

1942.  
NEW ZEALAND.

DEPARTMENT OF SCIENTIFIC AND  
INDUSTRIAL RESEARCH

(SIXTEENTH ANNUAL REPORT OF THE).

*Presented to both Houses of the General Assembly by Leave.*

CONTENTS.

|                                                  | PAGE |                                                       | PAGE |
|--------------------------------------------------|------|-------------------------------------------------------|------|
| Minister's Statement .. .. .                     | 2    | Reports of Research Committees of the Council of      |      |
| Secretary's Report .. .. .                       | 3    | Scientific and Industrial Research— <i>continued.</i> |      |
| Reports of Research Committees of the Council of |      | Timber Protection Research .. .. .                    | 20   |
| Scientific and Industrial Research—              |      | Leather and Shoe Research .. .. .                     | 22   |
| Dairy Research Institute .. .. .                 | 4    | N.Z. Wool Manufacturers' Research Association ..      | 22   |
| Food Preservation and Transport Advisory Com-    |      | Research Work at Agricultural Colleges—               |      |
| mittee .. .. .                                   | 4    | Canterbury Agricultural College .. .. .               | 23   |
| Plant Research Bureau .. .. .                    | 5    | Massey Agricultural College .. .. .                   | 25   |
| Sugar Beet Research Section .. .. .              | 11   | Physical Testing Laboratory .. .. .                   | 26   |
| Plant Chemistry Laboratory .. .. .               | 11   | Dominion Laboratory .. .. .                           | 27   |
| Soil Survey .. .. .                              | 11   | Geological Survey .. .. .                             | 28   |
| Mineral Content of Pastures .. .. .              | 13   | Dominion Observatory .. .. .                          | 30   |
| Mineral Resources Committee .. .. .              | 15   | Magnetic Observatory .. .. .                          | 32   |
| Wheat Research Institute .. .. .                 | 15   | Meteorological Branch .. .. .                         | 33   |
| Fruit Research .. .. .                           | 16   | Liaison Office, London .. .. .                        | 33   |
| Fruit Cold Storage Research .. .. .              | 18   | Research Scholarships .. .. .                         | 33   |
| Tobacco Research .. .. .                         | 19   | Imperial Agricultural Bureaux .. .. .                 | 34   |
|                                                  |      | Publications .. .. .                                  | 34   |

### MINISTER'S STATEMENT.

THE report of the Department for the past year indicates throughout the very close association existing between its activities and the Dominion's war effort. For the purpose of developing this association so that it would function as completely as possible, a special and very representative committee, the Defence Scientific Advisory Committee, was established, and has been responsible for the rapid exploration and implementation of various projects which have been of real assistance in connection with defence.

During the year it has been possible to make the maximum use of the Dominion's scientific resources, both of personnel and of equipment in connection with a very wide range of problems associated with the needs both of the fighting forces and the civilian population. In addition, it has also been found possible to provide help by way of scientific personnel loaned to Great Britain, Australia, and other parts of the Empire.

The year has revealed the importance of scientific assistance to industry in a number of directions. The successful drying of low-grade butter and the preparation of dried butterfat of acceptable quality has enabled the shipment in unrefrigerated vessels of quantities of a valuable food material which previously could not be exported. Investigations in drying of meat have resulted in the preparation of a foodstuff which is acceptable to Great Britain, while dried vegetables produced experimentally have possessed quality eminently suitable for Service requirements. The value of New Zealand species of seaweeds has been demonstrated for the production of agar of good quality, supplies of which from original sources were cut off as the result of the war. Valuable new information concerning the culture and curing of tobacco has been acquired and will promote the sound development of this industry. The introduction of new non-shrinkage treatment for woollen materials marks another noteworthy advance. Methods for the production locally in bakeries throughout New Zealand of supplies of yeast have eliminated potential dangers which would arise in the baking industry through interruption of communications. Coal surveys and investigations have helped greatly towards maintaining a high output and securing optimum utilization of New Zealand's coal resources during a time of national emergency.

Soil survey and grassland research are proving of direct advantage to the defence forces through information relating to mapping, topography, aerodrome-maintenance, and water-supplies, while a magnetic resurvey of the whole of the Dominion is providing data of immediate value in connection with the war.

There has been maintained through the scientific services of the Department a very close contact with both military and industrial developments throughout the Empire. Many of these contacts had been established for some years, but during the past year, which has been beset with so many difficulties, their real worth has been demonstrated, and there has been built up a system of helpful co-operation. The free exchange of knowledge and the painstaking research by our scientists is the very basis of the Empire's war effort and will be of great significance in our future industrial and social development.

I would take this opportunity of expressing my appreciation of the good work the Department has achieved and the excellent response of the staff in all branches in carrying out the heavy and responsible tasks they have had to undertake during the past year.

D. G. SULLIVAN,  
Minister in Charge of Scientific  
and Industrial Research Department.

## SECRETARY'S REPORT.

The Hon. D. G. SULLIVAN, Minister in Charge of the Scientific and Industrial Research Department.

I have the honour to submit herewith the annual report of the Department for the year 1941-42.

The Council of Scientific and Industrial Research held six meetings during the year.

The personnel of the Council is as follows :—

Professor H. G. Denham, M.A., D.Sc., Ph.D., F.I.C., F.R.S.N.Z., Professor of Chemistry, Canterbury University College, Christchurch (Chairman).  
 Dr. J. C. Andrews, Ph.D., M.Sc., Freezing-works Manager, Auckland.  
 Mr. A. H. Cockayne, I.S.O., Director-General of Agriculture, Wellington.  
 Professor E. R. Hudson, B.Sc., B.Agr., Dip. C.A.C., Director, Canterbury Agricultural College, Lincoln.  
 Dr. R. O. Page, D.Sc., Tannery-works Manager, Christchurch.  
 Mr. G. A. Pascoe, Factory Controller, Department of Industries and Commerce.  
 Mr. J. M. Ranstead, Dip. C.A.C., Bledisloe Medallist, Matangi, Farmer.  
 Professor W. Riddet, B.Sc. (Agric.), N.D.A., N.D.D., Massey Agricultural College.  
 Sir Theodore Rigg, M.A., M.Sc., F.I.C., F.R.S.N.Z., Director, Cawthron Institute, Nelson.  
 Dr. E. Marsden, M.C., C.B.E., D.Sc., F.R.S.N.Z. (Secretary).  
 Mr. F. R. Callaghan, M.A., F.R.E.S. (Deputy Secretary).

Mr. T. H. McCombs, M.P., M.Sc., is the special representative of the Hon. the Minister on the Council.

The expenditure of the Department during the year was as follows :—

### Permanent services—

|                                                                                                                                                                                                                                                                                                              |  |  |  |                |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|----------------|
| Head Office : Comprising general expenses of administration, publications (including the <i>New Zealand Journal of Science and Technology</i> and departmental bulletins), research scholarships, and grants to the Royal Society of New Zealand, the Imperial Institute, and the Carter Observatory .. .. . |  |  |  | £              |
|                                                                                                                                                                                                                                                                                                              |  |  |  | 14,977         |
| Dominion Laboratory (with branches) .. .. .                                                                                                                                                                                                                                                                  |  |  |  | 22,421         |
| Dominion Observatory .. .. .                                                                                                                                                                                                                                                                                 |  |  |  | 1,615          |
| Geological Survey .. .. .                                                                                                                                                                                                                                                                                    |  |  |  | 10,805         |
| Magnetic Observatory .. .. .                                                                                                                                                                                                                                                                                 |  |  |  | 3,171          |
| Grants to Imperial Agricultural Bureaux .. .. .                                                                                                                                                                                                                                                              |  |  |  | *              |
| Physical Testing and Standards Laboratory .. .. .                                                                                                                                                                                                                                                            |  |  |  | 10,950         |
| Research investigations .. .. .                                                                                                                                                                                                                                                                              |  |  |  | 139,227        |
|                                                                                                                                                                                                                                                                                                              |  |  |  | <hr/> 203,166  |
| Recoveries .. .. .                                                                                                                                                                                                                                                                                           |  |  |  | 40,509         |
|                                                                                                                                                                                                                                                                                                              |  |  |  | <hr/> £162,657 |

### Grants were made to the following research organizations in Great Britain :—

|                                                        |               |
|--------------------------------------------------------|---------------|
|                                                        | £             |
| Imperial Agricultural Bureaux Headquarters .. .. .     | 1,438         |
| Cambridge Low Temperature Research Station .. .. .     | 500           |
| Farnham House Laboratory .. .. .                       | 375           |
| Wool Industries Research Association, Torridon .. .. . | 50            |
| Imperial Mycological Institute .. .. .                 | 350           |
| Imperial Institute of Entomology .. .. .               | 450           |
| Imperial Bureau of Dairy Science .. .. .               | 113           |
| Imperial Forestry Bureau .. .. .                       | 187           |
|                                                        | <hr/> £3,463* |

\* Contributions to research organizations in Britain as shown were paid by the High Commissioner for New Zealand, but the relative vouchers arrived in New Zealand too late to be included in the accounts for the financial year ended 31st March, 1942. The total payment of £3,463 will be brought to charge in the financial year 1942-43.

During the year the activities of the Department as a whole have been further concentrated on problems of a defence nature and problems arising from war conditions. Certain research and development problems are being investigated by a special branch of the Department in collaboration with University colleges and other Departments.

The membership of the special Defence Scientific Advisory Committee is as follows :—

Dr. E. Marsden, Director of Scientific Developments (Chairman).  
 Representative of the Chief of the General Staff.  
 Representative of the Chief of the Naval Staff.  
 Representative of the Chief of the Air Staff.  
 Mr. R. L. Andrew, Dominion Analyst.  
 Dr. J. C. Andrews, Freezing-works Manager, Auckland.  
 Professor P. W. Burbidge, Professor of Physics, Auckland University College.  
 Squadron Leader G. Carter, Munitions Controller.  
 Professor H. G. Denham, Professor of Chemistry, Canterbury University College.  
 Professor T. D. J. Leech, Professor of Engineering, Auckland University College (Deputy Director, Engineering).  
 Professor F. G. Soper, Professor of Chemistry, University of Otago (Deputy Director, Chemical).  
 Mr. N. A. Marris, Department of Scientific and Industrial Research (Secretary).

Professor Soper is also Chemical Adviser on Munitions, and Chairman of the Chemical Panel of the Defence Scientific Advisory Committee.

Many urgent problems in connection with the supply, overseas transport, and storage of foodstuffs, and the provision of substitutes for imported industrial materials now unavailable or in short supply, are receiving attention.

#### STAFF.

I desire to record the praiseworthy way in which members of the staff have carried out increased duties and responsibilities arising from the war effort.

E. MARSDEN, Secretary.

## REPORTS OF RESEARCH COMMITTEES OF THE COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH.

### DAIRY RESEARCH INSTITUTE.

*Dairy Research Management Committee.*—Mr. A. Morton (Chairman), Professor H. G. Denham, Messrs. T. C. Brash, A. H. Cockayne, G. A. Duncan, H. E. Johnston, A. Linton, C. A. Marchant, A. J. Murdoch, J. Murray, G. M. Valentine; Director, Professor W. Riddet; Secretary, F. R. Callaghan.

The Committee held five meetings during the year at which the work of the Institute, which was mostly on a war basis, was under periodical review.

*Cheese.*—The problem of phage control has necessitated a large amount of close fundamental study during the year, and marked progress has been made towards starter-room design which will maintain aseptic conditions within the room. Improved design of filters have played a large part in overcoming starter problems, though a different and often very elusive problem seems to appear at every factory.

Trials relating to bitterness in cheese flavour gave results which indicated that such was not attributable to the salt used.

In addition to the control secured over mould in cheese-stores through control of ventilation and humidity, trials of ultra-violet lamps indicated that a further measure of control could be secured, as mould failed to appear in surfaces exposed to radiation.

Investigations on the control of cheese-mites in unrefrigerated stores by the use of ammonia gas are proceeding.

*Butter.*—A concentrated effort was made during the greater part of the year on the investigatory work necessary for the production of dried butterfat on a commercial scale. Dr. F. H. McDowall's original investigations indicated satisfactory methods for converting whey butter and non-export grades of factory butter to dried butterfat, and details of what was achieved are given in the subsequent section, "Food Preservation and Transport."

*Dried Milk.*—Investigations have centred on methods of packaging dried, skim, and whole milk to permit of both long transport and long storage.

*Dairy Husbandry.*—Records are being kept of the influence of pastures and supplementary fodder on the solids-not-fat content of milk, which has an important bearing on cheese quality in the autumn months.

### FOOD PRESERVATION AND TRANSPORT ADVISORY COMMITTEE.

*Personnel.*—Professor H. G. Denham (Chairman), Dr. J. C. Andrews, Mr. A. H. Cockayne, Mr. G. A. Duncan, Mr. F. W. Grainger, Dr. E. Marsden, Mr. G. M. Pottinger, Professor W. Riddet, and Mr. F. J. A. Brogan (Secretary).

A Committee constituted as above was set up during the year by direction of the Hon. the Minister of Scientific and Industrial Research and the Hon. the Minister of Agriculture and Marketing, with the following order of reference:—

- (1) To consider and report on proposals for the modification of foodstuffs for export and transport under war conditions:
- (2) To initiate and co-ordinate any experimental work or investigations arising from (1), and to make recommendations thereon.

The Government made a special grant to the Committee for developmental work under its direction, which up to the present has been chiefly concerned with the production of dry butterfat and dried meat.

The following is a summary of the Committee's work during the period under review:—

*Dry Butterfat.*—Prior to the establishment of the Committee, experimental work by the Dairy Research Institute had shown that pure dry butterfat could be successfully extracted from butter on a commercial scale by a process involving treatment of the melted butter (preferably unsalted) in a dairy separator to remove the bulk of the water and curd, followed by a further drying of the separated fat in a vacreator. The cooled fat is then run into tins and sealed for storage. The fat so prepared retains all the nutritive qualities of the original butterfat, occupies less shipping-space and weight, and can be transported overseas in unrefrigerated space without deterioration. Conversion into dry butterfat also offered a ready solution to the problem of the utilization of surplus whey and second-grade butters, which under war conditions could not be marketed locally or shipped overseas. The fat extracted from these butters could be safely stored as a valuable reserve foodstuff, for which it was anticipated that markets would ultimately be available both locally and overseas.

Utilization; Experiments arranged by the Dairy Research Institute in collaboration with local food-manufacturers and the Home Science School of Otago University showed that dry butterfat was very suitable for the manufacture of ice-cream, cakes, biscuits, and confectionery, and reports from Great Britain indicated that it would find ready acceptability.

Contracts with Great Britain: Following very favourable reports on experimental shipments to Great Britain, a contract was received by the Export Marketing Department for a trial shipment of 600 tons of dry butterfat prepared from creamery, second-grade, and whey butters in equal proportions, and the Committee arranged for this contract to be executed at the Dairy Research Institute butter-factory.

**Conversion of Whey and Second-grade Butters:** On the recommendation of the Committee, the government decided to erect a dry-butterfat-processing plant at Auckland to deal with surplus whey and second-grade butters. This plant, with a capacity of 10,000 tons of dry fat per annum, will be operated by the Internal Marketing Division, with the assistance of an advisory committee comprising representatives of the Marketing Department (Export Division and Internal Division) the New Zealand Dairy Board, the Dairy Research Institute, and the Departments of Agriculture, Scientific and Industrial Research, and Treasury.

**Fibre-board Butter-boxes.**—The Committee arranged experimental shipments of butter in fibre-board boxes to test the suitability of this type of box as a substitute for the customary wooden boxes for the purpose of saving shipping-space and weight. The results were promising.

**Butter-wrapping Experiments.**—Experimental shipments were arranged to determine the relative value of Pliofilm and Pliofilm + parchment for wrapping butter forwarded as chilled cargo with cheese.

**Dried Meat.**—Reports received through the Scientific Liaison Officer in London drew the Committee's attention to the possibilities of dried meat as a means of facilitating and augmenting the supply of meat from New Zealand to Great Britain during the war period. Experiments carried out by the Cambridge Low Temperature Research Station of the British Department of Scientific and Industrial Research demonstrated that dried meat prepared under carefully controlled conditions had very good keeping-qualities and could be reconstituted into a variety of palatable and nutritious meat dishes. Negotiations with Great Britain were followed by a trial order from the British Ministry of Food for 20 tons, and the Committee arranged for its production by an Auckland firm under the supervision of Dr. J. C. Andrews. This order will consist of mutton, except for a trial lot of 1 ton of dried pork produced from second-grade porkers and a trial lot of beef. The plant at Auckland is a small one, capable of producing only 1 ton of dried meat per week, but the data obtained from its operation, together with information supplied from Great Britain, will be of great value in designing an improved plant capable of large-scale production.

Dried meat has definite possibilities as a special ration for the armed forces, and this field is being explored in collaboration with the defence services.

Experiments are in progress on the packaging of dried meat in suitably-lined waxed cartons in substitution for tins, and on the compression of the meat into blocks to secure maximum economy of shipping-space.

**Dried Milk.**—Following an inquiry from the British Ministry of Food as to the possibility of greatly-increased production of roller-dried whole milk in New Zealand, steps were taken by the Committee to explore sources of supply of milk, the availability and cost of the necessary plant, and the problems involved in such a project. The Dairy Research Institute initiated experiments on the gas packing of dried whole milk and its compression into blocks as a means of saving tinplate.

**Dried Vegetables.**—As a result of the special interest shown by the defence services in dehydrated vegetables, laboratory experiments on the drying of the following vegetables are being undertaken by the Department's Fruit Research Officer in collaboration with the Plant Chemistry Laboratory at Palmerston North: Carrots, parsnips, potatoes, beans, onions, and cabbage. This work is to determine the best methods of pre-treatment to preserve as far as possible the flavour, nutritive quality, and physical properties of the vegetables after reconstitution. The laboratory results have been translated to a commercial plant, where sufficient quantities of dried material have been produced for full trials.

**Overseas Contacts.**—Very valuable assistance has been given to the Committee by Mr. Nevill Wright, Scientific Liaison Officer in London, by keeping it in close touch with developments in Great Britain in the preservation and transport of foodstuffs under war conditions, by forwarding technical data and special reports in connection therewith, and by facilitating arrangements for experimental shipments of various classes of dehydrated foodstuffs forwarded from New Zealand and their examination on arrival in England.

#### PLANT RESEARCH BUREAU.

**Plant Research Bureau Committee.**—Mr. A. H. Cockayne, Chairman; Dr. F. W. Hilgendorf, Vice-Chairman; Professor G. S. Peren; Professor E. R. Hudson; Sir Theodore Rigg; Dr. E. Marsden; Mr. R. B. Tennent; Mr. C. A. Marchant; Mr. Alan Grant; Mr. F. R. Callaghan, Secretary and Chief Executive Officer.

