

development of a further block of coastal sand country totalling 220 acres, which has provided excellent experience in such operations as land clearing, cultivation, pasture establishment, fencing, top-dressing, and building.

This is the commencement of a much larger land-improvement programme which has become possible by the completion of a new road through the sand country on the Station. The property is at present carrying 7,004 ewes, 1,323 cattle (including 85 milking-cows), and 111 pigs.

During the year crops such as wheat, oats, potatoes, maize, and most types of forage crops were grown. A large number of experiments on crops and pastures were also carried out on the farm.

Young Farmers' Clubs

Further progress has been made in the Young Farmers' Clubs movement during the year. The number of clubs has increased by 20, the total now being 330 with an active membership of about 9,900: in addition there is an honorary and advisory membership of about 1,500. The numbers of clubs in the four council areas in the past three years were:—

Council.	1947–48.	1948–49.	1949–50.
Auckland	108	115	125
Wellington	97	95	97
Canterbury	54	53	58
Otago-Southland	47	47	50
	306	310	330

Considerable progress continues to be made in the Auckland Council area, where the pre-war total of 53 clubs has now been increased to 125. There is still scope for expansion in all districts, as the present membership of the clubs is only about half the potential membership.

The usual club activities of lectures, debates, discussions, field-days, &c., generally have been well organized and attended. Parties of young farmers have travelled to see farming in other districts and during the year twenty-two tours were arranged, including those of two parties which visited Australia. A national ploughing match was held at Waimate, South Canterbury, and the contest drew competitors from North Canterbury and Southland as well as local entrants. Shearing contests have again been conducted on a district scale and on a council scale in Wellington. These contests are proving of value in interesting young men to become proficient shearers. The usual debating and stock-judging competitions were again held on a national scale. A national miniature-rifle competition was conducted by means of a postal shoot and was competed for by over 140 club teams.

The leadership courses instituted last year were held again this year. The Wellington and Canterbury Councils held conferences lasting several days at Massey and Lincoln Colleges respectively, and each course was attended by 50 to 60 club delegates. Unfortunately, through lack of accommodation, a similar course in the Otago-Southland Council area had to be abandoned, but will probably be held next year. The Auckland Council followed its former course by holding a series of one- and two-day conferences on a district scale.

The Country Girls' Clubs movement sponsored by the Y.F.C. Federation is making progress and has now 24 affiliated clubs. The movement has achieved greatest success in Canterbury, but clubs have been formed from North Auckland to South Otago. The Rural Sociology Section of the Division has given assistance to the movement and field officers have given lectures and demonstrations to clubs and provided a secretarial service.

Show Exhibits

The Division is responsible for the general organization of departmental exhibits at summer and winter shows and during the year a very comprehensive exhibit was staged at twenty shows. Because a considerable number of shows were held on the same dates, it was impossible to cover many centres with the main exhibit, but wherever possible a local exhibit was staged by the Extension and Horticulture Divisions. A modified exhibit was staged at a ploughing competition and six farm schools in North Auckland. The exhibits proved of great interest to the farming community.

Farm Engineering

The demand for the services of Farm Machinery Instructors has increased and advisory work has been carried out by farm visits, radio talks, articles in *The New Zealand Journal of Agriculture*, lectures, and demonstrations. A number of farm machinery inventions have been reported on and a low-volume spray equipment design evolved for farm construction at low cost. Farm safety precautions in the use of machinery have been studied and arrangements made to collect information on the causes of serious accidents on farms so that farm safety advice information may be expanded.

The Farm Forestry Officer has continued regional study of farm plantations in the Bay of Plenty, Northland, and Mid-Canterbury. Advisory work has covered *Journal* articles, visits to farms (at the special request of local Instructors), lectures to farm schools and Young Farmers' Clubs, and the preparation of exhibits at winter shows.

Planting plans have been prepared for the Winchmore Irrigation Station, Flock House Farm of Instruction, and Invermay Agricultural Research Station.

Rural Sociology

The research project on "Housing in Vincent County" has been completed. The project on water-supply for farm houses in South Canterbury is nearing completion and a study of farm housing in Ashburton County has been commenced.

Extension work in the Home Economics Section has been carried out by means of articles in the *Journal*, lectures, radio talks, and demonstrations.

Seed-production

The quantities of the various pasture and crop seeds harvested during 1949 have shown little variation from those saved the previous season.

The total yield of short-rotation rye-grass seed was the highest to date and reveals the wider use being made of this grass.

The level of cocksfoot-seed production is still low and has led to a shortage for local requirements, with no seed available for export. An exceptionally large crop of chewings fescue was harvested in 1949, the figure of 5,250,000 lb. being half as great again as the highest yield of the five preceding seasons.

The production of chou-moellier seed has further recovered to a point where the locally grown seed is sufficient to meet requirements. The fluctuation in production of turnip and swede seed is caused largely by adjustment of the acreage sown in accordance with stocks of seed on hand, a full supply of seed of a comprehensive range of varieties being available.

Contract Growing of Seeds.—The programme of multiplying under contract nucleus lots of seeds supplied by the Department of Scientific and Industrial Research has been maintained.

After multiplication to a sufficient quantity these seeds are distributed into the seed-growing areas. The following is the distribution list of these seeds for 1949 :—

A. *For Further Seed-production*

Perennial rye-grass	1,443 bushels
Italian rye-grass	547½ bushels
Short-rotation rye-grass	1,704½ bushels
Timothy	1,114 lb.
White clover	4,370⅓ lb.
Montgomery red clover	1,082 lb.
Cowgrass	1,633 lb.
Lucerne	15,503 lb.
Rape seed—	
Broad leaf Essex	4,335 lb.
Giant	625 lb.
Seed oats—	
Abundance	723 bushels
Algerian	535 bushels
Achilles	120 bushels

B. *For Sowing Commercial Crops*

Seed oats : Binder	264 bushels
Rape : Club root resistant	114½ cwt.
Italian rye-grass	1,200 bushels
Seed maize	1,056 bushels

In addition to these, 1,243 bushels of oats surplus to seed requirements were sold for feed and 218 bushels of wheat were sold for a milling trial.

Seed Certification.—The production of certified seed has in its trend followed fairly closely the pattern of the total seed-production.

The following table shows the quantities of the various seeds certified in 1948 and 1949 respectively :—

Seed.	1948.	1949.
Perennial rye-grass	565,562 bushels	575,905 bushels
Italian rye-grass	32,154 bushels	26,876 bushels
Short-rotation rye-grass	83,225 bushels	115,309 bushels
Cocksfoot	485,869 lb.	503,169 lb.
Brown-top	379,349 lb.	367,449 lb.
Timothy	15,031 lb.	21,390 lb.
Phalaris tuberosa	..	644 lb.
White clover	2,993,090 lb.	2,724,508 lb.
Montgomery red clover	598,957 lb.	488,052 lb.
Cowgrass	693,760 lb.	740,784 lb.
Subterranean clover	155,898 lb.	17,851 lb.
Lucerne	20,105 lb.	24,706 lb.
Linen-flax seed	..	3,514 cwt.
Seed wheat	113,251 bushels	110,033 bushels
Seed oats	1,158 bushels	14,196 bushels
Seed maize	..	1,056 bushels
Seed barley	..	3,116 bushels
Sweet blue lupin	..	104 bushels
Rape	494,456 lb.	473,669 lb.
*Turnip	94,393 lb.	414,598 lb.
*Swede	340,491 lb.	175,244 lb.
Chou moellier	26,051 lb.	68,845 lb.
*Kale	13,764 lb.	8,870 lb.
Onion seed	14,587 lb.	8,625 lb.
Seed potatoes	8,515 tons	6,591 tons

* This seed is termed "Government Approved."

Certified *Phalaris tuberosa* seed and certified sweet blue lupin seed have been produced in limited and irregular quantities for several years.

The decline in production of certified subterranean-clover seed is the result of an unfavourable season for this crop, most of which is harvested in the Marlborough district.

Linen-flax seed was certified in 1949 in order to meet overseas orders being received for this seed. This procedure is being continued and enables surplus stocks of locally grown seed to be sold to European markets.

The certification of seed oats has shown the expansion normally to be expected of a crop newly introduced into the scheme, and it is too early yet to forecast its ultimate standing. A similar remark applies to seed barley, which was introduced into the scheme a season later.

All seed maize certified is of hybrid type grown from parent material imported by the Department from the United States of America. The seed distributed is sufficient to sow about half of our maize grain acreage, and it is intended that all seed certified should be the immediate product of further parent material imported by the Department.

The production of Government-approved turnip and swede seeds and of certified chou-moellier seed has fluctuated according to the stock position of these seeds, and is not an indication of market shortages or surpluses.

The production of kale seed is at present not equal to the demand.

General.—The Agronomy Section supervises the details involved in the export and import licensing of agricultural seeds. The general principle adopted is to restrict export only in so far as protection of local requirement is necessary and to permit import of those seeds not being grown locally in sufficient quantity.

The section co-operates with other sections of the Department in the testing-out of strains and varieties of farm crops, and with the Divisions of the Department of Scientific and Industrial Research in the multiplication and release of improved types. It is associated with the activities of Advisory Committees dealing with various crops while the operations of the Department's Seed-testing Station are closely linked with it.

Seed-testing Station

The volume of work at the Seed-testing Station continued at a high level during 1949; the numbers of tests carried out during the past three years have been as follows:

	1947.	1948.	1949.
Purity	35,623	32,451	32,986
Germination	48,922	45,158	44,703
Ultra-violet ray	6,087	3,952	4,768
Picric acid	6,398	6,231	5,596

Staff.—Recruitment of staff has improved, but staff numbers are still below establishment. The research sections of the Station have been improved and an effective liaison has been built up between the research and testing sections.

Pre-harvest Examination of Rye-grass Seed.—Substations staffed by five officers of the Seed-testing Station were established at Christchurch and Timaru for examination of blind-seed disease. A total of 714 samples was examined.

Seed-purchasing.—During the calendar year 1949 seed for Government Departments was purchased to a value of £266,000.

General.—The work of the Seed-testing Station was brought to the notice of farmers and merchants through show exhibits, radio talks, and lectures. A large number of persons comprising students, farmers, merchants, and teachers have visited the Station during the year.

Field Experimental Work

The research work of the Extension Division is a major activity of the staff and covers a large and expanding field of work. The demands from the farming community and trade interests for an increasing amount of experimental work are being met as far as the number of trained staff available allows. The scope of research is ever-widening and it becomes increasingly necessary to have available the services of specialists and research stations if the field staff is to be used with the greatest efficiency. The integration of the research work of all sections of the Extension Division has been accomplished with this object and this report, although primarily concerned with co-operative experiments conducted on private farms, summarizes results of projects in which various specialist officers and research stations have played an important part.

The total numbers of trials conducted are shown by the following table :—

Numbers of Trials

Nature of Trials.	Co-operative Trials.	Rukuhia Soil Research Station.	Marton Experimental Area.	Winchmore Irrigation Station.	Flock House and Demonstration Farms.
Pasture-production measurement—					
As at 1st April, 1949	1	11	12	1	7
Laid down during year ..	1	3	4	6	1
Discontinued during year ..	..	..	..	..	1
As at 31st March, 1950 ..	2	14	16	7	7
Observational top-dressing on pasture—					
As at 1st April, 1949	220	11	..	2	4
Laid down during year ..	106	4	..	..	3
Discontinued during year ..	86	..	..	..	..
As at 31st March, 1950 ..	240	15	..	2	7
Pasture species—					
As at 1st April, 1949	251	..	5	3	11
Laid down during year ..	61	..	..	..	..
Discontinued during year ..	67	..	3	..	1
As at 31st March, 1950 ..	245	..	2	3	10
Annual crops—					
As at 1st April, 1949	227	3	6	14	19
Laid down during year ..	193	2	5	12	23
Discontinued during year ..	224	3	6	13	19
As at 31st March, 1950 ..	196	2	5	13	23
Miscellaneous—					
As at 1st April, 1949	318	..	4	2	10
Laid down during year ..	81	..	1	1	15
Discontinued during year ..	167	..	3	..	15
As at 31st March, 1950 ..	232	..	2	3	10
Totals—					
As at 1st April, 1949	1,017	25	23	22	51
Laid down during year ..	442	9	10	19	42
Discontinued during year ..	544	3	12	13	36
As at 31st March, 1950 ..	915	31	25	28	57

Grand total of trials open at 31st March, 1950, was 1,056.

In addition to carrying out the statistical analysis of the results from these trials the Crop Experimentalist's Section has undertaken a number of additional projects including measurements of the spread of fertilizer distributed from aircraft and from blower-type top-dressers, the analysis of results from surveys of factors affecting the yield of wheat, of factors influencing the incidence of blind-seed disease of rye-grass, and of factors associated with the occurrence of clover seed producing abnormal growths

in germination tests. The design and analysis of a number of trials and surveys for other Divisions of the Department have been undertaken. The value of a competent group for experimental statistical analysis is recognized and increasing demands are being made for its services.

The research work of the Extension Division has the primary aim of providing the extension officer in the field with reliable information for passing on to farmers. It has, therefore, in the majority of cases, a practical and local rather than a fundamental or general approach to farming problems. In this field of work the scheme of conducting co-operative experiments on farms has given fruitful results with a minimum expenditure of time and money.

(1) *Pasture Top-dressing*

Nutrient Requirements of Soils for Pasture Growth.—This is a long-term investigation by means of a limited number of pasture-production measurement trials in selected localities and a large number of observational top-dressing trials to cover the major soil types of the Dominion. The grouping and naming of New Zealand soils by officers of the Soil Bureau of the Department of Scientific and Industrial Research have provided the basis for the mapping of the pasture lands according to their manurial requirements. In a number of districts the work has progressed to a stage where the best fertilizer practice for all the major soil types may be confidently advised. However, in those areas, such as most of the South Island, where the soil survey is incomplete, much additional experimental work requires to be done.

Trials With "Concentrated Phosphates."—Superphosphate is easily the most widely used phosphatic fertilizer in New Zealand, as it is in most overseas countries. However, for top-dressing from aeroplanes, which is now being developed, and for districts where transport charges are heavy, a more concentrated form of phosphatic fertilizer than superphosphate would be advantageous in reducing distribution costs. Pasture measurement trials have therefore been commenced at the Rukuhia Soil Research Station and the Marton Experimental Area and a number of observational trials have been laid down in various parts of New Zealand to compare these concentrated fertilizers with superphosphate on the basis of equivalent rates of phosphate applied. In general, most products tested have given results equivalent to superphosphate per unit of phosphoric acid applied, and one or two of the products made by the fusion of raw rock phosphate with other materials, such as serpentine, compare more than favourably with superphosphate. Unfortunately, the cost per unit of phosphoric acid of concentrated fertilizers is generally much higher than that of superphosphate and the new materials would have to show considerable advantages in efficiency or reduced application costs before they could compete with the standard fertilizers.

Comparisons of Other Forms of Phosphatic Fertilizers.—A large number of measurement and observational trials compare various commercially available phosphatic fertilizers such as basic slag, ground rock phosphates, serpentine-superphosphate, reverted superphosphate, and organic fertilizers with superphosphate. Trials are conducted under a variety of differing conditions on hill and flat country. In general, ground North African rock phosphates and basic slag have proved to be valuable fertilizers in high-rainfall country where adequate liming is difficult and the soils are naturally acid. Under most conditions other than these serpentine-superphosphate, reverted superphosphate, basic slag, and superphosphate do not give greatly differing results, but ground-rock phosphates are less effective. Ground-rock phosphates of the Nauru type have given disappointing results in practically all cases.

Liming Trials.—In a number of measurement and observational trials the following factors are studied: Rates per acre of lime applied, fineness of grinding of limestone, purity of limestone, and reactivity of the limestone. The effect of liming on the availability of soil nutrients and on the responses shown by fertilizers is also being evaluated. It

would appear that in some districts, especially in Southland, certain soils are being overlimed, with the result that the uptake of other minerals from the soil is being reduced. An endeavour is being made to obtain additional data on which to base standards for fineness of grinding of limestone. The optimum rate of limestone to apply per acre is being investigated for several different soil types. A production measurement trial at the Marton Experimental Area is still giving significant responses in pasture-production to limestone on plots which received their last lime application ten years ago.

"Rate of Growth" of Pastures.—Measurement trials are in progress in various districts from Winton in Southland to Dargaville in Northland. These trials study seasonal and yearly changes in pasture-production and in the growth of the various species of the pasture sward. This work gives fundamental information which can be applied to many practical farming problems such as the provision of supplementary feed.

The past year was one of above-average pasture-production in most districts. Figures in excess of 11,000 lb. dry matter per acre were recorded at the Marton Experimental Area where the mean yearly production over the last nineteen years is 9,700 lb. dry matter per acre. At that area winter production figures were about 25 per cent. above normal.

Pasture Responses to Potash Fertilizers.—A survey of pasture responses to potash fertilizers in Taranaki by means of a large number of simple observational trials to cover the soil types of that area has revealed that practically all the volcanic soils of Taranaki are in some degree deficient in potash and that this deficiency appears to be more pronounced and to extend over a greater area than previously thought. In the Rotorua and Bay of Plenty districts several types of pumice soils, but especially those derived from the Kaharoa ash-shower, have been shown to be deficient in potash. Investigations at the Rukuhia Soil Research Station and in a number of other localities in both Islands have shown that peat soils in general require liberal dressings of potash fertilizers if satisfactory pasture is to be established and maintained. Deficiencies of potash appear to be becoming more general in most districts that have been farmed for a number of years, and from the evidence available farmers in New Zealand could profitably use a considerably greater amount of potash fertilizers than they are using at present. Nevertheless, the need for potash is by no means as widespread as the need for phosphates, and farmers intending to use potash fertilizers for the first time are advised to consult their local Instructor in Agriculture as to the need of the soils of their farms for these fertilizers.

"Minor" Elements.—Apart from those "trace" elements, such as copper and cobalt, which are needed for stock health, but the need for which is not normally seen in pasture growth, there are a number of elements whose absence is reflected in "deficiency diseases" of pastures and crops or in unsatisfactory pasture growth, particularly of clovers. The need for boron for the prevention of brown heart of swedes and turnips has been demonstrated on a variety of soils throughout New Zealand and occasionally on other crops such as lucerne. Trials are at present under way in Northland to determine whether pasture responses to boron may be secured on some of the gumland soils of that area which are said to be deficient in this element.

Molybdenum deficiency has created interest in New Zealand following the discovery that on large areas in Australia spectacular results in pasture growth have resulted from the application of minute quantities of molybdenum salts. In New Zealand, however, apart from the occurrence of the deficiency disease known as whiptail in cauliflowers, no evidence is available which suggests that there are considerable areas of pasture land in New Zealand which would respond to molybdenum applications, but the investigation into a number of soil types which may give such results is being continued.

(2) *Pasture Species*

Pasture Species and "Strains" on Ploughed Land.—A considerable number of trials of this type is laid down primarily as demonstration plots for farming, but the majority of trials investigate factors such as the optimum rates of seeding of both the clover and grass elements of the sward; the place of the subdominant species in high-production swards; the value and place of "special purpose" pastures such as lucerne-cocksfoot mixtures, and the evaluation of recently developed strains of pasture plants such as short-rotation rye-grass. Under adequate rainfall and high-fertility conditions—whether such fertility is natural or has been induced by fertilizers—the pasture sward which is dominantly perennial rye-grass and white clover remains as the ideal one which it is entirely possible for farmers to achieve. The optimum utilization of the sward by correct grazing management has also been established. Experimental work with pasture species on ploughed land is therefore being directed more to "problem" soils and climates such as the light shingly country of Canterbury, where the establishment and maintenance of a satisfactory pasture sward is difficult. Here the possibilities of species such as *Phalaris tuberosa*, cocksfoot, lucerne, subterranean clover, perennial veldt grass, and a number of other species are being investigated, as are methods of establishing these species and their management requirements. Cocksfoot, subterranean clover, and lucerne promise to be useful species under such conditions.

Pasture Improvement on Unploughable Hill Country.—The problem of the establishment and maintenance of a satisfactory pasture on unploughable hill country in a manner which is economically possible to the farmer is in many cases not solved or is only partially solved. As in all swards, clovers are the basis of success in the hill country, and experimental work is directed basically towards the introduction of desirable strains and species of clovers into hill-country swards and their encouragement into vigorous growth by suitable top-dressing and controlled grazing management. A large and increasing number of trials is in progress to discover ways and means to this end. Though the majority of such experiments are of small-plot types, several paddock-scale trials are also being established where the factor of grazing management can be more adequately controlled and evaluated. This work has direct application to soil conservation, a vigorous, dense pasture sward being an efficient preventative of some forms of erosion.

Results have shown that subterranean clover (on the land of lower fertility or lower rainfall), white clover (where the rainfall is reliable and the soil fertility can be maintained at a fairly high level), and *Lotus major* (in the areas of highest rainfall or in naturally damp locations) are the three most valuable species in the hill country. The exact conditions required for their successful introduction by surface seeding are not thoroughly understood, however, and investigation is proceeding along these lines. The establishment of grass species by surface seeding under hill-country conditions is much more difficult than that of clovers, but to achieve the full benefit from clover introduction it is probable that ways and means will have to be found to introduce more productive grass species than are normally found in hill-country swards.

Problems of reversion to fern, scrub, and secondary growth must be investigated in any scheme for the improvement of hill-country pastures. Although some work is in progress with the use of chemical weed-killers on scrub growth, in the majority of cases such a method probably will be more costly and give less lasting results than one which results in improved density and growth from the pastures and includes controlled grazing and particularly the avoidance of over-grazing of such pastures.

A possible means of improving the percentage establishment of surface-sown species is by "pelleting" or coating their seed with materials which will protect them from damage by birds or adverse weather and the inclusion in the pellet of fertilizing materials to stimulate growth during the critical establishment period. A considerable number

of trials with "pelleted" seed is under examination. Results to date have not been very promising, but improved types of pellet are being developed at the Rukuhia Soil Research Station and these may prove more satisfactory.

Trials on Tussock and Depleted Country.—The improvement of the tussock and depleted country must follow the control of rabbits, of burning, and of grazing. Until this is accomplished the chances of successfully introducing species by seeding are very small. Several trials involving studies of natural tussock regeneration following shutting up from grazing are in progress in the Cass district, where a series of plant-introduction plots has also been established. In the Central Otago depleted country work on species introduction is being continued at the Pisa Experimental Area, and an area has been secured for large-scale plant introduction trials on the hills bordering Hawea Flat. Several species have been successfully established at Pisa. They include danthonia, *Poa pratensis*, *Phalaris tuberosa*, tall oatgrass, tall fescue, sheep's burnet, yarrow, the grasses *Brachypodium phœnecioides* and *Agropyron scabrum*, and lucerne.

(3) *Annual Crops*

Wheat.—The field testing of crosses bred by the Wheat Research Institute continues to be an important link in the improvement of wheat varieties. Testing of the yielding ability and agronomic features of these crosses in co-operative trials on farms has given reliable information concerning the probable commercial merits of new varieties. A comprehensive series of wheat-manuring trials has been completed. These showed that wheat soils in general have sufficient available potash for wheat and that land of high natural fertility and which has been generously dressed with phosphatic fertilizers before the wheat crop did not give responses to phosphate applied with the wheat. Nevertheless, on heavily cropped land or on medium to light wheat land some response to phosphates might be expected. Significant responses to nitrogenous fertilizers top-dressed on the growing crop in the spring were secured in a large number of trials. More evidence is needed, however, of the conditions under which such responses to nitrogen might be expected. The survey of factors affecting the yield of wheat crops in the Christchurch and Ashburton districts, which has been in progress for the past five years, has shown the importance of previous cropping history. Trial results require re-analysis on this basis and future work will be planned to study more carefully the inter-action between rotational history of the trial area and the responses to fertilizers.

Oats.—Work with oat varieties has not progressed very far, as none of the new crosses developed by the Crop Research Division, Department of Scientific and Industrial Research, has given very promising results in field trials. The primary aim is a high-quality milling oat of good yielding ability and showing resistance to lodging. The testing of new varieties from overseas against standard local varieties appears likely to continue as the main type of trial with oats.

Barley.—Some new introductions, particularly the Danish stiff-strawed variety Kenia, have compared more than favourably with local varieties in field experiments for yielding ability, resistance to lodging, and suitability for harvesting with the header harvester. Barley varieties which have been standard types in New Zealand for many years are rapidly losing ground to new introductions, and in Canterbury particularly to Research, an Australian variety. Research has performed well in trials, but the lines available in New Zealand have not been favoured by maltsters due to their mixed nature in respect of times of maturity. The Crop Research Division, Department of Scientific and Industrial Research, has made a number of selections from Research which mature at different times, but each is even in this respect within the selection, and these are being tested in field trials this year.

Linen Flax.—The experimental work with this crop has declined as has the importance of the crop in New Zealand. Some promising rust-resistant varieties of Russian origin are being tested in field trials.

Linseed.—The scope for improvement in this crop in the immediate future lies mainly in the use of better varieties, and some new introductions are giving promising results in trials.

Maize.—Marked yield increases over local varieties have been obtained in trials from several maize hybrids secured from various sources in the United States. The maize hybrid line Pfister 360 from that country has rapidly replaced local varieties in the main maize-growing districts, but experiments have shown that other hybrids will considerably outyield Pfister 360 as well as local varieties in many circumstances. Maize variety trials with such hybrids are therefore being extended as rapidly as possible in order that evidence may be accumulated which will enable the selection of the most suitable varieties.

Potatoes.—A considerable number of trials which include most of the common potato varieties are laid down in various districts throughout New Zealand, primarily as demonstrations to departmental officers and farmers, but in addition to give valuable information as to the yield, disease resistance, and general suitability of varieties in the various potato-growing areas. A number of more detailed trials compares lines of the same variety of different origins, but this work is still in the initial stages. A series of trials has been completed where sulphate of ammonia was applied with the seed (together with phosphatic fertilizer) in comparison with its application as a side dressing at various stages of growth of the crop to flowering. Contrary to overseas results the later applications of sulphate of ammonia showed no advantage over application with the seed.

Three comprehensive trials in the Apiti-Rangiwahia district investigated the effect on the production of seed tubers of row spacing, the spacing of tubers in the rows, the effect of time of planting, and of size of seed. The trials gave conclusive evidence that the closer the spacing of tubers sown within the rows and the closer the spacing between rows, the higher the yields of seed-size tubers and the lower the yields of table-size tubers. The closest spacings were 24 in. between the rows and 10 in. within the rows.

Lamb-fattening Crops.—The value of several varieties of sweet lupins in comparison with different varieties of rape and chou moellier as lamb-fattening crops is being investigated. Sweet yellow lupins have proved very useful in the North Island, especially on the sand country of the Manawatu and in districts where rape is an uncertain crop. However, the strain at present available has been most difficult to harvest for seed and the recent development of a non-shattering strain of sweet yellow lupin is therefore a necessary development if this crop is to be grown widely.

(4) *Miscellaneous Trials*

Weed Control.—The rapid commercial development of new forms of chemical weed-killer since the war has been paralleled by a demand for information concerning their relative merits, the weed species against which they are effective, and the best time and method of application of the chemicals. The range of hormone-type weed-killers in particular is increasing and these substances have needed extensive experimental work to determine their merits as agricultural chemicals. Experimental work to date has enabled the classification of the majority of plant species of importance to agriculture according to their resistance or susceptibility to most of the weed-killing materials at present commercially available. However, the definition of the conditions under which these substances may be most efficiently used requires much further investigational work. More precise information is also being sought as to the effects of these chemicals in terms of crop and pasture yields.

Although of necessity over the past few years the emphasis has been on the place of chemical weed-killers in the control of weeds, future experimental work will have a more balanced approach to the subject. Chemical methods of control will be examined in relation to other more important methods of controlling weeds such as plant competition, cultivation, and clean farming practices generally.

An interesting new development is the use of the hormone-type material 2, 4, 5-T (2, 4, 5-Trichlorophenoxyacetic acid) in the control of woody plants and especially of blackberry and gorse. Although the evidence is as yet by no means conclusive, this chemical is probably the most promising material yet discovered for the control of scrubby growth in general. Most plants of this nature are resistant to the commonly used weed-killers of the 2, 4-D (2, 4-Dichlorophenoxyacetic acid) type.

Yield trials on cereal crops have on one or two occasions shown marked yield responses from the application of hormone-type weed-killers, but in other instances no effect was measured. At the time of spraying it is most difficult to decide whether the weeds present will offer serious competition to the crop, and little or no benefit will result from the application of weed-killers unless the competition from weeds for light or moisture is a serious factor in crop growth. Much more experimental evidence is required to give reliable advice concerning the advisability of treating crops in a great many instances.

The susceptibility of economic crop plants to damage from weed-killers and the circumstances under which such damage may be severe have been studied in a limited way in crop-tolerance trials, but more work of this nature is planned. Certain crops, particularly grapes and tomatoes, are extremely sensitive to minute traces of hormone-type materials, and others such as turnips, rape, and chou moellier are damaged by small quantities. The greatest care must be taken if hormone-type weed-killers are applied in the vicinity of such susceptible crops. The development and use of non-volatile forms of the weed-killers and a better appreciation of the circumstances under which damage to crop plants can occur should greatly reduce the number of complaints of crop damage from these chemicals.

Blind-seed Disease of Rye-grass.—Experimental work with fungicide dusts and sprays and heavy top-dressings of sulphate of ammonia have not yielded any practical means of controlling this disease. The breeding of a resistant strain of rye-grass appears to be the most promising method of reducing the losses caused by this disease.

Control of Insect Pests.—Field trials have been conducted against important pasture pests, especially grass-grub (*Odontria zealandica*), using the basic chemicals D.D.T. and "Gammexane." Although the adult grass-grub beetle has been found to be readily killed by D.D.T., only limited success has been attained with treatments aimed at killing the grub or the beetle as it emerges from the soil by applications of insecticides to the pasture.

Abnormal Growths from Clover Seeds.—Investigations have been commenced of the factors causing high percentages of red and white clover seed giving abnormal growths when submitted to germination tests, but no conclusive results are as yet available from this work.

Survey of Wheat-growing Practices.—Investigations were carried out on wheat crops in the areas near Christchurch and Ashburton as in previous years. In the Christchurch area the most outstanding factor in influencing yield was the previous rotational history of the field. The highest yields came from crops which followed either peas, a fallow, or a fed-off crop when these are in cropping rotation. In the Ashburton area the most important factor causing differences in yield was soil type, there being two distinct series of soils of different fertility. The previous rotational history was not as important, but there was a noticeable superiority in yield of crops in a grass-peas-wheat rotation over those in a grass-grass-wheat rotation. The average yield of crops in the Christchurch survey area was 40·4 bushels per acre and in the Ashburton survey area 39·7 bushels per acre.

Distribution of Fertilizers from Aeroplanes.—Measurements on the ground spread of fertilizers and seed dropped from aeroplanes were carried out on several occasions during the operations of aerial top-dressing in the Wairarapa. One specially detailed trial was carried out on Ohakea Aerodrome. The trials showed that the fertilizer was spread in bands roughly parallel to the lines of flight of the aircraft and that there were sometimes marked gaps between the bands of fertilizer. However, it was shown that with correct distances between flight lanes, a sufficient degree of skill of the pilot, and accurate ground control it is possible to obtain a most satisfactory distribution of fertilizer.

All the measurements conducted in the past year have been of screened superphosphate distributed from aircraft of the Royal New Zealand Air Force. It is hoped in the near future to measure the ground spread that light, privately operated aircraft are obtaining with commercial fertilizers.

Rukuhia Soil Research Station

Developmental work has continued to occupy an important place during the year. New areas have been prepared for peat research, for fertilizer-placement trials, and for pasture-production measurement trials. With some improvement in the staff position it has been possible to stabilize existing projects and to derive important interior conclusions from several of them.

Many farmers from peat lands have visited the Station's experimental plots and have appplied suggested procedures for drainage, soil preparation, and fertilizer treatment to their own farms with striking success.

Another activity which has received much attention from farmers in the Auckland Province is the experimental work on spray irrigation of permanent pasture. The past summer has been favourable for demonstrating the benefits of irrigation and numerous irrigation plants have now been installed on private farms.

The use of radio-active isotopes of elements important in plant nutrition is a new and rapidly growing method of investigation of problems of fertilizer application and uptake from soils. Special equipment and laboratory facilities have been installed at the Station so that this method may now be applied to any problems that can be best solved by this means. A preliminary study of the fate of phosphatic top-dressing applied as superphosphate has yielded useful information and has confirmed previous evidence of the exceedingly high phosphate "fixing" power of the Horotiu sandy-loam soil of the Waikato.

Techniques of Measuring Pasture Responses.—A comparison of four techniques of measuring pasture response to fertilizers has shown that while all give similar differences between treatments, the "mowing only" is preferable on the score of simplicity and ease of operation. Responses to 4 cwt. of superphosphate alone on Hamilton clay loam varied from 8 to 10 per cent. and to superphosphate and lime from 16 to 21 per cent. There is no response to potash on this soil type.

Kinds of Phosphates.—A comparison of thirteen different kinds of phosphates at equivalent rates of application has shown none significantly better than superphosphate in pasture-production on Hamilton clay loam. Thermophos, an American fused product, gave the highest actual yields.

Fertilizer Placement.—When serpentine-superphosphate was used with swedes on Hamilton clay loam and on Horotiu sandy loam and the fertilizer was placed in seven different positions relative to the seed, the greater yields were obtained where the fertilizer was placed close to the seed. With potash and nitrogen fertilizers there appears to be less difference in yields between treatments.

Seed Pelleting.—A fertilizer preparation has been devised for coating clover and other seeds which show no germination injury and swell and break readily on becoming wet. It is being used in pelleted clover seed oversowing trials which are being conducted in various districts by Instructors.

Peat Research.—Liming experiments on peat have shown that liming to increase the pH (or decrease the acidity) from 4·3 to 5·0 more than doubled the yield of white clover. Further liming was of no benefit. Where lime was ploughed down before sowing plots remained green over the drought period in January, whereas where lime was applied to the surface only, the pasture dried up severely. Analysis of the soil from various depths below the surface three years after the lime application showed that it had affected only the surface 2 in. of peat in that time. These results have practical importance in indicating that lime should be worked into acid peat before sowing. Fertilizer experiments on raw acid peat have shown that the best results so far have been secured by an initial treatment of 2 tons of lime, 2 cwt. of superphosphate, and 1 cwt. of muriate of potash worked into the peat before sowing in autumn, followed by top-dressing with 2 cwt. of superphosphate and 1 cwt. of potash in the following spring and again in the following autumn.

Pasture-growth measurements have shown that moisture content and water-level are the determining factors on peat. The return from top-dressing on drained peat is limited to a short period in spring and early summer largely because peat when dry does not re-wet sufficiently even with heavy rain in autumn. The full development of peat land cannot be achieved without some control of water-level as practised in other countries.

Irrigation Research.—Results to date indicate that on Hamilton clay loam irrigation increases the total annual dry-matter production from pasture by 15 to 25 per cent.; waterings of $\frac{1}{2}$ in. per week are not sufficient, and there is no advantage in application rates above $1\frac{1}{2}$ in. at each watering.

On irrigated paddocks there was no added growth from applications of sulphate of ammonia during the irrigation period in summer, but there was an increase in growth in early spring before irrigation began.

Soil-moisture studies have been maintained by means of a lysimeter and the installation of electrical resistance blocks. Losses of lime and magnesia from the lysimeter are decreasing from the initial fairly high figures recorded. No top-dressing has been applied. Additional lysimeters which will receive top-dressings are under construction.

Microbiological Section.—Studies of earthworm distribution and of trials in which earthworms have been planted out have shown that lime content and moisture are of paramount importance in determining the health and density of earthworm populations. Where conditions are favourable and worms are not present introduction may result in pasture improvement, but in most cases worms have already spread by natural means to such areas. Irrigation may result in considerable increase in numbers of earthworms per acre.

Chemical Laboratory.—Considerable numbers of soil samples are now being analysed by quick-test methods for plant nutrients, and the results are being found of value by Instructors in their advisory work for farmers. A fairly widespread tendency towards low levels or deficiency of potash in soils of the Auckland Province has been found and some notable responses to potash applications have resulted.

Supplementary to soil analysis, especially for market gardens, the Station has employed plant analysis by sap tests and other means fairly extensively. Well-marked visual symptoms of magnesium and potash deficiencies have occurred in some cases. Glasshouse tomatoes are especially prone to such effects.

Further investigations into the role of fineness of grinding of limestones in rendering them soluble in the soil have enabled tentative conclusions to be drawn as to desirable standards for commercial products. As this is an important matter both for farmers and lime companies, some very carefully controlled field trials have been put down to check the results of pot experiments and laboratory methods before attempting any modification of existing procedures or standards.

Lime and molybdenum have been found by soil investigations in various countries, notably Australia, to be closely interrelated in their reactions in the soil and plant. In Southland very heavy lime applications have been common practice for a number of years and it was thought desirable to check the effects on soil reaction, lime content, and molybdenum content and availability in a number of representative areas. In several cases where lime dressings were reported to be still necessary for good yields it was found that the reaction was almost neutral and the lime content high, so that some other factor must be responsible. Soil molybdenum was found to be low, especially the available fraction which appeared to be increased by liming. Field trials with molybdenum have therefore been instituted.

Invermay Agricultural Research Station

The Invermay Agricultural Research Station is situated one and a half miles from Mosgiel, and the property, which has an area of 1,260 acres, was taken over from the Department of Lands and Survey in July, 1949. The land consists of 220 acres of first-class alluvial flat, 500 acres of second-class undulating clay land, and 540 acres of third-class hilly land still in its native state.

The first-class flat land will be used for fertilizer, crop, and pasture trials and for lamb and beef production investigations. A dairy farm to study town-milk supply problems will also be established. Twelve acres of the flat land will be devoted to a horticulture research station where variety, manurial, and spraying trials will be carried out with vegetables and small fruits.

The second-class undulating land will be subdivided and worked on a rotation of pasture, cereal, and fodder crops. Investigations will be carried out on pasture and crop production problems on this type of land and on fat-lamb production. Drainage problems will also be investigated.

The third-class hill land will be devoted to land reclamation and improvement work.

Since the Division took over the property the main work has been to prepare the Station for experimental work. Plans have been prepared for drainage, roading, fencing, shelter planting, and the erection of laboratories, offices, and farm buildings.

Winchmore Irrigation Research Station

Good progress was made on the development of the Winchmore Research Station, and all buildings necessary for immediate work have been completed, so that the research staff have now laboratory facilities available.

On the research area a large number of experiments have been laid down, the main projects being as follow:—

(*a*) *Pasture Establishment.*—On pastures established following varying preliminary treatments, measurements of pasture-production were continued throughout the year. This trial has now been completed and results are being prepared for publication.

(*b*) *Sheep-carrying Capacity.*—This trial, which is designed to investigate the number of sheep which it is possible to carry entirely on grass, consists of 30 acres of irrigated pasture subdivided into three paddocks. In June 90 ewes were placed on the area and growth so far has been sufficient to maintain them, fatten their lambs, and provide hay for winter feed.

(*c*) *Irrigation Intervals: Pasture.*—This experiment has been designed to determine the optimum irrigation interval for pasture growth. Pasture is being irrigated at weekly, two-weekly, three-weekly, and six-weekly intervals. In addition, the effect of irrigation practice and use of soil treatments upon grass-grub and porina population and damage is being investigated. Because of the retarding effect on grass establishment following the use of arsenate of lead for grass-grub control, the commencement of the trial was delayed until late in the season.

(*d*) *Irrigation Intervals: Lucerne.*—To measure the effects of various water applications between cuts of lucerne this trial was put into operation last season and the yields of two cuts have already been obtained.

(*e*) *Grass-seed Production.*—This trial investigated the effects of different irrigation treatments on the yields and incidence of blind-seed disease in perennial rye-grass and short-rotation rye-grass. Results have shown that irrigation increases the seed yield very considerably, but there was no significant effect on germination. Next season a similar trial on seed yields will be carried out with white clover and red clover.

(*f*) *Other Grass Trials.*—Preliminary investigations into seeds mixtures, pre-irrigation, and manurial practices have continued.

(*g*) *Crop Trials.*—The effect of irrigation on the yields of wheat, swedes, chou moellier, rape, and mangels is being investigated.