The Plant Research Bureau now comprises five Divisions, viz. :—

| —                       |    |    |    | Location.                                   | Director.                            |
|-------------------------|----|----|----|---------------------------------------------|--------------------------------------|
| Agronomy Division       | .. | .. | .. | Canterbury Agricultural College, Lincoln .. | *Mr. R. A. Calder (Acting-Director). |
| Botany Division         | .. | .. | .. | 8 The Terrace, Wellington ..                | Dr. H. H. Allan.                     |
| Entomology Division     | .. | .. | .. | Cawthron Institute, Nelson ..               | Dr. D. Miller.                       |
| Grasslands Division     | .. | .. | .. | Massey College, Palmerston North ..         | Mr. E. Bruce Levy.                   |
| Plant Diseases Division | .. | .. | .. | Owairaka, Auckland ..                       | Dr. G. H. Cunningham.                |

\* Mr. J. W. Hadfield, Director, was seconded to Linen Flax Section, Industries and Commerce Department, as from 1st June, 1940.

Participating in the Bureau are (1) the Department of Agriculture and its various Divisions; (2) the Department of Scientific and Industrial Research and its several research sections; (3) Massey Agricultural College; (4) Canterbury Agricultural College; and (5) Cawthron Institute.

#### AGRONOMY DIVISION, LINCOLN.

Acting-Director: Mr. R. A. CALDER.

In pursuance of the policy decided upon subsequent to the outbreak of war, this Division, although still maintaining some research work, has been concerned mainly with pure-seed-production undertakings. New Zealand must now depend almost entirely upon her own resources for her seed-supplies of agricultural crops and, if quality is to be maintained, it is essential that pure seed stocks be available.

**Wheat.**—The production of nucleus supplies of pure and smut-free seed, which are increased and distributed under certification, has now become a major effort, and during the past season 11 acres of the main varieties were harvested and yielded 557 bushels.

*Oats*.—Of the many recent introductions, four—namely, Binder, Line 834, Elder, and Victoria × 524—have shown sufficient promise to warrant extensive trial, and increase areas of each were grown to provide seed for the purpose.

Several lines developed from the crosses Ruakura × Lampton and Ruakura × Gartons Abundance were under trial during the year.

*Barley*.—Increase areas were grown of the two six-row barleys, Newal and Oderbrucker, which were received from Canada, and which have proved to be superior to Cape and Black Skinless in regard to rapidity of growth for green feed. The produce will be used for extensive trials.

Twelve varieties of two-row malting barley were grown at the Division to enable single plant selections to be made. Eleven of these, excluding the new variety Rex, have significantly outyielded the standard varieties in previous trials, and were grown this season in an extended trial by the Canterbury Seed Co. to provide material for malting tests.

*Linen-flax*.—Seed-production: To provide pure and disease-free stocks for the newly established industry, nucleus supplies of the following varieties were raised from hot-water treated seed: Liral Crown, Concurrent, and Stormont Cirrus. Small increase areas of Hercules, Blenda, and Triumph, which are recent introductions, were also grown.

Breeding-work: A number of F.2 lines from crosses between the disease-resistant Rio linseed and various fibre varieties were grown. No disease was seen on any of them. If possible, these will be carried on with a view to developing a disease-resistant fibre strain.

Weed Control: Sinox, the sodium salt of dinitro-ortho-cresol, has been tested for the control of weeds in linen-flax. The trials show it to be of outstanding value in controlling fat-hen, wireweed, and black bindweed in linen-flax experimental areas.

Processing: The straw from a number of variety trials carried out by the Department of Agriculture was deseeded, retted, and scutched, seed and fibre yields determined, and the results forwarded to the officers concerned. pH and buffer capacity curves were plotted for all flax rets carried out, the aim being to establish an easier method to determine the end point of a ret than the usual physical tests. No easier method was found, although much information was obtained on the effect of liquor dilution and the advantage of close control of temperature. Experiments on a small scale at Lincoln and on a commercial scale at the Leeston Flax-factory were carried out to determine the effect on material spread out for dew retting of daily spraying with water. The results demonstrated that the period of retting could be reduced by as much as 30 per cent.

*Rape*.—Three acres of Giant rape, yielding 3,310 lb., and 3 acres of Broad Leaf Essex rape, yielding 3,060 lb., were grown for increase and distribution under certification. A distinct type developed from the cross (Giant × Broad Leaf Essex) × Broad Leaf Essex behaved very satisfactorily both in trials at the Division and in trials arranged by the Fields Division, Department of Agriculture.

*Marrow-stem Kale*.—Two distinct selections have been raised by the Division; one is a tall type with a well-developed stem and a comparatively low proportion of leaf, and the other a shorter, more leafy form. One acre of each was grown last season, the tall type yielding approximately 300 lb. and the shorter one 350 lb. seed.

*Garden Peas*.—The policy of growing reselected stocks of the main commercial varieties for distribution to merchants is being maintained, and the following varieties were grown during the past season: Greenfeast, Onward, Little Marvel, William Massey, and Harrisons Glory (Marrowfat).

A promising selection, 8/13/2/3, developed from a cross between Greenfeast and Greatcrop, is a green-seeded Greenfeast type and is being increased for distribution.

*Field Peas*.—A new blue boiling pea, 5/7/1/6, developed from a cross between Blue Prussian and Harrisons Glory, and a new white splitting pea, 3/42/3, developed from a cross between Blue Prussian and Greenfeast, considerably outyielded their respective controls, Blue Prussian and White Ivory, in trial plots this year. Both also were increased at Lincoln College, and good yields were obtained.

Another promising white-seeded type is line 12/10, a cross between Victoria and Stratagem. It possesses very large attractive seed, and in trials this year slightly outyielded White Ivory. A small increase block was also grown.

*Lupins*.—Two acres of the sweet blue lupin and 1½ acres of the sweet yellow lupin were grown to provide reserve stocks of pure seed. Samples of sweet-blue-lupin seed harvested from commercial areas, submitted for alkaloid test, have proved that the crops concerned are suitable for certification.

Sweet blue, sweet yellow, and New Zealand blue lupins were compared in a replicated trial. The establishment of the first two was rather poor. A similar trial was carried out by the Grasslands Division at Palmerston North, and the yields per acre in the two trials are shown below:—

|                          | Lincoln.      |             |           | Palmerston North. |             |           |
|--------------------------|---------------|-------------|-----------|-------------------|-------------|-----------|
|                          | Green Weight. | Dry Matter. | D.M.      | Green Weight.     | Dry Matter. | D.M.      |
|                          | lb.           | lb.         | Per Cent. | lb.               | lb.         | Per Cent. |
| New Zealand blue .. .. . | 33,324        | 5,865       | 17.6      | 37,268            | 3,950       | 10.4      |
| Sweet blue .. .. .       | 25,192        | 4,308       | 17.1      | 35,816            | 4,119       | 11.5      |
| Sweet yellow .. .. .     | 27,359        | 4,104       | 15.0      | 33,880            | 2,914       | 8.6       |

Weights at Lincoln were taken at the end of flowering, before the leaves started to wither, while weights at Palmerston North were taken at the start of flowering.

At Palmerston North, in addition to ascertaining the yields given above, indoor feeding trials with sheep were carried out, chemical analyses were made, and a grazing trial for determination of palatability conducted. In the latter the ratio of preference was approximately, sweet yellow, 10; sweet blue, 8-9; New Zealand blue, 1.

*Potatoes*.—Work on potatoes is being confined to testing the behaviour of a large number of hybrid lines many of which have been raised from crosses between commercial varieties and "wild" types obtained indirectly from South America.

*Lucerne*.—The first pedigree strain raised from a combination of several plants of the Marlborough variety selected on the performance of their inbred progenies was placed under trial against Marlborough in several districts last year.

Several hundred single plants of the species *Medicago glutinosa* have been under observation. It is possible that from the best a satisfactory grazing type may be established.

*Mangels*.—A small area of a reselected line of Yellow Globe was grown to provide seed for increase and distribution under departmental supervision.

In a small trial last year, Kirsches Ideal, a recent introduction, proved to be somewhat lower in yield than Yellow Globe but to possess a much higher dry-matter content.

#### BOTANY DIVISION, WELLINGTON.

Director: Dr. H. H. ALLAN.

Over one thousand specimens have been reported on from the usual sources, several new weeds being recorded, with special attention being given to weeds introduced through linen-flax seed. The herbarium of marine algæ has been considerably enlarged.

#### SEAWEED UTILIZATION.

*Agar*.—About half a ton of dry *Pterocladia lucida* was purchased, chiefly from the Bay of Plenty, and about 100 lb. was processed by the Dominion Laboratory. The agar produced was submitted to local laboratories and to the High Commissioner in London. Reports show that the agar compared favourably bacteriologically, physically, and chemically with the best Japanese, and that there is a good demand both locally and overseas. Following these reports, and using data provided by this Division, arrangements are in hand to collect much larger quantities for commercial processing. Supplies come entirely from the North Island, and the beds can be harvested once a year.

*Carrageen*.—Certain species of *Gigartina* were recommended by this Division to take the place of imported carrageen, or Irish moss. As a result, more than 20 tons of dry *Gigartina* have been sold during the year from Stewart Island and the Southland coast for use in New Zealand. On experimental plots in Cook Strait it was found that this species can be harvested once annually without depleting the beds or diminishing the yield. Samples of New Zealand carrageen have been supplied on request to local firms for trial in pharmaceutical preparations and in the manufacture of tooth-paste.

*Potash*.—A paper, "Seaweed as a Source of Potash in New Zealand," prepared by A. M. Rapson (Marine Department), L. B. Moore (Botany Division), and I. L. Elliott (Department of Agriculture) for the *Journal of Science and Technology*, records the results of a quantitative survey of the chief kelp beds, with observations on the growth rate of *Macrocystis*. It is estimated that Cook Strait could yield annually about 4,000 tons of dry kelp containing approximately 1,000 tons of potassium chloride, and Foveaux Strait 1,200 and 300 tons respectively. It is estimated that 5,000 tons of dry *Macrocystis* should contain at least 5 tons of iodine.

*Sodium Alginate*.—American analyses show that dry *Macrocystis* contains some 16 per cent. of alginic acid. In view of the increasing interest in sodium alginate in Great Britain, arrangements have been made and material provided for a determination of the algin content of New Zealand kelp.

*Vitamins*.—References in the literature to the vitamin content of seaweeds have been reviewed for the Health Department, and supplies of promising kinds can be provided for assay if required.

#### MEDICINAL PLANTS.

Four acres of experimental plots were laid down in the spring, and harvesting from most has been completed. The drier using hot-air circulation has proved very satisfactory.

*Atropa belladonna*.—Growth surpassed that obtained in 1940, and the leaf has been harvested. A good yield of root was obtained from two-year-old plants, and the root is under test.

*Datura stramonium*.—Growth was good, but no significant results were obtained from the different manurial treatments. A  $\frac{1}{10}$  acre plot of a local type with upright growth and low seed yield gave 1,000 lb. of green leaf, as against 600 lb. to 700 lb. from the English type. A comparative test of the alkaloid content is being made.

*Hyoscyamus niger*.—Plots of both the annual and the biennial types were harvested for testing. Incidence of disease was decreased by sowing seed in the open, while root-rot trouble was largely eliminated by sowing on sandy, well-drained soil.

*Digitalis lanata*.—Further seed-supplies came to hand during the spring. Plants gave excellent growth and ample leaf obtained for testing. Seed has been saved, and selection work on this and other medicinal plants will be undertaken.

*Papaver somniferum*.—Plants of an Indian variety made poor growth, and bolted to flower, producing very small capsules. Seed of a Chinese variety, sown late in the spring, gave excellent growth with capsules of a good size. Preliminary tests indicate the material to be quite satisfactory.

Other medicinal plants are under smaller-scale trial, including *Ephedra*, *Barosma*, *Ricinus communis*, *Mentha piperita*, *Glycyrrhiza glabra*, *Chenopodium ambrosoides*, *Coriandrum sativum*, and *Feniculum officinale*. The Division has supplied technical assistance to a commercial firm and to the Department of Agriculture in its work on medicinals on a commercial scale.

#### PHORMIUM.

Major trials laid down on the experimental area are—

*Spacing Trial*.—Using four varieties, to determine the most economic spacing for greatest yield, and the best spacing for growth and weed control.

*Season-of-cutting Trial*.—Over four seasons with four varieties, to determine effect on yield and recovery, with special reference to frost damage before, at, and after cutting.

*Cultivation Trial*.—Using various methods, to determine the effect on growth rate and yield, most economical practice, and best establishment of fans.

*Age-of-plant Trial*.—To determine seasonal and total yields and most efficient practice, and effect on quality of fibre.

Minor trials and investigations are in progress, including studies on water-table conditions, nursery methods, and soil conditions.

## TUSSOCK GRASSLAND.

Work has had to be somewhat curtailed under present conditions, but the taxonomic work has nearly all been completed up to the publication stage, while much has been done on life-history studies of the more important species. Special attention has also been paid to the possibility of introducing suitable legumes, seed-supplies being sought for from various grassland areas of similar types in other countries.

*Nassella Tussock*.—A detailed survey was completed in collaboration with the Department of Agriculture, the acreages affected being summed up in the following table:—

| County. |    |    |    | Class 1. | Class 2. | Class 3. | Class 4. | Total.  |
|---------|----|----|----|----------|----------|----------|----------|---------|
| Waipara | .. | .. | .. | 2,700    | 3,700    | 60,000   | 118,400  | 184,800 |
| Kowhai  | .. | .. | .. | 950      | 1,900    | 9,900    | 28,900   | 41,650  |
| Cheviot | .. | .. | .. | ..       | ..       | ..       | 90,200   | 90,200  |
| Amuri   | .. | .. | .. | 20       | 100      | 3,000    | 14,400   | 17,520  |
| Total   | .. | .. | .. | 3,670    | 5,700    | 72,900   | 251,900  | 334,170 |

*Nassella* is so concentrated on classes 1 and 2 that the land is virtually useless and requires special treatment. Class 3 has scattered plants that could be dealt with by concentrated effort, while class 4 is land liable to early invasion by seed, wind or animal borne, from established areas. A survey revealed that about 5,000 acres are infested in Marlborough, 300 acres heavily so. Experimental work on the life-history of the tussock, and its response to various treatments, is being carried out, and larger-scale work is planned for the first opportunity.

## WEEDS.

Field work on hard fern is being completed, and a report prepared. General survey work has continued and detailed reports on the needle grasses and certain thistles prepared. Special attention has been given to gorse in the Wellington area.

## MISCELLANEOUS.

Brief mention is made of only a few of the further researches of the Division in progress. Preliminary work on linen-flax fibre shows that the relations of fibre to soil conditions and manurial treatment are worth following up. A report on the tung situation has been prepared, with recommendations as to possible further action. The growth of hemp (*Cannabis sativa*) on the experimental area has been poor this season, but again a good crop of seed has been obtained.

Collection of spores of *Lycopodium volubile* was organized, some 15 lb. being secured. This was submitted to a vulcanizing firm for test on a factory scale. The local material was found equal to that of the best European lycopodium powder.

Assistance was given to the Army medical services in the location, collection, and testing of koromiko (*Hebe salicifolia*) as a dysentery remedy.

## ENTOMOLOGY DIVISION, NELSON.

Director: Dr. D. MILLER.

*White Butterfly* (*Pieris rapæ*).—The pupal parasite, *Pteromalus puparum*, continues to exert a major control on this insect. The larval parasite, *Apanteles glomeratus*, received some three seasons ago from American-bred material, shows every indication of having become successfully established in the Nelson region.

Another recently imported parasite for use against the white butterfly is a tachinid fly (*Compsilura*), from Canada. This fly has a very wide host range, including *Pieris*. No liberations of the tachinid have been made.

*Diamond-back Moth* (*Plutella maculipennis*).—Field surveys strengthen the opinion formed earlier that the parasitic control of the diamond-back moth will be secured. Of the two parasites (*Angitia cerophaga*—larval, and *Diadromus collaris*—pupal), the pupal is found to be exerting the greater influence. Field surveys in the Waimea Plains show that the combined attack of both parasites has given 81.2 per cent. control—19.9 per cent. by *Angitia* and 61.3 by *Diadromus*.

*Cheese-mites*.—Owing to the need for protecting cheese in storage, an investigation into the control of cheese-mite is being developed on a considerable scale. This work is being carried out in co-operation with the Dairy Research Institute.

*Subterranean Grass-caterpillar* (*Oxycanus sp.*), or *Porina*.—Last season's work indicated that the use of poison baits was the most practicable and efficient method of controlling *Oxycanus*, and that Paris green was the most effective of the poisons which were tested in such baits.

The pre-eminence of Paris green as a poison for use in baits against *Oxycanus* was confirmed by this season's work. A bait containing 2 lb. of Paris green, 50 lb. of bran, and 16 lb. of molasses per acre gave a reduction in numbers of *Oxycanus* caterpillars of 70 per cent. to 80 per cent. with one application of bait. It was found that a reduction in the quantities of molasses or even its complete elimination produced no significant lowering of the efficiency of the bait.

In many infestations the quantity of bran might be reduced to 25 lb. without lowering the efficiency of the bait. The cost of material for the original formula was about 12s. per acre, and the elimination of half the bran and all the molasses would reduce this to 8s. per acre.

The use of the bait resulted in a reduction in the numbers of *Oxycanus* caterpillars. On untreated areas only 25 per cent. of the ground was covered with pasture at the conclusion of the experiment, while on the treated areas 58 per cent. of the ground was still covered by pasture.

On the basis of experience this season, it is estimated that a population of *Oxycanus* caterpillars exceeding 10 per square foot is sufficient to completely defoliate a pasture by early autumn.

The treatments last year were applied at the end of May. The main work in the coming season will be to determine whether similar baits will give good results when applied to heavy infestations in February or March.

Under the supervision of the Division, an *Oxycaus*-infested area of 12 acres on the Nelson Aerodrome was treated by the Public Works Department, with satisfactory results. The bait in this case was applied with a tractor-drawn Simpson manure-distributor which gave fairly satisfactory results, though it was slow and not capable of fine adjustment to the rate of feed.

A poison-bait distributor of American design has been ordered. This will be available to make application of the bait on larger areas this coming season.

*Introduction of Parasites.*—Through the aid of the Belleville Parasite Laboratory in Canada, parasites of the codling-moth (a shipment of which is now on its way to the Dominion) and of the wheat-weevil (which it is hoped will be ultimately secured from the Argentine) are being secured or searched for on behalf of the Division.

#### GRASSLANDS DIVISION, PALMERSTON NORTH.

Director: Mr. E. BRUCE LEVY.