(*h*) *Spray Irrigation.*—The necessary equipment has been secured for investigations into various aspects of spray irrigation to be carried out next season.

With the completion of the laboratory more detailed research work on the trials in progress should be possible.

Dairy Farm

On the Demonstration Dairy Farm following a comparatively mild winter a good season was experienced. The growth of pastures has been excellent on the irrigated fields totalling 110 acres. An undesirable feature, however, is the clover dominance of most of the pastures. There was also a critical period during July, August, and September, as grass growth during this period was almost negligible. Nevertheless, stock wintered very well on the small amount of grass available, with the addition of ample hay, which is apparently very necessary in this district. It was also indicated that an area of roots, preferably swedes, was also required for wintering dairy stock. Stock carried on the 150 acres devoted to the dairy farm, 40 acres of which are not irrigated, were 60 milking-cows, 25 yearling heifers, 3 bulls, and 12 calves. There are also 4 breeding sows and a boar and it has been necessary to purchase a number of weaners and stores for fattening during the season. It is expected that the present season will conclude with a total butterfat-production of approximately 15,000 lb. or 100 lb. per acre. There are still some very low producers in the herd, but culling will proceed, replacements will be made with better stock, and the herd will be increased to about 70 milking-cows next season. Shelter is very necessary and the planting of shelter belts has proceeded. Irrigation of pastures commenced on 21st September and continued at regular intervals during the season. Water was available on two days each week and it has been the practice to use water irrespective of weather conditions and to irrigate for approximately nine hours each day. From the commencement of irrigation until the end of February 3,513 cusec-hours of water was used.

Mixed Farm

Apart from early spring, when little growth took place due to lack of rainfall and frosty weather, the season has been a good one on the Demonstration Dairy Farm. The spring feed shortage occurring at the most critical time—just before lambing—had an adverse effect on the ewe flock.

The whole of the irrigable portion of this farm, amounting to 330 acres out of a total area of 350 acres, has now been border diked and during the season 350 acre-feet of irrigation water has been used.

During the season 620 ewes together with 120 ewe hoggets were carried. From the ewes 721 lambs were tailed and 9,332 lb. of wool was obtained from the flock. During the coming season it is intended to carry 750 to 800 ewes and 160 hoggets. Wheat was grown on 32 acres and yielded 861 bushels; 227 bushels of perennial rye-grass seed were saved and approximately 3,000 bales of hay were harvested from the lucerne area of 25 acres. The object on this farm is to explore to the full the greatest carrying-capacity possible under irrigation on this class of land, which without irrigation is one-ewe-to-the-acre country.

Demonstration Farms

The Division has continued to be associated with the work of the Northern Wairoa (Dargaville), Stratford, and Waimate West Demonstration Farms, and experimental work on these farms is being continued. The Winton Experimental Farm has been used for pasture, fertilizer, and annual crop trials.

Fertilizers and Lime

As from 1st July, 1949, controls over the sales of all fertilizers were lifted and both phosphatic and locally produced organic fertilizers have been on an open market. The International Emergency Food Committee also relinquished the allocating of supplies of sulphate of ammonia and of potash, and as a result greater tonnages of these fertilizers have become available to New Zealand. Further, the Marketing Department relinquished its wartime function of being the sole importer of sulphate of ammonia and potassic fertilizers, and the importation of these fertilizers has now reverted to normal trade channels.

With the lifting of rationing it was considered that the output of the existing chemical-fertilizer works would be insufficient to meet the increased demand for phosphatic fertilizers. Thus the Government approved of a subsidy on imported basic slag, finely ground North African phosphates, and guanos. The maximum subsidy was £3 per ton, reducible so that in no instance would the ex-wharf selling-price, less subsidy, fall below £9 10s. per ton. The subsidy arrangements for imported phosphatic fertilizers applied only to shipments effected before 30th April, 1950, and the scheme is to be reviewed early in May, 1950.

It is expected that the 1949–50 imports of phosphatic fertilizers for direct application will be approximately 45,000 tons of basic slag, 50,000 tons of finely ground North African phosphates, and 8,500 tons of guanos. For superphosphate manufacture the requirements were estimated at 429,000 tons of raw rock phosphate, which would manufacture approximately 715,000 tons of superphosphate.

Locally produced organic fertilizers continue to be in very short supply.

The use of lime remained steady during the year. Lime transport assistance was continued and the former rebate of 50 per cent. on rail charges (after the first 15 miles and up to the 115-mile limit) was increased to a 75 per cent. rebate as from the 1st July, 1949. Other benefits were increased accordingly, while in special areas the maximum railage distance has been extended.

During the year a Lime Advisory Committee was appointed and held its first meeting in September, 1949. The Committee is to report from time to time on certain aspects relative to the production costs and distribution of lime.

Phormium Tenax

Production has been maintained at about the same level as last year and for the year ended 31st January, 1950, was as follows:—

	Tons.
Fibre	1,620
Tow	442
Unscutched fibre (straw)	3,157
Stripper slips	226
	5,445

Production costs in relation to the present guaranteed price have been investigated by an inter-departmental committee. Maintenance work has been carried out on a satisfactory level on most of the green-leaf areas and development work has been initiated on several areas.

The Moutoa and Makerua Estates have been controlled by the Department of Agriculture since 1st March, 1949. Development work has been reorganized under the direction of a management committee with representation from the Department of Agriculture, Department of Scientific and Industrial Research, and New Zealand Woolpack and Textiles, Ltd. The grazing of the pasture lands on the estates has been handed over to the Department of Lands and Survey.

An interim report on a comprehensive survey of the vegetative cover of the Moutoa Estate discloses serious tall fescue invasion and incidence of yellow-leaf disease.

Farmers' Field Competitions

Farmers' field competitions were again conducted in most districts and the Division assisted in their general organization and supplied the judges. Pasture competitions tend to increase at the expense of crops, although hay and silage competitions are still popular. All these competitions undoubtedly serve to place on record outstanding factors in the development of good pastures and the growing of good crops.

Field-days arranged in conjunction with the judging provide facilities for local farmers to see and discuss the best in their district and they are invariably well attended.

Nassella Tussock

Work on the control of nassella tussock in the South Island by the two Nassella Tussock Boards operating in Marlborough and North Canterbury respectively has continued under subsidy from the Government. The North Canterbury Board has had difficulty in getting labour for its grubbing team, but two extra rangers have been employed during the year and they have carried out useful work in grubbing out small infestations where sighted on their rounds of inspection.

Several badly infested areas planted in trees by farmers have been subsidized by the North Canterbury Board, but the dry winters experienced during the past few years have been detrimental to the establishment of trees. The New Zealand Forest Service has taken over and planted a property of 494 acres in trees during the year for nassella tussock control, and the effect not only of tree-planting but also of closing land from stock grazing is being observed closely on this area.

Investigational work on nassella tussock generally has been intensified by the appointment of a special officer to study eradication and preventative methods.

The Nassella Tussock (Grass Seed) Regulations designed to prevent the widespread distribution of nassella tussock impurities in grass and clover seed lines were inaugurated in the 1949–50 harvest season.

Land-utilization and Land-improvement

The Division has continued to give attention to the problems of land utilization and improvement. Its officers are represented on Catchment Boards and have devoted considerable time to the problems of soil conservation. The Division is also associated with land-settlement work through representation on the Land Settlement Board (Department of Lands and Survey) and Farm Advisory Committee (Rehabilitation Board). The Division itself has been mainly concerned with the problems of hill-country pasture improvement, land-utilization studies, pasture surveys, and the improvement of the over-all volume of primary production.

New Zealand's 14,000,000 acres of native tussock grassland represent a large area of low-carrying-capacity pastures. During the hundred or so years that this very variable country has been farmed very marked changes have taken place in its nature, owing to the effect of sheep, rabbits, and fires. Some of it is virtually unchanged; some has been altered a great deal.

For many years the Department of Agriculture has been investigating the question of re-vegetating the deteriorated areas of tussock country. It is only during the last three years, however, that a concentrated effort has been made. Three officers are now working almost full time on the problems presented in the various areas. A detailed study is being made of the rate of growth, seeding habits, and longevity of some of the tussock plants. The question of damage to the tussock by the "tussock grub" is being investigated, initially to ascertain the extent to which the "grub" is killing tussock plants.

In the depleted country of Central Otago investigations are sufficiently advanced for work to extend beyond the plot stage. On this depleted country rabbits are abundant, and all investigations must be carried out on areas that can be maintained virtually free of rabbits. As the result of trials conducted over the past thirty years or so certain introduced species of plants have been found that will survive under moderate grazing in this dry climate. The most valuable of these plants are the native grasses blue wheat-grass and *Danthonia pilosa* and the exotic plants Kentucky bluegrass, yarrow, sheep's burnet, tall oatgrass, tall fescue, cocksfoot, and *Brachypodium phoenicoides*. Zig-zag clover is the only clover tested that shows any promise of being valuable. Unfortunately it is a very shy seeder. This means, therefore, that unlike the hill country of the North Island the hill country of the South Island must be improved without the aid of a clover.

Many difficulties have been encountered in establishing clovers through oversowing on North Island hill-country pastures. It is now fully appreciated that clovers must be supplied with phosphate if they are to thrive and be of value. On easy country it is possible for both to be sown on a prepared seed-bed, and failures of the clover to establish are not common. On the hill country the failure of clovers to establish is frequent. Though failure is due to several causes, it is considered that one is the fact that when seed and fertilizer are broadcast much of the seed falls on ground without phosphate near it. To overcome this endeavours have been made to surround the seed with a phosphatic fertilizer, which will thus be immediately available to the young seedling.

Four pasture surveys have been commenced as a basis for extension work in pasture improvement. A survey of the pastures of Malvern County was carried out to define the areas where subterranean clover could be and yet was not being used for pasture improvement. Instructors in Agriculture will follow up this survey and discuss with individual farmers their problems in extending the use of subterranean clover. To secure a quick establishment of this clover officers of the Division have been experimenting with a drill attachment which enables clover seed to be drilled at 3½ in. centres (instead of the customary 7 in. centres) or to be broadcast in narrow bands just below the surface. Large areas of the native tussock grasslands in Tawera, Mackenzie, and Vincent Counties have been surveyed with the object of defining the type of covering in relation to soil, climate, aspect, altitude, and the effect of sheep and rabbits.

Farm Management and Economics

The scope of farm management research has been enlarged this year to include two economic surveys of sheep-farm organization and management in typical regions—namely, Akitio and Malvern Counties. The former is representative of large areas of the drier hill country on the east coast of the North Island. The study of Malvern County was confined to the eastern plains, which are typical of the many thousands of acres of light stony land occurring in the lower parts of the Canterbury Plains.

The general objective of these surveys is to reveal the economic and management structure of the systems of sheep-farming represented, and in particular to discover what factors of farm organization and management are associated with the most intensive use of the land and the most economic results. This factual information will provide the basis for farm-improvement work aimed at increasing the carrying-capacity and production of "marginal" sheep lands. Field work has been completed on the surveys and the detailed analysis is under way. The success of this type of work depends on the willingness of the farming community to supply the information required, and it is pleasing to record a high level of co-operation in this respect.

As part of a national economic survey designed to show the population and total production possibilities of New Zealand, the Economic Section is conducting, with the aid of the Fields Instructors, a county by county survey of the potential live-stock carrying-capacity of the Dominion, based on what the best farmers are doing on the various soil types.

In view of the growing importance of agricultural contracting a preliminary inquiry into the role of contractors in farm production was undertaken through the Fields Instructors. The results indicated that, in spite of the large number of farm operations being let to contractors, generally there were sufficient contractors to meet the needs of farmers, except in isolated instances and for certain operations, particularly hay baling. The tendency is for farmers to purchase their own cultivation machinery as far as possible, and as more farm machinery becomes available it would appear that many contractors will find less work of this type offering on farms. The demand upon contractors for heavy land-development work is likely to continue.

Plans are in hand for an extension of research into the economic aspects of farm-improvement work, in conjunction with Federated Farmers, using farm book-keeping methods.

During the year production cost surveys have been carried out by the Statistical Section on the following:—

(1) The pig-meat production cost survey which had been carried out in the previous year was completed and results were placed before the National Pig Industry Council.
(2) A canning-pea cost survey was carried out at Karaka and Pukekohe at the request of the Price Control Division.
(3) Main-crop potato costs were again revised and brought up to date.
(4) Hop-production costs were investigated in the Nelson district on behalf of the Price Control Division and Economic Stabilization Commission.

The compilation of statistics of butterfat-production, live-stock slaughterings, meteorological data, apple and pear crop statistics, railage of lime and fertilizer, exports of wool, and other general matters has been regularly carried out throughout the year.

Food and Agriculture Organization

The Economics and Statistical Section of the Extension Division continued the task of supplying information to the Food and Agriculture Organization of the United Nations, obtaining the co-operation, where necessary, of other Divisions, Departments, and interested organizations.

The annual progress and programme reports supplied to FAO by all member Governments provide the material on which the organization bases its studies of the world food and agricultural situations, which are the background for discussion at the annual session of conference and the basis of recommendations to Governments as to future action. The 1949 annual report was somewhat broader in scope than in the past and included a section on the general economy of the country and the place of agriculture in the national economy.

Work has continued on the routine aspects of FAO's requirements, the preparation of food balance-sheets, and the supplying of statistical information generally. In addition, reports have been supplied on a number of specialized items, including one on co-operative organizations in New Zealand farming prepared in connection with a conference on agricultural co-operatives held in India in October, and a report on milk and fats in connection with a fairly comprehensive study of the world oils and fats position, to be read at the next session of the conference of the International Federation of Agricultural Producers.

A project of considerable interest and importance to plant breeders is the compilation of a world catalogue of genetic plant stocks. Information on wheat and rice was collected during the year and it is intended to broaden the scope of the catalogue as circumstances permit. A somewhat similar project of interest to New Zealand, a world catalogue of forage plants, was inaugurated during the year.

President Truman's plan of technical assistance to under-developed countries in which FAO is to play a leading part was introduced in 1949. As background material in matters where New Zealand's experience could prove of assistance to an under-developed country, a comprehensive report on seed certification was prepared and a further report on land development is nearing completion.

The Division has continued to disseminate information from FAO among State Departments, producer boards, farmer's organizations, the agricultural colleges, and other interested bodies. FAO data were utilized in the preparation of graphical material shown at the Royal Society's Exhibition in Wellington on " Science and Food."

ANIMAL RESEARCH DIVISION

REPORT OF J. F. FILMER, DIRECTOR

The primary function of the Animal Research Division is, and always must be, research. It is realized, however, that animal research is of no value unless the results are made available to the live-stock owners who are to use them. Obviously, research workers cannot undertake this distribution of knowledge, or they would have no time for research. During the year some progress has been made in solving this difficult problem. The first Farmers' Conference Week was held at Ruakura and was attended by over 600 farmers. The proceedings have been printed and copies are on sale. A refresher course for departmental and other veterinarians was held at Ruakura, the subject being animal fertility. It is intended to repeat both these events annually. An Animal Research Extension Officer has been appointed at Ruakura to assist the Superintendent in arranging such conferences and to organize other forms of extension work such as broadcasts and films. One day of the refresher course for club veterinarians was held at Wallaceville, and two weeks' extra-mural training was provided there for 20 final-year veterinary students. In addition there have been numerous visits from organized parties and individual farmers to Wallaceville, Ruakura, and Manutuke.

The importance of problems of hill farming prompted the purchase of a typical hill property of approximately 1,400 acres in the Raglan district, and this is being developed as an out-station of Ruakura.

Diagnostic Services

There has again been a marked increase in the specimens submitted to the Diagnostic Section at Wallaceville, as shown in the following table in which the 1948-49 figures are given in parentheses :—

Number and Types of Specimens Received 1st April, 1949, to 31st March, 1950

Species.	Cases.	Specimens.
Cattle—		
Blood samples	505	2,706
Milk samples	232	1,776
Other samples	1,050	2,692
Sheep	868	2,068
Pigs	301	720
Fowls	965	2,284
Horses	118	315
Dogs	123	234
Bees	..	86
Miscellaneous	487	637
	4,649 (3,417)	13,518 (10,214)

A case represents all the material submitted at one time by a single individual and a specimen represents each unit of material in a case.

The milk samples include 1,504 submitted from mastitis cases, many from herds or quarters which failed to respond to penicillin treatment. The streptococci and staphylococci isolated were tested for penicillin sensitivity and the staphylococci by the coagulase test, which is the best single index of pathogenicity. No penicillin-resistant strains of streptococci were found in the 26 tested and of the 63 strains of staphylococci tested only 1, an atypical non-hæmolytic organism, was resistant.

The demand for blackleg and scabby-mouth vaccines has continued to increase, and the quantities prepared and issued free were as under, last year's production being given in parentheses :—

	Doses.
Blackleg vaccine—	
Cattle	80,000 (78,000)
Sheep	420,000 (172,500)
Scabby-mouth vaccine	690,200 (470,000)

Blackleg vaccine is no longer issued free but is available through commercial channels, prepared according to the new Wallaceville formula, which gives better immunity.

Some reports have been received of apparent failure of scabby-mouth vaccine to immunize sheep. Experimental work with material from these failures has shown that no new virus is involved. It seems most likely that failures were due to faulty technique at vaccination, and publicity will be given to the necessary precautions to ensure immunity.

Fowl-pox vaccine has been prepared and distributed through the Live-stock Division for a field trial covering 30,000 fowls.

The following conditions were diagnosed for the first time in New Zealand from specimens submitted to the Diagnostic Section :—

Sheep.—Congenital Cystic Kidney : This condition arises from failure of the junctional and collecting tubules to unite in the normal development of the kidney. Affected kidneys 6 in. by 4 in. in size have been seen consisting entirely of innumerable multilocular, fluid-filled cysts. In one case the condition was associated with liver changes consisting of fibrosis and œdema of the portal tracts, bile ductule hyperplasia, and excess of bile pigment in the bile ducts, giving the organ an orange colour.

Congenital Skin Fragility : On one farm several Southdown lambs recently born were affected by skin fragility so advanced that extensive tears were easily produced in handling. The skin was very loose and appeared to be attached to the underlying tissues by very rudimentary subcutaneous fascia. Histologically the epidermis was thin and the sweat and sebaceous glands and hair follicles were well formed. The blood vessels in the derma appeared normal and the remaining tissue consisted of very scant œdematous areolar tissue.

The second case concerned a five-month-old Romney lamb in whose skin extensive tears developed when it was handled.

Pigs : Glasser's Disease.—This condition was first described by Glasser in Europe in 1906 and more recently by other workers in Great Britain and Australia, under various names such as influenzal arthritis, infective polyarthritis, &c.

Six pigs two to three months of age out of 24 from the Greytown area showed inappetence and severe lameness in either fore or hind limbs with swelling of the joints. They showed acute pain on being moved and some were down for two days before death.

On post-mortem examination the most marked features were swelling of the joints, which showed an excess of fluid with large white fibrin clots and peri-articular œdema. An excess of pericardial fluid was a common finding.

On bacteriological examination *Haemophilus suis* was isolated from all affected joints, but not from any of the organs or pericardial fluid.

Sulphapyridine recommended for treatment was used in the above outbreak with excellent results.

Fowls : Infectious Avian Encephalomyelitis.—In October last chickens were received from the Palmerston North area which were showing ataxia and a history of deaths occurring in the first ten days. They gradually became weak in the legs, displayed a staggering gait, and eventually fell over. The chicks were quite bright in appearance but unable to stand. The condition occurred only in Black Orpington chicks, although they were in a brooder-house with White Leghorn chicks.

Histological examination of brain sections showed changes similar to those described in infectious avian encephalomyelitis. Unfortunately no material was available for transmission tests, and although material was received later from the same farm, such transmissions were negative, as was also the histology, so it would appear that the suspect condition had cleared up in the interim.

Infectious avian encephalomyelitis has never been diagnosed in New Zealand previously, but the above typical history and histological picture strongly suggest its existence, and a keen look-out will be kept in the next breeding-season.

Dogs: Hepatitis Contagiosa Canis (Rubarth).—Sudden deaths in 3 dogs aged six weeks, eight weeks, and fifteen months were associated with lesions similar to those described for infectious hepatitis by Rubarth and other workers. These cases came from the Wairoa and Gisborne districts. The liver lesions were essentially areas of intralobular necrosis and hæmorrhage and in the adjacent cells intranuclear inclusion bodies were seen.

Cats: Lung-worm.—Mature nematode parasites were seen in the lungs of a cat from the Wairoa district.

The parasites were probably *Aleurostrongylus* spp., which require snails and slugs as intermediate hosts in their life cycle.

Research Work

Sheep-breeding Projects

Flushing Studies.—To obtain further data on the influence of live-weight changes in the breeding performance of ewes and, in particular, to study the effect of flushing on lambing percentage, a flock of 300 ewes, on 21st February, 1949, was split into two equal groups comparable in respect to live weight and degree of fatness. The group to be flushed was grazed thereafter for six weeks on an area of the best pasture available which had been specially spelled for the purpose. The control group was grazed on pastures designed to permit neither gain nor loss in body weight. Regular weekly check weights of all ewes were obtained to permit adequate control of the grazing management. At the end of six weeks both groups were run together again as a single flock.

Vasectomized rams were run with both groups before and during the first week of the experimental period to obtain data on the time of onset of first heat periods. After this time fertile rams were introduced to both groups. All rams were raddled.

The "flushed" group gained an average of 17·1 lb. per ewe over the six weeks. The control group gained only 5·2 lb. over the same time. Lambing performance of the two groups can be summarized as follows:—

Lambing Performance

Group.	Number Conceiving.	Number Not Conceiving.	Number of Lambs Carried.	Number of Lambs Alive at One Month.	Lambing Percentage.*
Control	139	11	154	141	94·0
Flushed	133	16	173	152	101·3

* Based on lambs alive at one month and ewes mated.

Of the 139 ewes conceiving in the control group, only 10·8 per cent. carried twins. The comparable figure for the flushed group was 30·1 per cent. From the work the following tentative conclusions have been reached:—

(1) Imposition of flushing treatment during the fortnight before the time when the number of ewes coming into œstrus for the first time reaches a maximum has a very slight effect, if any, upon the time of onset of the breeding-season.

(2) Œstral cycle lengths of flushed ewes tend to be somewhat shorter than those of ewes not flushed.
(3) The practice of flushing leads to an increase in the ovulation rate within a period as short as one to two weeks, but for the best results a flushing period considerably longer than this is probably desirable.
(4) The increased ovulation rate which results from flushing ewes probably persists for some weeks after the flushing treatment is discontinued.
(5) Ewes which are flushed tend to be rather more difficult to get in lamb than ewes which are not flushed.

All the points enumerated above require verification. In addition, information is very much needed on the question of whether under New Zealand conditions ovulation occurs before the onset of the breeding-season proper, as determined by the time of occurrence of the first heat. If one or more such "silent" heats do occur, so that the sexual cycle is in fact established some time before the occurrence of the first heat, flushing treatments designed to bring ewes into œstrus earlier in the season would have to be imposed considerably sooner in the year than was the case in the present investigation.

During the current year it is proposed to repeat the investigation along lines similar to those followed last season.

Pre-lambing Nutrition of the Ewe.—A further year's results are available from the experiment to measure the effect of nutrition during the latter stages of pregnancy. During 1949 300 five-year-old Romney ewes, which had been mated to Southdown rams and run together since tupping, were divided into three groups five weeks before lambing was due to begin and fed on high, medium, and low planes of nutrition respectively. All ewes were run together again after lambing. The effect of the three treatments on the live-weight changes of the ewes during the month before lambing is summarized below: –

AVERAGE WEEKLY LIVE-WEIGHT CHANGES OVER LAST MONTH

Season.	High Plane.	Medium Plane.	Low Plane.
	lb.	lb.	lb.
1948	+5·0	+2·6	+0·8
1949	+4·3	+2·2	−0·03

The effect of the treatments on the growth of lambs over both seasons is summarized in the following table:—

GROWTH OF LAMBS

	Birth Weight (Weighted for Sex).			Weight at Ninety-eight Days.		
	High Plane.	Medium Plane.	Low Plane.	High Plane.	Medium Plane.	Low Plane.
Singles—	lb.	lb.	lb.	lb.	lb.	lb.
1948 season	10·3	10·2	9·9	62	61	62
1949 season	10·2	10·1	9·5	56	56	56
Twins—						
1948 season	9·2	8·8	7·5	52	52	51
1949 season	8·3	8·3	7·5	48	51	51

The lambs were slaughtered in three drafts, being picked as in normal fat-lamb practice. There was no difference between the groups in the proportion killed in each draft. Carcass weights and gradings were similar between groups, confirming the finding that growths of the lambs were little affected by the pre-lambing feeding of their mothers.

At shearing all fleeces were weighed (after skirting, but minus bellies), graded for character, measured for staple length, and graded for faults:—

	High Plane.		Medium Plane.		Low Plane.	
	1948.	1949.	1948.	1949.	1948.	1949.
Fleece weight (lb.)	8·5	7·6	8·4	7·7	7·7	7·1
Staple length (in.)	4·8	4·5	4·6	4·6	4·1	4·5
Character—						
Percentage excellent	37	26	33	23	18	26
Percentage good	34	50	33	42	23	39
Percentage medium or poor ..	29	24	34	35	59	35
Percentage of fleeces with "break" or "cotts" .	22	16	28	17	40	49

The detrimental effects on the wool-clip of poor pre-lambing feeding noted in 1948 were again apparent in 1949, though to a smaller degree. In this connection it will be noted that the over-all weight and quality of the 1949 wool-clip was inferior to that of the previous year. Different classes of sheep were involved. In 1948 the ewes employed were Ruakura-bred sheep which carried fairly uniform, heavy, and good quality fleeces. In 1949 the ewes concerned were bought-in five-year-olds from the Raglan County and were probably more typical of the average class of fat-lamb breeding-ewe employed in the Waikato, carrying inferior fleeces of lighter weight. Under these circumstances it is interesting to note that nutritional level did not affect these fleeces as much as better quality fleeces.

The most important observation from the work to date is the continued lack of effect on growth rate and quality of the fat lambs produced from ewes subjected to quite extreme differences in pre-lambing nutritional levels. The work is being continued for a further year.

Fecundity in Ewes.—The second year's results from the experiment designed to determine the improvement in lambing percentage possible of achievement through breeding for greater fecundity are summarized below. The first year's data are also given for comparison.

	High-fertility Flock.		Low-fertility Flock.		Unselected Control Flock.	
	1948.	1949.	1948.	1949.	1948.	1949.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Ewes conceiving to first mating ..	81	87	76	83	67	93
Lambs born	125	121	98	91	107	117
Lambs alive one month	100	90	84	74	90	94
Dry ewes	4	14	11	16	8	6

Results were substantially the same as in the first year, except for the percentage of dry ewes, which was higher in both high- and low-fertility flocks. In the high-fertility flock this was due mainly to the high proportion of two-tooth ewes failing to conceive.

The following table eliminates differences due to dry ewes, and, based on the ewes that actually lambed, shows that the performance of the three flocks in the two years was similar.

LAMBS BORN PER EWE

—	1948.	1949.
High-fertility flock	1·36	1·39
Low-fertility flock	1·15	0·91
Unselected control flock	1·23	1·30

It should be emphasized that the present differences in fertility levels have resulted from the initial selection and subsequent culling rather than from any progress so far made through breeding for this character. The numbers of two-tooths so far bred and lambing in the flock are too small to make comparisons worth while.

In another small experiment observations have been made on 35 Romney ewes which failed to lamb as two-tooths in 1947. These were all mated in 1948 and 9 of them again failed to lamb. These 9 ewes were remated in 1949 and again failed to lamb.

Œstrogens in Pasture.—Work in Australia has shown that œstrogenic substances in subterranean clover produce infertility in ewes and lactation and swelling of accessory sex-glands in wethers. The occurrence of lactation was observed during the year in a large proportion of 700 wethers grazing on sandhill country sown with subterranean clover, red clover, and short-rotation and perennial rye-grass. A second lot of wethers showed teat development when red clover had become dominant on the same area. The bulbo-urethral glands showed typical changes. Ewes are being grazed on the area to observe their reaction.

During the year assays have been made of clovers collected from a number of districts in both islands and of thirty pasture species, as well as samples of mixed pasture collected at weekly intervals under two methods of pasture management during spring at Ruakura. Only the subterranean clover and red clover were shown to contain œstrogens. In red clover œstrogens were present in the leaf but absent from flower heads, stems, and roots.

To date no symptoms have been noted in sheep in New Zealand, other than the lactation reported in wethers, and it seems likely that no trouble will be experienced as long as a reasonable proportion of grasses is grown with subterranean and red clovers. The effect of feeding red clover to ewes before and during tupping is being studied.

Excretion of Œstrogenic Substances by Pregnant Ewes.—Chemical techniques for the extraction and concentration of œstrogens in sheep urine have been explored. The earlier concentrates were found to contain a substance toxic to the mice used in the assay. This toxin has now been identified as p-cresol. It has further been shown that in sheep urine almost the entire volatile phenolic fraction consists of p-cresol, whereas in the urine of other species the presence of several simple phenols has been recorded by other workers. The daily excretion of p-cresol by sheep is about 1 g. Following identification of the toxin the method has been modified by introducing a steam distillation step whereby the p-cresol is removed from the œstrogen-containing fractions used in the assay.

Recovery tests, using human pregnancy urine (as a source of œstrons) added to sheep urine, show that little loss of potency occurs as a result of this modification.

A satisfactory field method for continuous collections of urine from grazing ewes has been developed so that estimations based on complete twenty-four-hour urine excretions of ewes under natural conditions has been possible. Twenty-four-hour collections were made weekly for two months before lambing and thereafter weekly for three weeks. Œstrogens were detected only during the last four weeks of pregnancy. The amounts excreted per day are very low in comparison with the daily excretion in human pregnancy

The amounts excreted rose steadily to the highest value twelve to thirty-six hours before lambing. Detectable amounts were still present eighteen to twenty-four hours after lambing, but after six days all traces of histological activity had disappeared. Androgen assays showed it was possible to estimate this hormone in sheep's urine at least four weeks before lambing, but that none is excreted by the lactating non-pregnant ewe.

With this demonstration of the practicability of following œstrogen excretion in ewes, systematic studies can now be planned which should add considerably to knowledge of this aspect of reproduction. It is intended during the coming year to follow changes in excretion during the œstrus cycle, the effects of flushing, the effects, if any, of prolonged grazing on red clover, changes during the whole of pregnancy, changes in ewes affected with "bearing trouble," and excretion from ewes affected with liver dysfunction (facial eczema). Most of these studies will be related also to post-mortem histological examinations of the reproductive tracts.

Sheep Nutrition Projects

Supposed Rachitogenic Factor in Green-feed Oats.—Chick-feeding Trials: Further experiments have been made on the possibility of using chicks for work on the supposed rachitogenic (rickets-producing) factor in green-feed oats. The small effect of green-feed oats on chickens makes the value of this species doubtful.

Sheep-grazing Trials: At Wallaceville three groups of 8 hoggets were run on green oats, Italian rye-grass, and permanent pasture of mainly perennial rye-grass and some white clover from 21st June, 1949; 4 in each group were treated prophylactically with a massive subcutaneous dose of calciferol.

No lameness occurred in any of the animals. One of the 4 controls on green-feed oats and 3 of the 4 on Italian rye-grass developed hypophosphotæmia, while all animals treated with calciferol and all animals on permanent pasture had normal blood phosphorus.

There was no difference in growth rate between the treated and untreated groups on permanent pasture or on Italian rye-grass, though the results for the latter grass were unsatisfactory, as the quantity of feed available was insufficient to provide reasonably for the 8 hoggets. On green-feed oats the average weight gain of the two groups was as follows:—

	12/7/49.	16/8.	14/9.	11/10.	26/10.	16/11.	19/12.
	lb.	lb.	lb.	lb.	lb.	lb.	lb.
Control group	7·8	19·3	25·3	31·8	26·3	33·6	35·6
Calciferol group	10·5	29·7	37·0	46·0	35·2	42·8	44·0

Sheep shorn

By rat assay no vitamin D was found in green-feed oats, none in Italian rye-grass, and 140 international units per 100 g. dry matter in permanent pasture (perennial rye-grass).

Site of Vitamin D Storage in the Sheep.—No more than a trace of vitamin D was detected in any of the eight assayed fat depots (including liver fat) from a sheep slaughtered four months after receiving a massive subcutaneous dose of calciferol.

A second sheep was given a similar dose of 1,000,000 units of calciferol subcutaneously and killed one month later. Samples from thirty-five different organs, tissues, and fat depots were tested and in practically all cases a small amount of vitamin D was indicated. In no organ nor in blood serum was vitamin D detected in a concentration comparable with the blood-serum content reported by Fitch two and a half months after similar massive doses of calciferol.

Sheep Disease Projects

Facial Eczema and Other Photosensitivity Conditions.—Up to the 31st March, 1950, very few cases of facial eczema were reported. During April, however, a considerable number of cases were reported in Poverty Bay and a few cases were reported in other districts. Six clinical cases occurred in the experimental paddocks at Manutuke and considerable liver damage occurred in the majority of lambs which grazed in the experimental paddocks during March and early April. It is hoped that later examination of livers will provide considerable information concerning the relative safety of irrigated permanent pasture, irrigated short-rotation rye-grass, irrigated Italian rye-grass, white clover, lucerne, and kale, as experimental lambs were grazing on all of these during the period when liver damage occurred in lambs on the experimental paddocks. It seems likely that some of the pasture collected and dried will prove to be more toxic than any previously available for chemical study.

Guinea-pig Experiments.—Work was planned to study histopathology and time/symptom/lesion relationships in guinea-pigs fed plant materials known to be photosensitizing.

The hepatotoxic properties of 1947, 1948, and 1949 samples of *Panicum miliaceum* were examined at two dietary levels—25 per cent. and 75 per cent. in mash—using 65 guinea-pigs.

All three samples caused mild liver changes at the 25 per cent. level, and the 1949 *Panicum* caused bile duct hyperplasia at the 75 per cent. level; histological work for 1947 and 1948 samples has not been completed. Various methods of pre-treatment were examined, but the clinical course of 75 per cent. level animals did not appear to be significantly affected by any of the different treatments.

Hepatic damage was also produced in guinea-pigs by *Lippia rehmaani*, ngaio, phosphorus in oil, and by bile duct ligation.

Experience does not indicate that guinea-pigs possess advantages over sheep as experimental animals for this work.

Comprehensive studies were made of lambs grazing *P. miliaceum*. Detailed records of occurrence of photosensitivity, bilirubinæmia, and phylloerythrinæmia were obtained as well as morbid anatomical descriptions. Material for histological examination covers all stages from pre-photosensitivity to death of the animal. In one section of the programme it was shown that bilirubinæmia, phylloerythrinæmia, and gross liver lesions developed and some mortalities occurred in animals fed only at night and kept indoors during the day.

Previous observations that alcohol and ether extracts of *P. miliaceum* produced photosensitivity in rats have been confirmed and these extracts have been considerably purified by various fractionation methods. Even prolonged feeding of such extracts has not produced in rats either a Van den Bergh reaction or liver lesions of the type seen in sheep. The greater purity of the extracts has allowed the administration of reasonable quantities to guinea-pigs also, and photosensitivity has developed in these animals. Mild lesions of the type found in guinea-pigs fed dried millet were found in liver sections from the only guinea-pig so far examined.

Attempts to free the extracts of chlorophyll derivatives, and so test critically the assumption that the photosensitivity is due to disturbance of the hepatic excretion of such derivatives, and not caused by a pigment preformed in the plant, have not yet succeeded. Preliminary studies with light filters indicate that the action spectrum covers the phylloerythrin spectrum range, and that certain yellow pigments present in the extracts are not responsible for the photosensitivity.

The possibility that the high level of chlorophyll derivatives in such extracts was overtaxing the ability of the rat liver to excrete phylloerythrin and related substances has been eliminated by feeding pure chlorophyll and also extracts of various grasses. No reactions were obtained in any of these experiments.

As a result of these experiments much information on the solubility, stability, and other properties of the active principle has been obtained. It appears to form a sodium salt sparingly soluble in alcohol but soluble in water, a property which gives promise for the eventual separation from chlorophyll derivatives.

Two hæmolytic substances are present in millet; one extracted by alcohol, soluble in ether, and precipitated by acetone; the other a saponin extracted by water. Neither produces photosensitivity in small animals.

Alcohol extract of 22 kg. of the 1947 millet was fed to a lamb in capsules over eleven days—*i.e.*, extract equivalent to 70 g./kg. bodyweight/day. The only sunshine during this period was for a short time on the fifth day, and this gave no reaction. Van den Bergh and liver section were negative. The dose rate was small compared with that given to rats (320–800 g./kg./day). An improved dosing technique for these difficult extracts has now been worked out and preparation of such extracts from 1950 millet is in progress for sheep experiments.

Estimation of Phylloerythrin in Blood.—Detailed biochemical studies on facial eczema and similar photosensitivity diseases have previously been hampered by the lack of a reliable method of estimating phyllœrythrin in blood. Previous work had shown that the extraction of the pigment was incomplete and variable, an effect attributed to adsorption on precipitated proteins. The method has now been improved to give more constant recoveries, although these approximate only about 60 per cent., while use of the Beckmann spectro-photometer has made possible the detection of much lower levels, down to 0·003 mg. per 100 ml. blood.

Further attempts to improve the extraction are being made, but in the meantime the method can be used, with a correction factor, to give reasonably reliable estimations.

Daily estimations of phylloerythrin in blood from a group of lambs grazing *P. miliaceum* at Manutuke showed that photosensitivity may start several days before the phylloerythrin was detectable. Phylloerythrin usually reached detectable limits (over ·003 mg./100 ml.) on the same day as the Van den Bergh reaction was first positive (bilirubin about 0·1 mg./100 ml.), but in two cases phylloerythrin was measurable before the Van den Bergh appeared. The rise and fall of the phylloerythrin also ran approximately parallel to the Van den Bergh reactions. The highest level of phylloerythrin detected was 0·32 mg./100 ml. The very low level of phylloerythrin in these actively photosensitive cases is surprising; it is, however, possible that the pigment is transferred readily from the blood to the skin and other tissues, and that the accumulation in the skin may be sufficient to produce photosensitization before the blood-level rises appreciably.

A further application of the method is in connection with experiments to determine the form in which phylloerythrin is combined in blood and bile. Apparatus is at present being constructed to enable approximate molecular estimations, by diffusion, of the phylloerythrin-containing material in these fluids. Preliminary experiments with collodion membranes have been unsuccessful owing to the difficulty of constructing sufficiently permeable membranes without serious loss of mechanical strength.

In an endeavour to detect liver dysfunction in its earliest stages the effect of liver damage on the alkaline phosphatase activity of blood is being examined. In a preliminary trial periodic estimations were made on the blood of sheep dosed with ngaio, but owing to the low toxicity of the sample neither photosensitivity nor icterus was observed, although some elevation of serum phosphatase occurred. These experiments are being repeated with fresh material.

An experimental model of a photo-electric spectrum analyzer which will measure direct solar radiation and can be used to compare the efficiency of artificial light sources for use in photosensitivity studies has been built.

An attempt has been made to detect phylloerythrin and other photosensitizing substances at low levels in blood serum by following the destruction of ascorbic acid in serum exposed to light. The method gave promising results with phylloerythrin, hematoporphyrin, and hypericin added to serum in amounts approaching 0·05 mg. per 100 ml., but at lower levels was unreliable. Furthermore, simple practicable estimations of the ascorbic acid are liable to serious interference in the presence of bile pigments. The method has meanwhile been abandoned, but may yet prove useful in the study of those photosensitivity diseases, not associated with jaundice, in which the photodynamic agent is unknown.

In Vitro Rose Bengale Liver Function Test.—An attempt was made to evolve an *in vitro* rose bengale liver function test. Minced tissue in a medium containing rose bengale was agitated under oxygen + 5 per cent. carbon dioxide in a reaction flask in a modified Warburg bath. After a given period the concentration of the dye remaining in the medium was estimated spectrophotometrically. Assessment of vital activity was attempted by analysis of time-absorption curves, by comparison of liver with other tissues, by comparison of normal and pathological livers and liver of photosensitive Southdowns, and by comparison of normal and poisoned tissue from the same liver.

Inter-animal variation was about 9 per cent. for livers and 10·5 per cent. for kidneys. In any one animal, however, the greatest difference between the activities of two samples of one tissue was 1·6 per cent.

The photosensitive Southdown liver absorbed less of the dye than the average of Romney livers, but the difference was smaller than inter-animal variation in Romneys.

In the light of the most recent literature it now appears that the method estimates a preliminary physico-chemical adsorption stage and not the vital, biliary excretion stage, which is dependent on the intact liver, and in which interest lies.

Portal Streaming.—Examination of experimental factors in the production of portal streaming patterns by the dye-injection method showed that in rats general excitement, induction of anæsthesia, and excessive handling and cooling of the viscera are potent causes of scattering. Amyl nitrite inhalation before dye injection was found to be an effective preventative. Adrenalectomy, while reducing the effect, was not as reliable.

Japanese Millet Photosensitivity.—Seven cases of photosensitization developed in 76 lambs grazing on Japanese millet. Van den Bergh reactions were all negative. Three lambs were killed and histological examination showed slight but definite changes, consisting mainly of œdema in the portal tracts associated with some degree of hypercellularity and swelling of ductule epithelium.

Hogget Mortalities in South Otago and Southland.—The collection of data on hogget losses in this district by issue of a questionnaire formed the basis for intensified controlled vaccination trials. Closer contact was obtained by field work and by carrying out some of the laboratory work in premises made available by the Clutha Veterinary Club.

Controlled vaccination experiments covered 6,580 hoggets on sixteen properties, and the vaccines used were *Clostridium chauvoei* and *Cl. welchii* anacultures singly or combined. Losses were lower than usual in the experimental flocks and the results of the work were therefore inconclusive. In forty-eight outbreaks on other farms losses were caused by *Cl. chauvoei* and *Cl. welchii*, type D.

Clostridium Welchii Types.—During the investigations into entero-toxæmic conditions in sheep in New Zealand during the past two years a number of strains of *Cl. welchii* have been isolated from the alimentary tracts of sheep which differed toxigenically from the more familiar pathogen, *Cl. welchii*, type D.

Whilst these *Cl. welchii* strains appeared originally to be of the "C" type, they were atypical in that whilst capable of elaborating comparatively large amounts of the delta hæmolysin, the lethal toxin produced was of low concentration. Final decision on type awaits the conclusion of current studies in collaboration with Wellcome Physiological Research Laboratories, England. Investigations are continuing on the etiological significance of the organisms in ovine mortalities.

Pneumonia in Sheep.—Several outbreaks of so-called "Southland" pneumonia in sheep were reported during the last few months of 1949, particularly from the Milton area of South Otago. The following is a summary from the laboratory findings and field investigations to date:—

(1) "Southland" pneumonia is a specific condition of sheep occurring in the South Otago - Southland area and may be considered of economic importance. On ten properties visited in the Milton-Balclutha area during the recent outbreak 236 deaths were reported out of 7,070 sheep, or 3·3 per cent. The highest mortality would be in the region of 8 per cent.
(2) The condition occurs only in aged ewes, six-tooth and older, usually suckling one or two lambs.
(3) The ewes are invariably in good to fat condition.
(4) The condition apparently is more serious in certain years. For example, the Live-stock Superintendent at Dunedin reports a serious outbreak in the same area in 1935, when it was estimated that 6,000 sheep were lost.
(5) It has a distinct seasonal incidence, occurring from October to January.
(6) The onset of symptoms is sudden and the course of the disease is rapid, culminating in death within twelve to twenty-four hours.
(7) Some of the most serious losses have been associated with shearing, deaths occurring four or five days later.
(8) Most common finding on post-mortem examination has been a severe fibrinous pleurisy, broncho-pneumonia involving about one-third of the lung, particularly the anterior lobes and the ventral marginal borders of the diaphragmatic lobes, and severe congestion of the non-pneumonic areas of the lungs.
(9) Cultural examination of the lung usually reveals the presence of a haemolytic "pasteurella-like" organism, but this is not constant.
(10) All transmission tests using cultures, macerated pneumonic lung tissue, and filtrates of lung tissue to date have yielded only negative results.
(11) Histological examination of lung sections shows a distinct pathological picture.

The condition in the past has been referred to as "pasteurella-like pneumonia": this would seem to be unjustified, as the presence of the organism is not a constant feature and laboratory tests have shown the organism to be non-pathogenic for sheep and all laboratory animals.

Salmonellosis in Sheep.—Salmonellosis in sheep due to *S. typhi murium* has reached important dimensions in the past year; twenty-three outbreaks were confirmed in Wanganui, Manawatu, and Central Hawke's Bay districts especially, and also in Southland, Westland, the Wairarapa, and King-country. Salmonellosis was seen on farms varying in type from flat plain to rolling ploughable hill country intersected with deep gullies and where the over-all rate of stocking varied from 2 sheep to 6 sheep per acre.

Most farmers experienced very light losses among their flocks during the previous winter and spring and the lambing percentages were very high. There was no shortage of feed at any stage, but it dried off from mid-December in most districts.

Of these outbreaks eighteen occurred in the period between Christmas, 1949, and March, 1950, and most were observed in January.

Adult ewes carrying plenty of condition were predominantly affected, but a few mortalities extended to involve wethers, rams, hoggets, and lambs, while in two others losses were restricted to two-tooth ewes only.

Although losses tended to be between 1 and 3 per cent. of the ewes carried on a farm, they reached 9 per cent. in one small flock of 90 ewes.

The course of each outbreak varied somewhat, but by and large an odd sheep died at first and in a few days the mortality built up so that daily losses amounted to a dozen or more in a thousand ewes for two to three days. Then, fluctuating somewhat, the death-

rate dropped and deaths ceased as quickly as they started or continued at a low level for several weeks. For instance, losses on one farm started in March, 1949, and deaths continued, apparently from *Salmonella typhi murium* infection, until the following June.

Deaths were so sudden that some farmers never saw a sick sheep, but most noticed affected animals sick, disinterested, and tucked up for a short period before death. They usually scoured profusely or passed small quantities of very mucoid dung, light green in colour, which had a fetid smell and sometimes contained flecks of blood. Early in an outbreak sick sheep rarely lasted longer than twenty-four hours, but later death was delayed for two to three days and some recovered after showing all the inital symptoms of those which died.

The influence of sheep husbandry practices on Salmonellosis is obscure. In December and January mustering is frequent for shearing, drafting fat lambs, weaning others, and dipping and culling the ewes. In addition, some farmers concentrate their breeding-ewes in small paddocks after culling to bring them down in condition for tupping, but there is no clear-cut relationship between these practices and either the onset or the course of Salmonellosis in affected flocks.

Foot-rot.—Foot-rot was eliminated from the Manutuke Research Station in January, 1947, and no other cases occurred until June, 1948, when the disease was reintroduced. It was again eliminated in January, 1949, and there has been no recurrence of the disease. This freedom from foot-rot at Manutuke has been maintained in spite of the introduction of several new lots of sheep with from 10 to 25 per cent. of foot-rot. Strict quarantine procedures were adopted in each case and no sheep was allowed into the paddocks until its feet had been inspected and pronounced completely free from foot-rot. Foot-rot has now also been eliminated from the Wallaceville Animal Research Station. There is no doubt that any farmer who has sheep-proof fences can eradicate foot-rot from his property. Extreme care and a good deal of hard work are involved, but the improvement in condition and production of the sheep and the elimination of continuous foot-rot treatment would make the effort well worth while.

Post-dipping Lameness in Sheep.—Following the proof that post-dipping lameness as it occurred in New Zealand in recent years was due mainly to a localized infection with *Erysipelothrix rhisopathiae* and that it could be controlled by the addition of bacteriostatic substances to the dipping-baths, good control of the infection has been achieved. No cases were reported in the 1949 season in which *Erysipelothrix* was involved, although there were a number of instances in which other organisms such as anærobes and *Corynebacterium pyogenes* were incriminated. The organisms mentioned are less susceptible to the bacteriostats at present in use. In the 1948 season more than one hundred and fifty outbreaks of lameness were reported. In the current season (1950) a number of outbreaks due to *C. pyogenes* have been reported and there were two cases suggestive of *Erysipelothrix* on clinical grounds, although the organism was not isolated. In both dipping-baths the concentration of the bacteriostat was below effective levels.

Dairy Cattle Breeding Projects

Artificial Insemination at Ruakura.—Winter Mating Group: This group was again used for training technicians. Four out of five candidates proved competent technically but one of these was temperamentally unsuitable. The experience gained over the past few years should prove valuable to any institution undertaking the training of technicians for commercial artificial insemination groups.

Spring Mating: Artificial insemination moved a further step forward this season with the organization of the first two commercial groups by the Herd Recording Department; a Waikato group comprised 15 herds and 720 cows and a Taranaki group 15 herds and 600 cows. The cows were mainly grades, though a number of pedigrees were included. Charges were 15s. for grades and 30s. for pedigrees. Semen was provided by Ruakura without charge, the Dairy Board accepting responsibility for all other work. At Ruakura itself the normal experimental grade group was continued, while the pedigree group was also carried on.

(*a*) The Ruakura Grade Group: For several years it has been apparent that conception rates with stored material have been unsatisfactory, and that, in particular, a marked fall in rate has occurred with second- as compared with first-day material. This observation, however, has tended to be confused by other operating factors which have been under experimental test. This season the grade group has been used to obtain straight data on storage time relative to conception rate. Semen was used mainly over three days. A total of 1,122 inseminations was carried out for an over-all conception rate of 51 per cent., 36 per cent., and 37 per cent., on the first-, second-, and third-day inseminations respectively. A dose rate of 25,000,000 sperm per insemination was used. The drop of 15 per cent. from the first to the second day is substantial and represents a fall from a satisfactory to an unsatisfactory level in so far as the dairy-farmer is concerned. The maintenance of conception rate on the third day at the same level as that on second-day material is also in line with previous years' results.

In addition to the experimental group, the data from both the commercial and the pedigree groups also provided a measure of this fall off in conception rate with storage. The two commercial groups showed a drop as between the first and second day of 11 per cent. in Waikato and 5 per cent. in Taranaki. These two groups used a dose rate of 50,000,000 sperm. The pedigree group drop for the same period was 10 per cent., using the lower dose rate of 25,000,000 sperm.

In attempting to assess the factors responsible it has been noted that individual bulls exhibited a marked difference in their ability to produce semen capable of standing up to storage. Thus in the combined grade and pedigree experimental groups bull J. maintained a fairly even percentage for the first two days with rates of 58 per cent. and 54 per cent., but dropped away to 34 per cent. on the third day. A similar picture was shown by this bull in the commercial groups, second-day inseminations being as good or better than the first, the figures being 56 per cent and 71 per cent. for Waikato and 54 per cent. and 50 per cent. for Taranaki. In contrast, bull S. exhibited a drop of approximately 20 per cent. from first- to second-day material in all groups.

There appears to be no doubt that marked deterioration occurs after twenty-four hours' storage with some bulls under low-dilution rates. The fact that the fall was less in the commercial group which employed a higher dose rate than the 25,000,000 used in the grade group suggests that the trouble is more serious with lower dilutions. The general results are in line with those now being reported from Denmark and the United States. Work both to discover the reasons and to correct the trouble is in progress.

(*b*) Pedigree Group: Work for the fourth year with this group proceeded along lines similar to those of previous seasons except that limitations of transport imposed still further restriction upon the area covered and several herds had to be dropped. Without any propaganda or persuasion, however, numbers were maintained at the level of previous years, 557 cows being inseminated, of which 67 per cent. proved in calf during the short season offered. The following table brings up to date the pedigree cows conceiving to merit sires as a result of A.I. work in this experimental group:—

PEDIGREE COWS IN CALF TO MERIT BULLS

Bull.	1946.	1947.	1948.	1949.	Total.
Jersey Glen Handsome Boy	134	139	64	182	519
Landsdowne Double Sam	..	83	110	90	283
Erinview Teddy	53	52	66	31	202
Fairymeadows Beau Geste ..	..	..	101	45	146
Muritai Oxford Lad	21	47	..	..	68
Cloverfield's Enid's Sam ..	..	..	..	11	11
Total	208	321	341	359	1,229

These figures provide some measure of the extent to which A.I. could make the services of such bulls available to breed sons of merit bulls for use by the industry. No real difficulty was experienced either in the initial organization of this trial group or in keeping it going over the past four years. In view of the limited number of pedigree herds of the industry headed by bulls of the quality used, the small total number of such bulls available, and the all-over difficulties of implementing a nation-wide service for grade cows, extension of this type of work on a pedigree basis is worthy of consideration. Plans to this end are in an advanced stage, and it appears likely that four commercial pedigree groups will be organized next season.

(*c*) Commercial Groups : The service was maintained for seven weeks of the breeding-season. In Taranaki only 61 per cent. of the cows in the herds concerned came up for service and in Waikato only 81 per cent. Of the cows serviced, 61 per cent. held in Taranaki and 74 per cent. in Waikato. Though these figures compare favourably with the normal number of cows proving in calf to natural mating over the same period in the districts concerned, the results from Taranaki were not as good as had been hoped for. The main reasons for this appeared to be that several of the herds concerned had a recent history of infertility and several of the bulls used dropped markedly in performance with both storage and transport of their semen. Summing up the results of A.I. work over the last seven years it has become abundantly clear that the provision of a service to commercial dairy-farmers on any adequate scale which would not only provide herd replacements of high quality but which also must succeed in getting the greater part of the herd in calf in the short mating period associated with our seasonal dairying is not only extremely difficult but hardly practicable with old proven bulls. On the other hand, since seasonal conception rates are not so critical on pedigree herds, and the supply of bulls is more nearly adequate, the extension of artificial insemination to pedigree cattle on a national basis now seems both technically possible and practicable.

Bull Fertility Studies.—During the past year further studies have been made of factors which may affect the sexual performance of bulls. Identical twins have been used as test animals.

(*a*) *Effect of Level of Nutrition During Growing Period :* Five pairs of twins were split into two groups and reared so that maximum differences in body weight were obtained during the first two years of life. By restriction of intake one group was reared so that the poorest body weight compatible with maintenance of life was aimed at. In contrast their mates were treated to attain the best possible growth and development. Previous experiments have indicated that wide differences in feeding treatment would be necessary to demonstrate differences in semen production, so relative extremes of treatment differences were imposed. The methods used with well-fed twins would correspond to the best conditions of the pedigree breeder rearing bulls for sale ; the poorly fed mates were typical of animals of the poorer class of commercial dairyman.

Sampling by the exhaustion-test technique occurred for the first time at 15 months—the age when young bulls are first used in New Zealand—and was repeated at three-monthly intervals. The following table summarizes the differences noted :—

RELATIVE DIFFERENCES IN BODY WEIGHT, TESTICULAR VOLUME, AND SPERM PRODUCTION OF HIGH- AND LOW-PLANE TWIN BULLS

(High-plane = 100 per cent.)

Age (Months).	Weight.	Testicular Volume.*	Sperm Production.
	Per Cent.	Per Cent.	Per Cent.
15	68·0	71·5	56·8
18	61·6	64·2	55·9
21	65·8	68·4	45·0
24	61·0	63·5	57·8

* Testicular volume has been calculated by assuming the organs to be cylindrical and the calculation made from the length and width.

All figures denote excess of high plane over low plane.

In addition to exhibiting marked differences of the order noted above, the low-plane bulls showed much weaker sex drive. Although their performance as measured by semen production was very low relative to their well-reared mates, and although their development of secondary sex characters was very poor and they gave an appearance of marked lack of constitution, they were by no means sterile, however, and could have been mated successfully to a small number of heifers.

The experiment is being continued with the modification that since the two-year-old stage the low-plane animals have been placed on equal rations with the high-plane to permit them to catch up their body-weight deficiencies, if possible. Semen-production tests are being made periodically during this period.

(*b*) *Effect of* B. abortus *Inoculation and Infection:* Four pairs of identical twin bulls were used to test the effect of inoculation with S. 19 *B. abortus* vaccine on semen production. One member of each pair was inoculated at ten months of age, and when titres of the vaccinated group had settled down to a constant level at eighteen months of age semen was examined. No effects on volume or morphology could be observed and all samples proved negative for *B. abortus*. All bulls were then infected through the occular route with a highly virulent strain of *B. abortus* and semen characteristics watched frequently over the next eight months. No changes could be observed and in neither vaccinated nor control bulls was active disease set up, despite the heavy dose of highly virulent bacteria used (150,000,000). Inoculation with this field strain was repeated on all bulls, using a 10,000,000,000 dose rate intravenously. In all cases a short period of fever followed with a few cases of extreme depression and anorexia. This stage passed in a few days. Again no effects could be noted on the quantity or quality of semen produced. *B. abortus* was recovered from the semen in one case only, but in the ensuing five months this animal has not developed any orchitis nor has the morphology of his semen deteriorated.

(*c*) *Effect of Œstrus State of Decoy Cow:* It has been suggested that the regular use of decoy cows not in œstrus in collecting from bulls in A.I. work might be responsible for the irregular fertility performance of some bulls and for failure to obtain the utmost work from a bull. Using four sets of identical twins, collections obtained from use of "hot" and "cold" cows have been compared. The method used was to take four services at fifteen-minute intervals from one group of bulls using a cow in œstrus and four from their twin mates using a cow not in œstrus. The groups were then switched for the next four services.

TOTAL SPERM PRODUCTION (MILLIONS)

Services.	"Hot" Cow.	"Cold" Cow.	Increase With "Hot" Cow.
			Per Cent.
First four	81,230	72,410	12
Second four ..	45,467	39,428	15

In terms of total sperm production collection from a "hot" cow gave slightly better results. The twins used with the cow in œstrus yielded 12 per cent. more sperm than their mates with the cow not in œstrus for the first four services. When the pairs were reversed the difference in favour of the "hot" cow collections increased to 15 per cent. for the second four services. As is usual, a drop in sperm output occurred between the two lots of four successive services and it is important to note that this drop averaged 52 per cent. in the change from "hot" to "cold" cow and 37 per cent. from "cold" to "hot" cow. The effects are sufficiently great to warrant repetition of the experiment.

Data will also be collected under conditions where the bulls serve a cow and the artificial vagina alternately to overcome the objection that the experiment as reported here was carried out with the artificial vagina so that effects must be psychic only. Physical contact with the cow in œstrus may be important.

(*d*) *Effect of Excessive Use as Yearlings:* One possible cause of fertile young bulls' failing to maintain high-level performance in later years may be excessive use during their first breeding-season as yearlings. Again using twin bulls, one member of each pair has been given a large amount of use, both with natural mating and by artificial service, from fifteen months of age. During the same period their mates were given light use only. The first group averaged over one hundred and twenty services as against ten for the second group. The influence of this treatment upon reproductive strength is being followed.

When the last three years' work on fertility with identical twin bulls is reviewed the general conclusion that reproductive performance is largely unaffected by environmental conditions is difficult to avoid. Equally, the converse, that such characteristics are largely a function of the individuality of the bull and thus very largely determined by inheritance, seems inescapable. Swedish workers are reaching a similar conclusion. If this is true, the possibility of success of straight selection for fertility levels is very favourable. The high incidence of infertility in purebred bulls in the industry points to the need for attention to this aspect by breeders.

Production of Artificially-bred Heifers.—In the 1948–49 season a third crop of A.I. heifers by merit sires completed their first lactation in the Waikato and elsewhere. Second and third lactations were also completed by the progeny of earlier work. Results are summarized below. This table shows the results for each sire separately where they had at least 10 daughters in production. All productions are on a maturity equivalent basis, and the production of mature cows in the same herd is shown on a comparative basis.

A.I. Bred Cows Born 1944, 1945, and 1946 (Waikato and Manawatu Districts) Production Records for the Three Seasons 1946–47 to 1948–49

Sire.	Commercial Herds.					Ruakura Animal Research Station.	
	Number of Daughters.	Number of Lactations.	Daughters Average (Pound Fat Maturity Equivalent).	Average of Mature Cows in Same Herds.	Increase in Daughters Over Mature Cows.	Number of Daughters.	Daughters Average (Pound Fat Maturity Equivalent).
Merit sires—							
E.T.	56	73	340	306	+34	11	388
J.G.H.B.	22	22	357	315	+42	4	383
G.H.P.	28	60	350	321	+29	1	322
L.G.L.	45	54	318	297	+21	10	351
M.O.L.	10	10	336	317	+19	5	329
K.K.B.K.	44	92	332	317	+15	4	462
A.P.	16	38	324	315	+ 9	..	000
G.A.	11	15	329	325	+ 4	3	412
McL.	7	10	314	294	+20	6	335
Average of nine merit sires	239	374	335	311	+24	44	372
Other sires—							
E.F.	55	77	309	302	+ 7	3	381
H.C.C.	36	55	312	301	+11	..	..
M.F.	13	15	318	307	+11	..	..
Nine other sires with less than 10 daughters	38	44	321	309	+12	1	332
Average for all sires ..	381	565	327	308	+19	48	372

The daughters of the 9 merit sires in commercial herds averaged 335 lb. of fat, compared with the 311 lb. of mature cows in the same herds, representing an average lift of 24 lb. of fat per cow. Other sires used, which were either not up to merit standard or were sons of merit sires, showed an average lift of 12 lb. fat on the same basis. Daughters of the same merit bulls in the Ruakura herds averaged 372 lb. fat or 37 lb. better than their mates in farmers' herds. The difference probably represents a feeding and management difference. It will be noted that all the average productions recorded are substantially above the Dominion average.

In the next table the daughter-dam comparison for bulls with at least 10 daughter-dam pairs is shown. In each case the A.I. daughters have also been compared with the daughters of the "average" sire mated to dams of the same production level.

(The figures for the "average" sire are based on an analysis of daughter averages of all bulls surveyed according to the production level of the cows they were mated to.)

DAUGHTER-DAM COMPARISONS BASED ON 1946–47, 1947–48, AND 1948–49 RECORDS

(Includes sires with at least 10 daughter-dam pairs)

Sire.	Number of Daughter-Dam Pairs.	Number of Lactations.	Daughters.			Dams.			Pound Fat Above Average.
			Milk.	Test.	Fat.*	Milk.	Test.	Fat.	
			lb.		lb.	lb.		lb.	
E.T.	25	28	6,720	5·03	338	6,310	4·92	311	+39
J.G.H.B.	12	12	6,740	5·58	376	6,160	5·19	320	+70
L.G.L.	11	13	5,730	5·28	303	6,160	5·04	310	+ 4
K.K.B.K.	17	24	6,380	5·11	326	6,530	4·86	317	+22
Average of four merit sires	65	77	6,470	5·19	336	6,310	4·97	314	+34
E.F.	23	32	5,700	5·40	308	5,820	5·27	307	+11
H.C.C.	13	16	5,860	5·17	303	6,350	4·90	311	+ 4
Average of two other sires	36	48	5,760	5·32	306	6,010	5·14	308	+ 9

* Maturity equivalent.

The following shows the production records of A.I. heifers compared with heifers born to natural matings in the same herds during the same season. The numbers here are small and refer only to daughters of merit sires.

COMPARISON OF PRODUCTION RECORDS OF A.I. HEIFERS WITH HEIFERS BORN TO NATURAL MATINGS

(Heifers born 1946—1948–49 production records)

(Includes daughters of merit sires only)

Member.	A.I. Daughters of Merit Sires.		Non-A.I. Heifers.		Increase (Pound Fat).
	Number of Daughters.	Average Fat.	Number of Daughters.	Average Fat.	
		lb.		lb.	
A	8	283	4	265	18
B	5	297	4	191	106
C	12	280	9	253	27
D	14	224	9	208	16

In 1948–49 only 4 herds were available for this comparison, but the results bear out the advantage for the A.I. heifers as shown by the other tables.

Below are the detailed results for the A.I. daughters of merit sires, in herds with at least 5 daughters, as compared with the average of the mature cows in those herds. In only one case, in that of herd 7, has the production of the mature cows not been maintained by the A.I. daughters.

PERFORMANCE OF A.I. DAUGHTERS ACCORDING TO HERD PRODUCTION LEVEL

(Analysis includes daughters of merit sires only; herds where there were less than 5 daughters of merit sires were excluded)

Herd.	Number of Daughters.	Daughters Average Fat (Maturity Equivalent).	Average of Mature Cows in Herd.	Increase in Daughters Over Mature Cows.
		lb.	lb.	lb.
1	5	356	350	+ 6
2	30	358	346	+12
3	5	352	344	+ 8
4	14	362	342	+20
5	12	350	325	+25
6	28	361	322	+39
7	5	313	322	— 9
8	6	340	316	+24
9	21	330	313	+17
10	5	319	312	+ 7
Average of top ten herds	131	350	330	+20
11	9	321	306	+15
12	6	312	298	+14
13	6	337	297	+40
14	6	354	290	+64
15	9	297	283	+14
16	5	367	278	+89
17	13	310	270	+40
18	14	294	268	+26
19	6	297	256	+41
20	5	255	233	+22
Average of lower ten herds	79	312	278	+34

The merit bulls have effected a greater improvement in the lower-producing herds than in the higher-producing herds. To what extent this difference is really significant, and, if significant, what conclusions can be drawn therefrom it is impossible at the moment to say. With an increasing number of A.I.-bred heifers coming into production it will be possible to extend all these tables on a more complete and therefore more satisfactory basis and to check the conclusions reached in this present survey. In the meantime it does appear clear that the productive value of the cows bred in commercial herds as a result of A.I. is quite substantial and that worth-while economic results can be secured by this means of improvement.

Identical Twins.—(*a*) *Collection:* A very successful season was experienced, 35 sets of heifers and 7 sets of bulls being located in a period of six weeks and mainly within the Waikato area. Two sets were transferred to the Dairy Research Institute. The total number located to date is 250 sets.

(*b*) *Uniformity Trials:* Continuation of uniformity trial work has established further efficiency values for twins relative to non-twin dairy stock for studying various characteristics in cattle. These may be summarized conveniently as follow: —

RELATIVE USEFULNESS OF IDENTICAL TWINS

Characteristic.	Number of Sets.	Efficiency Value.	Characteristic.	Number of Sets.	Efficiency Value.
Milk production—			Grazing behaviour—		
Milk yield	9	22	Grazing-time	6	72
Butterfat yield	9	54	Loafing-time	6	6
Fat test	9	15	Lying-down time	6	3
Casein, per cent.	9	10	Distance walked	6	3
Casein yield	9	50	Defæcations	6	8
Casein/fat ratio	9	15	Micturitions	6	1
Persistency of lactation	9	4	Drinks	6	5
Dairy merit	9	5	Feed intake and metabolism—		
Butterfat quality—			D.M. intake—(*a*)	12	8
Reichert-Meissl. value	4	11	(*b*)	12	5
Iodine value	4	4	Fæcal N.	12	21
Softening point	4	9	Fæcal D.M.	12	5
Saponification value	4	1	Blood characteristics—		
Live weight and growth—			(*a*) Physiological—		
Weight for age	10	26	Red cell count	12	4
Growth rate	10	9	Red cell volume	10	8
Growth coefficient "K"	10	11	Hæmoglobin	10	13
Body measurements—			Red cell fragility	25	15
Height	12	6	(*b*) Chemical—		
Length	12	10	Calcium	19	1
Depth: chest	12	15	Magnesium	19	19
Hip-pin	12	30	Phosphorus	19	16
Hip-hip	12	9	Sugar	19	1
Girth: chest	12	105	Acetone bodies	19	1
Girth: belly	12	10	Heat-tolerance tests—		
Head: length	12	10	Body temperature	7	37
Head: width	12	5	Respiration rate	7	15
Eye to jaw	12	7	General—		
Lower jaw length	12	19	Fæcal egg count	16	2·5
Tail length	12	7	Agglutination titre S. 19	12	2

According to latest statistical advice, it is possible that the above values are one unit too low in each case. This point is important only with the low values. As has been emphasized previously, the figures quoted should be used mainly as guides to the relative usefulness of twins for the different purposes concerned.

(*c*) *Grazing-behaviour Studies:* From grazing-behaviour studies under uniform conditions with twins the following "normal values" for twenty-four hours have been calculated:—

Grazing-time	411 minutes.
Loafing-time	195 minutes.
Lying down	580 minutes.
Distance walked	3,038 yards.
Number of defæcations	12
Number of micturitions	10
Number of drinks	4

Detailed observations on grazing and rumination habits of a limited number revealed the following:—

Number of bites (grazing)	24,000
Rate of grazing (bites/minute)	50
Rumination time (minutes)	325
Number of bites (rumination)	17,000
Rumination/grazing ratio	3 : 4

To date, continuous observations on approximately 2,000 cow days, each of twenty-four hours, have been made. In addition to the uniformity trials above, studies of (*a*) the influence of quantity of grass and of concentrate feeding on grazing behaviour, (*b*) the interactions of feed intake, milk-production, and grazing behaviour, and (*c*) the influence of grazing management (set stocking versus controlled rotational grazing) on grazing behaviour have been carried out. Though many tentative conclusions of some practical as well as theoretical importance promise to come from this work, analysis of the data is not yet complete.

(*d*) *Genetic Implications of Nutritional Levels:* The interaction of environment and inheritance upon identical animals has been studied. Fifteen sets of twins have been placed on three widely different levels of nutrition so that twin pair comparisons are possible between each level. The three levels used have been as follow:—

Treatment A: Maximum grass plus concentrates. Hay and silage *ad lib.* when grass inadequate.
Treatment B: Maximum grass and hay plus silage *ad lib.* when grass inadequate.
Treatment C: Grass at 60 per cent. of the level of treatment B. Hay and silage at 60 per cent. of treatment B when needed.

Thus the treatment A cows have been fed to ensure production up to the maximum of their inherited capacity. The treatment B cows have been fed to the limit possible under a high standard of efficiency of grassland farming. The treatment C cows have had a restricted intake of grass and grass products by having access to only 60 per cent. of the area grazed under treatment B.

The experiment has been designed to run a minimum of three years. Results for the first two seasons are summarized below.

AVERAGE PRODUCTION OF BUTTERFAT
(Mean of 5 sets of comparison)

	Season.		All Lactations Maturity Equivalent.
	1947–48.	1948–49.	
	Actual Productions.		
	lb.	lb.	lb.
Treatment A	402	416	455
Treatment B	305	341	374
Difference	97	75	81
Treatment B	266	353	359
Treatment C	237	318	326
Difference	29	35	33
Treatment A	316	417	419
Treatment C	179	308	296
Difference	137	109	123

The trends in results during the current season are very similar. Consideration of the genetic implications of this experiment necessitates detailed examination of the individual twin pairs. This will be done when the experiment has completed the third season. In the meantime the mean results at least suggest that an allowance of approximately 100 lb. of butterfat must be made in comparing the records of cows well fed on grass with those of cows whose diet is supplemented with concentrates to ensure maximum yields. This point is of considerable practical importance in the selection of bulls either on the butterfat backing of their dams under New Zealand conditions or on the production of their progeny.

(*e*) *Influence of Tropical Climate Upon Performance of Temperate Zone Cattle:* To study the possibility of climate *per se* being a limiting factor of major importance to the performance of dairy cattle in Fiji, an experiment has been commenced involving eight sets of identical twin heifers. One member of each set has been located in Fiji, the mate remaining at Ruakura. Feed supplied all animals will be grown in New Zealand to eliminate nutritional effects. All other conditions have been standardized as far as possible. The experiment is being conducted in co-operation with the Fiji Department of Agriculture, and, apart from its direct practical interest to dairymen in that country, is likely to yield general data on the interaction of climate, production, and inheritance of interest to breeders in all high-temperature zones, as well as information which will permit a better understanding of the interactions of climate and animal behaviour.

Dairy Cow Nutrition

Lifetime Project.—The object of this project is to examine the effect of two types of pasture management on the lifetime performance of dairy cows. In one case the pasture is so controlled by rotational grazing, autumn saving of pasture, and maximum conservation of hay and silage as to provide an even, high level of nutrition, while in the other the diet of the cattle is controlled almost entirely by seasonal effects. The different treatments are applied in two groups for the whole lives of the cattle and in the other two changes are made when the heifers calve for the first time. There are thus four groups, which are designated high-high (good nutrition throughout), low-low (poor nutrition throughout), high-low (good nutrition to first calving and poor nutrition thereafter), and low-high (poor nutrition to first calving and good nutrition thereafter). The results are reported in three stages, calf, yearling, and cow.

Calf Stage: Seasonal body weights of the well-reared (rotationally-grazed) and poorly-reared (set-stocked) calves for the last six years were as follow:—

BODY WEIGHTS AS AT 31ST MARCH

Seasons.	Well Reared.		Poorly Reared.		Difference.
	Number.	Weight.	Number.	Weight.	
		lb.		lb.	lb.
1944–50	110	381	120	288	93
1949–50	14	357	14	297	60
Twins (split)	12	408	12	325	83

Yearling Stage: Body-weight differences of the two groups of heifers were as follow :—

BODY WEIGHTS AS AT 31ST MARCH

Seasons.	Well Grown.		Poorly Grown.		Difference.
	Number.	Weight.	Number.	Weight.	
		lb.		lb.	lb.
1944–50	90	714	94	563	151
1949–50	10	785	11	618	167
Twins (split) ..	12	695	12	558	137

Cumulative data on reproduction behaviour of yearlings are summarized below :—

REPRODUCTION BEHAVIOUR
(All seasons)

——	Well Grown.	Poorly Grown.
Total number of heifers	90	95
Number showing heats before mating	88	71
Number of recorded heats before milking ..	401	159
Number of mating heats—		
Total	149	130
Fertile cows	119	126
Number in calf	80	93
Services per conception—		
Total	1·86	1·40
Fertile cows	1·50	1·35

The poorly-reared heifers continue to show fewer animals coming into œstrus before mating, substantially fewer total œstrus periods before mating, fewer mating heats, and a better conception rate than their well-reared mates. Culling rate for empty heifers was only 2.1 per cent. in the poorly-reared group and 11·1 per cent. in the well-reared group.

Cow Stage: The two farms in this experiment have now reached pasture conditions typical of the two systems of management as seen in the field.

On the whole a good grass year was experienced during the 1948–49 milking season.

Production Results: These are still difficult to summarize and interpret at the present stage. The cattle are still young and age distribution is abnormal. Results indicate trends only.

MEAN FAT YIELDS (SEASONAL BASIS)*

——	1948–49 Season.	All Seasons.			
	Herd Average.	Two Years.	Three Years.	Mature.	Total Herd.
	lb.	lb.	lb.	lb.	lb.
H.H.	363 (23)	295 (27)	358 (20)	381 (8)	331 (55)
L.H.	330 (22)	275 (29)	326 (19)	387 (7)	307 (55)
H.L.	301 (19)	280 (25)	292 (19)	317 (5)	289 (49)
L.L.	285 (19)	241 (28)	291 (15)	327 (4)	264 (47)

* Normal cows to 31st May.

Of general interest in relation to the two systems of feeding management followed—controlled versus uncontrolled grazing—the performance of the herds on the two farms might be noted. The former averaged 347 lb. fat for the season and the latter 293 lb. fat, a difference of 54 lb. of fat in favour of controlled grazing.

This difference probably over-measures the difference in per cow production slightly, since it tends to be influenced by the early rearing systems practised and, in any case, is a one-season figure. The herd average figures for the three seasons probably provide a better index, particularly if high-high animals (331 lb.) are compared with high-low (289 lb.)—a difference of 42 lb. per cow; and when low-high (307 lb.) are compared with low-low (264 lb.)—a difference of 43 lb. These comparisons are between animals of similar rearing and involve three seasons' production for two-year, three-year, and mature cows. The agreement between the two estimates is surprisingly good.

The observations made last year as to trends appearing might be restated in terms of the additional information available :—

(1) The advantage of good rearing over poor rearing when cattle are subsequently fed from first calving on a high even level of nutrition has not been great (plus 20 lb.) at the two-year-old stage, is more than maintained (plus 32 lb.) at the three-year stage, but has disappeared at the mature stage.

(2) The advantage of good rearing as compared with poor rearing when cattle are subsequently fed unevenly from first lactation onwards has been quite substantial (plus 39 lb.) at the two-year stage, has disappeared at the three-year stage (plus 1 lb.), and become a disadvantage at the mature stage (minus 10 lb.).

(3) The advantage of good rearing combined with high even feeding during subsequent lactations over poor rearing combined with uneven lactational feeding has been substantial in two-year-olds (plus 54 lb.), three-year-olds (plus 67 lb.), and mature cows (plus 54 lb.)

Farm-production Data.—The experiment has now reached a stage where it seems worth while summarizing the farm-production data from the two properties. The following table gives the mean production for all seasons for both normal and all cows and, in addition, shows the production per acre figure. All data refer to actual productions.

FARM-PRODUCTION DATA (BUTTERFAT)

——	Per Cow (Normals, All Seasons).	Per Cow (All Cows, All Seasons).	Per Acre (1948–49 Season).
	lb.	lb.	lb.
Controlled	319	315	251
Uncontrolled	277	253	189

On a normal cow basis the controlled farm has out-produced the uncontrolled by a mean of 42 lb. fat per cow and on a total cow basis by 62 lb. fat per cow. The difference is an expression of the fact that to date a higher number of abnormal lactations have been experienced on the uncontrolled farm. This, of course, may be an important consequence of this system of farming and will result, if continued, in a higher herd-wastage figure under uncontrolled grazing as compared with controlled. The per acre productions are quoted for one year only (1948-49), since this is the first year that a reasonably normal age population herd has existed. The difference of 62 lb. of butterfat per acre is substantial.

Analysis of Bloods from Cows on Various Planes of Nutrition.—Analysis of bloods from cows on various planes of nutrition has been continued monthly throughout the year and over the early lactation stages at weekly intervals. In addition the variation of these constituents around parturition was followed more closely by bleeding on the three days before calving, on the calving day, and on the three days after calving. This year's results are still being examined, but the main points of interest are: (1) The magnesium level of the low-low plane cows has not remained so consistently below that of cows in other planes as was indicated by the 1948 season's results. (2) Both calcium and phosphorus fall in almost all animals on the day of calving or the day after calving, values lower than 7 mg./100 ml. for calcium and lower than 3 mg./100 ml. for phosphorus being observed.

Measurement of Intake.—(*a*) *Usefulness of Chromium Faeces Output and Nitrogen Digestibility Techniques with Mixed Diets:* A digestibility trial involving 4 sets of identical twins was conducted with pasture, silage, and pasture-silage mixtures for the purpose of establishing any associative effects on digestibility which might be exhibited by this feed mixture. This investigation was essentially to determine whether the technique of measuring fæces output by chromium marker and digestibility by fæces nitrogen could be employed with cattle fed on grass supplemented with silage. The importance of this aspect is obvious when it is appreciated that for at least four to five months of the grazing year dairy cows in New Zealand under good management receive silage supplements. The experiments showed that no measurable associative digestibility effects resulting from widely different ratios of grass and silage existed, and, in addition, that the digestibility of a mixed diet can be determined satisfactorily from fæces nitrogen.

The experiment also indicated that satisfactory recoveries of chromium were obtained and accordingly that the marker technique can be extended to include measurements of the intake of mixed feeds of the grass-silage type.

The results with 7 sets of twins, all of which were fed measured quantities of food under indoor conditions, so that actual intakes of grass and silage were known, showed very good agreement between observed and calculated intakes.

(*b*) *Further Studies of Faeces Nitrogen as a Measure of Digestibility:* Regression equations for this purpose have been developed but are not yet considered completely satisfactory, since insufficient data from digestibility trials conducted with cows on pasture exist. The work is being continued. At the same time further studies of the possibility of using lignin instead of nitrogen as a digestibility index are still being pursued.

(*c*) *Effect of Bulking Grab Samples on Estimation of Intake:* It will be appreciated that the application of the present technique of measuring intake by an analysis of fæces obtained from "grab" samples at night and morning milkings involves a tremendous amount of analytical work if each sample is handled separately. To make the method applicable to any large number of animals some reduction is essential. This has been approached by developing methods of bulking "grab" samples from the same cow over a period of a fortnight to provide a measure of intake on this basis. The method developed has been shown to give very satisfactory results.

(*d*) *Preparation of Marker:* The twice daily dosing of cows with measured quantities of chromium presents a very difficult practical problem in the application of this technique. Various attempts have been made to mechanize the preparation of chromium tablets, but these have been only partially successful and the present method of weighing out the requisite quantity into cardboard capsules still has to be used.