##### PLANT BREEDING AND STRAIN ECOLOGY.

During the past year new increase areas of perennial, short rotation, Italian rye-grass, broad and Montgomery red clovers, and type 1 and type 2 white clover were planted out. Harvesting conditions were extremely adverse and yields in all cases were low. Breeding-work on Italian rye, short rotation, and broad red clover is continuing and crosses and selfings of selected types made. Selected plants of timothy were isolated in the glasshouse for a mass selection. A mass selection of promising types of cocksfoot is also proposed.

*Blind-seed Diseases.*—Inoculation technique has been improved further and is now very satisfactory. Resistant plants from previous trials were again inoculated and in the main continued to exhibit resistance.

*Strain Testing.*—Three thousand plots and rows for certification purposes have been established and reports prepared. Field investigations on the value of improved strains have been undertaken in co-operation with the Department of Agriculture.

*Substation, Lincoln.*—Useful information continues to be derived from this station to confirm observations made on breeding-material at Palmerston North.

Five acres of nucleus stock Italian and 2 acres of short rotation rye-grass were grown and harvested for seed by the Agronomy Division.

##### FIELD ECOLOGY.

*Sheep-nutrition Area run in conjunction with Massey College.*—A feature of the experiment is the excellent performance of the pedigree strains and also the good results obtained from low manuring with the small paddock control and continual rotational grazing. Under this intensive system there seems to be no great advantage to date of applying very high quantities of artificial fertilizer.

*Digestibility Trials with Sheep.*—Work on this project has been cut down this year to the determination of the digestibilities of last season's experimental silage to this year's experimental silage material, and to lupins under trial for the Agronomy Division.

*Sheep-grazing Trial to measure Effect of Dung and Urine on Pasture Growth.*—This trial has continued. The high differences recorded last year tended to level out, due to the presence of a good white clover in all plots.

It can be concluded that the value of a good clover well fertilized is great in itself, even though the nitrogen excreted into the soil is much slower to show its effect upon the grass than that which passes through the animal.

The trial has demonstrated and given opportunity for measurement of the well-publicized cycle of pasture growth. The trial has, however, brought out a very important phase of the cycle—i.e., the great value of the animal to the pasture in its young stage.

*Ensilage.*—Last year's programme of work has been completed and sent forward for publication. Features of the work are (a) the very high losses in nutrients that occur in unroofed but weighted stacks and pits, as compared with roofed but weighted stacks and pits; (b) the direct relationship of the value of the silage to that of the ensiled material.

Due to all the experimental work to date being carried out on small-scale pits, this year's programme consists of checking the losses on one type of material in pits and stacks varying from the smallest practical size to the large commercial proposition. The following series was laid down: (a) 1-ton silos roofed and unroofed; (b) 3-ton silos roofed and unroofed; (c) 25-ton pits roofed and unroofed; (d) 50-ton stacks roofed and unroofed; (e) 2-ton pits variable pasture covered.

All treatments were made with the same material and were well consolidated. On the very small silos gases and juices were collected and losses recorded periodically by moving the silos *en bloc* on to a weighbridge. Temperatures were recorded electrically at different depths.

*Simple v. Complex Mixtures.*—The project reported in last year's report has been laid down, and paddocks are now fenced and yards and sheds erected. Some striking differences are already apparent in the results from the different species and strains. To date the best all-round performance has been recorded on the fully utilized simple mixture of rye-grass and white clover, while the low productivity in their early stages of dogstail, cocksfoot, timothy, fog, and Phalaris is well marked.

The complex mixtures of several species have not to date shown a very great advantage over the simple mixture of pedigree strains in so far as spread of and total production of herbage and meat is concerned. It is also again apparent that simplicity or complexity of pasture swards do not depend so much on the seeds mixture as upon the management the pasture receives on the particular soil type.

*Facial Eczema.*—Due to staff shortage and restriction on travelling, this project has been confined to the growing and collection of grass suitable for the plant chemists of the bureau, and to the dissection of samples submitted for botanical examination. Collaboration has been maintained in the main field experiments of the Animal Research Division of the Department of Agriculture.

##### AERODROME-TURF PRODUCTION.

During the year the activities of three members of the staff have been confined almost exclusively to aerodrome-turf work both in an experimental and in an advisory capacity. The production of tough, hard-wearing, fibrous turf is essential for aerodromes, and the research work carried out in the past

has been valuable in supplying such information as has been necessary on aerodrome advisory work. Trials with various substitutes for fertilizers both to promote plant growth and to further acidify soil are now under way. It has been shown that the mixing of seed and certain fertilizers prior to sowing is detrimental to the establishment of grasses.

#### PLANT DISEASES DIVISION, OWAIRAKA, AUCKLAND.

Director: Dr. G. H. CUNNINGHAM.

##### I. PLANT DISEASES INVESTIGATIONS.

(1) *General*.—Four new fungus diseases and three new insect pests have been isolated during the year. The causal organism of blind-seed disease has been identified as *Phialia temulenta*. About sixty strains of the ergot fungus have been isolated from high-yielding ergometrine lines received from Great Britain. These have been applied to commercial rye with a view to ascertaining the factors influencing production of the alkaloid. Inoculation tests have also been made with varieties of wheat and barley, with negative results.

(2) *Potato Diseases*.—A line of the variety Dakota Red has been found to carry a necrotic virus in masked form and in addition two sap-transmissible viruses which cause a chlorotic and ring-spot condition of tobacco. Lines of several varieties of virus-free potatoes are being bulked in an insect-proofed glasshouse for further virus studies.

(3) *Legume Diseases*.—Thirty varieties of dwarf and runner beans were sown and inoculated with bacterial wilt organism (*Bacillus medicaginis*) to enable selection of resistant varieties. Tests of pea-mosaic resistance were carried out with crosses of Greenfeast rogue peas in the glasshouse. Lines which appeared to be resistant were then grown in the field for selection of type and earliness.

(4) *Linen-flax Diseases*.—Detailed surveys of the linen-flax crops for presence of disease have been made. Five major diseases, all seed-borne, are well established—namely, wilt (*Fusarium lini*), rust (*Melampsora lini*), pasmo (*Sphaerella linorum*), browning (*Polyspora lini*), and seedling-blight (*Colletotrichum*). The last has so far been found in only two seedling crops. Pasm has proved to be common throughout on the introduced weed *Linum marginale*. Linen-flax seed stored in the South Island has been found infested with Tyroglyphid mites. A survey has been made to ascertain sources of infestation and enable methods of control to be worked out.

(5) *Small-fruit Diseases*.—Tomato Leaf-mould: Seed of the variety Vetomold resistant to this disease has been grown under controlled conditions and sent out to commercial growers in different parts of the Dominion. The variety Bay State has been further rogued and selected seed grown on a commercial scale. Seed of a further new Canadian selection has been received and grown in pots under glass. Both Vetomold and Bay State are being tested in the field against the standard round variety Kondine Red for quality and yield trials.

Passion-fruit Diseases: A block of thirty-two passion plants have been established to enable control studies to be made with brown-spot (*Alternaria passiflorae*) and grease-spot (*Phytonomonas passiflorae*).

(6) *Miscellaneous Diseases*.—Suspected Virus of Rhubarb: Attempts have been made to transfer infection from rhubarb to the same host by two species of aphides, leaf-rubbing and hypodermic injections, so far without success.

Beet Virus: The disease has been identified as *Beta Virus 2* of Smith. It has been transmitted to all varieties of silver-beet and red-beet obtainable in the Dominion, and also to sugar-beet and spinach.

Copra Insects: A survey has been made of the insect pests present in copra imported from certain Pacific islands as pig-feed. Three insects were found to be prevalent therein—namely, copra-bug (*Necrobia rufipes*), saw-toothed grain-beetle (*Oryzaephilus surinamensis*), and red flour-beetle (*Tribolium castaneum*). All were able to maintain themselves and breed in copra throughout the year under New Zealand conditions.

Carrot rust-fly: A life-history study has been commenced of this pest, which causes considerable losses to market-gardeners in Auckland Province and virtually precludes growing of carrots by private gardeners.

(7) *Fruit-tree Diseases*. (See Fruit Research report, p. 16.)

##### II. PLANT PROTECTION.

(1) *Therapeutant Testing*.—Copper Sprays: Experiments have been undertaken in field and orchard to ascertain the relative values of copper oxychloride, copper oxide, and Bordeaux mixture in the control of late-blight (*Phytophthora infestans*) of potatoes and tomatoes.

Seed Dusts: Trials in control of pre-emergence damping-off of Greenfeast peas have established the superiority of cuprous oxide dusts over the organic mercury dusts at present used.

(2) *Therapeutant Disease Control*.—Carrot Rust-fly: Significant results in control of this pest have been secured with broadcast dressing of crude naphthalene. Less effectual was derris dust.

Onion-mildew and Thrips: Significant increases in yield have been secured in all treatments. The most effectual proved to be Bordeaux mixture plus summer oil plus nicotine sulphate.

Cabbage Diamond-back Moth and White Butterfly: Two programmes of control were tested, derris dust versus nicotine sulphate and wetter spray. Unlike previous seasons, white butterfly caused most injury, there being few larvae of diamond-back moth in evidence. The nicotine sulphate treatment failed to give control.

(3) *Improvement in Spray Programmes*. (See Fruit Research report, p. 16.)

(4) *Certification of Therapeutants*.—All certified materials have been retested during the year. It is pleasing to note that in every case the certified standard has been maintained. One or two products have been withdrawn by the manufacturer or agent owing to shortage of supply.

##### III. TIMBER PRESERVATION.

(See Timber Protection Research report, p. 20.)

##### IV. POMOLOGY INVESTIGATIONS.

(See Fruit Research report, p. 16.)

## V. MISCELLANEOUS.

(1) *Pyrethrum Production*.—Commercial-scale harvesting was carried out with the  $\frac{1}{2}$  acre of high-yielding pyrethrum being grown at Owairaka. Time taken, wages, and weight of dried flowers have been recorded. Analyses of yields of pyrethrins are being made.

(2) *Medicinal Plants*.—On behalf of the Botany Division, plants of *Hyoscyamus niger*, *Digitalis lanata*, *Atropa belladonna*, *Datura stramonium*, and *Papaver somniferum* were raised under glass and grown in the field at Oratia for tests of their medicinal value when grown under Auckland conditions.

(3) *Linen-flax Retting*.—Rets from some factories and retted straw from others have been examined and all organisms present isolated and compared. Considerable variations occur in organisms from different factories, different straw, and at different periods of the year. Pure cultures have been prepared from the main organisms, and rets are being carried out in the laboratory with a view to finding the most suitable strains for bulk distribution.

(4) *Industrial Microbiology*.—War conditions have stimulated inquiries relative to production under New Zealand conditions of materials manufactured with the aid of fungi. Collection and testing of strains used for manufacture of citric acid and marmite are being undertaken.

(5) *Lucerne Nodule Organism*.—Cultures sufficient to inoculate 127,200 lb. of lucerne seed were distributed to 1,371 farmers.

## SUGAR-BEET RESEARCH SECTION.

Research Officer: Dr. O. H. FRANKEL.

This Section was established in June, 1941. Its objects are to produce sugar-beet seed suitable for New Zealand conditions and to co-operate with the Department of Agriculture in agronomic investigations connected with the establishment of a sugar-beet industry in the Dominion. The work is carried out in co-operation with the Wheat Research Institute, staff, buildings, and equipment being used in conjunction by the Section and the Institute. A Sugar Beet Research Committee was established on which the Departments of Agriculture and of Industries and Commerce, the Plant Research Bureau, and the Wheat Research Institute are represented.

A laboratory for the testing of sugar-beet has been provided in one of the buildings of the Wheat Research Institute at Lincoln, and an experimental area of 4 acres leased at Tai Tapu.

Seed from a number of selected individual beets of Kleinwanzleben N was made available by the Department of Agriculture, which permitted of fifty-eight lines being taken into replicated progeny tests. A variety trial included seven American and three German varieties, in addition to a line of New-Zealand-raised seed. These areas, as well as the best of the fifty-eight lines, will be used for the selection of mother beets for further selection.

## PLANT CHEMISTRY LABORATORY, PALMERSTON NORTH.

Director: Dr. J. MELVILLE, on active service. Dr. B. W. DOAK, Acting-Director.

## RYE-GRASS ALKALOIDS.

The main work on these for the year has been the isolation of sufficient of a fluorescent alkaloid from perennial rye-grass to enable its toxicology to be studied. When injected into mice it is mildly photosensitizing, but this has not been the case when administered orally. The alkaloid is toxic to mice in 5 mg. doses intraperitoneally. Analysis of a pure specimen of the alkaloid hydrochloride gave the formula  $C_{36}H_{22}N_4(OCH_3)_4 \cdot 2HCl$ . The compound which has been named "perloline" is not directly connected with facial eczema of sheep.

Two methods have been developed for the rapid estimation of total chloroform-soluble alkaloids in herbage. It would appear that perloline usually amounts to about half of the total alkaloids present

## HAY AND SILAGE STUDIES.

In collaboration with officers of the Grasslands Division, work has been carried out dealing with the losses involved in making silage in pits and in stacks. Studies of the digestibility of silage have also been made. It has been shown that the digestibility of the protein suffers greatly if the silage has been allowed to overheat.

## EFFECT OF URINE AND DUNG ON CHEMICAL COMPOSITION OF PASTURES.

In conjunction with officers of the Grasslands Division, a trial has been conducted investigating the separate and joint effects of urine and dung on the botanical and chemical composition of the pasture. Marked differences in the botanical composition have been apparent, and the chemical analysis of samples is well under way. The total return of nutrients per acre by way of animal residues amounts to the equivalent of at least 1,400 lb. sulphate of ammonia, 1,400 lb. potash salts, and 500 lb. superphosphate, showing the great influence of the grazing animal on soil fertility.

## SOIL SURVEY.

Soil survey investigations are undertaken by the Soil Survey Division (D. L. I. Grange, Director), and by the Cawthron Institute (Sir T. Rigg, Director).

## SOIL SURVEY DIVISION.

## GENERAL SURVEY, NORTH ISLAND.

During the year soil maps on a scale of 4 miles to the inch covering the whole of the North Island were published in two colours, red for the topographic data, and black for the soil boundaries. In preparation is a comprehensive legend covering soil type and chemical data which will contain information which can be utilized for the taking-out of single soil values—i.e., for maps showing separately phosphate, lime, potash, and nitrogen content of soils, slope, drainage, erosion, &c., data which is essential for the effective utilization of the survey.

From the general survey in particular, and from others mentioned below, maps have been drawn for the use of the Army.

## GENERAL SURVEY, SOUTH ISLAND.

In the South Island the general soil survey has been confined to the completion of the mapping of the high country on the eastern side of the Southern Alps, a project which was commenced during the previous season primarily with the object of obtaining quantitative and qualitative data on soil erosion.

Soil types mapped during this survey were—

- (1) *Buff Loams*.—These are very fertile soils whose productivity is limited by low moisture conditions. They cover valley sides and bottoms of the parts of Central Otago where the rainfall is less than 25 in. and were originally covered with fescue and blue tussock. At present this is the type most severely eroded, and in many places now grows little more than scabweed and the desert poa (*Poa maniototo*). The texture of the topsoil ranges from a loamy sand to a coarse sandy loam.
- (2) *Grey-brown Loams*.—These are moderately-fertile soils occurring on the hill slopes and valley bottoms of the numerous areas in Marlborough, Canterbury, and Otago. The grey-brown loams are developed under a mixed fescue and poa tussock vegetation and an annual rainfall between 25 in. and 45 in. Topsoil textures range from coarse sandy loam to fine sandy loam.
- (3) *Yellow-brown Loams*.—These are soils of low fertility, and include most of the soils of the high-country runs above 3,000 ft. in altitude which are developed under an annual rainfall of between 45 in. and 100 in. approximately. The vegetation consists principally of danthonia tussock with some areas of *Nothofagus* forest. The textures of the topsoil range from sandy loam to silt loam.

Many analyses of soils taken on the ranges from Marlborough to Southland show that fertility levels correlate with effective rainfall. The buff loams of the lower slopes change through grey-brown loams to yellow-brown loams on the higher levels and correlate with percentage base saturation changes. About 80 per cent. base saturation in both topsoil and subsoil is characteristic of the drier soils, while 20 per cent. base saturation in the topsoil and 10 per cent. in the subsoil are typical figures of yellow-brown loams. Carbon and nitrogen figures have been used to show the extent of erosion in some cases.

## LINEN-FLAX SURVEYS.

Surveys of potential linen-flax soils in the Balclutha and Clydevale districts have been completed and the results handed over to the Fields Division. Surveys are now proceeding in Southland, South Canterbury, and Ellesmere.

The analyses of soils from all areas have confirmed last year's conclusion that flax does well on soils of fairly low fertility, provided that the moisture relations are right and the nitrogen is in proper supply.

## SUGAR-BEET SURVEYS.

In the Christchurch-Ellesmere district soils similar to those in the Orari-Temuka district, which from trials by the Department of Agriculture were judged to be suitable for the growing of sugar-beet, were found to occupy too small an area for the establishment of an industry. It is possible, however, that other acceptable soil types may be located if further field trials are laid down.

## AERODROME SURVEYS.

Soil surveys and analyses have been made of many aerodromes, with the object of facilitating the Grasslands Division's policy in producing chewing's-fescue - brown-top swards on airfields. Advice has been given on the present level of fertility of the soils in order that fertilizing programmes may be designed to bring the fertility to the level required by these pasture plants. Over a period of ten years the Grasslands Division has established at Hokowhitu a good wearing turf of chewing's fescue and brown-top, and the soil investigations were commenced with the object of finding what soil changes had taken place in bringing this alluvial soil down to conditions favourable to these grasses. The Grasslands Division obtained best results with ammonium and iron sulphates and superphosphate. Analyses showed that starting with a soil of pH 6.2 and base saturation 70 per cent. to 75 per cent., changes in the topsoil had taken place to the extent of reducing the pH to 4.7 and the base saturation to 25 per cent. to 30 per cent. These differences were most marked in the top 1 in., while at 3 in. to 6 in. depth there was very little change. The carbon-nitrogen ratio was significantly higher on the acidified plots than on the controls.

## SOIL CEMENT.

In view of the success overseas in the use of relatively small percentages of cement added to stabilized earth for roads and runways as a substitute for the more expensive foundations like concrete, investigations have commenced on the suitability of New Zealand soils for this treatment.

## BASALT SCORIA AS A REVERTING MATERIAL FOR SUPERPHOSPHATE.

Basalt scoria as a reverting material for superphosphate was found effective, and the results were published in the *Journal of Science and Technology*, Vol. 23, No. 1B.

## PHOSPHATE FIXATION.

Phosphate fixation proceeding to a marked degree in certain soils was investigated, and results show that alumina is the most active in fixing phosphate, followed by iron oxide. These absorbed phosphates are easily soluble in neutral ammonium citrate.