(*e*) *Extension of Intake Work to Sheep:* A preliminary investigation has been carried out with 5 sheep over a six-week period, using monastral blue marker for estimating fæces output. Results indicate that "grab" samples comparable with those used in cattle are not representative of the total fæces output of the sheep and, in consequence,

it seems unlikely that a technique for measuring the intake of pasture by sheep, similar to that in use with cattle, can be developed. The possibility of a considerably modified approach is being developed.

Studies of Milking Methods

Milk Ejection in the Pig.—The pig-milking machine, which after considerable trial has been found to milk satisfactorily, has been used in a series of preliminary experiments on the milk let-down problem. The first experiments concerned the relative activities of " Pitocin " and " Pitressin " in ejecting milk from the sow. " Pitocin " is the Parke Davis oxytocic extract from the posterior pituitary and it is claimed by the makers that it is contaminated with only 4 per cent. of the pressor principle. " Pitressin " is the corresponding pressor preparation with a 3 per cent. contamination of oxytocic principle.

Using injections at ten-minute intervals into the ear vein of a sow removed from her young for about one and a half hours, varying doses of " Pitocin " and " Pitressin " were compared in activity as judged by the amount of milk ejected into the milking-machine. These experiments showed that, in terms of international units (the equivalent activity of 0·5 mg. of international dried pituitary powder), " Pitressin " has about 30 per cent. of the activity of " Pitocin."

A second series of experiments using as a means of comparison the point at which the two preparations just failed to produce a marked response gave the same ratio of activities.

These results confirm the earlier experiments of Turner and Cooper with rabbits and suggest the possibility that the milk let-down hormone is not the oxytocic substance.

Duration of Activity of the Let-down Hormone.—Varying doses of posterior pituitary extract were injected into a sow and the time during which milk flow continued was determined. Sixty times the minimal dose is reduced to below the effective blood-level in about two minutes.

The foregoing experiments are essentially exploratory, but the results so far show clearly that the milk let-down activity of pressor extracts is much greater than can be accounted for in terms of their oxytocic hormone content. It is also apparent that the rate of destruction in the blood is very high.

The Effect of Interrupted Milking on the Milk-ejection Curve.—A cow with a good type of milk-ejection curve was selected and " double milked " by machine. After she had delivered half of the milk given at the previous corresponding milking the cups were removed to be replaced five minutes later. Despite the fact that this treatment was maintained for over three months, the curves continued when the machine was replaced as if the milking were normal. No sign of training or conditioning was evident. Over several consecutive days the period between milkings was extended to ten, fifteen, twenty, and twenty-five minutes with no effect on the ejection curve.

Once-a-day Milking and the Milk-ejection Response.—Two cows were selected at a stage of lactation at which the daily milk yield had fallen to half that at the peak of the lactation curve. This was done to obviate abnormal intramammary pressures when the cows were changed to a once-a-day milking procedure. One of the cows was simply milked once a day ; the other was normally milked at one milking, and at the other milkin she was fully stimulated and 1 lb. of milk withdrawn by machine. At the time of reporting (after over three months) there is no indication of a marked change in the shape of the lactation curve of either of the experimental cows compared with the normally treated cows in the herd. However, when the cow which once a day had 1 lb. of milk withdrawn was milked normally the response was the immediate ejection of about a pound of milk, followed (after extra stimulation had been applied) by the slow ejection of the volume expected at this milking. This result is a little startling and its significance will be explored in future experiments.

Milking-machines.—The Characteristics of Combined Milk and Air Flow in the Milking-machine: The milk system of the machine involves problems of flow of both milk and air. This applies to the milk line, releaser, milk rubber, dropper tubes, claw pipes, and claw tubes. No precise information has existed on the characteristics of flow of both milk and air in these components, and manufacturers and farmers have speculated on the supposed ill or beneficial effects from incorrect size of pipes. Such speculations have often resulted in unnecessary complex alterations to machines, leading to inefficiency. Need exists also for a better understanding of flooding of low-line plants and releaser flooding of high lines. The information sought in these experiments is essential to efficient machine design.

The flow characteristics in all the components mentioned above have been systematically examined under conditions where the influence of some nine major modifying factors have been varied experimentally over the range normally found in milking practice.

The results have shown that many simple but highly significant points which have a bearing upon machine design have been largely overlooked or have received inadequate emphasis. Introduction of the modifications indicated will eliminate in both high- and low-line plants many of the difficulties at present encountered in machine milking. As a result of the work much more reliable recommendations can now be made in respect to size, number, and position of air-admission holes, pipe diameter, design of inlet to releaser, releaser design, capacity necessary in lift pumps, size of droppers, &c. Good machine design in this connection involves stability of air and milk flow, which has been shown to depend upon well-defined conditions: slope of milk line, size of air-admission hole, releaser inlet conditions, and level of milk in releaser and lift tank. A complete set of design data that has been worked out should be of considerable assistance to milking-machine manufacturers and servicemen.

Magnetic Pulsators: The piston-valve magnetic pulsator developed at Ruakura has now undergone a further year's test at No. 3 Dairy. The only weakness in design apparent is the spring arrangement. The improved model with a compression spring and adjusted to work on A.C. is to be installed in the new No. 5 Dairy. A full season's operation with a short-squeeze pulsator (20 : 80 ratio) has shown no sign of trouble due to congestion of the teats as suggested by the Minnesota workers. As the short squeeze was used on heavy moulded inflations as well as on the soft type, the test would indicate that this kind of pulsation is quite safe. A full report on the experiments will be available when the statistical work is complete.

Sight Glass: Metal prototypes of a plastic sight glass with a cut-off point at half a pound of milk a minute have been under test at Ruakura and on a commercial farm. The performance as a sight glass has been excellent. When used on a bucket plant the units need to be disassembled for cleaning, but when used on an ordinary machine cleaning is quite automatic and a test sight glass, after six months with no other attention than the standard caustic soda cleaning procedure, was found to be in excellent condition The glass will be available for farmer use for next season.

Relief Valves: Plastic damped weighted relief valves have now been in widespread use in the industry for more than six months in commercial sheds and the performance appears to exceed that of any other relief valves so far tested.

Cattle Disease Projects

Mastitis.—Herd Treatment With Penicillin at Drying Off: In 6 herds cows were treated at drying off with one tube per quarter of penicillin cerate containing 25,000 international units of penicillin. The teats, udders, and adjacent areas of cows were disinfected, penicillin-sulphadiazine cream was applied to teats, and the sheds and all fittings and equipment were also disinfected.

Though dates for drying off were prearranged, the sheds were never entirely free of lactating animals and these were treated with a course of three tubes per quarter spread over three days.

Quarter milk samples were tested bacteriologically before treatment and twice during the next lactation.

Results were as follow :—

Number of Cows Treated.			Percentages of Infections With *Streptococcus agalactiae*.						Quarters Infected at Drying Off.	
			Immediately Before Treatment.		Next Lactation.				Number Treated.	Number Infected Next Lactation.
					First Test.		Second Test.			
Dry.	Lactating.	Total.	Cows.	Quarters.	Cows.	Quarters.	Cows.	Quarters.		
334	30	364	25·7	12·1	6·2	2·2	14·5	5·8	116	21 (18·1%)

One herd only was free of infection in the two tests subsequent to treatment; there was a very low incidence in this herd in the season before treatment. The source of infection in other herds is not known.

Incidence of infection determined bacteriologically was less for the tests after treatment than in the test before treatment. Similarly in three herds for which records are at present available there were 13·5 per cent. of cows and 5·2 per cent. of quarters clinically affected and treated by the farmer up to 31st December, 1949—*i.e.*, for the first few months of lactation in the year after drying-off treatment, whereas in the previous season for the same herds the figures were 19·5 per cent. cows and 6·5 per cent. quarters.

Further studies are in progress this season.

Experiments With Procaine Penicillin Cerate: During the year small quantities of 100,000-unit tubes of procaine penicillin cerate became available for experimental study. Comparisons were made of the penicillin levels in quarter milk samples following the injection of 100,000 units of procaine penicillin cerate and 100,000 units of calcium penicillin cerate.

The results from quarters varying in milk yield over a wide range suggested that the procaine penicillin cerate product was more efficient than the calcium penicillin cerate in maintaining penicillin concentration in milk.

Following these preliminary observations with procaine penicillin cerate, clinical trials using three injections of 25,000 units of a procaine penicillin cerate product were conducted. Seventy-nine per cent. bacteriological cures resulted in 162 quarters with latent *Streptococcus agalactiae* infection. Sixty-seven clinical cases of *Str. agalactiae* infection were similarly treated, with bacteriological cures in 65 per cent. of quarters.

Penicillin levels in milk from twelve quarters treated on three consecutive days with 25,000 units of procaine penicillin cerate and 25,000 units of calcium penicillin cerate are shown in Fig. 1. The results confirmed the greater efficiency of the procaine penicillin.

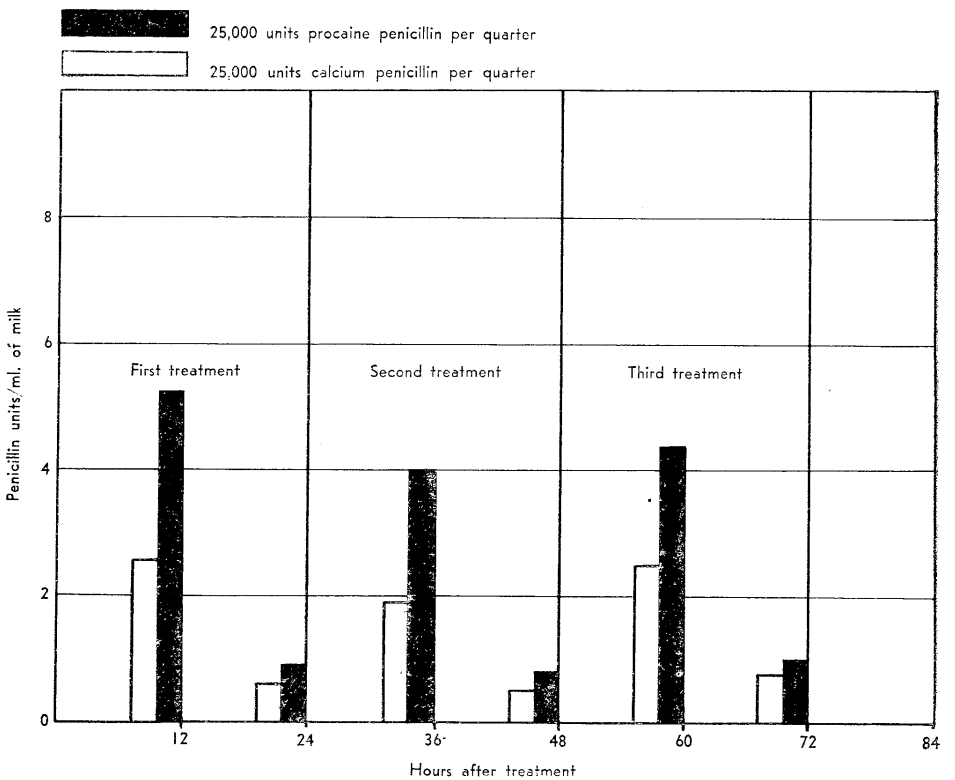

FIG. 1—PENICILLIN LEVELS IN MILK.

Three daily injections of (*a*) 25,000 units calcium penicillin cerate per quarter ; (*b*) 25,000 units procaine penicillin cerate per quarter.
Daily milk yield of experimental cows 26–45 lb.
Averaged results from twelve quarters.

Preliminary observations on penicillin levels in milk have been conducted with a special procaine penicillin cerate preparation. The summarized results of studies on twelve quarters treated with 100,000 units of the special procaine penicillin cerate and 100,000 units of procaine penicillin cerate of the original batch, shown in Fig. 2, indicate that the special penicillin cerate was superior to the original batch in maintaining levels of penicillin in the milk, although it provoked lower concentrations up to the thirty-sixth hour.

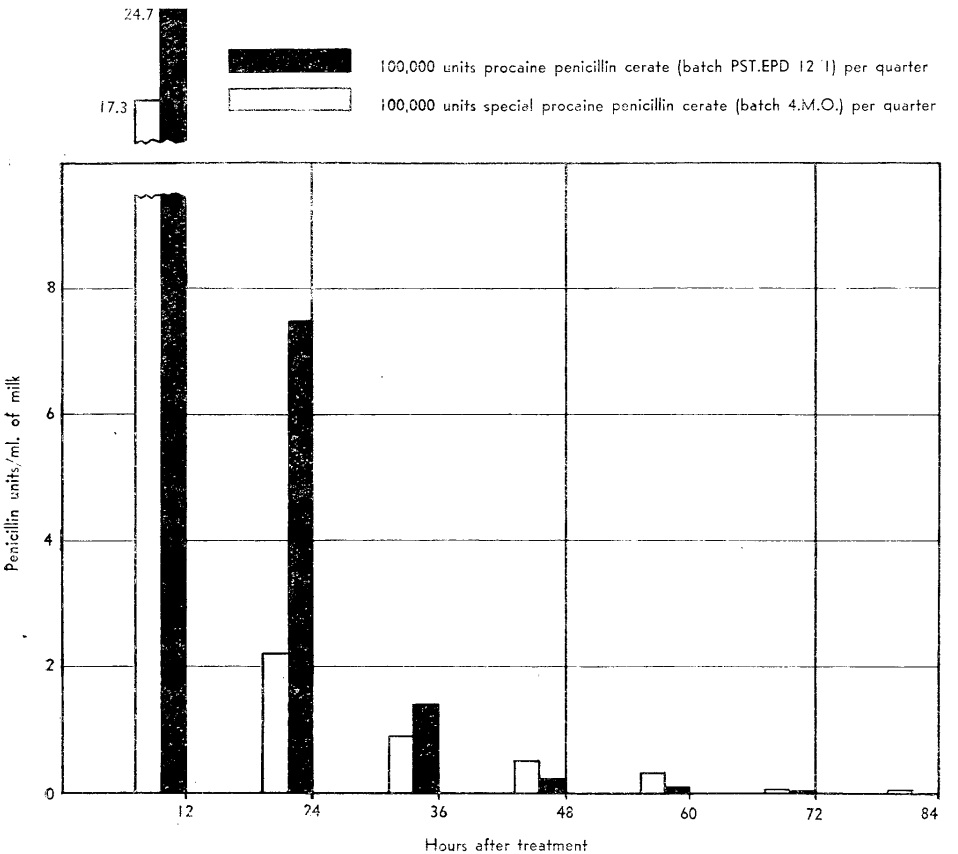

FIG. 2—PENICILLIN LEVELS IN MILK.

One injection of (*a*) 100,000 units of procaine penicillin cerate (batch 3/P.S.D E.P.D 12/1) per quarter; (*b*) 100,000 units special procaine penicillin cerate (batch 4 M.O.) per quarter.
Daily milk yield of experimental cows 35–47 lb.
Averaged results from twelve quarters.

Work has also been initiated on the distribution of penicillin in the lactating udder following the injection of the special procaine penicillin cerate product.

Clinical Trials With Other Preparations: Small quantities of an aureomycin preparation (Lederle) and a dibromopropamidine isethionate-penicillin preparation became available during the year for clinical trials. A preliminary trial with a *single* injection of the aureomycin preparation in latent *Str. agalactiae* infection resulted in bacteriological sterilization of nineteen quarters of a total of twenty injected. Aureomycin may

therefore possess a great advantage by being effective in a single dose. Data at present available from the clinical application of these experimental products in staphylococcal mastitis and more refractory cases of streptococcal mastitis are too meagre to evaluate reliably the efficiency of these products.

Trichomoniasis.—Trichomonas agglutination tests have been carried out on 806 samples from 96 herds, with the following results :—

Positive	.. .. ..	33 herds (34 per cent.).
Doubtful	.. .. ..	25 herds (26 per cent.).
Negative	.. .. ..	38 herds (40 per cent.).

Mucus samples from 74 herds were examined for agglutinins with the following results :—

Positive	.. .. ..	14 herds (19 per cent.).
Doubtful	.. .. ..	27 herds (27 per cent.).
Negative	.. .. ..	40 herds (54 per cent.).

Mucus samples suffered more than bloods from delays in transit, though few samples of either type had to be discarded. On the other hand, specimens likely to contain the actual organisms (fœtuses and pyometra fluids) were mostly unsuitable and the organism was recovered in only a few cases. It does not seem practicable to transport this type of specimen any distance.

Though data so far give no accurate picture of the distribution of the disease, since it has not been possible to make systematic examination of a representative sample of herds on all areas, the following list of districts where bovine trichomoniasis has been diagnosed is important in indicating that the disease exists throughout the more important dairying areas of the North Island. Very few specimens have been received from the South Island and none of these has shown positive results to date.

Kaitaia.	Huntly.	Hairini.
Whangarei	Waiuku.	Kiokio.
Wellsford.	Ngatea.	Mokauiti.
Great Barrier.	Paeroa.	Rotorua.
East Tamaki.	Matamata (2).	Te Araroa.
Ramarama.	Morrinsville.	Gisborne.
Ruawaro.	Katikati.	Dannevirke.
Pokeno (2).	Tauranga.	Maori Bank.
Onewhero.	Cambridge.	Patea.
Pukekohe.	Fencourt.	Hawera (2).
Te Uku.	Pukeroro.	Eltham (3).
Waitetuna.	Te Kawa (2).	Ohangai (2).
Te Rapa.	Otorohanga (2).	

Study of bovine trichomoniasis over the past three years leads to the belief that the trouble is not only widespread, but that it is the cause of much of the temporary infertility in herds. It has also indicated that the extent of the disease in New Zealand is reflected more in the spread of calving than in the proportion of cows failing to conceive each season. It seems likely that approximately one third of the herds experiencing sterility problems suggestive of the disease are actually infected with trichomoniasis. It is also evident that the trouble exists in many herds where it does not usually come to our notice, because either no serious infertility problem occurs at the time or by the time the presence of trouble is appreciated by the farmer the breeding-season is over and herd owners carry on in the hope of repetition of past experience that a bad season for getting cows in calf is often followed by a good one. More and more farmers, however, are appreciating the desirability of immediate veterinary examination and diagnosis. Advice appropriate to each case where the disease has been located has been given.

Sterility Survey.—A much reduced number of cows from the main A.I. groups with known breeding histories were available for post-mortem examination at the end of last dairying season. This was partly because a fair proportion of empty cows were high-producing daughters of merit sires and thus worth holding, and partly due to the success of penicillin treatment for mastitis, resulting in fewer cows being culled for the combined reasons of infertility and mastitis. The data from those available this year did not materially alter the picture presented by the 177 cull cows described in the 1948–49 annual report. In these 70 per cent. had normal general organs and a further 10 per cent. showed only endometritis. In consequence, it was suggested that a high proportion of such mated cows are probably fertile at the time of slaughter and could conceive if given the opportunity. Accordingly, the cows culled for infertility this season were artifically inseminated in March and April, six to eight weeks before slaughter. A single high dose rate of sperm was used to eliminate the male side as a limiting factor. Of 41 " sterile " cows inseminated, 23, or 56 per cent., conceived to this single insemination. It seems quite clear that a high proportion of " empty " cows normally culled each year are likely to be quite fertile at the time of culling. Whatever trouble has existed to prevent conception during the usual spring breeding-season has passed off and left the cow's breeding potential quite normal. This observation is supported by the results of the experiment conducted by the Herd Recording Department, in which a high proportion of cows similarly culled for sterility were held over until the following year to be successfully mated in the spring. The inescapable conclusion is that a large percentage of the temporary sterility in New Zealand dairy cattle is of economic importance mainly because of the seasonal mating system in the industry. The problem would create less interest among farmers if calving were spread more evenly throughout the year, but this is impracticable under grassland dairying conditions.

Feeding Trials With Cupressus Macrocarpa.—It has frequently been reported that ingestion of *C. macrocarpa* by cows near calving produces abortion. Feeding tests were conducted this year with 8 pregnant cows which ate from 7 to 10 lb. each of macrocarpa foliage daily for five weeks. Only 2 cows aborted, and one of these was infected with *Brucellosis abortus*. The experiment is to be repeated using cows which are brucella-free.

Johne's Disease in Cattle.—Observations have been continued on the field vaccination experiment which was initiated in selected infected herds in the Taranaki and Waikato districts in 1948. The fresh crop of calves born on the 7 farms in 1949 were vaccinated and intradermal sensitivity tests with avian and mammalian tuberculins were conducted regularly on the previous season's calves.

Laboratory diagnostic procedures were the subject of study during the year. The evaluation of the efficiency of techniques for the isolation of *Mycobacterium paratuberculosis* from infected fæces, intestinal mucosa, and lymph nodes was of particular interest.

Ketosis and Grass-staggers in Milking Cows.—Further experiments have been carried out to study the influence of negative energy balance on the incidence of metabolic diseases. Starting from the first week of lactation, 8 cows were underfed to the extent of about half their requirements, and 5 of these were dosed thyroprotein in addition.

Two cows developed moderately severe symptoms of grass-staggers after six days' underfeeding, for the final 3 days of which they received thyroprotein. They developed marked hypomagnesæmia (0·1 to 0·3 mg. per cent.), slight ketosis, and, on the day clinical symptoms developed, hypocalcæmia also (5 to 6 mg. per cent.). Both cows had a second attack of staggers with a similar blood picture 2 days later, and both responded rapidly to glucose and calcium gluconate injection at the first attack and to calcium gluconate and magnesium sulphate injection at the second attack.

Two other cows showed mild symptoms of grass-staggers not necessitating treatment. Both had been underfed and dosed thyroprotein, one for 7 days and the other for 12 days. Both showed hypomagnesæmia and slight ketosis.

The fifth cow to show clinical symptoms did so after one day's underfeeding, commencing from the day of calving. This was an attack of milk-fever, with serum calcium 5·1 per cent., and magnesium 2·3 per cent. She recovered after calcium gluconate injection. Three days later, twelve hours after she had had one dose of thyroprotein, she developed what appeared to be a mixture of milk-fever and grass-staggers, with serum calcium 3·8 mg. per cent., and magnesium 1·4 mg. per cent. She recovered slowly over the next three days after glucose, calcium, and magnesium injections and udder inflation.

The 3 remaining cows, which did not show any symptoms of grass-staggers, did develop hypomagnesæmia, but not hypocalcæmia. The normally-fed cows in the herd did not develop either grass-staggers or milk-fever attacks this season.

Grass-staggers has not been recorded in this herd in previous years. This experiment suggests that one of the ways in which grass-staggers develops is as a result of underfeeding or a negative energy balance. Thyroprotein dosing may be merely contributory to this effect. A further experiment without the use of this drug is proposed for the forthcoming spring.

Bovine Blood Groups. During the year we have been fortunate in having Dr. C. Stormont stationed at Wallaceville as a visitor under the Fulbright scheme. He has enabled considerable progress to be made in the preparation of blood group reagents, and it is hoped that Wallaceville will soon be equipped with a full series of reagents prepared in New Zealand.

Parentage Tests. Eighteen cases were received for determination of questioned parentage. Though in one case it was impossible to give a decision, satisfactory answers were given to the remaining seventeen cases. Twelve cases were of the type in which one or more bulls were suspected as being possible sires, five were of the type in which one or more cows were suspected of being possible dams, and in one case there were possibilities in both sires and dams. Seventy bloods were typed to provide data for these results.

Pig Projects

Economics of Meal Supplementing. Experiments have been conducted to determine whether the use of meal supplements with skimmed-milk ration is profitable, with special reference to the stage of growth of the pig and the level of meal feeding.

Sixty pigs, individually fed, were used, over a weight range of 50 to 110 lb. Information on feed intake for an additional 130 pigs fed to bacon weight (200 lb.) was used, as were the carcass yields of 73 pigs slaughtered at weight intervals between 50 and 130 lb. live weight. Meal fed varied from nothing to 60 per cent. of the total ration.

The results indicate that :

(*a*) One gallon of milk is equal in food value to 1 lb. of meal mixture (1 part by weight 60 per cent. protein meat meal to 3 parts of barley meal), irrespective of stage of growth or ratio fed.

(*b*) The food requirements per pound of live-weight gain increase with the body weight of the animal, the regression equation being $Y = 1{\cdot}724 + {\cdot}0152X$. X = live weight.

(*c*) The carcass weight rises with the live weight according to the formula $Y = {\cdot}763X - 4{\cdot}81$. This is equivalent to a carcass-weight gain of 1 lb. for every 1·31 lb. live-weight gain.

Calculations relating to economic returns are based on the fact that the value of a gallon of skimmed milk on a New Zealand dairy farm is only what it earns in the form of pig-meat produced. Meal, on the other hand, has a basic value which is the price paid for it. This cost must be offset by meat-production before a profit can be shown. Meal as a supplement to skimmed milk must, therefore, in its own right produce per unit fed a greater value of pig-meat than its own cost.

It is evident that meal feeding is profitable in the early stages of the growth of the pig, the weight to which it can be continued depending upon the price of pig-meat and the price of meal.

It is suggested that on this basis meal supplements can fill a useful and profitable role in times of milk scarcity, if at such times pigs of light weight are on hand.

Milk Production in the Sow.—Measurements of the milk yield of sows and of the composition of their milk have been made with a view to developing a more satisfactory basis to sow nutrition. The investigation to date has covered 5 Berkshire sows for their first three lactations. The following summarizes the results to date :—

(1) As a preliminary, observations were made on the suckling frequency of litters. The observed intervals were found to become longer as lactation progressed, being about one hour in the week following farrowing and about 80 minutes in the eighth week. There was a difference of from five to ten minutes between the average interval during daylight and the interval during darkness. The latter interval was the longer.

(2) The yields obtained were compared with the results of other workers in this field and were found to be much higher. The average yield per day per sow was 14·25 lb. and the average total yield for fifty-six days 798 lb. Yield increases with each lactation from the first to the third.

(3) The shape of the mean lactation curve as drawn for the Ruakura sows showed not only greater production, but also that the peak yield was reached approximately two weeks later than was the case in previous studies by workers in other countries.

(4) The average composition of milk in the third lactation as measured by the three constituents fat, protein, and lactose was fat 7·9 per cent., protein 6·5 per cent., and lactose 5·0 per cent.

(5) The food units required for a pound of live-weight gain by the suckling litters in the first four weeks of lactation as against the last four, when the litter, as well as the sow, is receiving skimmed milk and meal, were 3.5 and 3·0 respectively.

(6) As the milk-production fell with advancing lactation the intake of creep ration by the litter increased in almost direct proportion. The importance of creep feeding is emphasized.

(7) The better food utilization over the last four weeks is considered to be due to the use made of the creep ration by the litter. Food fed direct to piglets gives more efficient utilization than when fed via the sow. Methods of accentuating this effect are well worth investigation.

(8) An attempt has been made to measure the requirement for live-weight gain by the litter over the lactation period in terms of gross digestible energy. A further trial which will provide additional information on this point is in progress.

(9) It is suggested that once the energy requirements for growth are determined it should be possible to determine milk yield indirectly by measuring creep intake and milk composition each week over the lactation.

Progeny Testing of Berkshires.—This project aims to find what progress can be made in improving the following economic characters in pigs :—

(1) Prolificacy.
(2) Growth rate.
(3) Carcass quality.

On the male side the method employed is to mate at least 5 sows to each sire to be tested and to select 2 average pigs at weaning from two successive litters for growth-rate studies under standard conditions. These litter representatives are slaughtered and carcass evaluations made according to the original standards developed for pork and bacon judging under competition conditions in New Zealand.

To date 5 boars have been evaluated in this manner and 1 of these was selected as the main herd sire. This boar has been used over 14 sows in the current season to produce future breeding-stock and at the same time to allow a comparison between dams as a basis for selection on the dams' side. In the case of pigs dams as well as sires may be progeny tested, since each female usually leaves sufficient progeny within a year for accurate evaluation.

The progress that may be made in any breeding programme is to some extent dependent upon the number of animals that can be retained for evaluation from each crop. In order to increase the selection potential over that possible within the Ruakura stud alone, two schemes have been tried in the past.

(*a*) Leasing sows and boars to farmers until tested with the right to bring outstanding animals back into the stud.

(*b*) Leasing sows and boars to large-scale dairy company pig-farmers where sufficient animals could be run under standard conditions, again with the right to regain outstanding performers.

Both these methods had to be abandoned as unsatisfactory on various counts and the work restricted to Ruakura.

Based on the results of the 14 sows tested, breeding-stock have been kept from 4 sows during the current season. The records of the progeny of these 4 sows compared with those of the remaining 10 are shown.

COMPARISON OF PERFORMANCES OF PROGENY OF 4 SOWS FROM WHICH BREEDING-STOCK IS BEING KEPT WITH PROGENY OF THE 10 REMAINING SOWS IN THE HERD

	Four Sows (Retained).	Ten Sows (Culled).
Average number born per litter ..	10·4	9·75
Average total weaning weight of litters	313 lb.	287 lb.
Average weight at 112 days of progeny	98 lb.	91 lb.
Average weight at 180 days of progeny	183 lb.	165 lb.
Average carcass score as pork ..	73	71
Average carcass score as bacon ..	67·5	64

The two greatest weaknesses in the present stock are poor ham development and mediocre length. As shown by the table above, carcasses at pork weight score higher than at bacon weight. This is mainly a reflection of the length factor.

From now on selection on both a male and female basis will proceed concurrently.

Inheritance of Defects.—Selection in the Berkshire stud against short toes and consequent foot distortions is being continued and a reduction in incidence is noticeable.

The presence of a possible sub-lethal defect in this herd has been detected. The condition involves the development of diverticuli on the last 12 to 18 in. of the ileum, the subsequent rupture of one or more of which causes acute peritonitis and death. The incidence of this condition in the progeny of 7 sires has been studied, the mortality percentage, based on the number of pigs weaned, ranging from 0 per cent. to 20 per cent. for different sires.

The mode of inheritance of this defect is being studied.

Selection against inherited defects in the inbred strain of Large Whites has continued. Test matings have been carried out to find boars and sows free from the factors for anal atresia, cryptorchidism, and scrotal hernia. Progeny of 1 boar and sow believed to be free have been mated brother to sister and the litters from 3 sows so mated will provide some evidence as to the success of the selection made so far.

Foot-rot in Pigs.—The disease occurs chiefly in pigs three to six months of age being raised for bacon and kept on concrete floors. The average incidence is about 25 per cent., but up to 50 per cent. of pigs on some farms are affected.

The lesion develops on a lateral digit and takes the form of a deep necrotic ulcer involving horn, laminæ, and part of the coronary band of a sinus or sinuses which may reach as far as the joints, bones, and tendon sheaths.

The pathological process is similar to that in necrotic ulcers, necrotic jaws, and schirrhous cord in pigs, and the bacterial flora similarly are spirochætes and gram-negative fusiform organisms.

The lesion develops rapidly and, though mortalities do not occur, a considerable loss on each pig results from light weights, prolonged fattening, or need to destroy pigs for humanitarian reasons.

Most cases have been observed in Northland, but the disease has been seen also in the Waikato, Wairarapa, and Westland.

At the present stage of knowledge the disease seems to be associated with the type of flooring used.

Treatment by intraperitoneal injection of sulpha drugs has so far proved unsuccessful.

Trace Elements

Cobalt-deficient Areas: New areas of cobalt deficiency have been found in the Wairarapa and Southland districts.

In parts of Southland there is some suggestion that seasonal deficiency of cobalt may contribute to or cause suboptimal growth in unweaned lambs.

Aerial Top-dressing: Analyses of pasture samples collected from the bush-sick farm at Waimiha aerially top-dressed during August, 1947, with cobalt sulphate at the rate of 20 oz. per acre show that top-dressing has so far remained effective for more than two years. This is confirmed by analyses of sheep livers for cobalt content.

Copper and Molybdenum.—New areas on new soil types in the Canterbury district have been found where enzootic ataxia occurs in lambs. On these areas pasture copper is not low during the late summer and molybdenum is not abnormally high. The variation with season has yet to be determined. A Merino flock was carried on one property and "straight steely" wool occurred in this flock.

Fairly considerable areas of sandhill country and peat sand country west of Palmerston North are deficient in copper, and corrective measures have materially improved production on dairy farms. Further information on appropriate top-dressing for sands is required.

A fourth crop of lambs has been taken from ewes dosed with molybdenum at Wallaceville. Lamb livers at birth contained about 6 parts per million of copper—*i.e.*, lower than in many cases of enzootic ataxia—but this disease did not occur. The liver copper of the lamb is lower than is to be expected from the copper content of the mother's liver, which indicates an effect of molybdenum in inhibiting placental transfer to the lamb.

A reciprocal inhibitory effect of copper and molybdenum on liver storage of these elements in cattle and sheep has been observed.

Parasitology

Sheep-louse Eradication.—An attempt to eradicate the sheep-louse (*Bovicola ovis*) in an isolated flock, using a single application of benzene hexachloride with a power spray unit, was unsuccessful. The louse population was very materially reduced, but in a small number of animals a low level of infestation has persisted. It is uncertain whether failure was due to excessive exhaustion of the insecticide, to incomplete wetting, or to a failure to kill the eggs or newly-hatched lice. The experiment has been repeated using a double application.

Host Specificity of Ecto-parasites of Sheep and Goats.—A common belief among farmers is that goats may act as a reservoir for the lice that affect sheep. Specimens from both hosts were examined and were identified as *Bovicola ovis*, *Linognathus pedalis*, and *Haematopinus ovillus* from sheep, and *Bovicola caprae* and *Linognathus stenopsis* from goats. A heavily louse-infested goat was kept in the same pen as a sheep, but the sheep did not become infested. Goat-lice transferred manually to the sheep persisted only a few days and had completely disappeared after a week. Keds from the sheep, however, became established on the goat.

Coenurus Cerebralis.—*C. cerebralis* has again been diagnosed in sheep and the adult cestode has been recovered from dogs on the same property. The disease occurred on two neighbouring properties in Mid-Canterbury. On one of these farms the history suggested that the infection had been present for about ten years. In recent years the parasite has been reported from isolated farms in North Canterbury and South Canterbury, but this is the only recent record from Mid-Canterbury.

Toxicology

Phosphorus Poisoning.—Limited data obtained on the lethal dose of phosphorus for sheep show that this is very low, being approximately 1 mg. phosphorus per kilo live weight. Since phosphorized pollard pellets are resistant to weathering, there is considerable risk of mortality if great care is not taken.

The effects of ingestion of phosphorus vary with the amount eaten. Large doses cause sudden death with minimal lesions and phosphorus or its oxidation products can be identified chemically. With lower doses, and especially those near the minimum lethal dose, animals live longer and the phosphorus is metabolized so that it cannot be detected chemically after death. However, typical liver lesions develop and these may be employed in diagnosis. Progressive cirrhosis of the liver, leading to mortalities six or more months later, has been reported from Australia, but New Zealand experience has not confirmed this.

A transient photosensitivity developed four days after dosing a 28-kilo sheep with 0·43 g. phosphorus per kilo body weight. This symptom has not previously been recorded in phosphorus poisoning.

Deterioration of Phosphorized Pollard Pellets.—Pellets deteriorate to half initial potency in about eighteen days under winter conditions and in nine days under summer conditions. Since a pellet may commence with a content of 25 mg. phosphorus, it is apparent that long periods must elapse before danger to sheep is past. Even after three weeks' exposure five pellets could be toxic to ewes and smaller numbers to hoggets.

Phenol Poisoning in Sheep.—Experimental poisoning of sheep with phenol showed that if animals survive for twenty-four hours chemical examination of blood or liver for phenol is negative. In acute cases which survive less than twenty-four hours phenol can be detected in the liver, even if the lapse of time before chemical examination is as great as forty-five days.

Rabbit-destruction Methods.—Field trials are being carried out on sodium arsenite to test its suitability as a rabbit poison.

Zinc phosphide is also being examined for the same purpose and its lethal dose for the rabbit has been found similar to that of arsenic. There are certain difficulties surrounding its use in baits due to its instability, and these are being investigated. The most important aspect is to ensure palatability to rabbits.

B.A.L. Intoxication in Sheep.—The maximum safe single intramuscular dose of B.A.L. in the adult sheep was found to be close to 75 mgm. per kilo body weight. A large variation in sensitivity was shown by animals receiving higher doses, but almost without exception death occurred within eleven days.

Marked clinical symptoms—photophobia, salivation, foaming, panting, clonic and tonic convulsions, ataxia, methæmoglobinuria—developed with all doses used (50 to 150 mgm. per kilo), but were severe about 65 mgm. per kilo.

In animals surviving the acute phase methæmoglobinuria, photophobia, poor grazing, and progressive loss of condition continued for varying lengths of time. Intense reaction also developed in the injected legs, producing gross swelling, lameness, and knuckling of the fetlocks which persisted as long as seven weeks in some animals.

The acute post-mortem picture was one of widespread breakdown of capillary permeability (pulmonary œdema, ecchymotic and petechial hæmorrhages, &c.) associated with circulatory collapse.

The sub-acute post-mortem picture showed regression of congestion, but progression of lesions in the gut and kidney, while fatty infiltration of the liver and jelly-like degeneration of the spleen became prominent.

After seven weeks macroscopic lesions had subsided, but microscopic lesions persisted in the heart, kidney, and liver.

The limiting factor in chronic B.A.L. dosing by the intramuscular route was found to be the intense local reaction. Systemically, 5 mgm. per kilo three times daily at four-hour intervals was well stood for three weeks.

A small number of experiments on the effect of B.A.L. on copper excretion in the sheep produced negative results. Included were analyses of livers after acute B.A.L. intoxication and of blood during chronic B.A.L. treatment. In a presumed enzootic icteric sheep an incomplete course of the dithiol failed to lower the copper level.

Apiculture

Improvement of Strains of Bees by Artificial Insemination.—This project, which has been commenced on a large scale at Wallaceville, entails inbreeding selected queens, then crossing the inbred strains to produce hybrids, and finally testing the hybrids and their progeny under practical conditions.

An association of breeders of queen bees has been formed to provide suitable stock on which to base the project and to furnish the necessary organization for testing strains of queens produced. Fifty queens donated by members of the association have provided all the stock at present being used in the insemination project.

During the past season inbreeding of queens reached the second generation and this phase of the project will be completed for large numbers of queens next season, when hybridization will commence. Inbreeding of queens by both mother-son and brother-sister systems was investigated. In the mother-son method, egg laying of virgin queens is stimulated by treatment with carbon dioxide. Drones can thus be obtained from virgin queens and later the virgin queens are fertilized with semen from their own drones. This method was found to give very unsatisfactory results, as the bees were very intolerant of drone-laying queens. The simpler brother-sister method, in which a virgin queen is mated with her brothers, was found to give much better results and will be used throughout the project.

It is estimated that at least five years will elapse before the insemination project reaches a stage at which it will be possible to supply queens to the beekeeping industry.

The Toxicity of Chemical Weed-killers to Bees.—These weed-killers, which may be of the hormone or non-hormone type, are being used to an increasing extent in New Zealand. The beekeeper is naturally concerned with the question of whether they will constitute a new threat to the industry by causing a heavy mortality in field bees. The many commercial preparations of hormone weed-killers at present on sale in New Zealand are all derived from 2, 4-D and M.C.P. acids. Tests have shown that these substances are not toxic to bees. Similar tests were applied to sodium dinitro-orthocresylate, a

recently developed non-hormone-type weed-killer. It was found that this substance is a highly toxic internal poison, and under some conditions the liquid spray might cause losses to field bees carrying water or visiting flowers for nectar.

Poisonous Honey.—Two apiaries were established in the poisonous honey area to provide honey for chemical work on the extractions of unknown toxin. Honeys from apiaries in areas where poisonous honey may be produced were tested for toxicity.

Air Transport of Queen Bees to England.—The possibility of developing a market in England for queen bees raised in New Zealand is being investigated.

Supersonic Vibrations Emitted by Bees.—It appears that bees emit supersonic vibrations, and apparatus is being constructed to record these vibrations with a view to discovering if the bees use them as a means of communication.

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DAIRY DIVISION

REPORT OF H. A. FOY, DIRECTOR

The Season

The autumn of 1949, which comes within the scope of this review, was favourable for dairy production, and there were good supplies of winter feed available to prepare stock for early spring. Dairying districts were favoured with a mild winter, and conditions from spring to the flush months of the dairy season were almost ideal.