## SOIL EROSION.

Soil-erosion surveys on the high country on the eastern side of the Southern Alps has now been completed. Erosion on the three main soil types is briefly referred to below:—

(1) *Buff Loams*.—By 1900 the buff loams had reached a state of extreme erosion, mainly through the action of wind. At present practically no topsoil remains to blow, but the subsoil and zone of weathered rock is being rapidly removed by gullying. This is well illustrated on the hillsides behind

Bannockburn, where a severe stage of gully erosion has been reached. Erosion on this soil type, which began with the burning of the tussocks by the early settlers, was completed in the late seventies and eighties by the hordes of rabbits which overran Otago and Southland. Experimental plots laid down by the late Dr. Cockayne demonstrate that the progress of erosion on this soil type can be arrested, and under certain circumstances the topsoil can be rebuilt. No uneroded areas of this type exist at the present day.

(2) *Grey-brown Loams*.—The soils of the grey-brown-loam group show all degrees of erosion from practically-uneroded slopes to extensively-eroded slopes. In general the erosion is less severe than on the previous group of soils, and given suitable opportunity the soils recover much more rapidly than the buff loams, although it is a relatively slow process. Wind and water play an equal share as the agents of erosion, while burning of tussocks and rabbits are the major causes.

(3) *Yellow-brown Loams*.—The soils of the yellow-brown-loam group also show a wide variety in degree of erosion. Owing mainly to burning and partly to overstocking with sheep, the erosion of these soils is increasing at an alarming rate on the higher slopes, and if unchecked will result in removal of all soil from these slopes. This will be followed by wide extensions of the present scree slopes, with a consequent increased runoff and flooding at lower levels. The principal cause of the increased erosion is the burning of the danthonia tussock, and this should be forbidden, as the subsequent loss of topsoil and increased runoff quite overshadows the temporary growth of young vegetation, which is unable to check the removal of topsoil. The exposed subsoil is of very low fertility and is difficult to reclothe with vegetation. Rabbits are a negligible factor in the erosion of the soils of this group.

#### CAWTHRON INSTITUTE.

##### TOBACCO-SOIL SURVEYS.

Soil surveys of tobacco land in the Dovedale and Motueka valleys have been completed. Soil maps showing the classification of the soils into six groups, depending on their suitability or otherwise for tobacco-work, have been finalized and copies made available to the three principal tobacco-manufacturing companies, the Tobacco-control Board, the State Advances Department, and the Tobacco Research Station.

A detailed soil survey of the Moutere Valley has been suspended owing to the calling-up of men for the armed forces.

A preliminary examination was made of soils in the Takaka Valley, with a view to carrying out a detailed soil survey of this valley in relation to tobacco-culture. The preliminary examination showed that the area of light soils was largely restricted to the alluvial land in the vicinity of the river, but a considerable area of this land was subject to flood. Aerial photographs have been obtained of the Takaka, Waimea, and Upper Motueka valleys, and these will enable soil-mapping to proceed rapidly as soon as men become available.

##### SOIL SURVEY OF NELSON HAVEN.

At the request of the Controller of Employment, a soil map has been made of 1,000 acres of mud-flat at the northern end of Nelson Haven. The soil survey shows that there is considerable variation from fine sand to clay loam on different parts of the 1,000-acre block. There are some 330 acres of clay and silt loams, 420 acres of fine sandy loam underlaid by silt loam, and approximately 250 acres of fine sand.

##### LAND-UTILIZATION.

Maps showing the distribution of tobacco in the districts covered by the soil surveys have been prepared. These maps show the exact acreage of tobacco, together with the names of growers, for the 1940-41 season, and have been made available to the principal manufacturing companies and other interested organizations. Staff shortages prevented a check up on the exact distribution of tobacco during the 1941-42 season, but the data furnished by the Tobacco Control Board show an increase of 170 acres of tobacco grown in the district, the figures being 2,933 acres for 1940-41, as against 3,104 acres for the 1941-42 season.

The principal increases in acreage occurred in the Motueka-Riwaka, the Motueka Valley, and the Wakefield districts. There was an apparent reduction of acreage in the Dovedale and Orinoco valleys.

##### CHEMICAL WORK.

The analysis of soil samples collected show that tobacco soils, with the exception of some located on the Moutere Hills type of soil, have a high content of phosphate, but are invariably low in available potash. Great variation occurs in the percentage of base saturation, the figure ranging from 10 per cent. to 80 per cent., with the majority of the samples falling within the limits of 40 per cent. to 50 per cent. base saturation.

#### MINERAL CONTENT OF PASTURES.

##### INVESTIGATIONS AT THE CAWTHRON INSTITUTE.

H. O. ASKEW, Officer in Charge.

##### A. COBALT INVESTIGATIONS.

##### I. *Animal Trials*.

During the present season (1941-42) the same fields have been used for a further sheep trial as were used in the previous year. The Nelson limestone area of last season received this year cobaltized superphosphate providing 2 oz. cobalt sulphate equivalent per acre, while the Southland limestone area received the equivalent of 4 oz. cobalt sulphate. The control area received 2 tons per acre of Nelson limestone. No further treatment, except superphosphate, was given the cobaltized superphosphate

area of last year. Hoggets were again used as experimental animals. The sheep were drafted into groups on 18th September, 1941. All did relatively well until the middle of January, after which the control group became almost stationary in weight at about 92 lb. per head. The 2 oz. and 4 oz. cobalt sulphate equivalent groups continued to increase in weight and at 21st March, 1942, averaged 104 lb. On the cobaltized superphosphate area the sheep have again done very well and now average 122 lb.

Throughout both seasons samples of pasture from the four areas have been regularly taken. Chemical examination has shown that in the 1940–41 season the high-cobalt limestone for a time slightly increased the cobalt content of the pasture, while the low-cobalt limestone actually caused a slight decrease in cobalt content. The use of cobaltized superphosphate greatly increased the cobalt content of the pasture for the two seasons after application. The 2 oz. and 4 oz. cobalt sulphate equivalent applications gave marked increases in cobalt content of the respective pastures for at least six months after application.

## II. Cobalt in Milk.

A trial with cobaltized salt licks with dairy cows at Sherry River carried out several seasons ago did not indicate that any certain increase in milk yield followed the use of a cobaltized lick as against salt alone. Cobaltized salt lick was made available on 1st November, 1938, but no milk sample was taken until 8th March, 1939. The cobalt content on the dry basis at this date was 0.02 p.p.m. for milk from the cobalt-treated cows, compared with 0.01 p.p.m. for control cows. From this date the groups of cows were changed over—that is, the control group now became the cobalt-treated group. Further samples taken on 14th April gave 0.022 p.p.m. and 0.015 p.p.m. for milks from the cobalt-treated and control groups respectively.

## III. Use of Cobaltized Fertilizers on Pasture.

(a) *Cobaltized Superphosphate.*—Samples of pasture have now been obtained for three seasons from plots at Sherry River which were treated on 10th August, 1939, with cobaltized superphosphate at rates varying from 2 oz. to 16 oz. cobalt sulphate equivalent per acre. In succeeding seasons superphosphate only was used. The 2 oz. and 4 oz. applications appeared to lose their effectiveness in raising the cobalt content of the pasture by the end of March, 1940. The long-continued sampling has, however, indicated that in the following spring these plots again showed an enhanced cobalt content in the pasture. A dressing of 4 oz. cobalt sulphate given in March, 1940, was effective into the winter, and in the following spring gave analytical figures very similar to the 4 oz. application made in the previous spring. With the 8 oz. application the effects in later seasons were no more marked than with the 4 oz. applications. With the 16 oz. application, however, a marked effect can still be seen two years after the dressing was given, the treated pasture giving two or three times the cobalt content of the untreated pasture.

(b) *Use of Different Cobalt Compounds with Lime as Carrier.*—In December, 1941, an experiment was set out at Sherry River to test the efficacy of the following cobalt salts as suppliers of cobalt: Cobalt sulphate, cobalt carbonate, cobalt hydroxide, and cobalt phosphate. The quantities employed, with ground limestone at 1 ton per acre, provided the equivalent of 5 oz. and 10 oz. cobalt sulphate per acre. Samples obtained to date show that a large increase in the cobalt content of the pasture followed the use of each cobalt compound and that in general the larger application has given a distinctly higher figure than the smaller application. At the end of February, two and a half months after application, the cobalt content of treated plots was about 0.08 p.p.m. and of the control area 0.03 p.p.m.

(c) *Serpentine-derived Soil for Pasture Top-dressing.*—The plots treated with a Nelson soil carrying about 350 p.p.m. of cobalt on 2nd February, 1940, at 5 cwt. and 10 cwt. per acre have been sampled regularly since then. For the first three months a large increase in the cobalt content of the treated pastures occurred, the effects being at least as good as those from a dressing of approximately 8 oz. cobalt sulphate per acre. Later on the cobalt content of the soil-treated areas has been consistently double or treble the content of the untreated area. This effect is still apparent two years after the application of the soil, and appears to be at least as persistent as the effect from 8 oz. cobalt sulphate.

## B. MAGNESIUM INVESTIGATIONS.

### I. Mowing Trial of Pasture Plots.

Further applications of fertilizer, except ground limestone, were made in early spring on the Sherry River plots. Very marked responses to potassium sulphate have again been noted, especially where magnesium compounds were used in the fertilizer mixture. The following data illustrate the increases in yield for the two seasons 1940–41 and 1941–42, the corresponding treated plot in the absence of potash being taken as 100 :—

|                                 |     |     |                                |           |
|---------------------------------|-----|-----|--------------------------------|-----------|
| Basic superphosphate            | ..  | 122 | Magnesium carbonate* and basic |           |
| Basic cobaltized superphosphate | 131 |     | superphosphate                 | .. .. 127 |
| Serpentine-superphosphate       | ..  | 131 | Magnesium sulphate* and basic  |           |
|                                 |     |     | superphosphate                 | .. .. 144 |

### II. Hay Trial.

On a hay-field at Sherry River applications of sulphate of ammonia and superphosphate with or without potash and magnesium were made. When potash was omitted the growth was relatively poor, but when potash was added there was a great encouragement of clovers, especially the red clover. Magnesium carbonate still further increased the growth of hay. While no symptoms that could be associated with magnesium deficiency were seen, very definite symptoms of potash deficiency were visible on clovers on the no-potash plots, especially on the lighter soil. It was on this section of the field where the most outstanding responses were obtained from the fertilizer applications.

\* Supplying magnesia equivalent to that in the serpentine-superphosphate.

## C. SERPENTINE-SUPERPHOSPHATE.

Further work has been carried out with mixtures of ground serpentine and superphosphate to determine the best conditions for the local preparation of a serpentine-superphosphate. It had previously been determined that the addition of water to the superphosphate greatly accelerated the reaction with the serpentine. The later experiments have shown that the best results are obtained when the moist superphosphate (5 per cent. of water added) is mixed with the dry serpentine.

With the grade of superphosphate employed reaction was practically completed in twelve days. For the usual mixture of three parts of superphosphate with one part of ground serpentine at the expiry of this period the water-soluble  $P_2O_5$  content was 4.8 per cent. and the water-soluble MgO content 2.4 per cent. After a further twelve days the  $P_2O_5$  content was reduced to 4.1 per cent., with practically no change in the soluble magnesia content.

A trial with a ton lot at the works of the Nelson Freezing Co. indicated that it would not be difficult to make a mixture which would resemble in properties serpentine-superphosphate as prepared at superphosphate-works.

## MINERAL RESOURCES COMMITTEE.

*Personnel.*—Dr. E. Marsden (Chairman); Mr. C. H. Benney (Deputy Chairman); Mr. R. L. Andrew; Mr. W. M. C. Denham, M.P.; Mr. W. Donovan; Dr. J. Henderson; Mr. E. O. Macpherson; Mr. F. J. A. Brogan (Secretary).

Mr. W. Donovan, recently retired from the position of Director of the Dominion Laboratory, was appointed to the Committee during the year.

The following is a brief review of the Committee's work. Further details are given in the Geological Survey and Dominion Laboratory sections of this report.

*Magnesite.*—A geological survey of deposits of magnesite at Takaka was completed and a map prepared. Although veins of pure magnesite occur, the deposit as a whole averages 50 per cent. of magnesite, and removal of the remainder of the constituents, chiefly talc and quartz, would be necessary to provide a grade of magnesite sufficiently pure for such purposes as the manufacture of refractories or metallic magnesium. Inquiries are being made as to possible methods of concentration.

*Serpentine.*—Further surveys of serpentine deposits in North Auckland were carried out by magnetic methods, and a special report was prepared on serpentine at D'Urville Island, where ample supplies of high-grade serpentine are available. At a later date special contour surveys of serpentine areas and soundings were taken at two localities at D'Urville Island which were selected as alternative sites for the development of the serpentine deposits as a source of supply for the manufacture of serpentine-superphosphate.

*Phosphate Deposits.*—A geological re-examination of the phosphate deposits at Clarendon was made for the purpose of determining the possibilities of increased production of phosphate to supplement available supplies. As a result of this survey, certain theories regarding the probable extension of the phosphate-bearing horizon were formed, and appropriate steps will be taken to test them.

*Sulphur.*—A method for the concentration of volcanic sulphur by steam treatment to approximately 99 per cent. purity was worked out at the Dominion Laboratory and shown to be suitable for commercial operation if a serious temporary shortage of imported sulphur-supplies should occur.

*Mercury.*—The Committee kept in close touch with the development of the mercury deposits at Puhipuhi by private enterprise, actual production of mercury having commenced during the year.

*Oil-shale.*—Further geological work on oil-shale deposits at the Nevis was carried out. A report on retorting tests with Orepuki shale carried out in Australia indicated that the high sulphur content would add considerably to the costs of producing petrol of normal sulphur content from it. As soon as the necessary drilling equipment can be released from essential work, it is planned to put down the bores at selected points to determine the depth of the Orepuki deposits.

*Refractories.*—Data were assembled regarding the nature and quantities of refractory materials being used and produced in New Zealand, with a view to determining the possibilities of increasing the use of local products.

*Copper.*—Copper occurrences at Kawau Island, where some copper was extracted many years ago, were examined by geophysical methods in an endeavour to trace the continuation of certain lodes, and recommendations were made for further prospecting by the Mines Department.

*Peat Wax.*—A geologist made a special survey of the peat deposits at Chatham Islands which contain a wax of potential industrial value. A considerable number of representative samples collected were found on examination at the Dominion Laboratory to contain an average of about 10 per cent. of wax. The wax, which was examined by the Imperial Institute some years ago, has properties somewhat akin to those of Montan wax extracted from German lignites, which is used for the manufacture of certain classes of polishes, moulded materials, &c. Samples of the wax extracted by benzol have been submitted to the Imperial Institute, London, and to selected commercial firms for report on its industrial possibilities, particularly as a substitute for imported materials now unavailable or in short supply.

*Mica.*—A geological reconnaissance survey was made of some mica occurrences of promising quality in South Westland, and arrangements are being made for organized prospecting.

*Clays, Talc, Diatomite.*—Further surveys of industrial clays of various types, talc, and diatomite have been carried out.

## WHEAT RESEARCH INSTITUTE.

*Advisory Committee.*—Dr. H. G. Denham (Chairman), Mr. F. R. Callaghan, Mr. C. S. Sapsford, Mr. R. B. Tennent, Mr. R. K. Ireland, Mr. R. J. Lyon, Mr. J. P. O'Connor, Mr. C. E. Boon, Mr. W. S. N. Rennie, Mr. G. R. Harker, Mr. W. W. Mulholland, Mr. J. Carr, Mr. P. R. Talbot, Mr. W. O. Rennie, Mr. G. Fleetwood. Director: Dr. F. W. Hilgendorf.

## WHEATGROWING PRACTICE.

The threshing returns from the harvest of 1941 were analysed and the results published. Cross 7, a wheat bred by the Institute, has now reached the position of being the most widely-grown wheat in New Zealand. For the harvest of 1941 it covered 8,000 more acres and yielded 800,000 more bushels of grain than Tuscan, its nearest rival. The quality of the flour made from Cross 7 wheat continues to be highly satisfactory.

Fife-Tuscan, another wheat produced by the Institute, was first distributed to farmers in 1940 and in that year 220 acres were sown. In 1941 the estimated sowings were 2,600 acres, so that it appears to be spreading satisfactorily.

Tainui, still another Institute wheat, is spreading rapidly in the Manawatu District. It yields somewhat better and is much more resistant to summer storms than Jumbuck, the standard variety for the district.

## PLANT-BREEDING.

The crop sown in the glasshouse in April, 1941, flowered in August; all the desired crosses were successfully made, and the seed was ripe in October. It was immediately sown in the open field, and ripened in March, so that two crops were procured in one year. The greenhouse crop was better than that raised in the preceding year.

Owing to the calls of the war on the staff it has been decided to restrict the plant-breeding work to what can be carried out by the reduced staff available.

## LABORATORY WORK.

(a) *Moisture Testing*.—The service offered to farmers and others in testing their wheat to see when it is ready to harvest or deliver to store has this year been used to the utmost. In response to various requests, branch stations were established at Blenheim, Ashburton, Timaru, and Temuka, apparatus being borrowed from millers and others to enable these stations to function. The long-drawn-out harvest necessitated an excessive number of moisture tests, the total number of determinations made up to 23rd March being 4,823, compared with 2,000 last year, and with about 3,000 in the busiest year previously experienced.

(b) *High-extraction Flours*.—Much experimentation was done on flours of extraction higher than the normal 70 per cent. to 72 per cent., in case a shortage of wheat developed under war conditions. If such a position arises, the Institute is ready with plans for making bread of reasonable palatability from flours of up to 85 per cent. extraction. The method adopted has developed from previous work on the destruction of glutathione, an injurious constituent of certain fractions of the wheat-grain.

(c) *Emergency Yeast-supplies*.—Much time was given to working out plans for bakers to make their own yeast, or to use specially dried yeast prepared by a modern process, in case the ordinary supplies of compressed yeast failed. Copies of the formulæ found to give the best bread were distributed to all bakers and to the Emergency Precautions Committees.

(d) *Meals and Biscuits for Overseas Forces*.—After suitable experiments had been made, recommendations were offered to the Food Controller to secure that these food products should remain in good condition after long periods of storage under adverse climatic conditions.

## FRUIT RESEARCH.

*Advisory Committee*.—Sir Theodore Rigg (Chairman), Dr. G. H. Cunningham, Messrs. W. Benzie, T. C. Brash, F. R. Callaghan, A. H. Cockayne, J. Corder, W. K. Dallas, A. Osborne, R. Paynter, F. S. Pope, A. M. Robertson, H. E. Stephens, L. W. Tiller (Secretary).

## APPLE.

(a) *Long-term Manurial Investigations*.—Further evidence is given by the experiments at the Government Research Orchard, Appleby, and by the Mildura blocks of the Cawthron Institute, that a "complete" mixture containing P, N, and K is essential for orchards on Moutere loam. Over the nine-year period that has elapsed since treatments were first applied at the Research Orchard, Dunn's Favourite trees under PNK treatment have produced an average of 20 lb. more fruit per tree per annum than the untreated control trees, Delicious 48 lb. more, Cox's Orange 53 lb. more, and Sturmer 114 lb. more. The absence of any of these three major constituents is attended by more or less serious consequences, but especially is this so if nitrogen is omitted.

In the main block of Cox's Orange at Appleby, nitrogen appears to have had some effect on the biennial-bearing habit of the variety; the control plots and those with PK were almost devoid of fruit in 1941, while the N plots and the PNK plots carried  $1\frac{1}{2}$  and  $2\frac{1}{2}$  bushels per tree respectively. Nitrogen must not be used unwisely, however; Jonathan trees receiving 4 lb. ammonium sulphate per tree per annum still remain over-vegetative, with fruit of poor colour and poor keeping-quality—disadvantages that more than offset any increase in yield.

On both Sturmer and Jonathan, plots without potash remain inferior in yield to those with potash, and show the characteristic deficiency symptoms. Jonathan trees receiving potash continue to bear fruits of enhanced red colour, and yield remains higher on these trees.

In the Mildura blocks of Jonathan, trees that had been for twelve years without manurial treatment have been given various fertilizer combinations for the past four years. Trees receiving NK are markedly inferior to trees getting NP, and show poor growth, bear small-sized fruit of poor finish, and tend to defoliate prematurely. These trees demonstrate that phosphate-deficiency symptoms can be found under field conditions as well as in pot cultural experiments. At the Research Orchard, also, the necessity for inclusion of phosphate in manurial programmes on Moutere loam is clearly shown in the yield increments produced when P is included separately from and together with N on the Sturmer variety. Increments over the untreated controls in the 1941 season are as follows: P, 37 lb. per tree, N, 54 lb. per tree, PN, 142 lb. per tree.

(b) *"Minor" Element Studies*.—The Cawthron Institute has continued its field and analytical work on magnesium deficiency, and has found that magnesium carbonate at 2 lb. per tree has proved the best corrective to apply, and is accompanied by an increase in the magnesium content of the

leaves. On the Sturmer variety, in the Braeburn area, Nelson, both dolomite and magnesium sulphate are now giving considerable improvement in condition of foliage, although in other localities soil dressings of magnesium have not been entirely satisfactory. Standard rates of application are 6 lb. dolomite per tree and 7 lb. Epsom salt per tree, but double these rates have proved more effective.

In analytical studies it has been found that under magnesium-deficient conditions the concentration of magnesium is about twice as great in tip leaves as in basal leaves of the current season's growth on the leader, whereas when supplies are adequate the distribution is fairly regular along this growth. Tip wood has approximately 50 per cent. more magnesium than tip leaves, but other wood has rather less than adjacent leaves. Calcium is highest in the oldest leaves, while potassium tends to be highest in the tip leaves. Improvements have been made in the technique for rapid demonstration of magnesium and potash deficiency by ashing leaves and spraying the ash with appropriate indicator solutions.

(c) *Rootstock Trials*.—Routine recording work has been maintained in all these trials at the Plant Diseases Division, the Cawthron Institute, and the Appleby Research Orchard. At Auckland the Docherty variety has been planted on twelve different stocks, including four aphid-resistant Merton stocks, in the hope of finding one superior to Northern Spy stock in resistance to root trouble in heavy, wet soils. At the Cawthron orchard a French Crab seedling as a stock for the Statesman variety is now showing signs of giving a higher yield than Northern Spy stock.

(d) *Varietal Trials*.—The Plant Diseases Division is finding that the fifteen strains of Delicious and nine of Cox's Orange, classified in earlier years, are maintaining their distinctive characters and can be regarded as fixed types. Two Delicious and one Cox are of higher colour than the standard types, and seem to be equal to the standards in quality. The apple varieties in the plantation now number sixty; and this will be increased to one hundred in 1942.

(e) *Plant Protection and Therapeutant Testing*.—The Plant Diseases Division has continued studies on the nature and control of late-spot of Sturmer and has found that nearly 90 per cent. of the infections are due to *Neofabraea malicorticis*. Summer Bordeaux sprays of weak concentration have again caused damage on the Sturmer variety in Hawke's Bay and cannot be recommended in this district. Colloidal sulphur alone, however, has again given Sturmers of excellent quality without causing foliage injury. Unfortunately, this precludes the use of early summer-oil sprays. At Appleby, reduction in Bordeaux injury has resulted from increasing the proportion of lime in the mix. In both districts Bordeaux substitutes have continued to cause more fruit and foliage damage than normal Bordeaux spray, and in Hawke's Bay the substitutes have failed to control black-spot of apple or of pear. On Delicious at Appleby, Bordeaux sprays applied before Christmas have given excellent fruit without causing foliage injury, and in combination with summer oil have controlled red-mite. Summer oils applied fourteen days after sulphurs in January have caused foliage injury.

Certified spray materials have all maintained their standard, and thirty-one are included in the latest Certification List.

The Cawthron Institute has received a consignment of woolly-aphis parasites from the United States of America, and will be testing them under laboratory conditions during the coming spring.

#### QUINCE.

Brown-rot of quince on specimens from Hawke's Bay was examined at the Plant Diseases Division and proved to be *Sclerotinia fructicola*, the same organism that attacks stone-fruits in the Dominion.

#### STONE-FRUIT.

(a) *Peach*.—Studies of the varietal aspects of susceptibility to brown-rot and leaf-curl have been begun by the Plant Diseases Division on its earlier planted material. Brown-rot incidence has not been at all uniform among varieties, but this may be due as much to weather at time of ripening as to inherent varietal differences in susceptibility.

(b) *Plum*.—*Bacterium pruni*, bacterial-spot of plum, has been isolated from plum-trees in Hawke's Bay, and proved to be the cause of a somewhat serious shot-hole disease of peaches in Auckland.

#### CITRUS.

*Rootstock Trials*.—The Plant Diseases Division tests of rootstocks for lemon and sweet orange have now reached the stage at which a considerable number of trees will be planted on the permanent trial areas during the next few months. Marked variations in the growth of Washington Navel on the different stocks have already been noted.

#### MISCELLANEOUS.

(a) *Grapes*.—The Cawthron Institute has found that a chlorosis of the leaves and an internal browning of the fruit grown in the Braeburn area can be controlled by the combined use of boron and potash, preferably with the addition of nitrogen and phosphates.

(b) *Hybrid Berries*.—Of several types growing at the Plant Diseases Division in Auckland, only the Youngberry—a hybrid between Phenomenal Berry and Mayes Dewberry—has shown promise of meriting extended study.

(c) *Sub-tropical Fruits*.—The Peruvian melon (*Solanum muricatum*) and several varieties of Japanese persimmon are being tested by the Plant Diseases Division. Seed of a large-fruited guava from Egypt has germinated successfully.

(d) *Raspberry*.—The Cawthron Institute has given further attention to the control of raspberry bud-moth, and has further evidence that oil sprays against the eggs give effective control in the early part of the season.

## FRUIT COLD STORAGE RESEARCH.

*Advisory Committee.*—Mr. W. K. Dallas (Chairman), Sir Theodore Rigg, Messrs. H. G. Apsey, W. Benzie, F. R. Callaghan, J. T. Cross, F. W. Grainger, H. C. Heays, J. L. Mandeno, A. Powell, A. M. Robertson, H. E. Stephens, and L. W. Tiller (Secretary).

## REFRIGERATED GAS-STORAGE OF APPLES.

The investigations of the Dominion Laboratory on the gas storage of Jonathan and Sturmer apples were advanced to the pilot-plant stage this year, and in addition a beginning was made with detailed, small-scale studies on the Granny Smith variety. Owing to continued delays in completion of the contract for construction of the two new gas-storage chambers, it was not possible to give the rooms adequate trial runs before they were put into service. The Jonathan chamber fell somewhat short of the required standard of gas-tightness, and on the Sturmer chamber the evaporator developed a leak that permitted an escape of methyl chloride into the room. Apart from methyl chloride injury to the Sturmer, the results bore out the earlier small-scale findings.

*Jonathan.*—Rather more than five hundred bushel cases were stored successfully for twenty-four weeks at a temperature of 41° F. in an atmosphere containing 5 per cent. to 6 per cent. carbon dioxide and 16 per cent. to 15 per cent. oxygen. Since the desired 8 per cent. carbon dioxide could not be built up, the fruit was marketed in early September. After fourteen days' further storage at room temperature there was 97 per cent. of good-quality, marketable fruit in the gas-stored sample, and 87 per cent. of softer and more yellow fruit in the cool-stored control sample. The marketable fruit from gas storage included 21 per cent. showing slight defect of one kind or other, whereas from the controls the amount was 33 per cent. Gas storage eliminated Jonathan-spot and reduced internal breakdown.

*Sturmer.*—A similar quantity of this variety was stored for thirty-seven weeks at 41° F. in 9 per cent. carbon dioxide with 12 per cent. oxygen. Although the methyl chloride injury nullified the commercial significance of the test, the gas-stored fruit otherwise had less core-flush, wilt, and fungus than the control fruit. The amounts of marketable fruit in the two samples (ignoring methyl chloride injury) were 92 per cent. and 79 per cent. respectively, including corresponding amounts of 27 per cent. and 43 per cent. showing slight defect at the 22nd December examination, made after the fruit had been held out of store for fourteen days at 68° F.

*Granny Smith.*—Temperatures selected were 35° F., 38° F., and 41° F. Carbon dioxide concentrations of 3 per cent., 6 per cent., and 9 per cent., with corresponding oxygen percentages of 18, 15, and 12, and also two sets of air-stored controls were provided at each temperature. The results indicated that a temperature of 35° F. or 38° F. with 3 per cent. carbon dioxide and 18 per cent. oxygen was the most satisfactory combination of the conditions selected; breakdown was almost eliminated, core-flush and fungus were at a minimum, and superficial scald was less than in the control lots. In view of the apparently low tolerance of the variety to carbon dioxide, it is possible that control of oxygen as well as of carbon dioxide would add considerably to the storage life of the Granny Smith.

## EFFECT OF FERTILIZERS ON COLD-STORAGE QUALITY OF APPLES.

Cold-storage studies were maintained as part of the long-term manurial experiments at the Appleby Research Orchard, and following are the main points noted for each variety:—

*Cox's Orange Pippin and Dunn's Favourite.*—Crops on these two varieties were exceptionally light, and the storage samples were too small and variable to give reliable data.

*Jonathan.*—Breakdown was increased in proportion to the amount of nitrogen used in the fertilizer application, and fungus was increased when the quantity of nitrogen was large. Potash again reduced susceptibility to breakdown and fungus, but increased Jonathan-spot incidence.

*Delicious.*—Manurial treatments had no influence on the incidence of breakdown, fungus, pit, scald, or wilt.

*Sturmer.*—Internal breakdown and fungus were both increased by nitrogenous dressings, but phosphate counteracted this adverse result. Nitrogen and potash both seemed to increase scald susceptibility.

## COLD-STORAGE ASPECT OF SPRAYING EXPERIMENTS.

With both Jonathan and Sturmer, losses through attack by fungi were considerably less in Bordeaux-sprayed fruit than in lime-sulphur-sprayed fruit.

## CONTROL OF WILT IN WINTER COLE PEARS.

Wilt was reduced to a very small amount in cold-stored Winter Cole pears by the use of waxed-paper liners inside the boxes. The maturity of the fruit did not seem to be materially advanced by the treatment, and the losses from fungi were only slightly increased. On balance the treatment definitely proved economic.

## ORCHARD STORAGE OF APPLES.

This investigation was continued through the co-operation of the Internal Marketing Division and the Department of Agriculture. The economic storage-life of all varieties tested was materially shorter in 1941 because of the continuance of high temperatures late into the autumn. The tests emphasized the advantages of a store that gave a low fruit-temperature. Only the most significant findings can be given here.

*Ballarat.*—The commercial storage-life of the variety was ended by mid-June, owing to yellowing of the ground colour, and at this date there was practically no waste in any of the stores.

*Washington.*—Superficial scald was the main cause of loss, and was much more severe in the high-temperature stores.

*Rome Beauty.*—The fruit kept without loss till mid-June, when texture began to soften.

*Statesman.*—The low-temperature store gave slightly better results than the other stores. A very early picking, on the 26th March, suffered severely from fungus. Bordeaux-sprayed fruit was more resistant to rots than lime-sulphur-sprayed fruit, but Bordeaux injury to the lenticels of this variety seemed to make these areas liable to fungous attack.

*Granny Smith*.—Oiled wraps round every apple again substantially reduced the severity of ripe-spot, and also this year gave an appreciable control of superficial scald.

*Sturmer*.—A very extensive series of trials showed that although a waxed-paper case-liner controlled wilt fairly effectively it accelerated the ripening of the fruit and increased the losses from ripe-spot, chiefly *Neofabraea malicorticis*, in the lenticels. The use of such liners is not recommended for orchard storage. The low-temperature store again gave the best results, and early-April pickings kept better than late-April pickings. Early-picked fruit sprayed with summer-strength Bordeaux developed less ripe-spot and other fungi than lime-sulphur-sprayed fruit.

*Docherty*.—Scald was again confined to the uncoloured portion of early-picked fruit. For long holding, only very well coloured fruit of early picks should be stored. Fruit picked later, about mid-May, kept almost free from scald but developed some ripe-spot.

*Tasma*.—In all stores the variety kept in good condition without loss till the end of August.

## TOBACCO RESEARCH.

*Advisory Committee*.—Messrs. L. J. Schmitt (Chairman), F. R. Callaghan, W. K. Dallas, N. J. Adamson, H. L. Wise, C. C. Nash, E. M. Hunt, F. A. Hamilton, B. T. Rowling, J. F. Balck, and Sir Theodore Rigg.

Four meetings of the Tobacco Research Association Committee were held during the year. Further progress has been made at the Tobacco Research Station by the purchase of implements; additional buildings have been erected, including a 16 ft. by 16 ft. commercial kiln; additional quarters provided for casual workers; and the grading and bulking sheds have been enlarged.

Mr. R. Thomson, appointed Director of the Station in April, 1941, was then sent to Canada and the United States of America where every facility was granted to him for the study of the flue-cured-tobacco industry in these two countries. He returned to New Zealand early in December, and took up his duties as Director of the Station about the middle of that month. During his absence Sir Theodore Rigg acted as Director of the Station.

## WORK AT THE RESEARCH STATION, RIWAKA.

The tobacco crop from the 1940–41 season was the best crop yet handled at the Tobacco Research Station, 12 acres of tobacco producing 11,337 lb. of cured leaf. The quality was good, and no difficulty was experienced in the sale of the tobacco, an average price of 2s. 0½d. per pound being obtained for the whole crop.

Rather cold weather was experienced at the commencement of the 1941–42 planting season, and growth of tobacco was retarded until the middle of January, when rain and warmer weather were experienced. Dry weather in February affected the development of the crop, and brought about a rapid ripening of the leaf. It was fortunate that the new 16 ft. by 16 ft. kiln was ready, otherwise great difficulty would have been experienced in handling the ripening tobacco. Good progress was made with harvesting during February, enabling this to be completed prior to Easter. The crop, although much freer from mosaic, was not quite as heavy as in the previous season.

*Fertilizer Experiments*.—An experimental programme on somewhat similar lines to the previous season was conducted at the Station during the 1941–42 season. Field observations have indicated (1) that the heaviest application of standard fertilizer gave the highest yield and the darkest leaf; (2) the importance of nitrogen, in that the plots without nitrogen were poor in colour and inferior in growth and quality; (3) in a rotation, tobacco taken after oats was definitely darker in colour and gave slightly better growth than that from the continuous tobacco plots; (4) the importance of some of the fertilizer being placed within easy reach of the root system was again demonstrated; (5) that wider planting within the rows on coarse sandy soil was associated with better growth and bigger leaf production; (6) that tobacco seedlings transplanted from boxes enabled the tobacco to get away without much retardation, and to ripen at least three weeks earlier than plants transplanted from the seedling beds.

*Mosaic Investigations*.—A comprehensive series of experiments was conducted at the Station during the past season in an endeavour to ascertain what factors were associated with the incidence of initial mosaic in the field.

In the conduct of the mosaic experiments every care was taken to prevent introduction or transference of mosaic in the seedling beds. Generally speaking, the amount of mosaic, both in the seedling beds and in the field, was low until the end of December. In some experimental blocks the amount of initial mosaic was under 5 per cent., while perhaps 10 per cent. would represent an average for the Station grounds. Owing to the low incidence of mosaic, many of the experimental plots failed to show any striking differences due to particular treatments. The more important points emerging from the investigations were—

- (1) Apparent increases in the amount of mosaic in the case of plants obtained from seedling beds with heavy applications of manure. This was more striking in the pricked-out seedling beds than with bed-sown plants;
- (2) The association of higher percentages of mosaic in the field with certain manurial treatments;
- (3) The absence of any important differences in the amount of mosaic due to using soils of different texture for the seedling-bed work;
- (4) The absence of any significant differences in initial mosaic when tobacco plants were planted on areas where the previous crop had been pulled or alternatively disked in.

*Seed-production*.—One hundred lines of Harrison's Special variety were grown from seed saved from selected plants of the previous season. These lines covered selections of Harrison's Special grown by the three principal manufacturing companies. In addition, about seventy-five lines of "C" variety grown from seed harvested from selected plants of the previous season were planted out.

## WORK AT THE CAWTHRON INSTITUTE.

(1) *Soil Survey of Tobacco Lands*.—Owing to the calling-up of staff for the armed forces, it was found necessary to curtail and then finally suspend the soil surveys which were in hand. In the early part of the season soil mapping was continued at Lower Moutere, and a preliminary examination was made of Takaka soils with a view to carrying out a detailed soil survey of the Takaka district in relation to tobacco culture. The preliminary survey of Takaka showed that the area of light soils was largely restricted to the alluvial land of the river, much of which was subject to flood. Soil and tobacco maps covering Motueka, Riwaka, and the Motueka and Dovedale valleys have been prepared.

During the past season it was not possible to check up on the exact distribution of tobacco, but the following summary shows the approximate position as compared with the 1940–41 season :—

| District.                         |    |    |    |    |    |    |    | Acreage,<br>1940–41. | Acreage,<br>1941–42. |
|-----------------------------------|----|----|----|----|----|----|----|----------------------|----------------------|
| Motueka and Riwaka                | .. | .. | .. | .. | .. | .. | .. | 1,690                | 1,794                |
| Motueka River valley              | .. | .. | .. | .. | .. | .. | .. | 428                  | 505                  |
| Dovedale-Thorpe                   | .. | .. | .. | .. | .. | .. | .. | 275                  | 201                  |
| Stanley Brook, Tapawera, Motupiko | .. | .. | .. | .. | .. | .. | .. | 241                  | 231                  |
| Wakefield sector                  | .. | .. | .. | .. | .. | .. | .. | 178                  | 282                  |
| Orinoco Valley                    | .. | .. | .. | .. | .. | .. | .. | 52                   | 32                   |
| Upper Moutere sector              | .. | .. | .. | .. | .. | .. | .. | 71                   | 60                   |
|                                   |    |    |    |    |    |    |    | 2,935                | 3,105                |

(2) *Sand-drown or Magnesium Deficiency*.—In the past season, five experimental areas located at Thorpe, Umukuri, and Graham Valley were established to examine influence of ground dolomite and ground magnesite in the control of magnesium deficiency.