As a result dairy production for the first half of the season was very high, and there appeared every prospect of a record for the season. However, in northern districts during December and also in Canterbury there was a lack of rainfall, with the consequence that, although the total production for December was satisfactory over the Dominion, the December returns showed a decline from the November production.

From January until 31st March extremely dry conditions prevailed in Northland and in some South Auckland areas. Taranaki, Wairarapa, Manawatu, and Southland on the other hand experienced good pasture-growing conditions, offsetting to a certain extent the very marked decline in production in Auckland Province.

What may have been an outstanding year through the favourable autumn and winter of 1949 and the remarkable spring production has therefore eventuated, as far as the financial year is concerned, in satisfactory dairy production, but prospects are disappointing for late autumn and winter feed conditions in those areas where a large proportion of the country's butterfat is produced.

Dairy-produce Grading

Following are ten-year tables relating to the grading of butter and cheese by the Dairy Division :—

Butter and Cheese Graded for Export

Year ended 31st March,	Creamery Butter.		Cheese.		Total Butterfat Equivalent.	
	Tons.	Increase or Decrease.	Tons.	Increase or Decrease.	Tons.	Increase or Decrease.
		Per Cent.		Per Cent.		Per Cent.
1950	149,242	+7·78	100,437	+11·05	163,755	+8·54
1949	138,469	+4·30	90,440	+6·05	150,857	+4·71
1948	132,758	+11·45	85,274	−1·55	144,072	+8·13
1947	119,113	+10·71	86,624	−4·30	133,231	+6·45
1946	107,582	−10·18	90,523	−3·84	125,151	−8·47
1945	119,781	+26·12	94,140	+10·62	136,735	+21·52
1944	94,972	−14·08	85,100	−22·60	112,516	−16·80
1943	110,542	+0·76	109,955	−25·87	135,238	−9·59
1942	109,707	−20·92	148,331	+29·71	149,592	−6·77
1941	138,745	+12·48	114,355	+32·22	160,466	+17·37

GRADE POINTS AND GRADE CLASSIFICATION OF CREAMERY BUTTER GRADED FOR EXPORT

Year ended 31st March,	Total Graded.	Average Grade Points.	Finest Grade.		First Grade.	Under First.
			Total Finest.	94 Points and Over.		
	Tons.		Per Cent.	Per Cent.	Per Cent.	Per Cent.
1950	149,242	93·578	88·36	55·39	11·53	0·10
1949	138,469	93·541	88·16	51·89	11·77	0·06
1948	132,758	93·507	86·89	47·64	12·98	0·12
1947	119,113	93·376	82·94	41·27	16·86	0·19
1946	107,582	93·245	80·28	32·09	19·49	0·22
1945	119,781	93·402	84·72	40·38	15·10	0·17
1944	94,972	93·391	83·66	41·59	16·03	0·30
1943	110,542	93·173	77·87	35·22	21·66	0·46
1942	109,707	93·335	82·22	38·01	17·45	0·32
1941	138,745	93·253	80·50	34·65	18·94	0·55

WHEY BUTTER GRADED FOR EXPORT

Year ended 31st March,	Tons.	Average Grade Points.	First Grade.
			Per Cent.
1950	2,897	88·365	85·17
1949	2,526	88·377	83·84
1948	2,414	88·399	81·03
1947	2,406	88·451	82·58
1946	2,658	88·387	86·37
1945	2,779	88·503	94·26
1944	2,343	88·479	91·88
1943	2,274	88·491	92·74
1942	3,078	88·502	94·57
1941	2,766	88·559	96·05

GRADE POINTS AND GRADE CLASSIFICATION OF CHEESE GRADED FOR EXPORT

Year ended 31st March,	Total Graded.	Average Grade.	Finest Grade.	First Grade.	Under First.
	Tons.		Per Cent.	Per Cent.	Per Cent.
1950	100,437	92·212	27·64	69·20	3·15
1949	90,440	92·249	29·59	67·71	2·69
1948	85,274	92·182	28·35	67·69	3·95
1947	86,624	92·257	33·84	62·66	3·49
1946	90,523	92·114	25·33	69·84	4·82
1945	94,140	92·121	25·94	69·71	4·34
1944	85,100	92·064	21·43	74·21	4·35
1943	109,955	92·032	18·69	77·33	3·97
1942	148,331	91·839	21·11	71·00	7·88
1941	114,355	92·048	20·43	74·77	4·79

Grading Standards.—The standard of grading and testing of dairy-produce is mainly on sound lines. With a grading system as complete as ours, and considering the volume of production which is graded daily at the larger grading-stores, it can be claimed that grading plays its part in maintaining and improving the standard of quality.

Quality.—The quality of both butter and cheese has been satisfactory and fairly well maintained. Butter-factories in the Auckland district obtained Finest and Premium standard much earlier than for many years past, and some brands were scoring 94 points early in September. Feed flavours were less pronounced in this area, although cress taint reduced the grade points of the butter from some factories for a long period.

In Wellington, Taranaki, and the South Island the quality did not improve as rapidly, feed and land cress flavours being evident until late in October. However, afterward the butter soon reached Premium standard, and the over-all position shows an increase in the Finest class of 0·85 per cent. over last year's figure for the period 1st August to 31st March.

Whey butter has largely been on a par with last season. In Taranaki the bulk of this product is of good first-grade quality, but in other districts, particularly the Waikato, it is somewhat mediocre. Though steps have been taken by one company in the Waikato to deal with whey cream at more convenient butter-factories, thereby avoiding long delays in transport, it does seem that more attention to the efficient treating of the cream at cheese-factories is necessary before any great improvement in the quality of this type of butter will result in this district.

The quality of cheese up to the present has not been up to the standard of last season, and the percentage classed as Finest is approximately 3 per cent. less than for the same period last year. There is also a slight increase in the quantity below First Grade of about 0·60 per cent.

During the early months of the season the cheese were rather disappointing, openness in texture and body defects keeping many lines out of the Finest class; "slittiness" was also in evidence when higher temperatures and drought conditions prevailed.

Lack of uniformity in the body of the cheese has been a noticeable feature this year and it would appear that some trouble has been experienced in obtaining regular manufacture from day to day and even, in some cases, in a day's make. It is difficult to point to the actual cause of this irregularity, but there has been evidence of more starter failures in some districts than usual, which gives the impression that starters may be partly responsible for the variation noted.

Since the beginning of 1950 these defects have been less apparent and there has been an improvement in the cheese coming forward to most grading-stores. Finest quality is more in evidence, and at one port the quantity in this category for February was the highest recorded for several years.

If climatic conditions are suitable for the remainder of the season, quantities of cheese in the various classifications will show no outstanding difference from last season.

Processed Cheese.—The grading and testing of this type of cheese for export have been carried out at the Auckland, Wellington, and New Plymouth ports throughout the season when and as required. The quality has been mainly up to standard, although in some cases the moisture content has exceeded the tentative figure of 40 per cent.

It has since been decided to increase the maximum moisture content to 42 per cent., and manufacturers have been advised accordingly.

The drafting of regulations to govern the export of this type of produce and also cheese-spread is now in hand and should be concluded in the near future.

Examination of Stored Butter.—During the season butter stored for approximately three months was examined at Auckland, Wellington, and New Plymouth. With a few exceptions the butter was mainly in line with the original classification, and the bulk indicated that the outturn in the United Kingdom should be satisfactory. One pleasing feature was the freshness of the butter, very little storage flavour being noticeable.

Analytical Work.—The testing of butter and cheese has received the usual care and attention, and testing rooms and appliances have always been found neat and clean.

Analytical work has increased during the season because of the grading of processed cheese and milk-powder products. Considerable extension to the laboratory facilities at Auckland and an increase in the technical staff have been necessary as a result of the analysis and grading of milk-powder products.

Though the grading and some of the testing have been done at Wellington and New Plymouth for the factories shipping through these ports, the more detailed analytical work has been done at the Wallaceville Laboratory. However, provision has been made for additional testing accommodation at the Wellington stores, and this port should be able to undertake all the analytical work next season. It is also intended to provide equipment at New Plymouth for essential analysis and grading to be done there.

Finish and Packing of Butter and Cheese.—The finish and appearance of the bulk of the butter and cheese exported have been mainly satisfactory. These are watched closely by the grading staff, and any defects are promptly brought to the attention of the offending factory.

There is a tendency for the "Fernleaf" brand on the surface of the butter to become defaced, which is partly caused by the carton container. However, a little more care on the part of the factory operator would make for improvement.

The finish of the cheese has generally been of a good standard; some cases of defective lips and cracked crowns and rinds have been noted, but in the main the cheese have been clean and free from mould.

Butter and Cheese Packages.—Although a small quantity of butter from the South Island and Gisborne factories is still packed in the sub-standard white-pine box, the fibre-board container is now universally used in other districts. This container is proving satisfactory, and very little complaint can be found with this box when it is made from suitable material.

Experience has shown the necessity for a high wet-bursting strength factor, and recently the specifications covering the strength of the board used in the manufacture of containers have been changed to give higher standards. The question of the colour of the material and the tape used for binding was also considered with a view to avoiding the variations in colour which exist to-day.

The new specifications and the arrangement whereby all board must be fully laboratory tested not only for strength but also for odour and taint before receiving approval for its use in the fabrication of butter-boxes should ensure butter being packed in the best container of this type obtainable.

The space allotted in the design of the impressed brand for the brand and registered number of the factory is insufficient for a long name; consequently some brands and numbers are placed on cartons in an irregular manner, which, besides making them unsightly, causes them to be unreadable.

There does not appear to be any reason why the impressed design could not be slightly enlarged to allow sufficient space for brands and numbers, thereby leading to neater and more legible branding.

The *Pinus radiata* crate makes quite a serviceable container for cheese, provided it is made of sound timber free from knots and finally wired and stapled in the prescribed manner.

In the South Island some beech timber is still used for cheese-crates, but *Pinus radiata* is gradually replacing it, particularly in Canterbury and Otago.

Grading-store Facilities.—The facilities for the grading of produce are mainly in line with requirements and are of a good standard. Cool-store authorities are usually co-operative to the extent of providing suitable accommodation and also effecting any additions or improvements necessary.

Storage Conditions.—The storage of butter at the various stores usually receives proper care and attention. The question of butter temperatures has caused some concern at Auckland, where butter was arriving at the wharf high in temperature and delivery was consequently refused by ships' officers. The matter was taken up with the freezing

company by the Shipping Inspector and the Grader in Charge with a view to effecting improvement. Part of the trouble was apparently caused by the fact that some difficulty had been experienced in reducing the temperature of butter-chambers to the required degree, particularly during the summer.

Cheese-chambers are generally well looked after, and the condition of the cheese as regards mould is receiving more attention on the part of cool-store authorities.

There is a general feeling on the part of all concerned that the "dust" nuisance must be reduced to a minimum, and there is an endeavour to effect improvement in this direction.

Butter Instruction

The quality of butter manufactured compared favourably with that of last year, and the indications at the time of grading were that the bulk of it possessed sound keeping-qualities. The importance of quality cannot be over-emphasized in view of the competition now developing overseas, and it has been the practice of officers to stress this point during the course of their duties.

Feed taints detrimental to butter quality have been less pronounced in some of the major butter-producing districts and this is attributed to improved pastures and better pasture management in the grazing of dairy herds.

Trouble with spotted and streaky butter has again been experienced by a few companies and is caused by incorrect manufacturing technique. Too frequently rush methods are employed, and the working-time is consequently too short for salt to be dissolved thoroughly before incorporation in the butter.

In the course of instruction work at creameries officers have closely examined the sanitary condition of manufacturing equipment and it has been found on occasions that the method of cleaning has not been sufficiently thorough to maintain equipment in a satisfactory state of cleanliness. This is the result of increased outputs and the long hours which employees are required to work because of staff shortages.

The neutralization of cream has been given special attention, and efforts made to have acidities at time of churning increased slightly have met with a measure of success. This tends to give more "butter character" and so helps to avoid the flatness which some of our butters are sometimes considered to have.

Unwashed Butter.—During recent years several managers dispensed with the washing of butter in granular form. This practice has not been encouraged by departmental officers because it is considered that it is likely to have an adverse effect on the keeping quality of butter subjected to long periods of storage. During the past year there has been less butter unwashed than before.

Moisture and Salt in Butter.—The care exercised in the control of moisture has again been good, and the moisture content of a large percentage of dairy companies' butter has averaged around 15·7 per cent.

There has been a nice balance of salt with butter acidity, and, except in those cases where spotted or irregular colour has been evident, salting generally has been satisfactory, the average ranging from approximately 1·3 to 1·5 per cent.

Unsalted Butter.—A shipment of unsalted butter for the French market, manufactured by dairy companies nominated by the Dairy Division, was reported upon as being of excellent quality and it seems likely that a larger quantity may be ordered for next season.

As Continental countries are extremely critical of butter containing coliform organisms, the utmost care in the selection of cream and a hygienic state of the plant are necessary to ensure that unsalted butter for this market is manufactured from sound-quality cream and under the best conditions possible in all other respects.

Quality and Grading of Cream.—Feed flavours were not as pronounced as in the previous season, and cream affected with unclean flavours showed a marked reduction. There is, however, a tendency in some districts to grade to a lenient standard where there is competition for supply. Consequently check grading of cream at these creameries requires continued and close attention. Some managers aim at correlating the grading of cream with the butter grade and when the butter is grading high they adopt a more lenient standard of cream grading. Where this practice exists the tendency is for suppliers to relax accordingly, with the result that the work of the Farm Dairy Instructor is less effective and the standard of quality of cream lowered. Where such conditions obtain the importance of maintaining a correct and uniform standard of grading throughout the year, irrespective of butter quality, is always stressed by officers.

Staffing of Creameries (Butter-factories).—Owing to increased outputs and shortage of labour the staffing of several dairy factories has been more difficult than in the previous year. This has resulted in reduced efficiency during the flush months. Difficulty is being experienced in attracting the most suitable type of young men to take up dairy-factory work and many of those at present engaged in the industry appear to be reluctant to accept increased responsibility and promotion.

If this position continues, the selection of competent executives to replace those retiring from the industry is likely to be a problem in the near future.

The housing position at dairy factories has improved, but the problem has not yet been overcome. With good housing available, the dairy industry offers ample scope for careers for young men who are prepared to fit themselves educationally and to work and thus qualify for the higher positions.

Cheese Instruction

Starters.—The use of single-strain starters in cheese-factories is now almost universal and even in Canterbury and Otago, which previously used mixed strains, their use is being extended each year.

Eight separate strains are available and these are commonly used on a four-day rotational basis, with two strains each day. A noticeable feature is that starter failures have become more prevalent, even in Southland, which previously enjoyed almost complete immunity. It would appear that more extensive use of these cultures has concentrated bacteriophage, which affects their vitality to an extent that renders protective measures during propagation and the process of manufacturing more difficult.

Starter failures have an obvious effect on cheese quality, and there is a feeling in the industry that the difficulty which exists in attaining the desired closeness is related in some measure not only to the actual failures of the cultures but also to a general falling off in their vigorous action.

An alternative to single-strain cultures would be to revert to the use of the mixed strains previously used, and the general reluctance to do this is influenced by the desire of cheese-factory managers to maintain the closeness of texture which is so desirable, a characteristic which up to the present has been more easily obtained when using the single-strain type of culture.

Penicillin.—Reports received from the Gisborne, Southland, and South Taranaki districts indicate that the use of penicillin by farmers in the prevention of mastitis in their dairy herds has caused some hold up in the development of acidity during manufacture through the milk from cows treated with this drug being delivered for cheesemaking.

It does appear certain that this sometimes happens, and with a view to reducing trouble from this source district officers have been instructed to keep a close watch on the position and to advise managers of the possibility of interference with normal manufacture from this cause.

Manufacturing Methods.—Most cheese-factory managers adopt sound methods of manufacture which result in the production of cheese of good commercial quality. This is indicated by the opinions of the trade and the reports of officers overseas. There is, however, a tendency on the part of some to rush the manufacturing process unduly, which is not in the best interests of quality. A general desire to escape overtime payment is probably the main reason for hurried methods, which would no doubt be extended if it were not for the fact that the majority of managers are quality minded.

Milk Grading.—Although milk grading is mainly performed by sound methods and to satisfactory standards, there is still evidence that some managers adopt a rather tolerant attitude towards border-line quality, which results in some second-grade milk being classified as first. Constant checking by Dairy Instructors has effected considerable improvement, and these efforts will be maintained in the future.

Curing-rooms.—A pleasing feature noted during the year is the improvement in the care and condition of curing-rooms, which is reflected in the clean appearance of the cheese and a comparative absence of mould growth. Though it can be claimed that the season has not been conductive to mould, there is ample evidence of more interest and greater efforts to restrict this growth. A good number of temperature and humidity controlled curing-rooms are in operation and at least one additional unit will be in use next season.

Labour in Cheese-factories.—The staffing of cheese-factories is still not sound in most districts. Numerically there may have been some slight improvement, but the class of operative available is far from satisfactory, and men possessing qualifications academic and otherwise to fit them for a cheesemaking career appear to find better reward for their talents in other industries. Housing is closely linked with this aspect and it is pleasing to note that many dairy companies have realized the value of a sound housing policy and are now building extensively and providing houses of a good type.

Inspection of Dairy-produce in Britain

The London office of the Division provides the final link in the Division's operations. Since the office was established in 1911 the value to New Zealand's dairy industry of its expert watchfulness of the outturn of dairy-produce has been recognized. With their New Zealand experience in London officers can translate consumer demand and trade reaction into terminology understood by the makers, and thus it is that to-day New Zealand makes butter and cheese which in the main meets the requirements of the buyer. The attainment of this objective is influenced, of course, by the distance of the markets from New Zealand, and therefore instead of following the Danish practice of manufacturing high-acid butter, which will not keep, the endeavour has been to cultivate a taste and a demand for sweet cream butter which will store and travel well. In this New Zealand has been outstandingly successful.

Cheese has also been required to withstand storage and transport conditions. To be successful in this, quality must be sound, and the fact that good Cheddar cheese improves with age has been of advantage to New Zealand, particularly as English-speaking people favour Cheddar as against any other of the numerous varieties of cheese.

Reports from the Division's London officers show that butter quality has been well maintained. There is a criticism that some New Zealand butter is inclined to be flat and neutral in flavour. This characteristic is not due to an excess of neutralizing agent, but rather to the fact that fresh cream in some areas is inclined to lack "bloom." The Division's London officers have expressed the opinion that a carefully controlled increase in churning activities would assist in overcoming this flatness and further that when distributing conditions return to normal it may be advisable to reintroduce a small percentage of "starter" to the cream to give more fullness. The use of "starter" was discontinued after the outbreak of war because of the disruption of normal marketing and distribution.

The comment from the London office regarding flatness in flavour is intended to be taken in the strictly critical sense. In general there is no complaint from the dairy-produce trade on this score.

Suggestions that the moisture and salt analyses of butter at the New Zealand end were not confirmed by analyses at patting factories were investigated by the London officers, aided by laboratory checks, with the result that the work in New Zealand was proved correct. These matters are of some importance to the industry, as the control of moisture and salt in manufacture affects the yield of butter and consequent returns to producers.

Reports indicate that for Continental markets especially the bacteriological condition of butter is important, particularly regarding *B. coli* organisms. Complaint in this respect was made about one shipment of unsalted butter and resulted in greater attention being given to the condition of creamery plants when subsequent consignments of unsalted butter for these special markets were manufactured. The butter complained of was faulted on laboratory tests and not on senses grading.

Numerous reports on the outturn of cheese indicate that New Zealand manufacturing technique is sound and, in fact, that the Dominion's reputation for cheese quality has been raised to a very satisfactory level in recent years. Comment has freely been made in Britain regarding " mouse-trap " cheese, the inference being that much of the cheese on the ration has been of mediocre quality and uninteresting in character. That appellation could apply to any cheese marketed in an immature condition, but conditions of supply and distribution in Britain at the present time are such that there is a tendency to hold New Zealand cheese as reserve stock. This gives greater maturity, and, providing the conditions of storage are right, will enhance the reputation of New Zealand cheese. In the main this has been the case, but there have been occasions when, through indifferent storage, our cheese has been heated or mite infested when marketed. Fortunately traders recognize this as not the fault of New Zealand, but this fact may not always be known by the consumer.

All routine examinations of butter, cheese, and milk powder are the subject of reports which are forwarded to the dairy companies concerned, thus ensuring that the dairy-factory manager receives first-hand advice of the outturn of his produce.

Special reports cover Cheshire-type cheese, the outturn of which has been somewhat variable, 52-per-cent-fat cheese, which has been reported on favourably, and numerous other experimental lots of produce shipped from time to time.

Regular reports on butter, cheese, and milk-powder containers provide a useful check on the suitability of packages and assist in the improvement of both materials and assembly.

The transport of export butter requires a number of special characteristics in the material used for packaging, whether it is timber or fibre. Largely as the result of the efforts of the Division's London officers, with the assistance of research laboratories in Britain, the present very satisfactory fibre container has been developed. As most of the material used is manufactured in Europe, liaison between the London officers and the manufacturers has been possible and has been quickly effective when changes have been required.

It is a function of the London office to keep closely in touch with research and technological workers in Britain and Europe and thus keep New Zealand up to date with information about quality controls and processing and manufacturing techniques used in all forms of dairy products.

The senior officer in London, Mr. F. H. Taylor, after twenty-eight years' service with the Division, twenty of which were spent in London, retires on 30th April. Mr. Taylor is to be succeeded by Mr. M. H. Wallace, Assistant Inspector of Dairy Products for the past three years.

Market Milk

Organization.—No change has taken place during the year in the organization first developed by this Division to implement the Dairy (Milk Treatment) Regulations 1946. The Dairy Instructors continue to operate as field men; the Market Milk Instructor, stationed at Palmerston North, pays regular visits to the milk-treatment stations in both Islands, concentrating on those where particular assistance is required; and the Superintendent, stationed in Wellington, pays sufficient visits to ensure co-ordination between the efforts of the different officers and has also held himself available for special visits where these have been requested. Now that there are no really bad milk-treatment stations in the country the Market Milk Instructor is endeavouring to increase the length of time spent at the treatment stations, and this practice is being developed at the expense of some slight reduction in the frequency of ordinary visits.

Milk Quality.—During the year a suggested basis for a town-milk grading scheme was distributed to producer co-operative supply companies, individual producers, and other interested parties. It was hoped that this would form the basis of discussions between the Marketing Department and the producer organizations. So far, however, action on these lines has not eventuated.

The year has shown a steady improvement in the quality of town-milk supply.

The efforts of town-milk producers to achieve this satisfactory result have been considerably assisted by the encouragement given by this Division to milk-treatment-station owners to maintain a daily milk-testing routine. The results of these tests have been passed to Live-stock Division officers for their guidance in farm dairy inspection.

To some extent difficulties were experienced in ensuring benefit from methylene blue tests applied to milk collected twice daily and milk collected from farms equipped with mechanical refrigerators. In an endeavour to equate the results of such tests between milk collected once daily, milk collected twice daily, and milk collected once daily from farms equipped with refrigerators a system of sample holding, or ageing, at atmospheric temperature was introduced in several milk-treatment stations. This system of testing showed up latent weaknesses in production methods where twice-daily collection or collection from mechanically refrigerated farms had been the practice. It is interesting to note, however, that poor results under this more severe sytem of testing were evident in only a minority of cases. Nevertheless, it is necessary to eradicate these occasional lapses in production methods if the bulk of the milk from the satisfactory producers is not to be contaminated.

Unfortunately, toward the latter part of the year under review exception has been taken by some interests to this more rigorous standard of testing. A reversion to a system of testing which demands that the milk be tested immediately on arrival at the treatment station can readily result in a lowering of the high standard attained during the year. It seems manifestly unfair that producers enjoying twice-daily collection or enjoying the benefits of mechanical refrigerators in their farm dairies should be placed in an advantageous position regarding testing over those producers whose milk is collected once daily and whose standard of production must therefore be particularly high. Many of the gains made during the past year will be discounted if reversion is demanded.

Milk Grading.—The most notable feature of the past year's work has been a very marked development in the milk grading at the milk-treatment stations. A survey carried out during September, 1949, showed that more than 98 per cent. of all producers supplying town-milk-treatment stations were having their milk regularly tested in the milk-treatment stations.

As most of the milk-treatment stations had to be persuaded to undertake this work as a regular practice, had to obtain a substantial amount of milk-testing and laboratory equipment, and had to obtain trained laboratory personnel or had to have their own

staffs trained, the attaining of this goal in three years has been a creditable achievement. Of all the registered milk-treatment stations only one now is not making regular tests. The treatment station concerned handles the milk of only two producers.

Now that the Dairy Division has introduced regular testing it remains for the Division to ensure that the testing continues to be competently carried out and that the results of the tests are correctly interpreted for the guidance both of the Live-stock Division officers and the milk-treatment-station owners themselves.

Technical.—With a few exceptions milk-treatment stations are not properly equipped to handle cream efficiently and hygienically. These weaknesses are caused in some degree by the widely fluctuating daily demand for cream and to the lack of proper cream-treatment equipment in the treating-houses. Ideally, cream for urban consumption should be separated, processed, and packaged at a registered treating-house. Unfortunately, the present set-up of the town-milk industry does not always permit cream to be prepared in this manner and the benefits of technical and laboratory controls over the preparation of the cream are lost. As a result consumers are being supplied with raw cream and pasteurized cream indiscriminately in some areas, the worst feature being that raw cream is finding its way to consumers who depend on the safety of pasteurized milk.

The whole technical problem of cream-production and sale is now being considered so that the problems and suggested solutions may be put before the industry.

The increasing use of bottled milk and the increased demand for pasteurized milk have been notable features of the year under review. The consumption of bottled milk has increased in Auckland, Rotorua, Te Aroha, New Plymouth, Greymouth, Oamaru, Dunedin, and Balclutha, and a complete bottled supply has newly been made available in Hamilton, Hastings, and Masterton. The steadily increasing consumption of pasteurized milk is a gratifying feature, the increase being greatest where local milk-treatment stations have been re-equipped with up-to-date pasteurizing plants.

Marketing Department and Central Milk Council.—As previously, a close liaison has been maintained between the Dairy Division and the Milk Division of the Marketing Department. This has been particularly so in the developments in treatment station building and re-equipping. Specific assistance has been rendered to the Department in connection with the new milk-treatment station at Hastings ; a descriptive brochure on this station has also been prepared by this Division during the year.

Liaison has also been maintained between this Division and the Central Milk Council, and during the year a report on the Division's work over the past three years was prepared for the Council. It would appear that the maintenance of a close liaison between this Division and the Council can prove of definite benefit to the industry.

Though a real shortage of men of executive calibre for staffing milk-treatment stations is a serious enough problem to-day it is bound to give rise to still more serious difficulties when the present re-equipping and rebuilding programme has been completed.

Dairy Laboratory, Wallaceville

During the past year the total number of samples has increased slightly to nearly 3,900, compared with 3,450 during the previous year. Of this total nearly 2,800 were bacteriological, which is a decrease of about 300, and there were more than 1,000 chemical samples, an increase of about 700. This increase is more than accounted for by the total of more than 800 samples of dried-milk powder. Thus, the laboratory work has been diversified, but this has caused the reduction to some extent in the number of certain types of samples.

Bacteriological.—The main work of the bacteriological laboratory has been the regular examination of butter samples forwarded from the dairy-produce grading-stores at Wellington, New Plymouth, Patea, Castlecliff, Gisborne, and Lyttelton. It is apparent that the results of these examinations are of value to the Dairy Instructors and to many factories to enable them to maintain good hygienic conditions. Some factories, however,

do not appear to take much notice of the results and continue to produce butter of poor bacteriological quality. Though these high counts rarely make any appreciable difference to the grading of the butter while it remains in cool store, there is every reason to believe that when the butter is defrosted and stored at normal atmospheric temperatures the initial bacteriological condition has a marked influence on the rate at which the butter deteriorates. This is a matter which merits more detailed investigation, especially at temperatures such as prevail in domestic conditions. To assist in making improvements there is also scope for more detailed examination of samples of cream, butter, and buttermilk taken at individual factories.

A few samples of dairy-factory water-supplies were examined. This feature of the laboratory work should receive a great deal more attention, but in recent years it has diminished considerably owing to pressure of other work.

Miscellaneous samples have included evaporated whey mother-liquor which developed yeast fermentation during storage at warm temperatures. In another case several water samples from a polluted creek on a dairy farm were examined. Seepage and overflow from a septic tank serving a works construction camp were causing serious pollution of the stream, and as the milk supply from the farm was for town supply, there was a potential menace to public health.

Owing to staff changes and pressure of other work, it has unfortunately been impossible to continue the investigational work on butter, which, as explained in last year's annual report, was giving such useful information about undesirable types of bacteria found in New Zealand butter.

Chemical.—Although the scope of the chemical laboratory work has been somewhat restricted, the total number of chemical samples dealt with has increased from about 340 to more than 1,000. Miscellaneous samples have included milk, cheese, whey, detergents, &c. The main chemical samples examined, in increasing order according to the numbers received, are as follows: Water, butter, and cream and milk-powder. The number of milk-powder samples was nearly 900.

More than two dozen water samples have been examined, mostly from farm sources. It is evident that in some cases an unsatisfactory water-supply may be the cause of difficulty in cleaning dairy equipment, but in one or two other cases a water-supply which was quite satisfactory seems to have been blamed for defects which were the result of faulty methods of cleaning the equipment. One cause of much trouble and expense to farmers is the use of corrosive water derived from shallow or deep wells. Such water-supplies can usually be easily treated to improve them after simple analysis to verify the corrosive nature. Only very few samples of dairy-factory water-supplies have been examined. There is clearly a need for much more work on both farm and factory water-supplies.

About 120 samples of butter, including both creamery and whey, have been examined for copper and iron contamination. Besides these, a few cream samples have been examined. Past work of this kind has effected suitable improvements, but there is still need for vigilance and further work in eliminating unsuspected sources of these metals.

The development of an export trade in the manufacture of milk powder dried by the roller process has involved considerable effort to organize the analytical work needed to provide the basis for grading the powder as required by the export contract with the British Ministry of Food. For this purpose visits have been made to the grading-stores at Auckland, Wellington, and New Plymouth and plans evolved for the necessary extensions of laboratory facilities at Auckland and Wellington. Good progress has been made and the laboratory has been fortunate in being able to obtain or borrow just enough apparatus and equipment to keep abreast of the essential work.

During the winter a series of investigations was carried out of various methods of moisture estimations in milk powder to find out the limitations of certain types of ovens, &c., so that alternatives would be available if required. An important result of this work was that a method was devised whereby a sample of milk powder could be heated for a short time with dry sand in a specially constructed heating bath and the moisture result obtained within twenty minutes. This has provided a very useful method for factory control purposes. By finding the moisture content of powder soon after manufacture adjustments can be made to the machine to effect improvements needed.

Pending the provision of the facilities needed at Wellington and New Plymouth to do the analytical work needed on dried-milk powder being graded for export, samples have been sent for analysis to Wallaceville. Although other work has had to be set aside to enable these samples to be dealt with, some useful experience has been obtained of the value of different methods and of apparatus used for analyses. The range of results has provided a useful indication of several quality problems which need more detailed investigation.

Although good progress has been made, there is a need for further investigations of methods for fat and moisture estimations when suitable glassware and other apparatus are available. Besides these basic features of control work, there is also a need for some detailed investigations of other properties of dried-milk powder which affect quality, particularly solubility, alkalinity, copper and iron content, and bacterial content. When more staff becomes available it is hoped to be able to study these properties in detail to safeguard future quality requirements.

Dairy Laboratory, Auckland.

This year, with the commencement of milk drying by 17 factories in the Auckland area, much time has had to be devoted to the analyses of buttermilk, whole-milk, and skim-milk powders.

In the development of new techniques for dried-milk analysis, very little of which had been done in New Zealand, much of the routine work has had to be reduced. This applies particularly to the bacteriological examination of butter and cream and to chemical analysis of farm and factory water supplies.

An attempt was made to analyse one sample representing each twenty-five bags of powder received. In spite of shortage of equipment, delivery of which is very slow, and a shortage of laboratory space which was not overcome until about half-way through the season, it was found possible to keep abreast of the work offering. Delays in completing the analysis of some consignments did occur, but as experience was gained these have become less frequent.

Considerable success has also been achieved with Jefcoate's modification of the Gerber test for fat in milk powders. This has been further modified, with excellent results, and a similar technique which has been applied to the Babcock test has now been brought to the stage when it should be suitable for use in dairy factories.

Comparisons with the gravimetric methods show that the accuracy of both Babcock and Gerber tests is satisfactory for grading purposes.

Up to 31st March approximately 1,200 samples of skim-milk, 3,900 of buttermilk, and 500 of whole-milk powders have been analysed for moisture and titratable acidity, and 1,200 samples of skim-milk, 1,700 of buttermilk, and 500 of whole milk have been examined for fat content.

Regular checks on the bacteriological quality and the acidity of butter passing through the port have been made on approximately 2,400 samples. This is a slight decrease from last year's figures. Particular attention was paid to shipments of unsalted butter, and as much co-operation as possible was extended to Instructors and to factory managers in their endeavours to reduce the incidence of coliform contamination.

One professional officer and four technical assistants and technicians were appointed during the year, and one technical assistant resigned. Two of the appointees are Estonians who came to New Zealand with the first party of displaced persons. They have settled down very well and are performing extremely useful work.

Analytical Tests.

pH Testing.—During the year 5,063 tests were made, compared with 5,992 of the previous year, a decrease of 929. The testing was done at nine grading-stores, and the number of tests for each was as follows: Auckland, 2,694, Wellington, 659, Patea, 310, New Plymouth, 820, Wanganui, 187, Lyttelton, 292, Gisborne, 67, Napier, 16, Bluff, 18. The purpose of these tests is to reveal any tendency toward over-neutralization which would impart a flat or alkaline flavour to butter.

Bacteriological and Chemical.—The number of samples from the various grading-stores submitted to chemical and bacteriological examination was as follows: Auckland, 2,677, Gisborne, 200, Lyttelton, 468, Patea, 308, New Plymouth, 820, Wellington, 825, Wanganui, 160, Napier, 16, making a total of 5,474, compared with 6,145 for the previous year. As in the past, all samples from ports other than Auckland were forwarded to the Division's Dairy Laboratory at Wallaceville for examination.

Moisture.—Some 127,882 churnings of butter were tested for moisture, and of these only 0.22 per cent. was found to exceed the legal limit of 16 per cent. Churnings tested during the previous year totalled 120,999, of which 0.24 per cent. was found to be too moist. The average moisture content of New Zealand butter graded for export during the past season is estimated to have been 15·668 per cent. This is a most satisfactory achievement and reflects credit on buttermakers for the skill exercised in the operation of manufacturing equipment.

Salt.—Samples of butter tested for salt totalled 125,608, of which only 0·06 per cent. failed to comply with the regulations. For the previous year 119,879 samples were tested, 0·06 per cent. being found to infringe the regulations.

Farm Dairy Instruction

Visits of inspection and instruction to supplying dairies made by Farm Dairy Instructors during the year totalled 122,028, an average of 1,584 visits per officer.

The classification of milking-sheds was 13·8 per cent. good, 54·9 per cent. fair, and 31·2 per cent. bad. The percentage of milking-machines classified as good was 18·9, with 54·2 as fair, and 26·9 as bad. It is obvious from these figures that there is ample scope for improvement in the sanitary conditions at many dairies. New milking-sheds erected during the year totalled 1,232, and the number substantially reconditioned was 929, compared with 1,141 and 838 respectively for the previous year.

The amount of cement available for milking-shed improvements has again been inadequate and after requirements of new sheds have been met there has been very little left for repairs and renovations to existing sheds, which, if completed, would help in improving and maintaining the standards of sanitation at supplying dairies.

The issue of priority certificates for structural and repair work regarded as urgent by departmental officers is being continued, as this is considered to be the most effective means of ensuring that cement allocated to the dairy industry is ulitized to the best advantage.

Galvanized piping for the conveyance of water to new milking-sheds is also in short supply; consequently the quality of milk and cream has suffered in those dairies where the supply of water has been inadequate for efficient cooling and cleaning purposes.

Caustic soda, which is used extensively for the cleaning of milking-machines and dairy utensils, is now more plentiful and is rapidly displacing detergents that were used as substitutes during the time that it was in short supply.

Some of the advantages gained from the more positive policy of farm dairy instruction implemented in 1947 are now becoming apparent.

Classification of milking-sheds and milking-machines has become more uniform, and the adoption of rotational inspections has resulted in an increased number of visits in relation to the total mileage travelled by Instructors. In the main the change in policy has been well received by the dairy industry, and individual factory managers have commented most favourably on its introduction.

Complaints and criticism of grading and allied matters have been less prevalent since the adoption of a stricter attitude by officers to the sanitary condition of dairy sheds and equipment as a source of contamination. A few suppliers have, however, been inclined to criticise this firmer approach, but in all cases investigated it was found that the conditions at the dairy justified the action taken.

In the last year 3,822 notices were served, 167 of which forbade the removal of produce from dairies until such time as they had been satisfactorily cleaned. Officers have felt that in all cases where closures have been applied because of uncleanliness they have had the support of dairy companies and suppliers who are interested in maintaining and improving the quality of dairy produce.

The need of a stricter attitude in those cases where the state of sanitation at dairies was persistently unsatisfactory had been apparent for some years, and it was not until after the matter had been given consideration that it was decided that, if the farm dairy instruction service was to be effective as a means of raising the quality of milk and cream, a more positive approach to uncleanliness was necessary. The change in policy which has now been in operation over the past three seasons has proved that although the percentage of bad sheds and machines remains high, the consensus of opinion of those in close touch with the work is that the means adopted is proving effective and that the number of sheds and machines which were usually found to be in a consistently bad condition are steadily being improved. In line with a more positive policy the standard of classification was raised; consequently the figures do not indicate the actual improvement in conditions generally. The success achieved in this direction is in a large measure due to the encouragement given by officers to producers to improve the standard of sanitation.

In dealing with the more difficult and persistently bad cases the attitude adopted must be one of inspection, but in all other respects the service given by officers is predominantly one of instruction. There is reason to believe that this is appreciated by producers and is evidenced by the numerous requests made to officers for help and advice in locating the cause of quality defects, the selection of shed-sites, and general planning of the layout.

Occasions do arise when the action taken is criticised, but on the whole it can be accepted that improvements are being effected which will ultimately be of benefit to the dairy industry.

The difficulty of obtaining satisfactory replacements for Farm Dairy Instructors retiring or leaving the service has not decreased during the year and consequently there have been vacancies for varying periods in some districts.

Milking-machines

During the year 1,717 new and 1,052 used milking-machines, a total of 2,769 machines, were installed. In the previous year the figures were 1,456, 953, and 2,409 respectively.

Check Testing of Milk and Cream Samples

This work was continued as part of the routine duties of Dairy Instructors and Special Inspectors, who during the year checked the factory testing at 684 visits and checked 4,128 samples. The check testing revealed that with few exceptions the work has been carried out accurately and conscientiously. Warnings in regard to compliance with the regulations were issued where necessary.

Check on Yields and Overruns

By carrying out fat and moisture analyses on all butter and cheese submitted for grading the Division maintains a check on yields and overruns and records the balance-sheet payout of all dairy companies.

The analyses of these products furnish a fairly accurate guide to an assessment of the total butterfat received by dairy companies compared with that for which payment was made to the suppliers, and serves to curb any practice involving a degree of under-crediting which results in the production of yields, overruns, and payouts that are not supported by the analyses.

There is of course a close relationship between either over- or under-credits and the sampling factor referred to in another section, and any work in connection with checking undertaken by officers includes investigation in this field.

Crediting by companies manufacturing butter is not entirely unsatisfactory. The tendency to slight under-credits is fairly consistent, and it appears that corrective measures are largely in the hands of the managers concerned. In view of this, some form of publication of the amount of under-credits on the annual balance-sheet could have beneficial results.

With cheese, the position is more complex owing to a greater number of variables in losses during manufacture and, more particularly, variations in sampling methods.

These factors are evidenced by the analyses showing under-credits as well as over-credits. It is pleasing to note, however, that the action of local officers has resulted in some reduction in the number showing under-credits, and with strict attention to sampling a similar improvement in respect of companies showing over-credits should be possible.