On only one area (at Thorpe) was sand-drown definitely seen during the season, and on this experimental area all magnesium treatments gave satisfactory control of the trouble. On the other experimental areas, although no symptoms of sand-drown developed, the magnesium-treated areas showed a darker green in the leaves of the tobacco plants.

(3) *Moisture Uptake of Tobacco*.—A comparison of United States of America and New Zealand samples shows a surprisingly rapid increase of moisture uptake for tobacco samples when the humidity rises above 70 per cent. American samples gave slightly higher figures at 100 per cent. humidity, but at lower percentage humidities New Zealand samples gave rather bigger figures for moisture uptake than the American samples.

(4) *Chemical Composition of Cured Leaf*.—A large number of samples of cured leaf of varying type and origin has been analysed for sugar, nitrogen, and mineral content. Where the fertilizer applications ranged from 600 lb. to 1,200 lb. per acre the analytical data showed little difference in total reducing sugars or nitrogen content for tobacco samples under the different treatments. Total ash, lime, magnesia, and potash content were highest with the largest dressing of fertilizer.

A series of ten samples of North and South Carolina and of Virginian leaf comprising cutter leaf and lug grade, on analysis showed that the cutter grades were appreciably higher in glucose contents and often higher in fructose than the other types of leaf. The top cutter grades were also high in sucrose. Nitrogen content was relatively low in these grades. The sugar-nitrogen ratio clearly demarcated the cutter grades from the leaf and lug grades. These two latter grades showed an average of 2 per cent. nitrogen, against 1.45 per cent. for cutters, and were low in reducing sugars. Good samples of New Zealand leaf compare favourably in chemical composition with corresponding American samples.

Examination of Nelson samples of cured leaf for sugars, nitrogen, and minerals has shown that very great differences occur in the composition of tobacco leaf. It has been shown previously that tobacco leaf of high grade has a high reducing sugar content and a relatively low nitrogen content. There is new evidence that relatively high sugar content is also associated with high-quality tobacco. New Zealand leaf compares favourably with corresponding American leaf in these constituents. In so far as the mineral composition of New Zealand leaf is concerned, it appears to have a higher ash content than is considered desirable by American authorities. While some New Zealand leaf fall within the limits shown by American samples, many are considerably higher in ash.

(5) *Disease Survey*.—During the early part of the season, visits were paid to nurserymen growing commercial tobacco seedlings on behalf of the companies. The incidence of damping-off fungi was carefully watched, and assistance was afforded nurserymen in their control measures.

On the whole, mosaic has not been severe this year, though several exceptions, particularly in the Motueka-Riwaka area, were noticed. Foot-rot under field conditions was seen in several areas at different times during this season. This trouble generally follows the occurrence of damping-off or foot-rot of the *Sclerotinia* type in the seedling beds. Isolated cases of wilt were noticed in the Upper Motueka Valley.

(6) *Tobacco Seed Germination Tests*.—Eighteen lines of seed have been tested at the request of different manufacturers.

With a view to accelerating the germination of lines of tobacco seed, tests were carried out on the value of intermittent heat and of cold pre-treatment before incubation. Intermittent heat gave very satisfactory results, and increased the germination of a poor line of seed from 59 per cent. to 93 per cent. by the fourteenth day. Cold pre-treatment from one to three weeks gave somewhat similar results in improving the germination of immature seed.

## TIMBER PROTECTION RESEARCH.

*Timber Protection Research Committee*.—Mr. L. E. Brooker (Chairman), Mr. R. L. Andrew, Mr. F. R. Callaghan, Dr. G. H. Cunningham, Mr. R. L. McPhail, Dr. D. Miller, Mr. E. H. Walden, Mr. N. A. Marris, Mr. A. F. Clark (Secretary).

The following is an account of the work which has been carried out during the year :—

## DOMINION LABORATORY.

During the year the Laboratory carried out such chemical work as was required by the Timber Protection Research Committee. Many samples of wood were examined to ascertain the depth of penetration of certain copper compounds.

## ENTOMOLOGY DIVISION, PLANT RESEARCH BUREAU.

The researches projected for the year were of necessity curtailed, and the activities have centred round (1) the identification of termites in the Auckland and New Plymouth region; (2) the study of the systematics of the insects; and (3) the biology of native species. The identification of termites is a routine activity in relation to the administration of the Termites Act. The results show a wide distribution of Australian termites: Onehunga, Epsom, Mount Roskill, Mount Eden, Great North Road, Remuera, Mount Albert, Point Chevalier, Herne Bay, and One Tree Hill; while at New Plymouth an interesting reinfestation is recorded. The systematic study of the Australian termites reveals that several additional species occur in New Zealand. Further, there are certain groups of "species" that are apparently biologically the same though specific from the systematists' point of view. It is here that the clear identity of the forms or "species" breaks down. The outcome of this phase of the work is reaching a stage where a publication of the results can be made. A certain amount of work, from which valuable data have been secured, has been carried out on the biology of the native termites. The studies so far have been made on termites infesting buildings, but a study of the insects under field conditions has been inaugurated.

## PLANT DISEASES DIVISION, PLANT RESEARCH BUREAU.

Work has again mainly been directed towards determining a standardized method for toxicity tests of products used to control fungous and insect diseases of timber.

*Testing of Fungicides.*—It has proved a difficult matter to secure satisfactory conditions for block tests with wood-rotting fungi. However, experiments have been carried sufficiently far to enable work to be commenced on this phase.

*Testing of Insecticides.*—Dowel tests with *Ambeodontus* have been progressing favourably until recently, when a parasite injurious to the larvæ appeared and upset results. Difficulty is still being experienced in breeding large numbers of *Anobium* in the laboratory as a preliminary to using this species for test purposes. Treatment of subterranean termites has now been taken over by the State Advances Corporation. Experiments are being carried out to ascertain if treated and untreated "Pinex" wallboard is resistant to native drywood termites.

*Testing of Therapeutants.*—A method has been devised to test the length of time a certain therapeutant will remain in selected timbers. A new method has been devised for measuring penetration of petroleum oils into woods.

## STATE ADVANCES CORPORATION.

The State Advances Corporation has concentrated upon field investigations of timber-infesting insects and fungi, the field application of termite control, and the field application of wood preservatives.

*Termite Control.*—Under the Termites Act, 1940, the application of chemical measures to control foreign termites is the responsibility of the State Advances Corporation. The work, however, in the initial stages was placed in the hands of the Plant Diseases Division, which was engaged in developing a technique for the application of arsenic dust. Most of the early termite treatments were carried out by the Plant Diseases Division in collaboration with the State Advances Corporation, but in the middle of 1941 the treating technique was found to be giving satisfactory results and the whole of the chemical control work was taken over by the Corporation. The Corporation, however, continues its very close co-operation with both the Plant Diseases Division and the Entomological Division in all termite-control work. Special attention is being paid to the biology of Australian termites, and numerous specimens and colonies are supplied from time to time to the Entomological Division for study. In addition, both the Entomological Division and the Plant Diseases Division co-operate with the State Advances Corporation in field studies, both biological and those connected with the application of poison dust. Although the control of termites is a function of the Minister of Housing, its work is closely connected with this Committee, and it is not out of place to mention that some 230 individual infestations have been treated to date and there is every indication that a very large measure of success has been obtained.

*Native Termites.*—The Corporation is particularly anxious to obtain further information regarding the biology of native termites. Field studies which have been conducted show that the incidence of native termites in some portions of Auckland is very high and considerable damage is being done. In co-operation with a commercial concern a new method of chemical control for native termites has been planned, and the early trials which have been conducted appear to be promising. The method, however, is fairly costly, and it is hoped that some modification may be adopted which will reduce this cost.

*Ambeodontus tristis.*—This house longhorn continues to engage the attention of the Corporation, and cases have been found in which houses which have been erected for a few months only have yielded infested timber. Unfortunately, this insect attacks heartwood as well as sapwood, and it is often the more valuable timber which is damaged by this beetle.

Supplies of insects have been obtained from time to time for the Entomological Division and the Plant Diseases Division.

*Fungi.*—Field information upon the incident of wood-rotting fungi in houses, especially in relation to the type of house construction involved, is still being obtained.

*Wood-preservation.*—The application of wood-preservatives on a field scale is still proceeding. In order to gain information regarding the penetrability of the commercial species of New Zealand timber by water-soluble wood-preservatives under pressure, arrangements have been made with the Forest Products Division of the Commonwealth Department of Scientific and Industrial Research to have a series of pressure impregnation tests carried out in Melbourne. Supplies of the main commercial species of timber have been obtained, kiln dried to the correct moisture content, and shipped to Australia. It is expected that the results of the tests will be to hand in the near future.

## LEATHER AND SHOE RESEARCH.

Director: MR. P. WHITE. Assistant Director: MR. F. G. CAUGHLEY.

## LEATHER RESEARCH ASSOCIATION.

*Advisory Committee.*—Messrs. A. E. Lawry (Chairman), C. Arlington, J. E. Astley, S. L. Wright, R. L. Andrew, and F. Johnson.

The main object of the Leather Research Association is to obtain information on the fundamental processes of leather-manufacture and by the application of this knowledge to help the tanners to maintain and further improve the quality of the leather produced. The importance of this knowledge is realized when processes which have been balanced over a number of years have to be modified to suit conditions which are enforced by the war. In spite of the intensified difficulties of manufacture during the past year, the quality of leather produced in New Zealand, both sole and upper, has been fully maintained.

The materials used in the manufacture of leather, apart from hides and lime, are mostly imported. It is essential, therefore, that waste of these materials should be reduced to a minimum in order not only to reduce shipping-space, but also to conserve the materials themselves. From time to time investigations have been carried out with this object in view.

*Storage of Hides.*—Certain changes have been found to take place in hides when stored. If the conditions of storage are reasonably good, it has been established that these changes are not detrimental from the point of view of leather-manufacture.

*Crackiness and Stretch of Upper Leather.*—During the year the lastometer has been used to investigate the crackiness and stretch of upper leather. The effect of the different processes, both wet and dry, on these qualities has been determined.

*"Feel" of Upper Leather.*—In many factories the "feel" of upper leather is dependent on the colour. This has been shown to be associated with the acidity of the dye or dye-bath in relation to the fat-liquoring process.

*Thickness of Upper Leather.*—The effect of processes on the thickness of the leather has been determined. Quality in leather is a summation of many properties; if one is accentuated, then it may be at the expense of one or more of the other properties. If the thickness of upper leather is increased by pressing, then fullness and feel are improved but the leather is made more stretchy and the area is decreased.

## SHOE RESEARCH ASSOCIATION.

*Advisory Committee.*—Messrs. W. Denby, P. E. Edwards, U. S. Livingstone, D. MacDonald, and R. L. Andrew.

During the past year the footwear industry has been confronted with many difficulties. Many materials used have become unprocurable and substitutes have had to be used, and problems have been encountered in the change-over from civilian to military footwear. That so many of these manufacturing problems have been submitted to the Research Association for investigation and help is an indication of the confidence of the industry in the Association.

Information has been obtained and circulated on the following:—

*Factory lighting* in relation to output, comfort of workers, and economy with special reference to fluorescent lighting.

*Factory ventilation* in relation to those parts where toxic substances, chiefly solvents, are used.

*Drying-chambers* in connection with the drying of shoes in the process of manufacture.

*Adhesives.*—One of the great problems of the industry has been in connection with adhesives. The supply of solvents both for nitrocellulose and rubber adhesives has been short. The questions of conservation of supplies and the use of substitute solvents have involved a large amount of work during the year. In addition, the compounding of other adhesives with rubber latex to impart certain required characteristics to it and also to conserve supplies has been investigated.

*Factory Visits.*—In view of the greater number of problems submitted for investigation, the visits to the factories have been of especial interest. It would appear from the personal contacts made on these visits that the Research Association has fulfilled a very useful function during the year.

*Monthly Circular Letters.*—The interest of the industry in the activities of the Research Association has been fully maintained by the continuance of the monthly circular letters, in which are described the work being carried out and other topics of interest.

## NEW ZEALAND WOOL MANUFACTURERS' RESEARCH ASSOCIATION.

*Wool Manufacturers' Research Association Committee.*—Mr. W. R. Carey (Chairman), Professor H. G. Denham, Mr. T. E. Donne, Mr. H. Lee, Dr. R. O. Page, Mr. T. C. Ross, Mr. W. L. Wood, Dr. E. Marsden (Secretary).

*Director.*—Professor F. G. Soper.

## WOOLLEN BATCHING OIL MILL TRIALS.

In the woollen industry the type of oil used as a lubricant on the fibres plays an important part in the satisfactory processing of the wool. That the processes can be appreciably affected by the characteristics of the oil added to the wool is readily understood when it is realized that the addition of as much as 12 per cent. on the weight of wool of lubricant is sometimes deemed necessary. Two further mill trials have been carried out in which a number of oils, including neatsfoot and oleine and several blends, some of which contained high percentages of mineral oil, have been compared. It has been possible to include for comparison with the New Zealand lubricants two well-known imported oils. During the trials the carding, spinning, scouring, and piece dyeing are the processes on which attention is concentrated. Afterwards in the laboratory, on representative samples of yarn and fabric, numerous physical and chemical tests are carried out. Samples of yarn are also subjected to storage tests. The trials are showing certain oils, not necessarily the more expensive ones, to be far superior in all-round performance to others.

During a mill trial much information is collected concerning the different processes, and when this is presented in a comparative form with that from other trials it provides the members with information concerning the relative efficiency of their own processes.

Reports of the trials are circulated to all members.

## UNSHRINKABLE TREATMENTS.

A comprehensive comparison of the Freney-Lipson unshrinkable treatment with various wet chlorination processes carried out in members' mills is nearly completed. For this comparison, representative samples of most knitwear produced in the country were sent, as a result of a kind offer received from Dr. I. W. Wark, to the Council for Scientific and Industrial Research (Australia) to receive the alkali treatment. Other samples from the same material were, when possible, treated by the industry, and still further samples were left untreated. Shrinkage and various chemical tests for damage have been carried out on all the fabrics. Tests on the comparative resistance to bacterial attack of these fabrics are in progress. This work is being undertaken in the Bacteriological Department of the University of Otago, under the direction of Professor C. E. Hercus. Individual reports are to be sent to each member concerning his own fabrics, and a general report is then to be prepared for the benefit of all members.

Many shrinkage and other tests for severity and evenness of treatment have also been carried out for the industry, and assistance has been given at certain mills to establish better methods of control.

## INFLUENCE OF HAIRINESS ON PROCESSING.

In this work, which is being carried out in collaboration with Dr. P. R. McMahon, it is intended to compare the processing properties of two lots of specially-selected crossbred wool differing only in a slight degree of hairiness. Tops have been made, and they are now ageing prior to the spinning, weaving, &c. The New Zealand Wool Council made a grant to the Association for the financing of this investigation.

## OTHER ACTIVITIES.

A large variety of problems has been handled in the laboratory in addition to those relating to unshrinkable treatments, which have been the greatest in number. Others of major importance have related to stains and dyeing and many of the type necessitating extraction tests for grease, oil, and soap residues. Several fabric faults of a physical nature and a number of samples for analysis of products used by the industry have been submitted.

In addition to the quarterly bulletin which is sent to all members, a bi-monthly report giving details of the work handled by the Association during the preceding period is now circulated. Members are invited to ask for further information on any problem reported in which they are specially interested. In this way the industry is kept in very close touch with the work being done by the Association.

All members have been visited at least once during the year. One committee meeting has been held, and a report of research activities was discussed at the annual meeting of the Woollen-mill Owners' Association.

## RESEARCH WORK AT AGRICULTURAL COLLEGES.

## CANTERBURY AGRICULTURAL COLLEGE.

## WOOL METROLOGY LABORATORY.

Dr. P. R. McMAHON.

*Measurement and Grading Techniques.*

Further studies have been made of the repeatability of subjective methods of wool judgment, as used in animal selection and in wool-classing. Statistical analyses have shown that for count, character, and staple length, judgments made by any one observer are satisfactorily consistent, although it is difficult to eliminate personal equations with different observers when seeking fine discrimination.

*Environmental Studies.*

In extending work reported last year on non-genetic effects on wool growth, some five hundred Corriedale sheep of the Kirwee Experimental Farm flock have been examined for fleece characterization. Differences have been shown to be associated with the various nutritional treatments, and by courtesy of the Department of Agriculture samples have been collected for determination of clean scoured yield. As the nutritional status of these sheep is accurately known, it is hoped that this co-operation will permit detailed examination of points raised on an extensive scale using the survey technique.

*Wool Survey.*—Using rapid visual techniques and a simple weighing-apparatus, data on a further twenty-seven thousand fleeces have been collected during the last season in about twenty-five different localities spread over Hawke's Bay, Taihape, Manawatu, and Canterbury. Briefly, the main aim of this survey is to determine which counts and types of wool give the most efficient wool-production, as judged by high fleece weights and high gradings for character, on different environments. It is already evident that the tentative conclusions reached last year will be confirmed and extended. Results for wool character, for instance, in the different count and type groups appear to be following the general trends outlined for gross fleece weight. Particularly important is the mounting evidence that a number of flock-owners on more productive North Island areas are decreasing their average wool-production appreciably by growing a high proportion of fleeces finer than 48's count; nevertheless, counts of 44's and stronger, and Romney wools tending towards the Leicester, only give high fleece weights when environmental conditions are good. Similarly, under some Canterbury conditions no increase in weight was found with wools stronger than fine Romney (43's to 50's count), while in a Corriedale flock the maximum weight was found with 54's. Finally, on high-country stations in Canterbury with half-bred sheep only the very fine counts seem to give fleece weights which are appreciably lower than the flock average, but here no final conclusions can be drawn until the results of scouring tests for the different counts are available. Results for Canterbury are put forward merely in illustration and with reserve, because possible effects of strain differences cannot be evaluated over the small number of flocks examined.

*Genetic Investigations.*

Detailed analyses of observations made on Romney stud flocks in the North Island are practically completed. While these clearly indicate the importance of non-genetic factors and the ineffectiveness of mass selection of parents in influencing the grade of certain economic characters, such as fleece weight and fleece character, of offspring, other characters such as count and type may be passed on relatively strongly to the next generation. For the former features the progeny test is essential as a basis for selection if rapid improvement above the level of the breed is to be achieved.