Much has been achieved by the close attention given by divisional officers to yields and overruns, mainly in collaboration with dairy-factory managers, and appropriate supervision will be continued in an endeavour to affect greater uniformity in future.

Government Herd Recording

The maximum number of cows on test for any one month during the past year reached the record figure of 17,867, and the number of testing breeders, 741, was also a record. This was for January, 1950. The previous year's peak was 697 breeders, with 13,709 cows on test. These figures cover both Certificate-of-Record and Government Official Herd test. The noticeable features of recent years are the steady falling off in support of the C.O.R. system, the increase in O.H.T. entries, and, more particularly, the increasing number of breeders who are testing whole pedigree herds under O.H.T. C.O.R. testing reached a peak in 1946–47, when 1,484 cows were on test. This year the number is down to 1,080.

The testing of registered purebred dairy cows for milk and butterfat yield, conducted by the Dairy Division, is obviously meeting with the approval of breeders of pedigree dairy cattle generally. The C.O.R. system, introduced in 1912, and the O.H.T. system, introduced in 1927, have enabled authentic production statistics of many thousands of animals to be available, thus providing reliable data as a basis for breeding, selection, herd management, and herd building. The full twenty-four hour check on production each month and the strictly surprise visit contribute greatly to authenticity.

The Certificate-of-Record test is no doubt declining in favour because it is an individual cow test and was more popular in earlier years when interest was concentrated on the making of high records by chosen animals which were handled and fed during the period of test in a manner likely to permit them to produce to their maximum capacity.

On the other hand, the Government Official Herd test is more in line with the modern and more practical outlook of the development of herds, principally through proven sires, of a high and uniform average standard of production.

Each year more breeders voluntarily place their whole herd on O.H.T., and for several years it has been the intention of the Department to introduce a rule making it compulsory for any breeder desiring to have his herd tested by the Dairy Division to place on test all sound pedigree cows in the herd. This " all-cow " rule is, however, expected to require an increased staff of Herd Recorders and consequently additional motor-vehicles. Inability to obtain such additional transport has unfortunately necessitated continual postponement of this proposal. Though the testing systems operated by the Dairy Division are undoubtedly rendering excellent and essential service, maximum effectiveness will not be reached until the introduction of the " all-cow " rule is achieved.

The monthly visits to the farms of testing breeders now requires a staff of 53 Herd Recorders (previously designated Testing Officers). New appointees before taking up duty are given an intensive training course of up to two weeks under the Field Organizer of Government Herd Recording at Palmerston North.

During the year 2 Senior Herd Recorders were appointed and after passing through special training were stationed at Palmerston North and Hamilton. These officers are already filling very useful positions in supervisory and special check testing and inspection work.

The difficult staff position in the head office of the Dairy Division has been relieved by decentralization of the figuring and issuing of monthly O.H.T. returns to the Department's offices at Whangarei, Hamilton, Palmerston North, and more recently Christchurch. As a result breeders are now receiving their monthly returns more punctually.

This clerical staff relief has also enabled the introduction of a merit register service so that testing breeders may have lifetime production records and other accompanying data of their test cows for herd-management purposes. A considerable number of certificates have already been issued. It is hoped to introduce a sire-survey service during the coming year, but much clerical work remains to be done and the introduction of the service will depend mainly on the clerical staff position.

Milk Powder

The development of the manufacture of powdered-milk products has now reached industry proportions, and 26 factories are now producing milk powder of one form or another. The greatest interest has been displayed in the manufacture of buttermilk powder by butter companies for the following reasons: (1) That the return from buttermilk, a by-product of butter manufacture, can be very greatly increased, compared with feeding of the liquid buttermilk to pigs; (2) the United Kingdom Ministry of Food was agreeable to a five-year contract for the powder; (3) the establishment of roller-drying units is not unduly expensive and becomes part of the operation of a butter-factory.

Twenty-one factories are engaged in roller drying of buttermilk, 7 in roller skim-milk powder manufacture, 4 in spray skim-milk powder, and 5 in whole-milk powder, both roller and spray processes.

The outputs of the various products for the year are approximately as follow:—

	Tons.
Whole-milk powder (including baby foods)	4,900
Skim-milk powder (roller process)	1,140
Skim-milk powder (spray process)	19,500
Buttermilk powder (roller process)	3,770

All of these products, with the exception of whole-milk powder, utilize a by-product of butter manufacture, and therefore, apart from the added financial returns, more effectively utilize valuable food products than in the past.

The Dairy Division is concerned with the licensing of these establishments, pursuant to the Dairy Factories (Licensing) Regulations, their registration from the viewpoint of suitability of the premises and plants, instruction in manufacture, and quality and analytical grading of powders, particularly those produced under the roller process.

The instructional work has been of material assistance, especially as so many plant operatives are as yet relatively inexperienced in powder manufacture, and has helped in building design and plant layout.

The responsibility for quality control has necessitated the establishment of proper laboratory facilities with adequate analytical staff and has also imposed an additional burden on the grading staffs at those ports through which milk powder is shipped. The experience during the year has demonstrated very clearly the need for the Division's control over quality and composition. Those engaged in the manufacture of milk powder have responded well in the effort to make good products, and reports received from the United Kingdom show a reasonably satisfactory outturn.

The proportion of powders graded under First Grade has in some instances been rather high, but it is considered that with the benefit of the experience and knowledge now available the next year's results will be much improved. It is generally recognized by the industry that the future of these products, particularly buttermilk powder for human consumption, depends to a very large degree on quality.

Cheshire-type Cheese

The experimental manufacture of Cheshire-type cheese has been continued at two factories, Hautapu, Cambridge Dairy Co., and Dalefield Dairy Co. Several years' experience with this cheese has shown that a reasonably satisfactory article can be made, but owing to the long distance from the Home market and the fact that this higher-moisture type of cheese must inevitably show a more variable outturn than is the case with our standard Cheddar make, the results from Britain have not been as good as is considered necessary to create a demand. This applies particularly at present, when the British make of Cheshire has been stepped up considerably, with the result that the New Zealand product has had to compete with the Home-produced article, which can be marketed after selection of the quicker-maturing lots.

A further difficulty facing New Zealand is that under the present system of bulk distribution in Britain it has not been possible for the Ministry of Food to market our Cheshire cheese according to its maturity, thus involving selection from each shipment, and in accordance with normal demand in any particular locality.

The United Kingdom Ministry of Food has co-operated well with New Zealand and in fact has borne some losses in marketing.

In view of these various circumstances the Dairy Products Marketing Commission in collaboration with the Dairy Division, has arranged for the cessation of the manufacture of Cheshire-type cheese in the meantime.

The experience gained over the past four years has been well worth while and will be of value if and when it is considered desirable to take up manufacture at any time in the future.

The financial responsibility of the trials has at all times been accepted by the Dairy Products Marketing Commission, again in collaboration with the Dairy Division.

Overseas Visit

During August and September, 1949, the Director of the Division travelled to Europe primarily to attend the 12th International Dairy Congress, held in Stockholm, Sweden.

The congress was attended by some 2,000 delegates from 59 countries. In all, 400 papers were submitted for consideration of the congress and were divided into six sections as follow: Section 1, milk (production, hygiene, and control); section 2, physics, chemistry, and microbiology; section 3, dairy industrial technique (processing, engineering, and building); section 4, economics and trade; section 5, organization of the dairy industry; section 6, tropical dairying.

In order that the congress could deal more effectively with such a large number of papers in the time available it was previously arranged that 33 general reporters should summarize the papers under each heading and present their précis to the sessions personally. This procedure proved to be very satisfactory and enabled time for free discussion at all the sessions.

The New Zealand delegation comprised H. A. Foy, Director of the Dairy Division (leader); F. H. Taylor, Inspector of New Zealand Dairy Products, London; F. H. McDowall, Chief Chemist, Dairy Research Institute, Palmerston North; W. G. Whittleston, Physical Chemist, Animal Research Station, Ruakura; F. J. Grigg, Dominion Analyst, Wellington; and G. Appleton, Chairman, Northern Wairoa Co-operative Dairy Co., Dargaville.

It was arranged that the delegation should split up and thus ensure attendance at as many sessions as possible. Attendance at the congress was valuable from the viewpoints of keeping abreast with developments in science, technology, and administration in dairy industry matters and obtaining a useful opportunity of meeting world leaders of different fields of dairy industry work. Seven papers were submitted to the congress from New Zealand.

The visit to the Stockholm congress also provided an opportunity for a tour of dairying districts in Sweden south of Stockholm. Of particular interest were the predominantly co-operative aspect of the Swedish dairy industry, the rationalization of dairy-factory supply which has taken place in recent years, and the very high standard of construction and equipment of modern Swedish dairy factories. A number of farms were visited, the outstanding features noted being the high costs of production of milk consequent upon the necessity to house stock for at least half the year, the intensity of the farming operations, and the diversification of crops grown on the farms. Through a shortage of fats during the war the growing of oil-producing crops for margarine-production has been greatly increased. The dairy-cow population of Sweden approximates that of New Zealand, but, with a human population of 7,000,000 dairy production is only about equal to local consumptive requirements.

A short visit was also made to dairying districts in Denmark. The Danish economy was seriously affected as a result of the German occupation, but the dairy industry is making a determined effort to rehabilitate itself, and it is expected that before many years the output will be back to pre-war level. During 1950 the objective of 95,000 tons of butter for Britain is likely to be achieved. This compares with about 120,000 tons before the war.

The co-operative movement in the Danish dairy industry has for many years been very strong, but unlike Sweden, where the co-operative organization has been able materially to reduce the number of dairy factories, the Danish dairy organizations have yet to achieve their aim of eliminating redundant factories.

With fewer cows in milk than New Zealand, Denmark has almost four times the number of dairy factories. The administration of both Swedish and Danish co-operative dairy companies was of special interest in relation to that in New Zealand.

A brief visit was made to Switzerland to inspect the Senn buttermaking machine, which is not yet ready for shipment to New Zealand.

In London it was possible to review the work of the Dominion's office there, particularly the effect of Mr. Taylor's pending retirement. Discussions about our dairy-produce in the United Kingdom were held with the Ministry of Food Marketing Commission and dairy-produce trade representatives. These talks, together with personal examinations of New Zealand and other produce reaching Britain, were of definite value.

Dairy Industry Developments

Mechanization of Cheese Manufacture.—The committee which was set up to sponsor means of easing the labour burden in the manufacture of cheese by the further development of mechanical aids has functioned throughout the year with a fair measure of success.

As stated in a previous report, this committee is financed jointly by the Government and the dairy industry and is organized and operated under the auspices of the Dairy Board.

The basis of representation on the committee is as follows: New Zealand Dairy Board, 1; dairy-factory managers, 4; New Zealand Dairy Research Institute, 1; National Dairy Association, 1; Dairy Division, Department of Agriculture, 1.

The committee retains the services of a consultant dairy engineer and has recently co-opted the services of an engineer attached to the staff of the Dairy Research Institute.

In operation the committee has functioned very smoothly in the consideration of the various phases of mechanization presented for discussion and ultimate development if warranted.

The curd-stirring machine previously reported as under discussion has since passed the experimental stage to the extent that approximately 200 units are now on order or are installed and operating in various factories throughout the Dominion. This machine is efficient in action and reduces the labour of drying and curd turning to a minimum without injuring quality in any way.

Other developments at present under construction are a larger and fully mechanized cheese-vat and equipment for turning cheese on the shelves in curing-rooms. A wider type of curd-cutting knife is in the experimental stages, and a trial is being made with a wire-tying device for cheese-crate wiring.

Though the work of the committee may not appear spectacular, a useful function is being performed under the closest supervision of technical and administrative personnel in an effort to further the work of mechanization in the best interests of the dairy industry.

Reduced-fat Cheese.—The fact that so much of the milk used for cheesemaking in New Zealand is of high fat content has been of concern to the dairy industry for some time. The yield of cheese per pound of butterfat is less with high-testing milk than with milk of lower fat content. In consequence the payout of a cheese-factory with high-testing milk is less on a butterfat basis than where the test is low. A further industry consideration is that New Zealand is selling cheese of very high fat content to the United Kingdom under the contract and not obtaining due recognition for the value of the fat. This hypothesis is, of course, based on the fact that the fat is paid for at nearly double the price of fat in cheese.

During the years 1929–31 New Zealand attempted to rectify the position by standardizing the milk used for cheesemaking. This was not a success, as the quality of the cheese, already of a mediocre standard, was affected detrimentally. The trade reaction in the United Kingdom was unsatisfactory, and finally in 1931 the manufacture of only full-cream cheese was reverted to. During the period which has elapsed the fat content of milk for cheesemaking has risen somewhat, and the industry, through the New Zealand Dairy Board, asked that there should be some trials made of the manufacture of cheese from reduced fat.

This request was acceded to and the Dairy Produce Regulations 1938 were amended and arrangements were made for the manufacture of approximately half the output of two factories, one in the Waikato (Hikutaia branch of the New Zealand Co-operative Dairy Co., Ltd.), and the other in Taranaki (Riverdale), of cheese with a minimum fat in the dry matter standard of 52 per cent. In recognition of the importance of nomenclature and in order neither to create conflict with the regulations nor to mislead the trade in Britain these cheeses were designated "52-per-cent.-fat cheese," as distinct from "full-cream cheese." The manufacture of these cheeses under the joint supervision of the Dairy Division and Dairy Research Institute was commenced in October, 1949, with full-cream and 52-per-cent.-fat cheese being made every alternate ten days. These cheeses have been graded, analysed, shipped, and reported on separately in order that a true assessment of their quality may be possible. Reports from officers of the Dairy Division stationed in London indicate a satisfactory outturn up to the present, but these reports have as yet covered only a few shipments, and no retailer or consumer reactions are yet available. The manufacture of this "52-per-cent.-fat cheese," which involves the removal of some of the butterfat from the milk, has not presented any technical difficulties. The season's workings will thus provide an opportunity for an assessment of manufacturing problems, quality, and economics of standardizing in relation to full-cream cheese; but the most important consideration, that of consumer reaction and the possible effect on our reputation as a major cheese-exporting country, may not be so easily determined.

It is of the greatest importance that nothing should be done which will endanger our cheese quality and the reputation which has been so hard to win over the past fifteen years.

From the policy aspect and in the light of past experience the matter will therefore need to be approached with caution.

Milk Sampling.—Attention has been focused on the sampling for butterfat testing of milk deliveries to dairy factories during the past year or so as the result of a successful action by a supplier to a co-operative dairy company proving that the company had not taken "truly representative samples" of his milk-supply. There has been a small number of other cases in which suppliers have been dissatisfied, but after detailed investigations by Dairy Division officers no further action has been taken by these suppliers.

Officers of the Division over the past three years have been concentrating on the question from the broader aspect of the practicability of the Dairy Produce Regulations 1938 being amended to include details of approved methods of sampling, as distinct from the existing position whereby the onus is placed on the dairy company to take a "truly representative" sample without detailing methods. As the butterfat portion of milk is in globular form, varying in size and characteristics, and is of different specific gravity from other milk constituents, milk as it leaves the cow soon becomes unhomogeneous and care is necessary when an attempt is made to sample the milk to ensure that the sample is "truly representative."

The stage has now been reached where sufficient information has been obtained to allow detailed methods to be laid down and it is anticipated that shortly it will be possible to submit draft regulations for discussion with the New Zealand Dairy Board, which represents the industry.

It is essential that the fundamental principle that the purchaser should credit the supplier of milk with all the butterfat delivered should not be upset, and that both the buyer and seller receive adequate protection through the regulations in their endeavour to honour their obligations.

Investigations made overseas show that in no country is such close attention paid to milk and cream sampling as is given to it in New Zealand.

Co-operative Dairy Companies Act, 1949.—The passing of the Co-operative Dairy Companies Act during the last parliamentary session gave effect to the recommendations of the Dairy Legislation Committee, which reported to the Government on the administration of co-operative dairy companies, with reference particularly to the dry shareholder problem and articles of association. The new Act is designed to ensure that if a dairy company desires to be called "co-operative" it shall be co-operative in fact. To assist co-operative dairy companies to take advantage of various measures in the Act, a tribunal called the Co-operative Dairy Companies Tribunal was provided for in the legislation and has since been set up.

The members are: H. A. Foy, Director of the Dairy Division (chairman); W. E. Hale, chairman of the New Zealand Dairy Board; E. C. Adams, Registrar-General of Land; and J. E. Marshall, Department of Agriculture, secretary. The tribunal has already received applications regarding the resumption of shares from several dairy companies.

It is anticipated that this legislation will be of material assistance to the co-operative dairy industry; it does in effect mark the end of a phase in the dairy industry's development and provides the opportunity for consolidation and modernizing of dairy company administration in line with present-day and future needs.

Dairy Factories Licensing Regulations.—The developmental activity of the dairy industry during the past year has been clearly demonstrated through the Dairy Factories Licensing Regulations. These regulations serve a useful purpose in ensuring that manufacturing dairies to be established, reconstructed, or enlarged are justified from considerations of economic operation, avoidance of undue overlapping, and redundancy. They are not interpreted to restrict free, normal co-operative enterprise not in conflict with general policy.

In some cases the declining of an application for a licence is regarded by the dairy company concerned as a service in the form of an unbiased determination as to the economic justification of the proposal.

During the year 21 assurances were given that licences would be issued and these in the main involved the manufacture of buttermilk powder and skim-milk powder.

From the aspect of possible implications on dairy factory supply zoning, the Dairy Board, as administrating the appropriate zoning regulations, must consent to the issue of a licence before it can be issued. The co-operation of the board in this regard during the year under review is appreciated.

Dairy Research.—Although research work into the manufacture of dairy products is carried out by the Dairy Research Institute at Palmerston North, there is a definite and effective connection between dairy research and the Dairy Division.

The Director of the Dairy Division is a member of the Dairy Research Board of Management, and there is therefore possible a very good degree of correlation between the Dairy Research Institute and the Division. Further, the officers of the Dairy Research Institute co-operate freely with field officers of the Dairy Division, with the result that research findings are put into practical operation through our own officers. In May of each year a "Managers' Week" is held at Massey College, when results of the year's work at the Dairy Research Institute are discussed. Usually about 15 of the instructional staff of the Division attend this "week" and are therefore kept in direct touch with developments in research.

From knowledge generally and observations made overseas it appears that New Zealand is well served in dairy research.

Redundant Cheese Plant

During the year under review further progress was made in the clearing of equipment still remaining from the cheese plant which became redundant as a result of the change back to butter in 1942. The plant, which had an original list price of £64,000, has been reduced considerably by disposals over the years, and the few items now remaining naturally have a much reduced market value.

It is expected that the accounts will be cleared up during the forthcoming year. When the accounts are closed a substantial loss in realization will undoubtedly be disclosed, but as the plant was of a special nature and could be of use only in cheese-factories, the results will not be unsatisfactory.

Dairy Factory Managers Registration Board

The number of new applications for registration dealt with by the board for the year under review totalled 50, certificates being granted in 46 cases. There are at present 663 holders of certificates on the register; 241 hold creamery managers' certificates, 362 cheese-factory managers' certificates, 7 first-class cheese and second-class butter, 1 first-class butter and second-class cheese, and 52 first-class certificates for both butter and cheese.

Dairy Industry Scholarships and Bursaries

During the year the Dairy Industry Bursaries Selection Committee made the first selections of scholars and bursars under the scheme. As the scheme was in its first year of operation, it did not attract as many applicants as might be desired, but there were sufficient to indicate the need for financial assistance being given to dairy factory employees desiring to improve themselves educationally for careers in the dairy industry. As the scheme becomes better known and staffs in dairy factories appreciate the value of the special education offered to them the scheme will attract many more applicants.

Holders of scholarships and bursaries who attended the 1949 sessions at Massey Agricultural College comprised the following:—

Scholarships for B.Ag.Sc., (dairy technology): 1 first-year student and 1 second-year student.

Bursaries for Diploma in Dairying: 16 Stage I, 1 Stage II, and 2 Stage III students.

LIVE-STOCK DIVISION

REPORT OF J. E. McILWAINE, DIRECTOR

During the year production has been maintained at a very satisfactory level.

The seasonal conditions, on the whole, have been good, although Northland has experienced one of the driest autumns on record. The drought has seriously retarded production in this district, and stock have lost condition to such an extent that it will be some time before reasonable recovery takes place. Before the drought, which commenced in January, climatic conditions were very favourable to pasture growth and record dairy production resulted.

A favourable winter was common to all districts and stock wintered well, the sheep flocks and dairy herds being carried through with a minimum of difficulty with feed supplies. The dairying season opened well with many herds putting up records. Unfortunately an unseasonable cold spell of weather had an adverse influence on dairy production and in the fattening of lambs.

After the even, mild winter, lambing in most districts took place under good conditions, and all reports showed that the lambing percentages were good. Similarly in the dairying districts the prospects for a good season were favourable. In several of the intensive dairying areas mortality in dairy cows about and after calving was a matter for concern to many producers. Although many affected animals were successfully treated for disease, the mortality was higher than might have been expected after the favourable winter. The early-spring period favouring flush growth of pasture was undoubtedly responsible for many of the deaths, a percentage of affected animals failing to respond to treatment.

A rather dry season was recorded in Canterbury and although the feed position was serious at times, the subsequent rains helped to even out a season of irregular pasture growth. Although many farmers had difficulty in the fattening of their lambs, large numbers being sold as stores, the feed position in South Canterbury was good and many lambs were finished off in this district.

Wool-prices have reached a very high level; fat-lamb production and dairy production have been good and very satisfactory prices have been obtained for the produce.

The seasonal report from Otago and Southland is good. After a good autumn a mild winter enabled the ewe flocks to be carried through with a minimum of loss and the result was reflected in high lambing percentages all over the districts. Early shearing was practised in several districts and although a severe snowstorm was experienced, the mortality in shorn flocks was surprisingly low. It appears that if ewes are on good feed and have reasonable shelter, the risk in early shearing is not as great as it was thought to be a few years ago. North Otago experienced another dry spring and lambs did not fare so well. November was very dry in Southland and no doubt this factor contributed to the lighter average weight of lambs sent forward for slaughter.

The health of live-stock has remained good in all districts, no serious epidemics being experienced.

HEALTH OF LIVE-STOCK

HORSES

The draught horse on the farm has been replaced to a great extent by the tractor, teams of horses becoming less numerous as the years pass. On the other hand there is considerable interest in riding horses and ponies, as evidenced by the entries at many of the agricultural shows.

The thoroughbred industry experienced another successful year, high prices being realized at the annual yearling sales. Many high-class thoroughbred stallions have been imported by studmasters.

No serious disease of horses has been recorded, although strangles was seen among a number of young stock.

CATTLE

Diseases Scheduled Under the Stock Act

The number of cattle condemned under the Stock Act during the year for tuberculossi amounted to 5,834, 4,967 being condemned on clinical symptoms and 867 as reactors to the tuberculin test. To this number must be added 86 reactors to tests carried out by club veterinarians. In each case compensation was paid in accordance with the provisions of the Act. The tuberculin test was applied by departmental veterinarians to 18,978 cattle, of which 867 reacted, giving a percentage of 4·5.

The total number of cattle, exclusive of calves, examined at the various abattoirs and meat-export slaughterhouses was 629,010, an increase of 32,129 on last year's figures. Of these 35,673 or 5·7 per cent. were found to be affected with tuberculosis in varying degree, many being only slightly affected. This indicates a decrease of 0·6 per cent. infection among cattle slaughtered in these premises.

The testing of dairy herds supplying milk for town supply continues to be on a voluntary basis, mainly at the request of owners. The tuberculin test was applied to 5,123 head of dairy cattle, when 191 reactors were found. In addition, 11,634 cattle were tested at the owners' request, while 1,148 head of stock were tested at the various Government farms under the control of several Departments. The balance of testing covered the tests applied to cattle for export, import, or for other reasons.

Actinomycosis (and Actinobacillosis).—During the year 488 animals were condemned for this disease, and a large number of animals were successfully treated with iodides.

Malignant Growth.—The number of stock condemned was 172, an increase of 22 on the figure recorded the previous year. Compensation was paid in accordance with the Stock Act.

Johne's Disease.—A total of 303 animals was condemned for this disease under the Stock Act, the majority of the animals being in the Taranaki district. A further increase in the number of animals condemned for Johne's disease is again recorded, the figure last year being 244.

The vaccination of young calves against the disease is still in the experimental stage, 99 calves having been vaccinated again on six badly infected farms.

This most insidious disease of dairy cattle has now been reported on an increased number of farms spread all over the Taranaki district.

Anthrax.—No cases of anthrax occurred during the year. The protective vaccination of herds on farms where the disease occurred several years ago is being carried out annually.

Blackleg.—The numbers of calves vaccinated against this disease in the affected areas were: Taranaki, 27,165, and Auckland, 37,795, making a total of 64,960.

There is an increase of 1,433 in the number of calves vaccinated in Taranaki, the increase in the Auckland district being 3,148 when compared with the figures for last year.

There were 271 outbreaks in the Auckland district compared with 267 the previous year. This involved the vaccination of 6,177 calves on 271 farms. In addition 31,618 calves were vaccinated on 1,619 farms as a preventive measure.

Non-scheduled Diseases

Mastitis.—With the free use of penicillin in small tubes which enables treatment to be carried out in a very simple manner, dairy farmers have a potent agent to control the ravages of this disease. The drug may be said to be in general use throughout the country and has given very satisfactory results. Where inquiries have been carried out in cases which failed to respond to the standard treatment, a good response was obtained when the dosage rate was increased. The treatment of cows at drying off has been encouraged and is being more widely practised.

The continued use of the drug on the present satisfactory basis should increase the milking life of the dairy herds, or, in other words, less culling will be required on account of this specific disease. On the same reasoning, dairy farmers should have a more stable basis of production, as they have less to fear from the disease.

Contagious Abortion.—A very extensive programme of vaccinating heifers against contagious abortion disease is being carried out again this year. Though complete records are not available, more than 32,000 calves were vaccinated by our officers in the Taranaki west coast district. In the Auckland district applications have been received for the vaccination of 72,426 calves as compared with 67,643 last season. A total of 10,608 head were vaccinated in the Canterbury and west coast districts of the South Island. The number of vaccinations carried out in Otago and Southland has also increased.

The very large number of animals being vaccinated each year places a heavy load on field officers in the intensive dairying districts; many weeks of continuous work are required to cope with this problem alone.

One aspect of the very general use of the vaccine in pedigree herds requires some consideration by breeders who desire to export stud animals to Australia. In several States in Australia a dual system of control of abortion disease is in operation. Many brucellosis-free herds have been established; in fact, the State of Tasmania has almost eradicated the disease from its herds. Vaccinated animals are not likely to be introduced into disease-free herds or into disease-free districts on account of the danger of introducing the disease. Some difficulty has been experienced by a number of breeders in the last few years, and each exportation requires to be dealt with according to the conditions existing in the herd or State to which the animals are being sent. A brief explanation of this problem of export appears to be necessary.

Temporary Sterility.—Reports are fairly general in their reference to the prevalence of a form of sterility in dairy herds which caused concern in many districts. The suggestion has been made that the type of delayed conception most commonly seen may be due to œstrogenic substances in clovers in spring and early summer. The general history in many herds is that conception takes place later in the season when the cattle have been grazing more mature feed. However, general delayed conception is serious in that the subsequent season's production may be seriously retarded.

Grass-staggers.—Considerable numbers of dairy cows died from this disease last spring, many affected animals not responding to the treatment given. In a favourable spring with early growth of pasture the incidence of this disease takes on the nature of an epidemic in some districts. As curative treatment is not always satisfactory, every effort should be made to prevent the development of the disease. Too few farmers fully appreciate the value of feeding some good-quality hay or silage to cattle pastured on the lush spring feed. The supplementary feed acts as a balancing factor to the immature growth in the paddock. Lowered incidence of the disease in a backward spring when supplementary feeding is carried on for a longer period confirms this.

Milk-fever.—Many dairy cows were affected with milk-fever last spring, but the response to modern treatment is good. Where losses occur to-day it is invariably found that the diseased condition being treated is a complication of more than one disease, whether combined with acidosis or grass-staggers.

Salmonellosis.—This disease has been recorded as affecting cattle and calves as well as sheep and pigs in some districts. The disease has been found to be fairly widespread, the causative organism, *Salmonella typhi murium*, having been isolated from cows, calves, and pigs in Northland. In commenting on the disease the Live-stock Superintendent, Palmerston North, states: "The cases have been sporadic. One outbreak in a herd registered for town supply caused six or seven deaths, with six carriers detected. An embargo on the use of milk from the farm was a necessary precaution taken until the carriers all proved negative to fæcal tests."

Several incidences of the disease in sheep are also recorded from widely scattered districts, the organism being isolated from sheep on farms and from sheep in holding paddocks.

The Live-stock Superintendent, Dunedin, writes: "It is not clear what the significance of this condition is in cattle in this district. The trouble has occurred mostly in winter and early spring, and in young calves and older cattle. The problem requires further observation and investigation during the coming year."

Mortalities in Stock Due to Poisoning.—All mortalities in stock continue to be investigated. Despite the fact that publicity has been given to the various causes of poisoning of our farm animals, accidental poisoning occurs from time to time. Access to lead and paint is a common cause of lead poisoning in calves and cattle and in one instance five dairy cows died after having access to white lead. The poisoning of stock from arsenic, phosphorus, and the toxic plants laurel, fern, and yew is also recorded.

Parasitic Disease of Young Cattle.—Parasitic bronchitis and gastritis of calves have been commonly reported during the year. The treatment of affected animals with reliable worm medicine is common practice, but many overlook the advantageous results obtained where good feeding and calf husbandry are practised.

SHEEP

Owing to a good autumn and mild winter the ewe flocks wintered well. A good lambing percentage was expected and with favourable weather throughout the lambing period the loss of lambs at this period was low. Some local flooding accounted for losses, but over all the lambing percentages were excellent. There was a low incidence of disease in the ewe flocks, particularly pregnancy toxæmia and bearing trouble. Milk-fever in ewes was recorded in several scattered districts from Nelson Province to Southland.

Early shearing was again widely practised in many districts. Lambing everywhere was good and, owing to the fit condition of the ewes, the lambs were strong and of good weights at birth. These factors augured well for a good export season in fat lambs. As the season advanced, however, the climatic conditions were not always favourable, and a number of set-backs have been experienced. It is expected that very satisfactory results will be obtained before the season closes.

Dipping was carried out very generally but lice-infested sheep were exposed for sale in greater numbers than in some previous years. The wool-prices have been particularly good in all districts.

Lymphadenitis.—The incidence of this disease found in mutton carcasses in South Island works and abattoirs is slightly higher at 4·22 per cent. as against 3·97 per cent. for the previous year. The incidence in lambs continues to be particularly low.

Pregnancy Toxaemia.—This disease of the pregnant ewe was not prevalent during the past season. It appears to be well established that with a favourable mild winter normal husbandry of the ewe flock is comparatively easy and safe. Under abnormal seasonal conditions with shortage of feed and overstocking or sudden setbacks due to frost and storms, many farmers find trouble in preventing losses from the disease.

Although bearing trouble affected flocks in several parts of the Auckland district, the incidence was not high in flocks in other districts. Lambing was carried through very successfully and with a minimum of loss.

Parasitic Gastro-enteritis.—Hoggets wintered well in most districts and the favourable feed position played a big part in the control of the worm problem. Dosing with worm medicine is followed as a routine procedure, large quantities of phenothiazine being used each year. In a few cases where this drug did not appear to give good results use of the nicotine-bluestone mixture was tried.

Contagious Ecthyma.—The vaccination technique in the control of this disease is now well known to the sheep-farmer, the vaccine being supplied from the Animal Research Station, Wallaceville, at the request of owners.

Facial Eczema.—Some trouble was expected from this disease after the February rains in parts of the Wellington district. Fortunately the disease did not manifest itself clinically, although a few livers showed evidence of the disease in the Gisborne district. Some liver damage was also seen in sheep killed in the Waikato district.

Blackleg in Sheep.—The very great increase in the incidence of this disease in sheep flocks has been of a widespread nature. The Live-stock Superintendent, Palmerston North, writes: "This is now recognized as one of the most important single causes of mortality in ewes at lambing, lambs at docking, and all young sheep at shearing, crutching, and dipping. Large numbers of sheep are now being vaccinated." The following comments are recorded by the Live-stock Superintendent, Christchurch: "In recent years the incidence of blackleg has increased considerably in the Canterbury district, and this disease is now one of the main causes of death in ewes. A very big increase in the amount of vaccination work carried out is recorded." The Live-stock Superintendent, Dunedin, in referring to anærobic diseases of sheep deals with blackleg as follows: "The main avenue of prophylaxis is the development of vaccine therapy and there has been an increased demand for blackleg vaccine. In the field a number of demonstrations of the technique of vaccination have been given. Over 100,000 doses have been used by field officers and probably upwards of 200,000 have been used by farmers themselves."

Salmonellosis in Sheep.—This disease was reported in sheep for the first time last year and caused mortalities of from 2 to 6 per cent. in over a dozen reported instances in the Wellington district. The disease was suspected in other districts. The symptoms shown were diarrhœa, depression, and fairly rapid death, the causative organism being *Salmonella typhi murium*. Although the mortalities took place during a spell of hot weather, sheep have died from the disease at other seasons in other districts.

Liver Fluke in Sheep.—This parasitic disease of sheep has been recorded in a number of sheep killed at the Timaru works. On inquiry as to the introduction of the disease to Canterbury flocks, it was found that the sheep were purchased from fluke-infested districts in the South Island.

PIGS

The number of pigs slaughtered for the season 1949–50 at premises under inspection was 688,498, an increase of 73,350 on last year's figures.

Inspection of the carcasses at time of slaughter revealed that 96,368 carcasses were found to be affected with tuberculosis in varying degree, the percentage being 14. This is an increase of 0·3 per cent. as compared with last year.

Diseases of Pigs

Suipestifer Infection.—This disease is recorded as widespread in the Auckland district, but no heavy mortalities on individual farms have been reported. In a few large piggeries dependent upon bought-in pigs high mortalities have been noted. The use of drugs of the sulphonamide group has given encouraging results in some instances.

Among other common diseases of pigs coming under notice of the field staff during the year must be listed the incidence of necrotic ulceration, paralysis, pleurisy and pneumonia, middle-ear disease, arthritis, and zinc poisoning.

Foot-rot Disease in Pigs.—This disease is the subject of investigation in Northland, where the incidence appeared to be more severe than in other districts. The disease is also prevalent in pigs on the west coast of the South Island.

Swine Husbandry

Pig-meat Production.—Production continues to show a slight upward trend from the lowest point reached in the 1946–47 season. Although the quantity of dairy by-products available for pig-feeding was again reduced by commencement of operation of drying

plants handling the buttermilk from several large factories, this decline in food available in certain localities was offset mainly by the exceptionally good dairying season, particularly in the early part, providing increased quantities of by-products generally, and partly by better supplies of home-grown barley and other feed.

There does not appear to be any marked accretion of interest in pig-production. The breeding-sow population at 31st January, 1949, had shown a slight decline from the figure a year earlier, and the increased number of pigs killed therefore indicates that more efficient use has been made of the sows available. That the sow population is still too low for efficient use of the dairy by-products available, particularly during the flush months, is indicated by the figures for the quantity of dairy by-products available per pound of pig-meat produced. Pig-meat per 100 lb. butterfat declined from 30 lb. in 1944 to only 25 lb. for the year ended 30th September, 1949. For the same year it required 7·1 dairy by-product food units to produce 1 lb. of pig-meat as against 5·7 food units in 1942 and 5·9 in 1944.

The most important step in improvement of efficiency in these respects is the increase of breeding-sows to a point where sufficient pigs are being bred to cope with the peak supply of dairy by-products without waste, either direct or through overfeeding. This demands a rapid increase of sows to about 90,000 on our present level of dairy production. Many farmers have given up breeding their own requirements over the past few years and this trend should be reversed as soon as possible.

The number of pigs of the various classes killed in the year ended 31st March, 1950, compared with the previous year is as follows :—

PIGS SLAUGHTERED, TWELVE MONTHS ENDED 31ST MARCH (INCLUDING ESTIMATED FARM AND RURAL SLAUGHTERHOUSE KILLINGS)

Year.	Porkers.	Baconers.	Choppers.	Total.
1949	189,000	437,332	22,276	648,608
1950	238,341	462,677	24,110	725,128

The heavier killings to March, particularly the proportionately heavier porker kill, are largely a reflection of the less favourable autumn this year than last.

As figures for the twelve months ended March are subject to considerable fluctuation due to seasonal conditions and not connected with the real trends in the industry, it is desirable to review the production figures for years ended 30th September. These are as follows for the past eight years :—

Year.	Breeding-sows (as at 31st. January).	Total Pigs Slaughtered, Year Ended 30th September.	Pigs per Sow.	Slaughtered as—			Total Weight of Pig-meat in Carcass Form. (Tons).
				Porkers, 40–120 lb.	Baconers, 121–200 lb.	Choppers, over 200 lb.	
1942	91,338	925,982	10·1	494,126	397,717	34,139	47,987
1943	81,882	772,744	9·4	321,049	418,943	32,752	44,320
1944	77,300	740,913	9·6	254,126	464,558	22,229	43,251
1945	77,200	681,280	8·8	170,852	489,220	21,208	42,378
1946	72,000	664,275	9·3	256,821	385,782	21,672	38,437
1947	67,938	645,728	9·3	198,631	423,368	23,729	39,491
1948	68,354	650,464	9·5	195,903	432,299	22,262	40,384
1949	68,305	686,237	10·0	204,247	458,978	23,012	42,618

Feed-supply.—The early months of the 1949–50 dairying season were exceptionally good in all North Island dairying districts, with production exceeding previous records. The relatively small number of pigs being bred again proved inadequate to cope with the supply of dairy by-products available for them over these months, considerable wastage occurring. A limited amount of interest was shown in conservation of surplus skimmed milk and buttermilk in the form of curd, and, in a small way, in Taranaki the concentration of the solids of whey for pig-feeding has been attempted. The better way to tackle the problem, that of adjusting the breeding programme to fit pigs to the fluctuating feed-supplies, does not appear to be fully appreciated, and prices for weaner and store pigs have reached record levels in the spring months. The reaction to these high prices would normally be that extra sows would be bred, but evidence of this effect so far is completely lacking.

Associated with this reluctance under present conditions to breed more sows is the reluctance on the part of dairy-farmers to provide special crops for wintering pigs. There is no evidence that more supplementary crops are being grown for pig-feeding. Rather better supplies of barley have been available this season, but the price is such that only very limited quantities can be used economically in pig-production. Less maize was grown than during the previous season and practically only that grown on farms to be used at home for pig-feeding was actually available for this purpose. Only on the farms where the crops are produced has it been possible to use substantial amounts of any of these grains for pig-feeding. A very limited number of farmers with cropping experience, and where conditions are suitable, produce crops of sugar-beet, carrots, and other special crops for pigs, but this practice shows no sign of spreading.

Supplies of meat meal have been insufficient to meet all needs and pig-raisers have been severely restricted in the quantities they have been able to obtain. This has been a factor militating against wintering of pigs and also against full utilization of whey.

Grades " K " and " L " tallow were again available for pig-feeders and some 400 tons were withdrawn from export stocks for this purpose. This has undoubtedly been a great help to those farmers wintering store pigs, and with the relaxation of controls over the inedible grades of tallow they will no doubt continue to be used to at least the same extent.

Grading.—A trial was made during the 1948–49 season of the system of grading proposed by a committee set up by the National Pig Industry Council and approved by the Council. This trial proved successful, sorting the whole kill into 17 per cent. A's, 69 per cent. B's, and 14 per cent. C's. In the desirable weight range of 131 lb. to 160 lb., however, the break-up was 35 per cent. A, 54 per cent. B, and 11 per cent. C.

It was considered that with the application of this system the break-up would quickly stabilize at approximately 30 per cent. A, 60 per cent. B, and 10 per cent. C, which would provide a very good basis for the payment of quality differentials. A comprehensive report on the requirements of a satisfactory system of grading pigs under New Zealand conditions was also prepared and circulated to all members of the National Pig Industry Council before the annual general meeting of the Council at which the results of the trial were reported and a recommendation in favour of the system made. However, the National Council decided to delay introduction of the system on the grounds that its immediate introduction would be likely to affect total production by causing some farmers to cease pig-production.

Carcass Competitions.—In the absence of grading and application of the carcass-quality scheme these competitions, which vary from small entries in local A. and P. shows to large inter-district competitions, have formed the only means whereby the producer can check up on the carcass quality of his pigs.

Considerable effort during the year has been put into revising the judging standards for both baconers and porkers and a final draft has been prepared and dispatched to all judges for their approval before publication.

Pedigree Sow Recording.—This work continues to show a decline, only 53 litters having been officially recorded during the year as against 73 last year. In each year a considerably larger number of nominations was received, but for one reason or another many failed to complete the course. The New Zealand Pig Producers' Association is continuing to use the official recording as the basis of performance requirements under its classification scheme, but the small number of recordings carried out restricts the value of work as a basis for stock improvement.

Extension Work.—The appointment of an Extension Officer in pig husbandry has enabled the extension work to be maintained. As aids in this work a film-slide and strip projector has been purchased and three film-strip series produced. For use with the Department's show exhibit a cabinet conversion has been arranged to enable continuous screening of specially prepared film-strips.

Liaison with District Pig Councils has been maintained and the new visual aids have enabled assistance to be given in connection with meetings organized by Councils.

Survey Work.—The work commenced last year on investigation of losses of pigs on the farm by the survey method has been continued. Field-work has been the responsibility of Supervisors of District Pig Councils and due to lack of uniformity of control the extent of the survey work carried out has varied considerably. The results should be forthcoming at an early date, although up to the end of March only thirty-one satisfactory farm returns had been received, these being from only two of the nine districts. In anticipation of the increased amount of technical work required to be done for the industry a research assistant has been appointed.

Meat Inspection and Slaughter of Stock

Many extensions and improvements to meat-works are now being carried out. The extra facilities being provided will assist in the through-put of stock, as rush periods crop up at many works from time to time. The comparatively short season in some districts tends to magnify the problem of handling the large numbers of stock as they become ready for slaughter. Seasonal conditions play their part from time to time and vary from district to district. In seasonal operations of this nature it is most difficult to provide facilities to meet every emergency that may arise.

The improved accommodation being provided at several centres promises a great improvement in working-conditions. There are, however, a few centres where the conditions are not satisfactory.

The following table shows the number of stock slaughtered at registered premises during the year ended 31st March, 1950 :—

Class of Stock.	Abattoirs.	Meat-export Slaughterhouses.	Total Slaughterings Under Direct Inspection.	Plus Rural Slaughterhouses.	Total at Registered Premises.
Cattle	194,188	434,822	629,010	70,845	699,855
Calves	41,354	1,163,802	1,205,156	930	1,206,086
Sheep	883,747	3,283,856	4,167,603	266,309	4,433,912
Lambs	159,455	12,409,714	12,569,169	18,331	12,587,500
Pigs	124,336	564,162	688,498	14,487	702,985

Of the animals shown in the table as slaughtered at meat-export slaughterhouses, the following have been consumed within the Dominion : cattle, 69,326 ; calves, 53,144 ; sheep, 446,068 ; lambs, 279,443 ; pigs, 264,575.

The following table compares the numbers of stock slaughtered during the past two years at meat-export slaughterhouses only :—

Class of Stock.	Year Ended 31st March,		Increase Compared with 1949.
	1949.	1950.	
Cattle	416,004	434,822	18,818
Calves	1,120,501	1,163,802	43,301
Sheep	3,206,370	3,283,856	77,486
Lambs	12,228,754	12,409,714	180,960
Pigs	504,661	564,162	59,501

The following table shows killings of sheep and lambs at meat-export slaughterhouses for four seasons, 1st October to 31st March (six months only) :—

Stock.	1946–47.	1947–48.	1948–49.	1949–50.
Sheep	2,348,620	2,232,301	2,300,880	2,383,306
Of which ewes were	1,729,109	1,703,989	1,875,939	1,833,403
Lambs	8,246,064	9,243,204	9,294,635	9,554,473

Compensation Paid for Stock and Meat Condemned

Compensation amounting to £21,715 5s. was payable during the year for animals condemned in the field under the provisions of the Stock Act, and £18,099 6s. 1d. for carcasses or parts of carcasses condemned for disease on slaughter for human consumption at abattoirs, meat-export slaughterhouses, &c., under the provisions of the Meat Act.

Importation of Stock

The following stock were imported during the year : cattle 57, sheep 411, pigs 12, horses 115 (including the movement of thoroughbreds between here and Australia). Of the above animals the following were placed in quarantine for the respective periods required : cattle 57, sheep 39, and pigs 12.

Exportation of Stock

During the year under review the following animals were exported : cattle, 499 ; sheep, 421 ; pigs, 172 ; and horses, 356. Of this total of horses the movement of thoroughbred horses to Australia accounted for 318 animals.

Dairy Inspection

The registration of town-milk-supply premises is carried out by officers of the Division in the various centres. The supervision of these town-supply producers requires constant inspection and to obtain uniformly good results uniformity of inspection is desirable.

There are thirty-six districts in New Zealand in which there are milk-treatment stations, and of these, thirty-two were visited during the year. In the smaller districts the Supervising Dairy Inspector, in company with the local Inspector of Stock, inspected practically all the dairies, and in the large centres extensive cross-sections of the farms were visited. Some of the districts have been visited on several occasions.

Opportunity was taken in every instance to contact the Mayor, Chairman of the Milk Board, Treating-station Manager, and the Chairman of the local Milk Producers' Association, when the causes of dissension and problems of production, distribution, and milk quality were discussed and adjusted.

Before the appointment of a Supervising Officer it was not unusual to find the various organizations interested in carrying out the provisions of the Milk Act, 1944, They progressed in their own particular direction with little knowledge or appreciation of the difficulties confronting other groups. Some milk authorities aimed at having their own inspectors, who were untrained in dairy-supervision technique, carrying out all inspection duties, even on to the farms. This must inevitably have led to a lowering of the standard of production, both in regard to dairy buildings and technique, because each district would have set its own standard without having the opportunity of profiting by ideas and methods adopted in other localities.

The national organization of the Live-stock Division with its trained staff of Inspectors progressing along similar lines and co-operating fully with Milk Boards and Producers' Associations alike was explained to meetings of these authorities and was accepted whole-heartedly.

Already the whole-milk industry is settling down quietly but rapidly.

Live-stock Division Inspectors are concentrating on raising the standard of town-milk production. All over the country old milking-sheds are being replaced by modern ones. With the extensive milk-testing being carried out, milk-producers are quickly educated to become "test conscious," and their willing response is evident everywhere by the commendably clean milking-sheds, yards, and milking equipment becoming so general everywhere.

Poultry

There has been a marked change in the poultry industry during the past twelve months. For some four or five years before 1949 poultry flocks were decreased in size and few new flocks established, owing to a marked shortage of poultry-foods, more particularly wheat. These conditions reduced egg-production and the demand for eggs exceeded the supply. During 1949 the food position eased considerably. Reasonable supplies of wheat and coarse grains became available, while ample supplies of poultry mashes could be purchased. This improved food position was reflected immediately during the breeding-season in the spring of 1949. Additional breeding-stock was retained and the output of day-old chicks increased. This has resulted in greater numbers of pullets being retained at the end of 1949 and in consequence increased quantities of eggs have been marketed this autumn. There are prospects of a surplus of eggs in the spring of 1950, and the necessity for importing egg pulp from Australia has ceased. This is a clear indication of how quickly the position in the poultry industry can change.

Eggs to the public are still subject to a maximum or ceiling price. A major change, however, has been made in the method of controlling egg-prices. Before the beginning of 1950 it was the policy to effect a number of small rises and falls in prices over a period, as between the higher winter egg-price and the lower price prevailing during spring and early summer—the "flush" period of egg-production. Two changes only are now to take place—an increase of 1s. 3d. per dozen in February and a decrease by a similar amount in August, 1950. Thus in place of a range of egg-prices, increasing or decreasing with the time of year, there are now only two prices—one for winter and the other for spring and summer. This change has been so adjusted as to afford producers the same over-all returns as previously, while at the same time not increasing the price to the consumer. The subsidy—total 7½d. per dozen—for all eggs marketed through authorized egg floors was retained during the past twelve months.

As at 31st December, 1949, the Wheat and Flour Emergency Regulations 1939 were revoked and with these regulations the Poultry Mash Control Notice 1946. This ended the licensing by the Department of manufacturers of standard poultry mashes ; a scheme introduced in 1946 to effect the equitable distribution of pollard and bran available to the poultry industry. Since that date, however, the poultry industry has requested that this scheme be retained on a voluntary basis, since present and expected supplies of pollard and bran are insufficient to permit of an entirely free market for these meals and at the same time assure the poultry industry of adequate supplies.

To summarize it may be stated that providing food-supplies remain adequate in quantity, an expansion of the poultry industry is to be expected with consequent greatly increased quantities of eggs. Closer attention must now be paid to the quality of eggs being offered to the public, as increased consumption will ultimately be needed to take care of the increased production. Without this the poultry industry may be faced with financial and economic problems.

New Zealand Poultry Flock Improvement Plan.—That this plan, started in 1945, is still receiving satisfactory support is confirmed by the following figures :—

——	1945.	1946.	1947.	1948.	1949.
Number of flocks accredited	28	71	105	142	169
Number of female breeders accredited ..	5,508	15,428	26,783	41,862	47,945

The number of female birds accredited in 1949 permits of the rearing of approximately half a million pullets. This figure indicates the extent to which the plan can affect the stock of the Dominion. It is hoped to expand this plan, controlled by a Dominion committee of producers and officers of the Department, and to render further assistance to poultry breeders.

Poultry-diseases.—The economic loss to the poultry industry from diseases among stock remains a matter for concern. Consequently the advisory service on disease, disease-control methods, and the diagnostic service from the Animal Research Station, Wallaceville, have been strengthened. The presence of a full-time field veterinarian (poultry) in each Island has increased the service being given by the Department and appears to have been appreciated by poultry-producers. An outbreak of fowl cholera in an acute form occurred in the South Island during 1949, and as this highly infectious disease had not been reported previously in this form in New Zealand, the affected flock was destroyed, disinfection has been carried out on the farm, and the poultry-farmer was compensated for his stock losses.

Advisory Service.—To overcome difficulties experienced in the past in obtaining the services of suitable men for appointment as Poultry Instructors, a scheme for training cadets was introduced early in 1949. Under this scheme four cadets are receiving a training in the several more important aspects of poultry husbandry. This is proving a successful method of obtaining the staff required and consequently will be continued in the future to maintain an adequate number of practical Poultry Instructors in the field.

The Poultry Demonstration Plant, Upper Hutt.—With the return of food-supplies to normal it became possible in 1949 to stock the plant fully. In consequence progress has been made with the breeding programme, particularly in respect of the Black Orpington stock. There are indications that the demand from poultry-producers for Black Orpington birds is on the increase, indicating an appreciation of the work already done on this breed. The programme of practical experiments and demonstrations started early in 1950 includes a study of the comparative value of green food and fish-oil

as sources of vitamin A for laying-stock and the comparative economic value for egg-production of the reciprocal crosses between White Leghorn and Black Orpington birds. The initial steps have been taken to obtain the necessary stock needed for an economic study in table-bird production, using Light Sussex males and Rhode Island Red females for cross-breeding a suitable type of table bird.

In March, 1949, a breeders' laying-trial was started at the plant and fifteen entries of 20 pullets each were received. This trial ended on 26th February, 1950. The trial proved satisfactory and was restarted on 13th March, 1950, with 23 pens or 8 pens more than in the previous year.

The results for the first year show that the best pen of White Leghorns laid 3,722 eggs in forty-eight weeks or an average of 186 eggs per pullet. Mortality during the trial for all breeds was 17·3 per cent., a third of this mortality being due to leucosis, a disease which is widespread throughout New Zealand and of considerable economic importance to the poultry industry.

There are indications that the establishment of this trial at Upper Hutt is appreciated by poultry-breeders and that the trial will receive increasing support in the future. Not only does it supply valuable information to the individual poultry-breeder who enters a pen of birds, but the data collected over all birds when summarized and published in report form supply material of educational value to all poultry-producers.

Wool

The Market for Wool.—Although at the time of writing the 1949–50 selling season has not yet run its full course, it is quite safe to say that it has broken nearly all previous records for prices of individual types of wool, and the over-all returns from this commodity will be far and away the greatest in the history of the Dominion. A very noticeable feature has been the increase in price for crossbred lines relative to Merino; which is of great economic importance to us with our predominantly crossbred clip, only some 3 per cent. of our wool now being Merino. It seems that pent-up buying pressure from consumers who had waited for years, through the war and after, to replenish wardrobes and furnishings created such a demand for fine wools that Merino prices were finally becoming too high. Manufacturers, fearing that their products might soon have to meet increasing sales resistance, began to substitute the cheaper crossbred types, and, as the past season has shown, increased demand for these has in turn pushed their prices up. Statistically wool is in a very strong position, as for all practical purposes the wartime accumulations have all been sold and the world is using wool faster than it is being produced. Any increase in production will take considerable time, and in the meantime it is likely that scarcity and high prices will give constantly improving synthetic fibres the biggest boost they have ever had.

Experiments and Investigations.—The work on power-spray dips has been continued. These dips are now very popular and are being installed as fast as the limited shipments from Australia become available. Properly used they are efficient, labour saving, and easy on the sheep, but they are not entirely foolproof and attempts to dip sheep carrying too much wool or to break speed records are likely to lead to disappointing results. The other main factor to be watched is that sufficient power and speed are available from the engine or motor to give adequate pressure at the pump. Sheep and Wool Instructors in their districts have made a point of checking these factors and generally assisting new owners of spray dips to get the best results from them.

Further trials have been carried out at the Animal Research Station, Ruakura, on the use of different dipping materials in a spray dip, and one of the facts which has clearly emerged is that strict adherence to manufacturers' instructions in regard to frequent replenishments is essential. With spray dipping there is rapid exhaustion or "stripping" by the fleece of the active ingredients in suspension in the dip, and if

replenishments are not made "little and often," the first few hundred sheep through the dip will carry out most of the active materials and the dipping fluid which is left may fall below effective strength for the remaining sheep.

Some work has been done on an adjustable drafting-race in which the width and degree of taper can be altered to determine the best size for general work in handling mixed lines of sheep. Much other data on sheep-drafting yards have also been assembled and are being incorporated in a bulletin.

An outbreak of mycotic dermatitis among Merinos, mainly in the Central Otago area, has led to some trials being initiated to discover what strength of copper sulphate (bluestone) solution can safely be used for its treatment without ruining the wool.

During the year a number of clean-scoured yield determinations have been made on wool samples submitted by other sections of the Department and by wool brokers.

Wool-marking Preparations.—Manufacturers still continue to submit samples of new preparations for testing and approval. During the year 62 samples were given scouring tests and of these 33 met the requirements for scourability and were officially approved for sale and use.

As some complaints about unscourable substances are still occasionally received, check tests extending over a period of twelve months have now been commenced on all the branding preparations on the market. This is to make sure that these substances as sold are up to the standards of scourability of the samples originally tested and approved. There is very little old stock-pile wool now left in the country, nor is there likely to be any quantity of the old branding-paints left on farms from before 1947, but much harm can still be done by farmers using non-approved substances such as ordinary paints, or by adding ingredients like linseed-oil or turpentine to approved branding-materials. Quite a number of farmers still appear to be unaware that these practices are illegal.

Extension Work.—Over the past twelve months Sheep and Wool Instructors in the seven districts have paid a large number of visits to farms to give advice, have lectured to farmers' organizations, and have prepared exhibits at A. and P. shows. They have also given advice on the installation of dips, the layout of sheep-yards and wool-sheds and on the best method of preparation of wool-clips for sale. Instructors have also played an active part in the Department's farm schools.

Wool-count Standards.—An innovation this year was the making-up and issuing of 100 sets of wool-count standards. With the active co-operation of the appraisers of the Wool Disposals Commission, bulk samples of the various counts were selected and these were carefully sorted and re-sorted to arrive at straight lines of wool, each representing a definite count or quality number as recognized by the trade and in line with the counts used by the Wool Disposals Commission in fixing their reserve prices. The aim in issuing these standards was to make available to the trade a "yardstick" which could be used for reference purposes—something which had previously been lacking. The wool was done up in glass-fronted enamelled metal boxes which were sealed to prevent opening and interference. Twelve of these comprised a set ranging from 36's to 70's count. The sets were sold at three guineas each, which barely covered cost of materials, and all were disposed of in a short time. Most of them went to woolbrokers, buyers, and teaching institutions. None was sold to individuals.

The Wool-clip.—Whereas last wool season late shearing was the rule rather than the exception, this year in most districts a number of farmers have shorn earlier than usual. The practice of winter shearing is on the increase, with the result that quite a number of clips have been short in staple length and the individual fleeces do not present a good appearance through failure to hang together during handling. These wools attract only a limited number of buyers and in consequence do not receive as good prices as fully grown wools.

As in most cases little or no premiums were paid for well-classed and for skirted clips as against badly prepared clips, farmers tended in quite a number of cases to go back to the old slipshod " all-in " methods.

Devaluation of sterling has brought a wider range of buyers into the market and the consequent rise in the prices of practically every type of wool has led to some carelessness in preparation of wool-clips generally.

Auckland : Favourable seasonal conditions resulted in a good to average selection of wools at the first sale. The wool was of quite a good colour and fairly light in condition with very little seed, and the oddments were also of good colour and free from seed or discoloration.

For following sales, however, faults started to creep in, in particular, seed and cotts, &c., and as in previous years growers for the most part paid little attention to the " get-up " of their clips.

Napier : The Hawke's Bay Province enjoyed a mild winter, but though the wool for the first sale was well grown and of a good colour, it was not comparable with the high standard of the corresponding sale last season either for condition or style.

The get-up of the clips in this district is always of a high standard and this year has been no exception. The main faults to be found were the early appearance of sheep's burr and the later appearance of bidi-bidi, which is very prevalent in the district. Hogget wools were for the most part extremely attractive and other fleece lines were well grown but slightly heavier in condition than usual.

Wanganui : Good autumn rains and a mild winter were responsible for a better growth of wool this year. Unfortunately, however, far too many growers spoil their clips by a somewhat haphazard system of preparation. Encouraged, no doubt, by the really excellent prices and the fact that in most cases no premiums were paid for good preparation, growers are slipping back to the old " all-in " methods.

Early-shorn wools were much in evidence in the early part of the season, and these wools are short in staple and unattractive. Hogget wools were disappointing, being mixed in quality and irregular in length. In later sales seedy wools became far more prevalent.

Wellington : A mild winter and good spring weather to follow resulted in excellent showings of wool at all sales. Early shearing, which seems to be on the increase, resulted in a quantity of the offering for the first sale being short in staple.

The good impression gained at the first sale has been maintained throughout and prices in consequence have been exceptionally good.

Faults were not conspicuous, except for touches of seed in the latter part of the season. Woolly hoggets were exceedingly well grown and sound.

Christchurch : Following on a dry winter the proportion of showy clips was less than usual at the first sale. There was, however, a good selection of all types in good average to super style wools. The fine wools were well grown and more robust than usual, though some Merino clips were irregular in quality. A few Marlborough Merino clips were outstanding.

The crossbred clips were for the most part unattractive and a few west coast clips, although light conditioned, were discoloured. Later offerings were much the same, but touched with seed, burr, and other vegetable faults.

Timaru : Owing to a dry autumn and spring, the wool-clip taken over-all did not open up as well as last year, a considerable portion being a little off colour and showing tenderness. Early-shorn wools were present at the first sale, these being short stapled but sound. Faults seemed to consist mainly of tender wools and yolk stains, but there was relatively little vegetable matter present.

Dunedin : Owing to exceptional seasonal conditions, shearing generally began about a month earlier than usual in this district. In consequence some of the fleece lines for the first sale were disappointing for length, although pleasing in other respects. This was especially apparent with fine and medium crossbred. The usual first-sale selection of superior style quarter-breds and half-breds was available along with a few choice Merino clips.

The good standard set in the first sale has been maintained, although seed and other vegetable faults have become more noticeable.

The hogget wools have been exceptionally sound and well grown.

Invercargill : Clips from this district have not opened up at all well. The selection has shown the effects of unfavourable winter conditions and in some cases earlier shearing. Tender, short-stapled wools have predominated and there has been an absence of the usual well-grown hogget wools, these being mostly short and tender. Seed and cotts and a high proportion of tender wools seem to be the main faults this season.

A table showing New Zealand sales, weights, and values for the last five years is given below. No figures are yet available for 1949–50, as the final sales have yet to be held :—

Season.	Number of Bales sold.	Net Weight.	Gross Value.	Average per Bale.	Average per Pound.
		lb.	£	£ s. d.	d.
1944–45	1,038,019	357,606,520	22,013,258	21 4 1	14·77
1945–46	1,022,124	349,365,289	21,552,153	21 1 9	14·80
1946–47	934,730	308,347,839	23,136,014	24 15 0	18·00
1947–48	844,522	286,004,976	29,868,425	35 7 4	25·06
1948–49	869,226	291,539,668	31,325,858	36 0 9	25·79

Rabbit Nuisance

In the past year there has been a remarkable advance in the constitution of additional rabbit districts, particularly in the back-country areas of the South Island where previously there was always intense opposition to board control. This trend can be attributed to (1) the continued low prices ruling for rabbit skins and carcasses ; (2) the realization by farmers that eventual control of the pest could be achieved only through the agency of Rabbit Boards conducting a vigorous, planned, all-the-year-round " killer " policy ; (3) the availability of finance to Boards in districts of low stock-carrying capacity, thus enabling a killer policy to be put into effect ; and (4) the work of the Rabbit Destruction Council, with the co-operation of departmental officers, in sponsoring and guiding the development of rabbit district formation. At 31st March, 1950, 149 Rabbit Boards were operating, covering an area of 25,000,000 acres and involving approximately 32,000 ratepayers. This shows an increase of 37 Boards. In addition 12 existing Rabbit Boards had new areas brought under their jurisdiction, totalling in all 264,868 acres. Amalgamation of small contiguous rabbit districts is meeting with some success and several proposals are in train. Two amalgamation proposals were completed during the year, one involving 2 Boards and the other 4 Boards.

The Hurunui Board, which was established in 1887, was subdivided into 7 separate Boards and at the same time a change-over from an inspection to a " killer " policy took place.

The levy on rabbit-skins was increased to 20 per cent. from 1st June, 1949, and for the year ended 31st March, 1950, £40,051 was collected and credited to a special deposit account. Of this, £32,200 was utilized by way of grants to needy Boards. In addition further grants, amounting to £231,940, were made from the Consolidated Fund,

making a total of £264,140 involved in grant payments. With additional areas coming under Board control, and existing Boards striking higher rates to meet increased working-expenses, the total subsidy paid to Boards on rates collected for the period under review amounted to £175,672. This makes a grant total of £439,812 made available to Boards for control measures generally.

With another mild winter followed by a dry spring and summer there was an uninterrupted breeding season. This has fully taxed all the resources of established Boards and in some instances, because of shortage of labour, a slight deterioration in the control of the pest was evident. In areas outside of rabbit districts and in recently constituted rabbit districts heavy infestation was common. Many of these new Boards had the greatest difficulty in making progress and the shortage of efficient labour seriously handicapped activities.

Because of fire risk the shipping of phosphorus from England was prohibited and this led to a complete cessation of the manufacture of phosphorized pollard for some time. This prejudiced the operations of Boards and in many cases their extermination programmes were disrupted. When fresh packing arrangements were made by the suppliers the shipment of phosphorus was resumed and supplies came to hand early in 1950. Strychnine supplies have been adequate.

The sowing of phosphorized pollard pellets from the air was undertaken by a number of Boards with uniformly good results. The cost compares favourably with normal, orthodox hand methods. The use of the aeroplane in coping with the pest might prove the solution to dealing with large tracts of back country and overcome the difficulty in getting labour to work this type of country.

The Rabbit Destruction Council has continued to give splendid service and has carried out its functions in a most commendable manner.

Noxious Weeds

A little progress has been made in noxious weeds control, but, in the main, land occupiers have confined their activities to dealing with better-class land. Chlorate weed-killers have been in reasonable supply and the use of hormone-type weed-killers is rapidly becoming recognized as a decided advance in the control of weeds. It has been demonstrated that hormones will assist in the control of blackberry. The use of mechanical units in weed-control work is also being more widely accepted in the general weed-control programme. The shortage of labour continues to retard progress in weed-eradication work. Many local authorities who were given grants to enable weeds, particularly ragwort, to be attended to on Crown and Maori lands were unable to expend their grants fully because of inability to obtain an adequate labour force. Another local authority has assumed administration of the Act, this making a total of 40 county councils responsible for weed-control work in their districts.

It was not found possible to introduce during the 1949 session of Parliament a Bill amending the Noxious Weeds Act, 1928, to incorporate the principal recommendations made by the Special Noxious Weeds Committee.

HORTICULTURE DIVISION

REPORT OF A. M. W. GREIG, DIRECTOR

Reorganization of Work

To enable it to play an even more efficient part in the more certain future of assured returns for certain products, such as apples, pears, and lemons, the Horticulture Division has been reorganized during the past year. The principal change has been a complete separation of the inspectorial and advisory services in practically all districts, the two phases of work being co-ordinated at the administrative level. The administrative section consists of a Director and Assistant Director in Wellington and four superintendents stationed in Auckland, Palmerston North, Nelson, and Dunedin. The inspectorial staff consists of thirty-eight Horticultural Inspectors in the districts and a Principal Horticultural Inspector in Wellington.

The thirty-three advisory officers stationed throughout the Dominion and known as Orchard, Vegetable, or Horticultural Instructors in future will concentrate on advisory work alone.

During the past year advisory officers in horticulture gave 197 public addresses and radio broadcasts, organized 134 field-days and demonstrations, and wrote 62 articles which were published in *The Journal of Agriculture*. Apiary Instructors delivered 115 addresses, organized 28 field-days, and had 13 articles published in the *Journal*.

To assemble and condense the vast amount of horticultural literature now available, to keep in close touch with research stations, to study economic problems, and to maintain liaison with marketing organizations, thirteen specialist officers are being appointed to concentrate on different branches of horticulture. These men, some of whom have arrived from overseas, will include specialists in pip, stone, berry, and citrus fruits, grapes, vegetables, and general horticulture.

In addition seven horticultural cadets are attending University full time under a bursary scheme studying the B.Sc. course. When they have completed their academic courses these officers will have a three-year practical course before becoming qualified Horticultural Instructors.

In 1949 staff-training courses for Orchard and Vegetable Instructors and Horticultural Inspectors were held at Auckland, Palmerston North, and Christchurch. At these courses lectures and demonstrations were given by specialists on many phases of practical and theoretical horticulture and by controlling and other officers on the organization and administration of the Horticulture Division. In addition officers visited nearby research stations and colleges.

An endeavour is being made to reduce the number of statistical returns from producers and divisional officers, to encourage decentralization, and to maintain uniform interpretation of grading standards and administrative actions.

Pip-fruits (Apple, Pear, and Quince)

In general the weather was favourable during the period in which the 1949 pip-fruit crop matured and was harvested.

In the second half of the year heavy spring frosts caused fairly severe damage in Hawke's Bay to the 1950 pear crop and minor damage to apples. Pip-fruits in this district suffered further damage early in October during a hailstorm of record severity, a number of orchards losing a portion of their crop and fruit in many others receiving varying degrees of injury.

The apple and pear crop in Central Otago was seriously reduced by a heavy frost on 8th November, apples being affected to a greater extent than pears.

Disastrous hailstorms on 11th and 13th February, 1950, caused major damage to maturing crops at Hastings, Hawke's Bay. The estimated total loss was 210,000 bushels of apples and 22,000 bushels of pears. In addition, about 93,000 bushels of apples and 4,000 bushels of pears suffered damage by hail, resulting in a lowering of grade.

The area planted in apple and pear orchards showed an increase of 93 acres during the year, apples accounting for 68 acres. More than half the new orchards, including both apples and pears, were planted in the Hawke's Bay district. There was no material change in the quince acreage.

A fairly considerable expansion of pip-fruit planting is expected in some districts in the near future. Development for ex-servicemen of the Motukawa Block in Marlborough will include the planting of 140 acres in apples. Additions to the present orchard area are also expected in Hawke's Bay, where planting is making steady progress, in Nelson, and to a less extent in the Auckland district.

The rate of replacement of casualties and unthrifty trees in established orchards is also rising steadily with the increasing supply of nursery trees on vigorous Malling rootstocks. Apple- and pear-crop statistics are included in the appendix on pages 127 and 128.

With the exception of a portion of the Central Otago district, throughout the country pip-fruit orchards are in better condition than for some years past. The general healthy tone of the industry, especially in Hawke's Bay and Nelson, is reflected in the increase in purchases of new tractors, spraying machinery, and fruit-graders and in the erection of new packing-sheds and the installation of orchard cool stores.

The trend in Nelson and Hawke's Bay toward replacement of stationary spraying outfits by mobile sprayers continues. Mobile plants include a number of speed sprayers operated on the air-blast principle; chief advantages of these machines are rapid coverage of orchards and one-man operation of both traction and spraying.

In Marlborough and some orchards in Central Otago, principally at Roxburgh, a factor limiting production is the high cost of irrigation equipment.

A shortage of labour, especially of experienced workers, still exists around Auckland, in Hamilton, Wairarapa, Christchurch, and in the Nelson area of the Nelson district. In Auckland the problem is aggravated by lack of accommodation on orchards.

Pip-fruit Diseases.—With the increasing use of new insecticides toxic to some pests and to the natural enemies of others, control of red mite was again a major problem in Auckland orchards. This pest was also troublesome in Nelson, principally at Motueka, and in Canterbury. Improved control is expected in the near future as a result of current investigations by the Department of Scientific and Industrial Research and observations in the field by officers of the Department of Agriculture.

Woolly aphis was more in evidence this year in the Nelson area. Spraying may become necessary to keep this pest in check.

Pear-leaf blister mite was prevalent in the Central Otago district, mainly at Roxburgh.

In Nelson, control of late black spot with standard fungicides was difficult on Delicious, Granny Smith, and Golden Delicious apples, but new therapeutants under trial by the Department of Scientific and Industrial Research show promise.

Die-back of reworked apple-trees caused by *Coriolus versicolor* was still a problem in the Auckland district and to a less extent in Marlborough.

Late in the year fireblight in pears and quinces gave concern in Nelson. As this disease is hindering the establishment of young quince-trees, the possibility of obtaining more resistant varieties will be explored.

Green crinkle of apples increased during the year in Nelson and was also fairly widespread in Mapua. The variety chiefly affected was Granny Smith.

Diseases of this nature remain of major importance as the chief cause of mortality of pip-fruit trees, especially apples.

Sour sap continued to take a steady toll of trees in Auckland and Nelson districts, where large areas of orchard are established on clay soils with poor natural drainage. Following trials by the Department of Scientific and Industrial Research, a more resistant rootstock, Malling No. XII, is coming into use on this class of soil, but supplies are limited as yet. The primary cause of sour sap is an excess of soil water. Methods of draining these clays therefore require investigation, as no known rootstock can survive in water-logged soils.

Gnarling of Gravenstein trees remains an unsolved problem and one that is seriously affecting the health and productivity of orchards planted with this important variety. Trials conducted by the Department of Scientific and Industrial Research and observation of the disease in orchards by officers of the Department of Agriculture have shown that trees propagated on Gravenstein roots, though not immune, are much superior in vigour to trees on Northern Spy stock. Own-rooted trees are therefore being recommended for all future plantings of this variety.

In Nelson a disease causing sudden collapse and death of healthy, mature Cox's Orange Pippin trees has shown greater incidence this year. Delicious trees are also susceptible, though decline is less rapid in this variety. No causal organism has been isolated and affected trees usually have healthy roots. Trees thirty-five years of age or older are the most susceptible.

Henderson spot or thumb mark, a suspected virus disease affecting fruit of the Granny Smith apple, has spread rapidly throughout the Auckland district during the past two years. The disease first came under notice in 1938. Almost all orchards contain infected trees, the number of diseased fruits on individual trees varying from a few to almost the whole crop. The disease is being observed closely by officers of the Department.

In Nelson and Marlborough several rabbit and hare-repellant materials for application to fruit trees have proved effective in tests made by the Department. In similar trials at Motueka the materials protected the bark of trees from injury, but new growth was attacked in the spring as it appeared.

The "long lateral" system of pruning apple-trees has given good results in Marlborough trials and is being increasingly adopted by local growers.

Stone-fruits (Peach, Apricot, Nectarine, Plum, and Cherry)

Several factors have contributed to the continued expansion of stone-fruit growing. One has been the high prices which have been general during the past few years and greater in proportion than the controlled increase received by pip-fruit growers. Allied with this is the fact that peaches in particular begin to produce much earlier than apples and pears. Another factor has been the increased supply of trees, both locally grown and imported from Australia, which has enabled growers to replace uneconomic trees or fill gaps in orchards as well as to extend their areas.

The most noticeable increases have been in apricots (about 110 acres) and peaches (90 acres). Practically all these apricots have been planted in the Central Otago area, but new peach plantings have been made fairly widely, the most important being in Central Otago (30 acres), Auckland (20 acres), Hawke's Bay (19 acres), and Nelson (14 acres). Smaller increases have taken place in the numbers of plum-trees, mainly Japanese varieties; Central Otago shows the greatest increase (about 25 acres), followed by Hawke's Bay (7 acres), and Auckland and Nelson (5 acres each). Areas in nectarines and cherries have remained fairly steady, though Central Otago has recorded an increase of 10 acres of nectarines and 5 acres of cherries.

A number of new orchards, either wholly or partly of stone-fruit trees, have been established, particularly by ex-servicemen, and further plantings are projected. On the Motukawa settlement, near Blenheim, which will be planted shortly, fourteen ex-servicemen will each have approximately 5 acres of stone-fruit.

Concern about market prospects when the large number of trees planted in recent years come into full production is natural. Though many trees are replacements, there is little doubt that in normal seasons increasing quantities of fruit, especially peaches, will have to be disposed of. Japanese plums already tend to be in oversupply for short periods on the Auckland markets. To maintain payable prices much more attention will have to be paid to distribution, and possibly alternative outlets will be necessary. Short-term cool storage helps to avoid temporary gluts, but cannot alleviate a sustained oversupply. If suitable varieties were available, canners and jam manufacturers possibly could take more than they do at present; this is certainly the case with apricots. These factors will be taken into account in formulating any future recommendations made by this Division to intending planters.

With the exception of Auckland, stone-fruit districts suffered in varying degrees from late spring frosts. These may be regarded as normal in Central Otago, and more frost-fighting equipment has been bought in recent years. Many growers were caught unprepared by the exceptionally late frost of 9th November; a number had already collected their pots in preparation for cultivation. Cherries and early peaches appeared to suffer less damage than other kinds of fruit. Substantial reductions in crop and complete losses in some orchards were general in Canterbury, Nelson, Marlborough, and Hawke's Bay, where fewer growers have fire-pots.

Investigations are being carried out by the Fruit Research Station, Department of Scientific and Industrial Research, on critical temperatures for apricots at different stages. Further work will be done on improved types of fire-pots, present indications being that heating by oil is likely to be the most practicable method of protection for some time to come.

There is need for more weather forecasting for specific areas, rather than the general forecasts such as are available at present.

Localized hailstorms caused serious damage to stone-fruit in parts of Hawke's Bay. The most serious, in February, was responsible for the loss of about 25,000 bushel cases of late peaches.

In many districts warm summer weather caused fruit to mature ten to fifteen days earlier than usual.

Stone-fruit Diseases.—The major insect pests of stone-fruits during the past year were leaf-roller caterpillar, green and black aphis, and pear slug. The leaf roller appears to be increasing and in some districts is causing concern. Brown beetle (grass-grub) caused damage to foliage in Hawke's Bay and the Hamilton district, and red mite was common on stone-fruit in Hawke's Bay. Possibly increased insect infestation has been caused by seasonal conditions, but in many cases extra control measures will be necessary to deal with the carry-over to next season.

A species of capsid bug, as yet not identified, is believed to be the cause of damage to peach fruits in several Auckland orchards.

Silver-leaf disease is by far the greatest menace to stone-fruit orchards and is general throughout the Dominion, causing considerable tree mortality and reduction of crop in trees not killed outright. Once established in a tree, there is no certain means of eliminating it. The recommended method of prevention—the protection of all cut surfaces of any size—involves more labour than is normally available. There is urgent need for the development of a cheap, speedy, and reliable method of sealing pruning and other wounds. In some districts where there are areas of waste ground near orchards stumps of such trees as willow, poplar, and broom killed by silver leaf are a potential source of infection.

Brown rot continues to be a serious problem in northern orchards and also causes losses in the drier areas, the degree depending on seasonal conditions. Where orchard hygiene is strict and spraying is thorough losses are kept reasonably low. New fungicides so far tested by the Plant Diseases Division, Department of Scientific and Industrial Research, do not appear to offer an easy means of control.

Leaf curl is not serious in commercial orchards, and rust is not normally troublesome, but was responsible for considerable disfigurement of nectarines in Hawke's Bay this season.

A comparatively new disease of stone-fruit, verticillium wilt, is causing concern to growers in Central Otago, Hawke's Bay, and to a less extent Canterbury. So far it has appeared only where potatoes or tomatoes have been grown.

Bacterial spot is present on many varieties of Japanese plums, especially in Auckland. Weak Bordeaux sprays are being used successfully to keep down fruit losses, but there is yet no means of eradicating the disease from the tree or repairing the damage done to the wood.

Plum mosaic is present on plums and to a less extent on apricots in most districts. As yet its effects do not seem serious in orchards, but in nurseries infected stocks appear more difficult to bud successfully than those free from the disease. A survey of its incidence in Hawke's Bay is being undertaken at present by the Fruit Research Station, Department of Scientific and Industrial Research, in collaboration with this Division.

A suspected virus disease of cherries in Marlborough is being investigated.

Dying back of mature trees, mainly cherries and apricots, and outright killing of young trees, particularly peaches, are general throughout Central Otago. Though not confined to this district, these troubles are probably accentuated there by the salt content and alkalinity of the soil. It is hoped that the survey of actual and potential orchard soils being undertaken by the Soil Survey Division of the Department of Scientific and Industrial Research will throw some light on these problems. Other aspects are under investigation by officers of the Fruit Research Station of the same Department.

Deficiencies of trace elements are suspected as the cause of the poor growth of trees in many districts, and sour sap continues to take a toll, especially on heavier soils.

Another problem of more than local importance is bud drop of peaches and nectarines.

Birds cause loss in some areas by damaging buds and flowers, and in cherry-orchards are a menace to ripening fruit. Though the new acetylene bird-scarers seem reasonably efficient, nothing yet tried can replace at least periodic shooting.

In the Hamilton district fears of wasps attacking sound fruit seem to have been unfounded, though there is no doubt that they will work on fruit already damaged by birds.

In a number of districts difficulty is experienced in getting some varieties of Japanese plums to bear payable crops. Investigations are being made on the pollination problems involved.

Economic Factors.—The rising trend in cost of production of stone fruits has continued, but in general has been offset by higher market realizations.

The labour situation is not serious, though there is a definite shortage of skilled workers, in part caused by a lack of housing for married workers in fruitgrowing districts. In the Roxburgh area the Coal Creek hydro-electricity scheme has tended to deplete the available labour supply; on the other hand, the pool of week-end labour is now greater, and when the scheme is fully staffed additional female labour may be available for seasonal work.

Because of the perishable nature of stone fruit, problems of harvesting and marketing have been complicated by recent trends in legislation dealing with hours and wages. To overcome these difficulties and to avoid temporary market gluts, a number of growers are installing small cool stores with capacities of up to 1,000 bushels. These are suitable for pre-cooling and short storage of stone-fruits, and in many cases are used later in the season for long storage of pip-fruits. These stores are confined mainly to districts distant from their markets—for example, Central Otago, Marlborough, Nelson, and Hawke's Bay.

Increasing frost-fighting equipment, such as fire-pots and alarms, is being installed, particularly in Central Otago, and frost prevention is now responsible for a higher proportion of growers' costs.

Mechanization is not as far advanced in stone-fruit growing as in pip-fruits, possibly because of the smaller areas of plantings. Apart from a greater use of air-blast sprayers and case-making machines and more modern sizing machines, mainly on the larger mixed orchards, no outstanding advances are apparent.