*Effect of Mild Hairiness on Wool-manufacture.*

Physical measurements have been completed on raw wool samples from the test lots in the manufacturing experiment being carried out in collaboration with the Wool Manufacturers' Research Association. No important differences in behaviour have been reported at the top stage, although samples of the two tops, like the raw material, show small but perceptible differences in handle and appearance.

## SHEEP-DIPPING TRIALS.

During the past twelve months the work has been carried on under the ægis of Canterbury Agricultural College with financial assistance from the Department of Scientific and Industrial Research and the New Zealand Wool Council.

In September, 1941, it was considered that the work had progressed to such a stage that some of the information could usefully be published. Trials revealed that  $\frac{1}{2}$  lb. of ground Derris of 5 per cent. rotenone content to each 100 gallons of water gave satisfactory control of ticks and lice in sheep, a result which persisted for a period of up to three months.

## SUBTERRANEAN-CLOVER INVESTIGATIONS.

The third grazing season was completed on 30th March. In the spring the growth of the clover herbage was very good and one series of plots was closed for hay. The yield of hay was about  $1\frac{1}{2}$  tons per acre and it is hoped to winter the stock with the aid of the hay produced on the area. This will be the first season that this has been possible.

The treatments concerned are :—

Treatment A : 1 cwt. of super one year, alternating with 5 cwt. lime the succeeding year, and so on.

Treatment B : 2 cwt. super annually (no lime).

Treatment C : 1 ton lime (initial) and 2 cwt. super annually.

Treatment D : 1 ton lime (initial) and 2 cwt. super plus  $\frac{1}{2}$  cwt. potash annually.

The stock carried on each treatment during the three years is as follows :—

|      | First Year.       | Second Year.      | Third Year.        |
|------|-------------------|-------------------|--------------------|
| A .. | 1.0 ewes per acre | 1.3 ewes per acre | 1.6 ewes per acre. |
| B .. | 1.3 „             | 1.2 „             | 1.2 „              |
| C .. | 1.6 „             | 1.7 „             | 1.8 „              |
| D .. | 1.6 „             | 2.1 „             | 2.3 „              |

The normal carrying-capacity of this class of land under the old system of farming—*i.e.*, with temporary grass and cultivation for rape, green feed and turnips—was approximately 0.75 ewes per acre.

The results of the third grazing season confirm and supplement the indication from the previous seasons, and may be summarized as follow :—

- (1) Lime and super in combination gives best results :
- (2) The relatively light application of 1 cwt. of super one year alternating with 5 cwt. of lime next season and so on—*i.e.*, treatment A—is nearly as effective as the heavier and more costly treatment of 1 ton of lime (initial) and 2 cwt. of super annually—*i.e.*, treatment C :
- (3) One-half hundredweight of potash annually in addition to lime and super—*i.e.*, Treatment D—has given a marked increase in production :
- (4) There is evidence of a gradual accumulation of fertility of the soil under the fertilizer treatments as measured by the increase in numbers of stock carried :
- (5) Subterranean-clover pasture adequately top-dressed provides an alternative method of farming light plains land at a higher level of production than the older method of temporary pasture with cultivation for supplementary feeds with its high labour and cultivation costs.

## ANIMAL PRODUCTION RESEARCH.

DR. C. P. McMEKAN.

*Pigs.*

(a) *Inbreeding Studies.*—This work has continued with the Cambridge White and the original population considerably increased ; the Tamworth strain is now well established and yielding promising results. The development of a “ new breed ” combining the red colour of the Tamworth with the body characteristics of the Large Whites is proceeding satisfactorily, and F3 inbred litters indicate that the red colour is recessive and accordingly capable of fixation in the cross.

(b) *Nutrition.*—Pigs have been fattened very successfully to the porker stage on a complete ration of Ceresan-treated barley without any harmful effects. This material is frequently available and represents a loss to farmers unless it can be fed to stock.

*Sheep.*

(a) *Growth Studies.*—Measurement data on over one thousand lamb, hogget, and ewe carcasses provide a basis for a survey of the carcass quality of Canterbury sheep and of the factors affecting it. Complete dissection data on all types are being accumulated to provide a foundation for future survey and experimental studies. An investigation of transit losses in fat lambs indicates that the time interval

between farm and slaughter is the major factor affecting carcass losses and that transport by rail suffers in comparison with motor-lorry only in so far as this time interval is lengthened. In a hogget wintering experiment (in association with the Animal Research Division, Department of Agriculture) it was shown that differences in the plane of nutrition produced differential effects upon bone, muscle, and fat greater than indicated by live- or carcass-weight differences.

(b) *Breeding*.—Practical problems involved in progeny testing sheep have been studied, with particular reference to the carcass- and breed-type aspect (in association with Dr. McMahon). Results show considerable promise of practical application. An attempt is in progress to establish an inbred line of Romneys for experimental purposes. Vitamin C (ascorbic acid) therapy has been tried in respect to sterile rams showing poor motility and/or morphological abnormalities of sperm, with negative results. Hormone therapy (testosterone) in a suitable subject has given good results. It is hoped to breed from such "sterile" animals in an attempt to investigate the inheritance of sterility and to assess the potential dangers of therapeutic treatment of sterility to future generations. In association with Professor K. Wodzicki, of the University of Warsaw, a study of the thyroid glands of New Zealand sheep has been commenced and a preliminary survey completed. Considerable variation in the thyroids of lambs reared under the same conditions has been demonstrated.

#### Cattle.

(a) *Identical Twins*.—A preliminary attempt to locate identical twins in cattle to provide material for experimental study has been unsuccessful. Some twenty pairs of heifer calves were examined on a basis of nose print, hair whorls, supernumerary nipples, and coat colour.

(b) *Hormones*.—A preliminary investigation, in association with the Otago Medical School, of the possibility of manufacturing pituitrin for medical purposes has yielded very promising results. In both the oxytocic and vaso-pressin principles the powder prepared has given assay results comparable with normal commercial products.

### MASSEY AGRICULTURAL COLLEGE.

#### SHEEP-NUTRITION EXPERIMENT.

Professor G. S. PEREN.

*Wool Characters*.—As in the previous year, the ewes were shorn by treatment groups and the following fleece characters judged and allocated a value on a scale of 1-7: Handle, lustre, back, staple, crimp, type, colour, tip, fleece as a whole, soundness. In addition, count was estimated, staple length, at mid-side, measured to the nearest  $\frac{1}{2}$  in. Each fleece was weighed and sampled for yield at the mid-hip position.

Analysis of the year's results has not been completed, but it is indicated that there are no very striking differences between treatments. A determination of the hairiness of each fleece has been made by the fleece-testing department in samples taken in the usual manner just prior to shearing.

*Fat-lamb Data*.—This year each lamb was slaughtered when approximately 70 lb. live weight and when it was estimated that the carcass weight would be 34 lb. This proved to be an improvement on killing at a definite live weight, as was done last year, and resulted in less variation in carcass weight. The mean carcass weight was 34.57 lb.

*Foot-rot*.—There have been no cases of foot-rot in the last twelve months. This subsidiary trial has been most successful.

*General Health*.—As a result, presumably, of very careful shepherding and a regular diet, the mortality in the experimental animals has been well below normal, and general health as indicated by freedom from troubles and by "bloom," exceedingly good.

#### PIG RESEARCH.

Mr. M. M. COOPER.

*Inheritance of Length in the Tamworth Breed*.—This long-term project has been continued during the year 1941-42 and considerable progress has been made in the fixation of long and short strains by inbreeding. The progeny of the long-type boar, Burleigh Chief, from matings with long-type sows had an average carcass length, measured from the first rib to the aitch-bone, of 740.6 mm. The mean carcass length of progeny of the original short boar, Massey King Luna, when mated to short sows was 726.2 mm. This difference was highly significant, but there was no significant difference between the two sets of carcasses in respect of leg length and thickness of back fat.

A selection of sows was made in the progeny of Burleigh Chief from sows which had proved themselves to be breeders of long pigs, and these have been mated to a son of Burleigh Chief, Massey Chief Dick, whose dam consistently produced carcasses of greater than average length. The average length of baconers from these matings is 745.0 mm. This compares with a carcass length of 725.4 mm. for the second generation of the short strain, sired by a son of Massey King Luna, Massey Luna Henry.

*Winter Feeding of Pigs*.—Exploratory group trials in the winter feeding of sugar-beet to pigs have been conducted with a view to determining the usefulness of this crop as a source of bulk food to dovetail with seasonal dairy by-product supplies. Pigs averaging 70 lb. at the commencement of the experiment and housed in a Nielsen-type piggery made an average weekly gain of 7 lb. per head through July and August when fed on a ration consisting of 2 lb. of mixed meal (equal parts of coconut and meat-meals) and sugar-beet to appetite. A comparable group fed 1 lb. mixed meal daily and as much sugar-beet as the pigs would consume made weekly gains of 6 lb. per head. In each instance the pigs were in prime condition and fit for slaughter at the end of the trial. Though no definite comparison can be made between the groups, the general conclusion can be drawn that limited feeding of meals combined with sugar-beet can be a very profitable undertaking. The rate of growth of the higher meal-fed group compares favourably with that of whey-fed pigs supplemented with 1 lb. meat-meal daily fattened during the spring and summer months.

*Comparison of Copra and Barley Meal as a Winter Supplement*.—A feeding trial with individually fed pairs of pigs, balanced for weight, sex, and breeding, was made to determine the comparative value of copra and barley meal as supplements for store pigs wintered on meat-meal and sugar-beet. All the pigs were fed the same ration of meat-meal and roots, quantities of the latter being increased

as the pigs grew. The daily intake of copra and barley was varied within limits of  $\frac{1}{2}$  lb. to  $1\frac{1}{2}$  lb. to maintain each pair of pigs on the same growth curve. The average live-weight increase per 1 lb. of copra was 1.53 lb., while the figure for barley-meal was 1.13 lb. The difference was significant at the 5-per-cent.-point. In other words, a farmer can afford to pay 35 per cent. more for copra than for barley-meal to obtain the same financial result from its use at the rate of about  $\frac{1}{4}$  lb. per day as a winter supplement for pigs receiving  $\frac{1}{2}$  lb. of meat-meal daily and sugar-beet to appetite.

*Copra-meal versus Meat-meal as a Supplement for Whey.*—In a trial with individual feeding of paired pigs a comparison was made between copra-meal and meat-meal as supplements for baconer pigs fattened mainly on whey. The pigs were fed the same amount of whey, and each of the pair received either 1 lb. of meat-meal or copra-meal daily. The average daily live-weight increase of the copra-fed pigs was 1.01 lb. daily, that of the meat-meal-fed pigs 1.20 lb. daily. This difference was significant at the 5-per-cent. point.

#### MOLE-DRAINAGE RESEARCH.

Mr. A. W. HUDSON.

Four additional experiments dealing with drain-installations were laid down during the year. During the drainage season stop-watch and bucket measurements of the outflow from experiments were obtained as frequently as possible, and the conditions of the mole channels in the observational trials was recorded.

#### ROOT-DEVELOPMENT RESEARCH.

Mr. W. A. JACQUES.

*Fertilizer Placement.*—The results obtained from pot trials with grass plants verifies American findings with crop plants that the correct placement of fertilizers leads to an increase in herbage yield. The problem resolves itself into a question of fertilizing the crop rather than fertilizing the soil.

The trials consist of a perennial rye-grass, cocksfoot, and white-clover plants grown in 12-in.-diameter pots with fertilizer at the surface, mixed in the top 6 in. of soil, and on a layer at 6 in.

There is no doubt that the surface application gave a fillip to seedling growth, and this was very marked as against the early response of the plants with the fertilizer at the 6 in. layer. Despite this early advantage, however, the plants with the fertilizer in a layer at 6 in. out-yielded the surface-fertilized plants by 17 per cent., and the fertilizer mixed in the top 6 in. yielded 13.5 per cent. higher than the top-dressed pots. This means that full use is not being made of the fertilizer when an area is being sown down to grass.

*Root Development as affected by Seasonal Mowing Treatment.*—Areas of grassland over the past two years have been mown so that hard or lenient treatments have been imposed at different seasons of the year. At present, root samples are being taken from these plots to determine to what degree root weight is affected by such treatment.

#### SHEEP-BREEDING.

Mr. R. WATERS.

The work is designed to effect a comparison of sires, based on their progeny tests, with a view to isolating any whose progeny are notably above average for characters of commercial value—meat and wool. Thereafter, by appropriate test matings, data is sought as to the homozygosity or otherwise of sires for commercial characters. Finally, with sires that satisfactorily pass these tests the possibility will be explored of establishing a nucleus flock for the production of rams prepotent for desired characters.

Progeny-tested rams or close-bred rams prepotent for required characters—good genotypes—are unprocurable, and our work to date discloses the same conditions as were found by Hagedoorn and other workers—namely, that high-priced males of notably good conformation (good phenotypes) or of reputedly good ancestry (*i.e.*, supported by good pedigrees), or of ancestry which actually have occasionally left good progeny, carry no guarantee of good performance. This condition of affairs for ram purchasers cannot be expected to improve until the search for outstanding sires, their progeny testing, test mating, and systematic utilization are seriously undertaken by breeders.

### PHYSICAL TESTING LABORATORY.

Director: E. R. COOPER.

*Advisory Committee (Industrial Standards and Testing).*—Professor T. D. J. Leech (Chairman), Dr. E. Marsden, Squadron Leader G. Carter, Mr. G. W. Wyles, Mr. R. C. Porter, Mr. R. Burn, Mr. J. Brooke, Dr. E. R. Cooper (Secretary).

The above Committee was set up following a visit by Professor Leech and the Director to Australia primarily to determine the requirements of a sub-standards metrology laboratory essential to mass production in New Zealand. A broad view of the New Zealand manufacturing situation was taken, with the object of rapidly expanding the standards testing and development work of the Department of Scientific and Industrial Research in the fields of physics and engineering basic to industry. Modern production demands technical assistance, and it is the aim of the Committee to supply this. Such technical assistance involves laboratory facilities, and trained staff with experience in the properties and uses of materials and skill in applying scientific knowledge to industrial problems.

#### (1) FACILITIES.

The staff, now totalling fifty approximately, are still divided into three sections: (a) Laboratory, (b) Design, (c) Workshop. The Laboratory can make investigations into most problems in the fields of physics except radio, though lack of trained staff is a limiting factor at present.

The Design Section consists of personnel with an engineering bias, and this section has complete control of the workshop as well as the design and measurement of tools, gauges, and instruments. A very close liaison exists with the Munitions Controller who is using the engineering

facilities to help in the production of gauges and tools throughout New Zealand. As a result of this liaison certain members of the technical staff have received training along special lines in Australia this year, covering subjects such as gauge design, metrology, and metallurgy. The opportunity is taken here of expressing appreciation of the kind co-operation given by the Australian Government. In co-operation with the Munitions Controller, a metrology laboratory equipped with measuring appliances has been established, and steps are also being taken to set up a sub-standards metrology laboratory for reference purposes, and arrangements have been made with the Australian Commonwealth Council of Scientific and Industrial Research to have this sub-standard equipment periodically checked by the National Standards Laboratory, Sydney. The workshop consists of a tool-room and an instrument section. The tool-room is fully engaged on munitions-production. The instrument workshop is engaged on instrument manufacture and repair for the armed Services, the munitions industry, and in servicing New Zealand laboratories occupied on essential work. A glass-working section has been incorporated with the instrument workshop, and this has proved a most valuable asset.

Accommodation has proved a problem this year in view of the rapid expansion. Work is being carried on under very difficult conditions in unsuitable premises. The realization of this has emerged, and new buildings at Lower Hutt are in course of erection to accommodate a laboratory for general physical work as well as laboratories for optical, electrical, metallurgical, and mechanical testing work; also a modern tool-room, instrument workshop, heat-treatment room, and glass-blowing section, which form part of the general set-up.

## (2) BRIEF REVIEW OF TESTING AND INVESTIGATIONAL WORK FOR 1941-42.

Tests on the following materials have been made: Cloth, felt, refrigerator insulating-materials, "Pinex" wallboard, engine pistons and piston-rings, luminous paint, canvas for life-jackets, tarpaulin, cardboard, electric lamps, catgut, plywood, bricks, plaster-board, asbestos roofing, bearing metals, electric cells, magneto insulation materials, Sisalkraft paper, tracing-paper, fluorescent neon tubing fire-hose nozzles.

Tests on the following instruments and equipment have been made: Pyrometers, thermometers, lenses, barographs, aneroids, binoculars, telescopes, theodolites, chronometers, electric instruments, cameras, sextants, photometers, water-flow meters, micrometers, surface plates, dial gauges, and production gauges of all types, including screw gauges.

## (3) DESIGN AND CONSTRUCTION OF INSTRUMENTS AND EQUIPMENT.

Instruments designed and constructed in the laboratory include spirit-levels, dial gauges, 0.001 in. comparator, toolmakers' microscope, pyrometer control, water-flow meter for land drainage, photometer for black-out tests, rock-grinding machine, screw gauge optical projector, stereoscopic telescope fitting, pyrometer-testing furnaces, voltage regulator, vacuum-pumps, aerial-mapping equipment, grass-juice extractor, micrometer-testing equipment, pressure testor for hand-grenade centre-pieces, psychrometers for cool stores, thermostats, screw-diameter-measuring machine, meteorological-balloon fillers and rollers, glass fractionating columns, thermometers, sugar-beet-testing equipment, ground glass joints, automatic pipettes, toolmakers' steel parallels, thermo regulators, and charcoal-testing machine.

In addition to the above, fully 50 per cent. of the instrument workshop's activities have been directed to the repair of a wide variety of scientific instruments and equipment.

## DOMINION LABORATORY.

Director: R. L. ANDREW.

The Dominion Laboratory is a service laboratory for Government Departments.

There was a further increase in the number of samples examined and reports made in connection with war conditions, and it has therefore been necessary to curtail some of the normal activities of the Laboratory.

### WORK FOR VARIOUS GOVERNMENT DEPARTMENTS.

The number of samples received from the various Government Department's were: Wellington (Main Laboratory), 11,049; Auckland, 6,299; Christchurch, 5,567; Dunedin, 1,856: total, 24,771.

*Customs.*—Fewer samples were received than in previous years.

*Police.*—Numerous samples, very varied in nature, were examined. Poisons were found in a number of exhibits submitted in connection with suicides and accidental deaths. Drugs suspected of being used for procuring abortion were examined, and also samples of alcoholic liquors. The year was notable for the number of glass fragments examined in connection with fatal motor accidents and cases of breaking and entering. In a number of instances these examinations provided conclusive evidence.

Samples of blood and urine were examined for alcohol in order to establish whether or not deceased persons were drunk at time of death. The Hilger quartz spectrograph was again found extremely useful, and particularly so in one case where paint marks and pieces of steel were examined in connection with a fatal motor accident. Information was obtained which would have been impossible by other means.