Interest in irrigation, and particularly in modern sprinkler systems, is increasing. It is realized that flooding and furrow methods are inefficient and wasteful of water. On the other hand, high capital cost and doubt about the suitability for orchards of equipment on the market have tended to slow down progress. There is scope for investigations into water requirements of crops and technique of application, as well as into the larger question of availability of water.

There have been no outstanding additions to the therapeutants available. H.E.T.P. is probably the only new insecticide used to any extent, but none of the new fungicides under test can yet be confidently recommended.

Air transport is being used increasingly for cherries grown in Central Otago and Blenheim for North Island markets.

In the following table the estimated crop for the 1949–50 season in the main districts is compared with that of the previous season :—

(Thousands of bushels)

——	Auckland.	Hawke's Bay.	Nelson and Marlborough.	Canterbury.	Otago.	Dominion Total.
Peaches—						
1949–50	60	135	40	4	45	284
1948–49	39	250	59	7	87	442
Nectarines—						
1949–50	1	13	1	..	9	24
1948–49	1	20	2	2	18	43
Apricots—						
1949–50	1	4	..	5	74	84
1948–49	1	2	..	8	118	129
Plums—						
1949–50	33	29	4	3	22	91
1948–49	45	43	9	6	23	126
Cherries—						
1949–50	..	1	1	3	9	14
1948–49	..	1	2	2	8	13

Citrus Fruits (Lemon, New Zealand Grapefruit, and Sweet Orange)

There have been no marked changes during the year in the area of citrus trees planted in the principal commercial districts. At Te Puke and Te Puna, near Tauranga, new citrus orchards have been established. In general, few lemon-trees except of the Meyer variety have been planted during the past ten years, and lemon-production will soon decline unless young trees are planted to replace the ageing lemon-trees.

Production of New Zealand grapefruit will continue to increase for a number of years if existing trees are retained in good condition, because many are still far short of maximum production and comparatively few of the older trees are showing signs of decline.

Weather.—In Auckland, North Auckland, and Bay of Plenty districts the weather was warm and the rainfall average. Conditions in Gisborne were warm, but the rainfall was insufficient. On the average, weather conditions were favourable for the production of citrus fruits.

Disease Control.—One of the main problems of disease control in Kerikeri orchards is the limited number of efficient spray outfits used by growers. The position is being improved as growers buy new equipment.

At Kerikeri a severe outbreak of red mite was caused in citrus orchards by the application of D.D.T. sprays for the control of dicky rice weevil. The D.D.T. sprays had reduced the number of insects that prey on red mite. The Division now recommends that only the lower foliage of the trees should be sprayed with D.D.T. for the control of dicky rice weevil.

The damage caused to citrus trees by citrus borer is still a serious problem to growers, as much time is used in finding and eradicating this infection. Older citrus trees are more liable to infection with citrus borer than young trees.

Soft- and hard-wax scales are infecting many orchards at Kerikeri and are a problem to growers because sprays must be applied later than the optimum period for the control of other scales.

No outbreak of citrus canker occurred in the main commercial citrus orchards in 1949. Steps have been taken to eradicate citrus canker infection found in a domestic garden on Great Barrier Island.

Sour sap induced by poor soil drainage continues to take its toll of citrus trees near Auckland.

Economic.—The production of citrus fruit in bushel cases in 1949 is estimated at :—

Kind of Fruit.	Kaikohe.	Auckland.	Tauranga.	Gisborne.	Total.
Meyer lemon	6,000	1,400	2,000	400	9,800
Standard lemon	9,000	35,000	75,000	4,500	123,500
New Zealand grapefruit	11,000	75,000	34,000	500	120,500
Sweet orange	13,000	1,500	2,200	2,750	19,450

At Kerikeri a small factory has begun the manufacture of candied fruits, including citrus and sub-tropical fruits.

Of the many problems in the citrus industry, the market prospects for New Zealand grapefruit in the future are causing most serious concern to growers because of the steadily increasing production of this fruit.

Sub-tropical Fruits

The growing of tree tomatoes, passion-fruit, feijoas, and Chinese gooseberries has proved commercially possible in North Auckland, near Auckland City, and in the Bay of Plenty district. There is no accurate information about the areas planted with these fruits, but the area in tree tomatoes and Chinese gooseberries has extended considerably since 1939. Feijoas are grown on a small scale in Auckland. Nearly all orchards at Kerikeri are planted with a mixture of citrus and sub-tropical fruits.

Production in bushels of sub-tropical fruits in 1949 is estimated at :—

Kind of Fruit.	Kaikohe.	Auckland.	Tauranga.	Total.
Passion-fruit	2,500	1,600	4,000	8,100
Chinese gooseberries	350	400	3,500	4,250
Tree tomatoes	4,000	5,000	2,000	11,000

A factor limiting the production of passion-fruit has been lack of effective control of disease. It has been proved that disease can be controlled only by pruning and regular spraying at two-weekly intervals during the growing season. The two fungous diseases that seriously restrict production are passion-fruit grease-spot and passion-fruit leaf-spot.

Berry-fruits (Strawberries, Raspberries, Loganberries, Currants, Boysenberries, and Cape Gooseberries)

Berry-fruit production showed little change during the past year. Areas planted have increased in Hawke's Bay (raspberries 21 acres, blackcurrants 3 acres), Wairarapa (gooseberries 20 acres, blackcurrants 25 acres), and Nelson (raspberries 8 acres, blackcurrants 10 acres, gooseberries 5 acres, the last two being in the Motueka area). Strawberry areas show decreases in Auckland of 40 acres, in Hamilton of 7 acres, and in Dunedin of 3 acres.

The following table shows the acreages in production in the main berry-fruit areas in New Zealand as at 31st March, 1950 :—

District.	Strawberries.	Raspberries.	Gooseberries.	Black Currants.	Boysenberries.	Loganberries.	Cape Gooseberries.
Auckland	140	..	..	..	6	6	15
Hamilton	14	..	..	..	..	..	..
Hawke's Bay	15	116½	15¼	16	20	..	..
Wairarapa	..	70¾	72¾	82¾	..	4½	..
Manawatu and Wanganui	6	20	6	..	..	..	..
Nelson	13	199	24	55	7½	..	36
Canterbury	76	361	3	20	..	7¾	..
Otago	26	86	6	8	..	..	..

The Dominion totals of areas in berry-fruits at 31st March, 1950, are :—

	Acres.		Acres.
Strawberry	305¼	Boysenberry	31½
Raspberry	867½	Loganberry	20¾
Gooseberry	145¾	Cape gooseberry	51
Blackcurrant	190½		

About 8 acres of red currants are also grown.

Crops.—In spite of severe losses through frost in some South Island districts, the estimated total production of berry-fruits shows little variation from the previous season. Strawberries alone show a substantial reduction of 81 tons caused by the reduced area grown in Auckland and frost damage in Christchurch. In all other cases losses have been offset by increased production in other districts.

The following table shows the estimated production of berry-fruits in tons :—

District.	Strawberries	Raspberries.	Black Currants.	Red and White Currants.	Gooseberries	Loganberries	Boysenberries.	Cape Gooseberries
Auckland	362	½	..	..	7	12	12	25
Tauranga	5	1	1½	..	6	1	1½	..
Gisborne	1	4	..	..	2½	1	..	..
Hawke's Bay	20	200	15	½	30	3	30	..
Wairarapa	2	100	100	2	210	13	2½	..
Manawatu and Wanganui	13	34	3	..	17	..	½	..
Nelson	11½	222	32	2	15	..	8	60
Marlborough	..	4	..	..	..	..	..	..
Canterbury	66	310	25	1½	10	12	..	..
Otago	19	58	18	..	16	2	2	..
Dominion totals	499½	934	194½	6	314½	44	56	85

In addition about 1 ton of young berries is grown at Roxburgh.

Weather.—After a particularly mild winter in most districts spring weather was very variable.

Auckland experienced a drought which hastened the ripening of strawberries, giving an early season with little reduction of crop in spite of decreased plantings. In Christchurch a severe drought throughout the berry-fruit season reduced crops still further after severe losses had been caused by frosts in October.

Otago and Central Otago experienced severe frosts in October and early November which destroyed some crops and reduced others, and hail caused some damage to strawberry crops in North Otago.

Waimate, Nelson, Wairarapa, and Hawke's Bay experienced a good season.

Berry-fruit Diseases.—Red spider mites (*Tetranychus* spp.): The warm, dry conditions in most districts during the season favoured the building up of insect populations generally, and red spider mite was particularly prevalent on all berry-fruits.

Eriophyid mites (*Eriophyes essigi* and others) again caused severe damage to boysenberries at Mapua and have now been recorded from most districts as attacking boysenberries, currants, and gooseberries.

Aphis populations have been greater than usual and special attention has had to be paid to their control on currants and strawberries. During the year a new species of aphis (*Amphoraphora* sp.) was found on black-currant plants imported by a Wairarapa grower from England.

Verticillium wilt (*Verticillium dahliae*) of strawberries was recorded for the first time during the past year. It is widespread from Invercargill to North Auckland and has been particularly severe on gooseberries this year. It appears that this fungus may be much more severe on strawberries in some districts than red-core root-rot is in Auckland.

Red-core root-rot (*Phytophthora fragariae*), a sod fungus attacking strawberries first recorded in New Zealand in 1947 at Auckland, has now been found in a number of districts, including Dunedin, Waimate, Christchurch, Wanganui, and the Wairarapa.

Dry seasonal conditions may have been responsible for the reduced incidence of other fungous diseases attacking berry-fruits.

To date strawberries are the only berry-fruits known to be affected by virus deseases in New Zealand. Infection is widespread and severe on many varieties.

A major problem, blind bud of raspberries, the cause of which has not been ascertained, is becoming more widespread. First reported from Nelson, it has now appeared in other districts, including Waimate, Christchurch, Wairarapa, and Manawatu. It is claimed in Nelson that some control is obtained by the application of 30 to 40 lb. of boron per acre, but it seems that efficient application of the recommended spray programme gives equally good results.

Marketing.—The lack of co-operation between processers and growers which was a factor in the break-down of prices in 1949 was not experienced during the past year, but difficulties arose throughout the country in selling the large quantities of raspberries and other berries during the Christmas period when hot weather caused rapid ripening.

Waimate has no outlet for its fruit except through the Dunedin and Christchurch markets, which can be supplied by local production in average seasons. These markets were able to absorb the Waimate fruit this year because of the crop losses in Christchurch and Otago and purchases by two factories, one in each area.

Organizations.—The first Dominion conference of the Berry Fruit Growers Associations was held in Wellington in November, 1949, representatives from only Nelson, Christchurch, Waimate, and Otago attending. This was an attempt to establish closer co-operation between districts and to extend the Nelson Raspberry Marketing Committee's Regulations to cover all New Zealand. To date no progress has been evident.

Some such control seems necessary to attain stability in the marketing of raspberries, to ensure adequate distribution to consumers and factories, and to effect some control over planting in the various districts to avoid local over-production.

Developments.—Greater interest has been shown in the use of irrigation and spraying equipment as means of ensuring better crops.

Interest in small cool stores on growers' properties to hold fruit during holiday periods is increasing and at least two such units have proved satisfactory.

Investigations and Experiments.—A spray trial demonstration at Motupiko, Nelson, to ascertain whether blind bud of raspberries could be controlled in this way was not conclusive in that respect, but was entirely satisfactory as a demonstration that efficient spraying is worth while.

A spray trial to control *Eriophyid* mites on boysenberries shows promising results.

Trials of virus-free strawberry plants imported from the United Kingdom have been carried on for the second year and results are encouraging.

The red-core root-rot trial of strawberries at the Te Kauwhata Horticultural Station to investigate the incidence of the fungus in certain nurseries is continuing and shows distinct promise.

Preliminary transport trials of raspberries have been carried out with refrigerated cases and pre-cooling.

The Plant Diseases Division, Department of Scientific and Industrial Research, is continuing investigations of the fungous diseases, red-core root-rot of strawberries, verticillium wilt of strawberries, gooseberries, and other crops, virus diseases of strawberries, and control of *Eriophyid* mites and red spider mites.

Cool Storage of Fruit

In 1949, 547,000 bushel cases of apples were dispatched to the United Kingdom.

In recent years, fifty small cool stores have been erected on growers' orchards and by merchants and retailers to prevent wastage and over-maturity of fruit, which is more likely to occur with the shorter working-week. These cool stores have proved satisfactory.

During the year cool-storage trials were made with New Zealand grapefruit at four different storage temperatures. Those of 50° to 52° F. and 48° to 50° F. were found to be too high because of the development of blue contact mould (*Pencillium italicum* Wehner). At a storage temperature of 40° to 42° F. severe cold injury resulted. Promising results were obtained by storing fruit at 40° to 42° F. for the first ten days and then at 45° to 47° F. for the remainder of the storage period.

Storage trials with tree tomatoes indicated that this fruit can be cool stored satisfactorily at 40° to 42° F. and at a relative humidity of 93 per cent. for two months if picked partly coloured but not ripe. There was little apparent difference in storage of fruit with stems cut or uncut.

Insulated containers of 19-cubic-feet capacity were tested for rail transport of precooled small fruits and stone-fruits. The results obtained from these trials are very promising. A decided advantage of this form of transport of perishable fruit is the elimination of multiple handling, especially when it is transported from South to North Island markets.

Further transport trials will be undertaken during the coming year in co-operation with the Railways Department.

Vineyards and Wine-production

The estimated area in vineyards in 1949 was 930 acres, producing about 3,000 tons of grapes, which were processed to yield 610,000 gallons of grape wine. In addition 85,000 gallons of wine were made from fruits other than the grape, making the total production for all classes of wine 695,000 gallons. The number of licensed winemakers operating was 196. About 98,000 gallons of cider were also produced in 1949, production being confined mainly to the South Island.

The wine industry has greatly expanded since 1938, in which year the gallonage of wine produced was 233,500 (including an indeterminate amount of fruit wine) and the area in vineyards 461 acres. The 1949 wine-production figure is about treble that of 1938, an increase of 461,500 gallons.

With annual importations of wine amounting to more than 200,000 gallons, of which 80 per cent. comes from Australia, a stage approaching saturation point for the existing Dominion market appears to have been reached. Prices paid for local wines in bulk particularly have fallen appreciably in the past two years. Winemakers report accumulated stocks and difficult trading conditions.

The estimated consumption of wine per head of population is about half a gallon. In Australia the consumption per head is more than three times this figure and in other winemaking countries the figures are much higher. It would appear that there is still a big latent market for wine in the Dominion which could be developed by an over-all improvement in the quality of New Zealand wines, a lowering of cost to the public, and active sales-promotion methods by the industry. It is regrettable that the lighter beverage wines which the country is better adapted to produce do not appeal to the palate of the general public.

During the past year many vignerons have taken advantage of the technical guidance provided by the Department through the Viticulturist and many improvements in operating efficiency and wine quality have been noted. Numerous wine samples were submitted to the Viticulturist for analysis, microscopic examination, and report.

To meet the competitive trading position a number of smaller winemakers have formed a co-operative selling organization in Auckland. Wines will be selected for quality, blended to maintain a uniform standard, and sold under the co-operative's label. Selling and advertising costs and profits will be shared. Such or similar organizations to stabilize the industry seem to be a move in the right direction. In South Africa the wine industry is mostly organized on a co-operative basis.

Diseases and Pests.—In the vineyards the most troublesome fungous diseases have been downy mildew, powdery mildew, and black spot. Frequent spraying has been necessary to keep these diseases under control.

The depredations of birds on the grapes is still one of the biggest problems. Shooting, the only satisfactory counter-measure at present, is a costly item in vineyard management.

The use of D.D.T. has become general in the control of mealy bugs in glasshouse vineries and thrips in vineyards.

A number of inspections have been made of vineyards damaged by 2, 4-D hormone weed-killing spray. Grape-vines are very susceptible to damage by this chemical.

European wasps (*Vespa germanica*) have been observed in a number of vineyards around the Auckland and Te Kauwhata districts, but not in sufficient numbers to do any appreciable damage. Growers are concerned about these wasps as a potential menace to their grape crops.

During 1949 some spraying trials were carried out on the Station and five new hybrid grape-vine varieties were imported from the Agricultural Experiment Station of the University of California at Davis. Of these varieties only three survived—Emerald Riesling, a white beverage-wine variety; Ruby Calimet, a red beverage-wine variety; and Delight, a white seedless table variety.

Several lots of experimental wine were laid down to determine the winemaking qualities of certain grape varieties.

As at 31st March, 1950, the area of the station was 121 acres, subdivided as follows:—

	Acres.
Established vines	32
Young vines	14
Nursery	1
Fallow land	32
Headlands, buildings, residences, roadways, &c.	42

Storage capacity on the property is now 30,000 gallons. The quantity of wine laid down in 1949 was 24,500 gallons. Half of this was made from grapes grown on the Station and the balance of requirements was bought from Te Kauwhata growers.

Experimental work proceeding at the Te Kauwhata Horticultural Station is as follows:—

(1) Testing fungicidal efficiency of a compound spray consisting of a mixture of copper oxychloride and lime sulphur at varying strengths.
(2) (*a*) Trials to improve spraying technique by using a fixed boom device.
(*b*) Trial of a spraying machine operating on an air-blast principle to determine its suitability for vineyard work.
(3) Experiments on stock and scion affinity.
(4) Making of experimental wines to determine the winemaking qualities of various vine varieties. There are 160 different vine varieties in the collection at Te Kauwhata.
(5) Making wines of the hock, claret, and sauterne types. It is considered that New Zealand is better adapted because of climate and other factors to make these wines than sweet fortified types.
(6) Assessing the qualities under New Zealand conditions of five new hybrid varieties imported from California.
(7) Conducting experiments on controlled-temperature fermentations and heat treatment of wine to accelerate maturation.

A successful field-day held at Te Kauwhata in March was attended by some 70 vignerons. Operating methods in the vineyard and cellar were demonstrated.

During the year about 5,000 cuttings of stock and scion varieties were sold from the nursery.

Tobacco

Tobacco-growing in Nelson has become the largest horticultural industry in the province, in both acreage and total revenue. Though there is an upward trend in acreage, the area grown may fluctuate a little from year to year. The total acreage from which tobacco was harvested in 1949 was 4,393 and the total yield 5,000,470 lb. The area contracted for in the 1949–50 season showed a reduction of about 400 acres. The yield in the 1949 harvest was a record notwithstanding serious loss through frost and hail. Though the 1949–50 season was favourable for most crops, tobacco did not benefit to the same extent, possibly because of the shallow rooting following ample rainfall in November and December, with a subsequent lagging in growth under drier conditions later.

Further mechanization of the industry has taken place, particularly for planting.

No new diseases have occurred, but a serious increase in tobacco miner or potato tuber moth (*Gnorimoschema operculella*, zell) caused damage which was confined to one locality. Adequate steps were taken to check the pest and destroy a source of infestation. Growers are alive to the danger and will now be prepared to take precautionary measures for control, and a similar recurrence is unlikely.

Hops

During the year a detailed survey of the hopgrowing industry in Nelson was undertaken, mainly to arrive at production costs as a basis for payment. The survey was widened to cover cultural practices as well as economic considerations. Exact acreages have been determined and figures are now available giving net and gross acreages including headlands. This will provide a valuable basis for the hop-research programme and an improved extension service.

The gross area in hops at the 1949 harvest was 750 acres, the same as in the 1948 season. Since then some 30 acres of hops have been removed and the land used for other purposes, mainly tobacco-growing. Production for the 1948–49 season was 767,466 lb., compared with 986,835 lb. in the previous year. Growing-conditions were less favourable, low rainfall and drying winds prevailing for several weeks before the harvest.

Particularly good growing-conditions and higher rainfall during the main growth period are likely to result in a much higher yield for 1950.

Vegetables

The area of commercial gardens registered under the Commercial Gardens Registration Act, 1943, increased slightly during the past year. Statistics of production areas are :—

District.	Number of Growers as at 30th September, 1949.	Area Under Glass.	Area not Under Glass.	Total Area.
		Acres.	Acres.	Acres.
Kaikohe	51	2	135	137
Auckland	597	24	5,168	5,192
Pukekohe	163	2	1,604	1,606
Hamilton	61	1	651	652
Tauranga	70	1	225	226
Gisborne	78	..	318	318
Hastings	392	6	2,426	2,432
Wanganui	169	1	1,193	1,194
Palmerston North	301	3	1,546	1,549
New Plymouth	28	..	263	263
Masterton	42	..	455	455
Wellington	73	5	186	191
Nelson	268	22	804	826
Blenheim	40	2	93	95
Christchurch	541	29	1,574	1,603
Timaru	176	4	970	974
Dunedin	70	1	525	526
Central Otago	70	1	113	114
Invercargill	17	..	45	45
	3,207	104*	18,284	18,388

* For the purposes of the Commercial Gardens Registration Act the area under glass is multiplied by nine.

During 1949 the production and sale of vegetables returned practically to pre-war conditions, most produce being sold at auction without ceiling-prices. The demand exceeded the supply of both fresh and canned vegetables. Production of canned vegetables, particularly peas, tomatoes, asparagus, and sweet corn, has increased. There is room for considerable expansion in vegetable-production in certain localities – for instance, less than half the vegetables consumed in Northland are produced locally and further development in the district is desirable. There is scope for greater use of glasshouses in Southland.

Mechanization of market-gardening is increasing and many new makes of garden tractors, cultivators, power dusters, &c., have appeared on the market.

Since the revocation of the Fertilizer Control Regulations 1948 on 1st July, 1949, vegetable-growers in the North Island have reported difficulty in securing adequate supplies of blood and bone manures. Stock foods are absorbing more and more of the products manufactured from abattoir offal.

The Division is represented on the inter-departmental committee studying organic waste materials. Government-subsidized experimental work on the utilization of city organic waste for the manufacture of compost is proceeding.

Vegetable Diseases—Molybdenum deficiency: In collaboration with officers of the Extension Division's Rukuhia Soil Research Station investigational trials have been established in the Dunedin and Auckland districts. Whiptail symptoms characteristic of molybdenum deficiency in cauliflowers were eliminated by the application of small quantities of soluble molybdenum salts to the soil. Extensive whiptail in cruciferous crops on the black calcareous soils at Totara, near Oamaru, has indicated that the condition is attributable to a deficiency of molybdenum salts in the soil rather than to a lack of availability induced by acid conditions.

Boron, magnesium, and *calcium* deficiency symptoms were noted in fairly widely distributed areas.

Spotted wilt, though less prevalent than in the previous year because conditions were somewhat less humid, took heavy toll of tomato crops, particularly in the Auckland and Christchurch districts. Because of the wide host range of the disease, control is difficult. A number of promising overseas varieties thought resistant have broken down under test.

Verticillium wilt was prevalent in tomato-houses, but soil sterilization as a routine measure is becoming the practice and good control is being effected with both steam and chemical methods.

Phytophthora infestans again proved troublesome with tomatoes and potatoes in many districts.

Cladosporium mould caused extensive damage to glasshouse tomato crops.

Reports of damage by the green vegetable bug (*Nezara viridula* L.) continued to come in from North Auckland, Auckland, Gisborne, Whangarei, and New Plymouth. Some measure of control has been obtained with D.D.T. dusts and sprays.

Carrot rust fly caused losses at Pukekohe.

Thrips: Onion thrips have become a problem in recent years and experiments with control measures are being conducted.

Aphides: Weather conditions have favoured the development of these insects and fairly high populations with corresponding damage were reported in all vegetable-growing areas.

Eelworms have caused serious damage to some carrot crops in the Pukekohe District.

Insecticides.—A number of new insecticides have been experimented with. D.D.T. and "Gammexane" have almost entirely replaced arsenate of lead for the control of chewing insects.

Hormones.—Trials with fruit-setting hormones in tomato-houses are being studied with interest.

Careless use of 2, 4–D sprays in adjoining areas has caused losses in vegetable crops.

Varietal Trials.—In association with the Agronomy Division of the Department of Scientific and Industrial Research blight resistance and vitamin C content trials have been started with local and imported potato stocks.

Fifty-six varieties of tomatoes, including a number imported from overseas, were planted in row trials at Levin and Pukekohe. Promising strains will be tested further in the coming year.

Several varieties of sweet corn were also tested and promising results obtained.

Results of trials with lentils at Blenheim, Auckland, and Gisborne proved disappointing.

Trials with twelve varieties of egg plants were conducted at Auckland.

Trials with a proprietary line of pelleted vegetable seeds of four species have indicated few advantages over ordinary sowing techniques. Though adequate supplies of vegetable-seeds were available throughout the year, quality left much to be desired.

Cold Storage.—Increased cool-storage facilities are available to growers at Auckland and Wellington.

Horticultural Research Station, Levin

Further development work was carried out at the Horticultural Research Station, Levin, during 1949. Some 22 acres are under cultivation. A further 12 acres was broken out of pasture during the autumn of 1949, and part of this area will be planted with the first of the long-term trials for the investigation of problems affecting the raspberry industry, the remainder being used for vegetable and flower trials and propagation work. Main and subsidiary shelter-belts were planted, worthless trees removed from the boundary lines, office and storage accommodation provided, and roading extended and improved.

The manager's residence is nearing completion and the building of two glasshouses and cold frames for propagation and isolation work is expected to begin shortly. The delivery of tractor, cultivation, and spraying equipment is expected at an early date.

Raspberries.—Further progress was made in the segregation of raspberry varieties and nine more varieties were acquired during the year, including one from Tasmania.

The cane nursery to provide material for planting trial areas produced sufficient canes of Lloyd George to allow some distribution to growers and nurserymen.

Currants.—The collection of New Zealand varieties of currants selected during 1948–49 season and one variety from Tasmania have been planted in order to segregate the varieties before they are planted in trials in competition with the eight English varieties already under trial

The collection now comprises :—

Black currants.—Eight varieties from English sources, sixty-four lines from New Zealand sources, and two from U.S.S.R.

Red currants : Twelve lines from New Zealand sources.

White currants : Two lines from New Zealand and one variety from Tasmania.

Strawberries.—Further acquisitions of strawberry varieties during the year from overseas sources include one from United States of America, two from Queensland, one from New South Wales, one from Tasmania, two from United Kingdom, and another consignment of virus-free plants of varieties previously imported from England.

In May, 1949, a further 30,000 plants of five varieties of strawberries were distributed to growers for trial, and at least two of these show distinct promise.

An outbreak of verticillium wilt in the runner beds this year is causing concern, but it is expected that up to 50,000 plants will be available for distribution in May, 1950.

Gooseberries.—During the year the New Zealand collection of forty-eight lines of gooseberries was planted, together with two varieties from Tasmania. Varieties will require segregation before any trial areas can be planted.

Brambles.—A collection including boysenberries, loganberries, youngberries, wineberries, nectarberries, and wonderberries from New Zealand sources and Phenomenal and Mammoth berries from Tasmania have been planted and will be propagated before trials are laid down.

Other acquisitions include Chinese gooseberries and so-called Himalayan blackberries.

Tomatoes.—Plants of fifty-six varieties of tomatoes from New Zealand and Australian sources were cropped as a preliminary to placing a few of the most promising varieties under trial next year.

Flowers.—Eleven varieties of asters from Australian sources were tested for resistance to wilt. Only two varieties show any degree of resistance.

Four varieties of zinnias from Australian sources were tested for behaviour under local conditions.

Hops.—After selections of hops had been transferred to the Hop Research Division, Department of Scientific and Industrial Research, the remainder of the cuttings imported from Tasmania in the previous year were destroyed. The older plants will be removed as soon as the crop has been harvested.

Plant Quarantine

The administration of plant quarantine, including the fumigation of nursery stock, bulbs, seeds, ornamentals, grain, nuts, &c., imported into New Zealand is the responsibility of the Horticulture Division and a complete revision of quarantine procedure and port fumigation facilities was begun during the past year. Information on the existing legal position and practices in operation in New Zealand and those of a number of other countries trading with New Zealand was assembled. An inter-departmental conference on plant quarantine was held in February, 1950, to co-ordinate the quarantine services of the Dominion. In the meantime the administration of the 1918 regulations, dealing with importation of fruit and plants into New Zealand, was continued, but the need for new regulations has become very apparent.

Particular attention has also been directed to the possible introduction of serious pests by overseas aircraft landing in New Zealand and in particular to the Oriental fruit-fly, *Dacus dorsalis* Hendl. Joint representations with the Government of the Commonwealth of Australia were made to the Government of the United States of America asking for the same pre-flight inspection and disinfecting of aircraft travelling south from Hawaii as is given to aircraft travelling east to the mainland of the United States. Proposals for the disinsecting of aircraft on arrival in New Zealand and the equipment required for this purpose have been studied and a charging station designed for servicing and recharging aerosol bombs used for the disinsecting of aircraft.

The establishment of internal plant quarantine to prevent the spread of pests and diseases within New Zealand has also been given serious attention.

During the year two serious insect pests new to New Zealand were intercepted on nursery stock.

Atmospheric fumigation chambers at Auckland, Christchurch, Dunedin, and Invercargill were repaired and those at Auckland and Christchurch were converted for the use of methyl bromide as the fumigant. It is proposed to convert the remaining chambers at an early date. The facilities at Wellington were condemned as unsafe, and efforts are being made to secure a site for the erection of an atmospheric vault and the installation of steel vacuum fumigation vaults.

Six 10-cubic-feet vacuum fumigation cylinders and their equipment for use on airports and for parcels post were designed and the first unit has been completed. Designs for large vacuum fumigation cylinders to be installed at the ports of Auckland and Wellington have also been completed. It is hoped to install these at an early date.

Royal New Zealand Institute of Horticulture

The Government has recognized the useful part the Royal New Zealand Institute of Horticulture plays in horticultural education, acting as a co-ordinating organization for all branches of horticulture and as the sole examining authority for horticultural students who are unable to attend either Massey or Canterbury Agricultural College. The institute now receives an annual grant of 30s. for each student registered with it taking the national diploma course and £2 for each student who sits for the annual diploma examinations.

Loder Cup

The late Mr. Gerald W. Loder presented the Loder Cup to lovers of nature in New Zealand as a challenge cup to be competed for annually in accordance with rules approved by the Hon. Minister of Agriculture. In 1949 the cup was awarded to Miss Noeline Baker of Stewart Island.

Plant Nurseries

Owners of nurseries who were raising for sale ornamental shrubs, rose-trees, forest trees, fruit trees and plants, and tomato plants were required in 1949 to have their nurseries registered before being permitted to sell plants. During 1949–50 858 nurseries were registered, including 355 tomato nurseries, compared with 881 nurseries in the previous season.

Beekeeping

Beekeeping as a full-time occupation and for domestic purposes has attracted a large number of persons in recent years. Following unprecedented demands for honey for domestic and manufacturing purposes during the sugar-rationing period, post-war adjustment is proceeding slowly. The general trend is a gradual expansion and consolidation of economic commercial units and a rapid falling off in the number of more recently established domestic beekeepers who are no longer interested in attempts to produce large quantities of honey formerly required for all food-sweetening purposes.

The latest available statistics are the same as those presented last year.

——	Beekeepers.	Apiaries.	Hives.
North Island	4,645	7,557	114,924
South Island	1,842	3,812	59,462
Dominion totals	6,487	11,369	174,386

The value of the beekeeping industry in New Zealand in bee stocks and plant based on present holdings is estimated at £1,217,400.

Production.—Though seasonal conditions for honey production were erratic in most parts of New Zealand during the 1949–50 season, fair to average crops of honey were harvested in all districts with the exception of Mid-Canterbury and North Canterbury, where pastures dried up early because of unusually dry conditions in spring and summer, resulting in light to very poor crops in those areas.

A fair estimate of normal production of honey during a favourable season in New Zealand is 75 lb. average surplus per hive, amounting to 5,524 tons, based on the present registered apiary holdings. The estimated production in commercial and domestic apiaries for the year ended 31st March, 1950, is 4,517 tons of honey and 135,500 lb. of commercial beeswax. Not only was production greater than in the previous season, but the quality of the honey produced in most pasture-land areas was higher.

Marketing Conditions.—Though the demand for honey continues fairly keen and beekeepers are able to sell large quantities locally at payable prices, in general sales in the main marketing centres are becoming slower as other competitive sweet foodstuffs reach the market in increasing quantities.

These conditions call for greater care in production, as honey now has to be stored for longer periods. Apiary Instructors are alive to the situation and are advising producers how to improve the standard of their packs to safeguard against deterioration during the time between production and consumption under the more normal marketing conditions now developing.

Inspection.—The usual practice of employing a number of competent beekeepers as local part-time Apiary Inspectors during the honey season to provide simultaneous inspection of apiaries over large areas at the most appropriate time for control of bee diseases has kept brood troubles to a minimum.

Ex-servicemen Established in Beekeeping.—A training course for ex-servicemen of the last war who are now engaged in beekeeping was conducted by the Department in May, 1949, at Hamilton. This enabled returned servicemen to acquire a knowledge of modern methods of apiary management. Sixty ex-servicemen from all parts of New Zealand attended and showed a keen interest in the subjects discussed.

A total of forty-eight ex-servicemen had been settled in beekeeping under rehabilitation by the end of February, 1950.

Research Work.—During 1949 beekeeping-research facilities were improved by additions to the apiary laboratory buildings at the Animal Research Station, Wallaceville, and the installation of additional scientific equipment, including standard equipment for instrumental insemination of queen bees for the development of strains of bees best suited to New Zealand conditions. This bee-stock-improvement programme of work is being conducted in close co-operation with commercial producers, who recognize the advantages to be gained by an over-all improvement in the strains of beestocks in New Zealand.

Wasps.—Five seasons have now passed since wasps (*Vespa germanica*) were first noticed in New Zealand in the Waikato district. Though it is considered impracticable to exterminate these pests because of their nesting habits and means of spread over the country, every effort has been made by the Department to study their habits under New Zealand conditions and to keep their number down to a minimum. The Department continued the free distribution of chemical powder for destruction of nests found, and arranged for the destruction of nests where required in certain circumstances. Wasp-control measures were also outlined in short radio announcements advising the public how to deal with the problem.

Comparatively few wasps were seen in the Hamilton district during the past season until the end of March, but a steep increase occurred suddenly early in April. There is also evidence of wasp activity in the Bay of Plenty, Poverty Bay, and Hawke's Bay districts, where the chances of finding and destroying the majority of nests established are very remote.

Tests are being made to determine the extent to which these wasps may become troublesome to orchardists and apiarists and what precautions, if any, may be taken.

Research officers of the Plant Diseases Division, Department of Scientific and Industrial Research, Auckland, are also engaged in testing natural baits and traps which may be used conveniently by the public and by local bodies in future for destruction of flying wasps.

APPENDIX

SUMMARY OF THE 1948–49 SEASON APPLE AND PEAR CROPS: DISTRICT RECEIPTS AND DISTRIBUTION THROUGH THE MARKETING DEPARTMENT AND OTHER CHANNELS (IN BUSHELS)

District.	Marketing Department Receipts.				Private Sales.		Sold to Canning Factories.		Sold for Pulping, Cider, &c.		Total.		Grand Total.
	Export.		Local Markets.										
	Apples.	Pears.	Apples.	Pears.	Apples.	Pears.	Apples.	Pears.	Apples.	Pears.	Apples.	Pears.	
Kaikohe	..	..	1,394	146	1,276	1,044	..	..	..	..	2,670	1,190	3,860
Auckland	10,298	..	164,600	33,447	45,000	7,000	12,000	1,000	13,000	..	244,898	41,447	286,345
Hamilton	..	..	3,654	3	29,146	6,657	..	..	..	..	32,800	6,660	39,460
Tauranga	..	..	..	536	2,800	300	..	..	..	..	2,800	836	3,636
Gisborne	1,609	..	24,636	3,183	9,000	1,000	..	..	..	..	35,245	4,183	39,428
Hastings	161,060	..	456,139½	163,737½	71,403	29,892	26,088	8,296	12,553	..	727,243½	201,925½	929,169
Masterton	..	..	18,386	2,455	4,490	130	900	..	3,383	..	27,159	2,585	29,744
Palmerston North	..	..	..	..	4,660	420	..	..	..	..	4,660	420	5,080
Wanganui	..	..	934	..	7,869	1,473	..	..	..	..	8,803	1,473	10,276
Nelson	104,061	..	122,122	13,347	14,375	2,479	16,989	1,535	4,679	200	262,226	17,561	279,787
Mapua	144,125	..	225,953	23,583	3,801	308	43,444	2,115	5,893	..	423,216	26,006	449,222
Motueka	83,880	..	161,702	30,545	1,000	240	32,788	1,741	1,482	..	280,852	32,526	313,378
Blenheim	42,220	..	28,095	1,724½	4,887	330	3,455	..	128	..	78,785	2,054½	80,839½
Christchurch	..	..	71,489	6,812	72,561	7,083	..	..	2,734	..	146,784	13,895	160,679
Timaru	..	..	5,900	1,703½	5,388	188	..	..	2,000	..	13,288	1,891½	15,179½
Dunedin	..	..	225	..	6,755	240	..	..	300	..	7,280	240	7,520
Roxburgh	..	..	99,561½	4,582½	10,888½	927½	520	..	..	..	110,970	5,510	116,480
Alexandra	..	..	22,809½	5,482	16,805½	7,323	..	..	..	..	39,615	12,805	52,420
Totals	547,253	..	1,407,600½	291,287	312,105	67,034½	136,184	14,687	46,152	200	2,449,294½	373,208½	2,822,503
Percentages	22·34	..	57·47	78·05	12·74	17·96	5·56	5·94	1·89	0·05	..	..	..

TOTALS AND PERCENTAGES OF FRUIT GRADED

——	Fancy.	Per Cent.	Commercial.	Per Cent.	Minimum.	Per Cent.
Apples	1,597,168	81·65	355,544	18·18	3,293	0·17
Pears	241,754	83·0	45,681	15·68	3,850	1·32

NUMBER OF TREES IN ORCHARDS WITH 120 TREES OR MORE AS AT 31ST MARCH, 1950
(To the nearest 500)

District.	Apple.	Pear.	Quince.	Peach.	Nectarine.	Apricot.	Plum.	Cherry.
Kaikohe	3,500	1,500	..	2,500	..	..	1,000	..
Auckland	134,000	12,000	7,000	72,000	2,500	..	46,000	..
Hamilton	17,000	3,000	500	12,500	..	1,000	2,500	..
Tauranga	4,000	1,000	500	1,500	..	..	1,000	..
Gisborne	12,000	1,500	500	5,000	1,000	..	2,000	..
Hastings	172,000	44,500	6,000	92,000	6,000	6,000	32,000	2,000
Taranaki	500	..	..	..	..	..	..	..
Wanganui	6,000	500	..	500	500	..	..	..
Palmerston North ..	3,000	..	..	..	..	..	1,000	1,000
Masterton	17,500	1,000	..	..	..	..	..	..
Nelson	103,500	10,000	1,500	15,000	1,000	..	3,000	..
Mapua	192,500	12,500	500	..	..	..	1,000	..
Motueka	138,500	15,000	1,500	21,500	500	..	6,500	500
Blenheim	46,500	1,000	..	5,500	500	500	500	1,000
Christchurch ..	88,000	8,000	..	5,000	1,000	7,000	8,500	3,000
Timaru	17,000	2,000	..	3,500	500	4,500	1,500	2,500
Dunedin	7,000	500	..	..	..	..	1,000	..
Roxburgh	73,000	6,000	..	25,000	6,500	44,000	18,000	5,000
Alexandra	34,500	9,000	1,000	43,000	10,500	43,000	16,500	10,500
Total ..	1,070,000	129,000	19,000	304,500	30,500	106,000	142,000	25,500

District.	Lemons.		Oranges.			Grapefruit.		Mandarin.
	Meyer.	Others.	Sweet.	Seville.	Poorman.	New Zealand.	Others.	
Kerikeri	4,000	5,500	18,500	..	..	6,000	2,000	500
Auckland	2,000	17,000	5,000	..	5,000	24,000	4,000	..
Tauranga	2,500	14,000	2,000	..	..	8,000	3,000	..
Gisborne	500	2,500	2,500	..	..	500	..	..
Hastings	..	1,000	..	..	..	..	..	..
Total	9,000	40,000	28,000	..	5,000	38,500	9,000	500

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