It is very satisfactory that the Police Department makes full use of the wide range of scientific aid available from the Laboratory.

*Department of Health.*—A very large number of milk samples, 15,396 in all, were examined in the main Laboratory and the three branches. Special attention has been given to milk supplied to schools and to military camps. With very few exceptions the milk supplied throughout the Dominion is of good quality.

*Water.*—Numerous samples from existing and projected water-supplies were examined. A number of these were from supplies to military camps.

*Sewage.*—An increased number of sewage samples were examined, most of them in connection with the disposal of sewage at military camps.

*Miscellaneous.*—A wide variety of articles used as food and drink were examined, many of them being from supplies to military camps.

Samples of air from factories, dusts, and paint were examined in connection with possible danger to the health of workers.

A number of drug samples were analysed to ascertain if they complied with the standards of the British Pharmacopœia.

*Mines Department.*—Prospectors' samples were assayed for gold and silver, and various ores, including those of iron and tungsten, were analysed.

Mine airs, gases, and stone-dusts were examined in connection with safety measures in mines.

*Government Stores.*—A very large number of miscellaneous materials was examined for the defence Services, Public Works Department, Main Highways Board, Post and Telegraph, Industries and Commerce, Railways, State Advances, and Housing Construction Departments, and Stores Control Board.

A considerable number of samples were examined for the Marketing Department.

*Gas Inspection.*—The gas-supplies of the four main centres and of most of the other principal towns of the Dominion were regularly examined for calorific value, freedom from sulphuretted hydrogen, and for pressure. With a few exceptions the gas complied with the required standards. The systematic testing of gas-meters going into service was also carried out.

#### RESEARCH AND SPECIAL WORK.

*Gas Storage of Apples.*—On account of urgent war work only part of this investigation is being carried on.

*Timber-preservation Research.*—Many samples of wood were examined to ascertain the depth of penetration of certain copper compounds.

*Coal Survey.*—The systematic work of the Coal Survey has been curtailed, and attention devoted to substitute motor fuels such as charcoal, cokes, chars, and anthracites.

A number of oil-shales were analysed for Geological Survey. A comprehensive series of samples of peat from the Chatham Islands was examined for wax, and sufficient wax was extracted from selected peat to allow of the wax being submitted to various firms in New Zealand and abroad for opinions as to its commercial value. The sampling was very thorough, and the completed work will give reliable data as to the possible value of the peat as a source of wax.

*Paint Investigations.*—Very large numbers of paints have been examined for various Departments and considerable investigational work done on special painting problems.

*Substitute Materials.*—Special problems in connection with substitute materials were investigated, and in view of present conditions the number of such problems tends to increase.

*Chemical Engineering.*—The work of this section has greatly increased. Work has been continued on gas-producer plants for motor-vehicles. Considerable work has been done on design of plant for drying medicinal plants and vegetables. Experimental lots of agar-agar were prepared, and its commercial production is being undertaken by a New Zealand firm.

A number of special problems in connection with defence have also been investigated.

The Chemical Engineering staff has acted in a consultative capacity to various Government Departments.

*Locally Grown Medicinal Plants.*—The work on the active principle of such plants was continued and the results obtained were very encouraging.

*Spray Materials.*—Analyses of various spray materials for the Plant Research Bureau were carried on, as in previous years. This is most valuable work.

*Spectrographic Analyses.*—The large quartz spectrograph was in regular use and the scope of the work done further extended. A small spectrograph has proved to be extremely useful in the examination of certain ammunition components. In this case special methods were developed in the Laboratory.

*Advisory and Consulting Work.*—The Director and senior members of the staff have been called on to much greater degree than in previous years in a consultative and advisory capacity. This is due partly to the war situation, but also to the greater tendency of various Government Departments to make use of the scientific services available at the Laboratory.

The Director and other senior officers have represented the Laboratory on various departmental committees, including those of the Standards Institute.

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## GEOLOGICAL SURVEY (36th ANNUAL REPORT).

### REPORT BY DIRECTOR (DR. J. HENDERSON).

During the twelve months ended 31st March, 1942, the Director was chiefly in Wellington attending to the many inquiries about mineral resources and other matters connected with the work of the Geological Survey, but also visited several localities in the North Island in order to report on their mineral possibilities or obtain other information.

Regional mapping was carried out on a small scale in the Dannevirke and Orepuki districts, and the very detailed mapping of the Grey Coalfield was continued. The time of most officers, however, was taken up in examining deposits of possible economic value. Arising from Empire supply considerations geological and geophysical reconnaissances were made along the Waikato between Cambridge and Atiamuri in order to assist the engineers of the Public Works Department to select suitable sites for dams.

Summaries of the results of the more important of these investigations are given below, and it is hoped to publish fuller accounts when opportunity offers.

## REGIONAL SURVEYS.

Dr. A. R. Lillie and Mr. C. A. Fleming completed the mapping of the Dannevirke Subdivision, and the former has nearly finished the manuscript of the report.

Mr. R. W. Willett continued the mapping of the Orepuki Subdivision into June, 1941. Dr. J. Marwick was with him for several weeks, and extensive fossil collections were made from the important Clifden section. Owing to his being engaged on mineral surveys, Mr. Willett was unable to resume work in the 1941-42 summer season.

## COAL SURVEY.

The mapping of the Grey Coalfield is approaching completion, the chief area as yet unsurveyed in great detail being that about Paparoa. The geologists engaged on this work have now a good grasp of the structure and sequence of the coal measures, and the coal-mining industry is making increasing use of their services; from a third to a half of their time is taken up in elucidating fault and thinning problems in the working mines, in selecting sites for prospecting bores, and in suggesting areas for exploitation by co-operative parties.

Mr. H. E. Fyfe visited the Mangapehi Coalfield and confirmed Mr. M. Gage's opinion as to the need for immediate boring and the programme to be followed. He also visited the Tatu Mine, in the Ohura district, in the workings of which the Cunningham Fault, mapped on the surface by Mr. N. Pratt some years ago, has now been encountered.

## PALÆONTOLOGICAL WORK.

Dr. J. Marwick was assisted during the winter months by Mr. C. A. Fleming, who identified the mollusca in the many collections from the Tertiary strata of the Dannevirke Subdivision.

Dr. Marwick made large collections from the well-known Clifden section in Southland and, in collaboration with Dr. Finlay, is endeavouring to place on a firm basis the subdivisions of the Middle Tertiary sequence of New Zealand. He and Mr. Fleming also visited North Westland, where the latter collected from the thick later Tertiary argillaceous sandstones of the Blue Bottom and by his work helped to determine the structure of an area where drilling is now proceeding.

## MICROPALÆONTOLOGICAL WORK.

Dr. H. J. Finlay, assisted by Mr. N. de B. Hornibrook, identified the foraminifera in the cores from oil-wells and in many samples forwarded by field geologists. Outside this routine work he spent much time in examining micro-faunas from the Miocene and Lower Pliocene portions of the Tertiary sequence from all parts of New Zealand where these are present. Beds of this age are of particular interest to the oil companies, and several lengthy discussions were held with their geologists and our field officers.

## PETROLOGICAL WORK.

Dr. C. O. Hutton determined many samples of minerals, both natural and artificial. An important investigation was to ascertain the mineral compositions of ganisters imported for lining steel furnaces used in railway workshops. Locally-occurring magnetite, suggested in place of imported material in the manufacture of intermediate frequency transformers and tuning coils for radio apparatus, is now used successfully. The Shell and Superior companies forwarded numerous heavy residues for determination; their identification helped to verify points of the stratigraphy of Tertiary sediments. Petrological examinations were made of schists from the upper Waikouaiti and Wakatipu districts, and mineral separations as well as investigations of igneous rocks from Brocken Range, East Wellington, and Lake Waiholo, Otago.

## GEOPHYSICAL WORK.

Mr. N. Modriniak continued investigations of possible dam-sites on the Waikato River between Atiamuri and Cambridge. He used seismic and magnetic methods. Mr. J. Healy carried out the geological studies in connection with these investigations and was able to map geologically a considerable area of this little-known region.

On Kawau Island Mr. W. H. Wellman measured the electrical currents naturally produced by the oxidation of sulphides of the copper lode worked there nearly a hundred years ago. His observations suggested that another lens containing sulphides lies a little north of the old workings on the same belt of mineralization. Prospecting by the usual methods is required to ascertain the cause of the observed anomalies.

At Clarendon, near Milton, basic lava overlies Tertiary sediments containing phosphatic horizons. Wind-blown silts thickly cover the surface and largely conceal the sequence. Mr. H. W. Wellman began magnetic work at the end of March, 1942, in order to fix the base of the lava so that prospecting by cuts and drill be made easier.

## SPECIAL EXAMINATIONS.

*Phosphates.*—Mr. E. O. Macpherson examined and mapped the phosphate occurrences at Clarendon. Before the higher-grade phosphates from Nauru and Ocean Islands came on the market phosphate rock was worked in this area, in all about 140,000 tons being produced. The phosphate forms irregular masses associated with Tertiary limestone, and calcareous beds in overlying sandstone are also strongly phosphatic. The generally-accepted theory of origin is that the phosphate segregated during the erosion of the limestone and so occurs in more or less isolated masses at the heads of gullies. Mr. Macpherson suggests that the phosphate was formed from bird droppings on a land surface and that there is a fair chance of large quantities being present under the overlying sandstone and basalt. He draws attention also to a second phosphatic horizon in the sandstone some 20 ft. to 30 ft. above the main horizon. This, though of lower grade, may, by processing, yield a commercial product. He recommends prospecting by cuts, adits, and bores.

*Talc.*—Mr. Macpherson examined and mapped talc deposits on D'Urville Island and the adjacent mainland. Rocky Point, in Catherine Bay, is the locality most likely to yield commercial talc. The talc lenses are partly concealed under surface debris and slope deposits, and prospecting is necessary to expose them. Outcrops of talc also occur at Cherry Bay, and near Cape Horn, in Admiralty Bay. At the latter a recent slip covers the talc more or less completely.

*Serpentine*.—A broad belt of serpentine extends north and south through the eastern part of D'Urville Island and vast quantities of serpentine are available. Mr. Macpherson traced and sampled this belt and mapped most of the coast-line of the island. The most convenient places for quarrying the serpentine are the middle branch of the east arm of Port Hardy, and Staff Bay, near Copper-mine Bay, at the south end of the island. The serpentine of these localities contains about 35 per cent. of magnesia. Later, Mr. Wellman made contour plans of about a square mile at each of these areas and took soundings of the adjacent inlets.

*Sulphides*.—In addition to the serpentine belt, a broad strip of gabbro, basalt, and other basic rocks lies along or near the west coast of D'Urville Island. In parts this is strongly pyritized. Mr. Wellman mapped and sampled the sulphide deposits, which, however, are too deeply weathered to allow of accurate estimates being made of the proportion of sulphur present.

*Mica*.—From time to time specimens of mica of good size and quality have been received from South Westland and North-west Otago. Messrs. H. W. Wellman and R. W. Willett walked from Paringa to the Eglinton and visited several localities at which mica had been reported. They found a deposit which may have commercial value on the front range that extends between Paringa and Haast rivers. This range, which rises to about 5,000 ft., consists of schist traversed by a multitude of pegmatite dykes striking parallel with the schistosity planes and the length of the range. In most of the dykes the mica is too small to have value, but one was found containing books 6 in. across and estimated to form 5 per cent. of the rock, the remainder being coarsely-crystalline quartz and feldspar. This mica has been proved to be of a quality suitable for electrical condensers. The dyke lies north of the Moeraki River, a stream that cuts the range into two parts. Prospectors have found mica of similar quality and even larger size on the range south of Moeraki River.

*Oil-shale*.—Mr. R. W. Willett was engaged from December to March, inclusive, in an examination of the Nevis valley where last year he had made a reconnaissance of the large deposit of oil-shale. On this occasion he mapped the deposit in more detail and explored the valley north and south but saw little shale in these parts. Mr. Willett found that the main deposit covers about 2,200 acres and contains over 90,000,000 tons above the level of the stream-beds. The probable maximum amount in the deposit he estimates as approaching 2,000,000,000 tons. This estimate is based on geological deductions only; there are no bores proving the thickness of the shale.

The chief economic advantages of this deposit are its large size and the practical absence of overburden; the chief disadvantage is the low grade of the shale, the crude oil content of the samples tested so far averaging only about 13 gallons per ton.

*Barite*.—Mr. M. Gage examined a series of barite veins exposed in Fly Creek, near Stockton Mine, Westport district. The veins strike nearly north, dip steeply west, and occupy a series of joint planes in the grit overlying the coal. They are well exposed, traceable for considerable distances, and range up to 9 in. thick, but average only 2 in.

*Mercury*.—During March the writer visited the mercury deposits of Puhipuhi; Ascot, near Karangahake; and Mangakirikiri, near Thames.

At the first mentioned a company is actively stripping the overburden and treating the ore in an oil-burning rotary furnace with an efficient condenser plant. The ore is cemented quartzite grit lying between the argillite and quartzite of the basement rocks of the district and the basalt that caps Puhipuhi Tableland. Both the argillite and the basalt are profoundly decomposed, no doubt by the thermal solutions connected with the formation of the cinnabar ore-body.

At the Ascot claim, half a mile north of Karangahake, layers of dark massive sinter form an escarpment extending for 40 chains in an east-west direction. At the eastern end an upper layer 20 ft. to 30 ft. thick and a lower 40 ft. or more thick are separated by a band of softer sinter 3 ft. to 4 ft. thick. This weathers to a nearly white finely-laminated friable material. The old excavations for cinnabar-ore are along this band. Recently a short tunnel driven north down the dip (10°?) of the softer band exposed cinnabar-ore at the top of the band and lining vugs in the upper massive layer of sinter.

The mercury prospect in the hills three miles east of Thames and 600 ft. above sea-level is about a mile from the road up Kauaeranga valley and 20 chains west from Mangakirikiri stream. Under masses of sinter and partly-silicified rock on a densely-wooded ridge a tunnel 25 ft. long is driven in andesite breccia now decomposed to clay. There is a short branch drive to the right in country with narrow seams of quartz containing cinnabar in partings and lining a vug. A winze is sunk to an adit 40 ft. (?) lower driven 50 ft. in decomposed breccia. A staining of cinnabar, not seen by the writer, is reported in this adit. Another adit, perhaps 30 ft. lower and under sinter, has collapsed. A good deal of sinter and silicified rock is scattered about the area, but not in the form of great flinty masses such as occur at Puhipuhi and Karangahake.

## DOMINION OBSERVATORY.

Acting Director: R. C. HAYES.

REPORT FOR THE YEAR ENDED 31st DECEMBER, 1941.

### TIME SERVICE.

*Control of Clocks*.—The clocks were checked daily by short-wave radio time signals from abroad, whenever possible. The American time signals were employed chiefly. In September there was some interruption of the daily checking owing to radio fade-outs, and some difficulty was experienced in December owing to the American time-signal service being temporarily disorganized at the outbreak of war with Japan. The practice of taking local transit observations at intervals has been continued.

*Time Signals sent out*.—The usual time-signal service was maintained. In addition to the scheduled time signals, correct time was supplied by telephone, in response to frequent calls from the Army, Air Force, Government Departments, firms, and the general public. The total number of telephone calls during 1941 was nearly the same as in 1940, but there was considerable fluctuation from month to month.

The degree of accuracy of outgoing time signals is shown by a summary of the errors of the radio signals sent out through station ZLW at 11 a.m. daily. In 1941 the errors of these signals exceeded 0.25 second on only 10 days out of the 365, and did not on any occasion exceed 0.50 seconds. These figures indicate a slightly higher degree of accuracy than in the previous year. There were no failures in these signals during 1941.

**Public Clocks.**—The Government Buildings and General Post Office clocks were checked daily. The maximum errors observed during 1941 were as follows: Government Buildings clock, 83 seconds fast (due to an error in resetting after the clock stopped on 18th April) and 35 seconds slow; General Post Office clock, 6 seconds fast and 10 seconds slow.

The synchronous electric clock, which was checked twice daily, showed good performance early in the year, but was more erratic towards the end of the year. The longest run without interruption was from 1st January to 18th March (seventy-six days), during which period the readings showed a maximum variation of only 15 seconds. On the other hand, from 18th October to 31st December (sixty-four days) the maximum variation observed was 42 seconds.

**Free Pendulum.**—Experiments which were commenced last year with a new drive for the precision pendulum terminated in its development into a free pendulum, with the synchronome pendulum (No. 13) as a slave-clock, operated on the same principle as the Shortt free pendulum. The mechanical work connected with this project was carried out entirely at the Observatory, and has resulted in a timepiece of much greater reliability than any of the other clocks. After final adjustment on 5th August, the free pendulum ran satisfactorily for the remainder of the year without any attention whatever.

**Chronometers.**—Two chronometers were purchased during the year, one locally for use in seismograph timing, and another of higher standard for use in the time service.

#### SEISMOLOGY.

**Seismic Activity in New Zealand in 1941.**—During 1941 the total number of earthquakes reported felt was 107, the smallest number in any year since 1928. Of the 107 shocks in 1941, 61 were felt in some part of the North Island, and 55 in some part of the South Island. Nine were felt in both Islands. The maximum intensity reported felt was R.-F. 8. Although the number of felt shocks was small, seismograph records indicated that minor activity was much the same as in previous years.

Earthquakes were comparatively frequent in the far north-eastern part of the North Island and in the central districts; and there was more activity than usual in Canterbury. On the other hand, most of Hawke's Bay was comparatively free from earthquakes. Occasional shocks originated in the far south-west.

The only two outstanding seismic events occurred early in the year. These were (1) a shock of R.-F. 8 originating near Taneatua, in the Bay of Plenty, on 9th January; and (2) one of R.-F. 6-7 near Lake Coleridge, in Canterbury, on 7th February. The Taneatua shock was of very shallow origin, and in spite of the high intensity in the epicentral region the maximum radius of the felt area did not exceed seventy miles. The Lake Coleridge shock was of normal depth and its felt area was also small (maximum radius about one hundred miles). Aftershocks of the Lake Coleridge disturbance continued at intervals throughout the remainder of the year. Both these earthquakes were approximately 5 on the instrumental magnitude scale.

Other important shocks during the year are listed in a table below. Two notable features of the 1941 results were—

- (1) A prevailing tendency for activity to be concentrated towards the north-western side of the general seismic region:
- (2) The occurrence of shocks slightly deeper than normal in the submarine region between Taranaki and Nelson and beneath the northern part of the South Island. This has been confirmed by a recent revision of the earthquake records of previous years.

A monthly summary of earthquakes reported felt in 1941 is given in the following table:—

| Month, 1941.    | Number of Earthquakes reported felt. |               |               |                       | Maximum Intensity (R.-F.). | Locality of Maximum.                            |
|-----------------|--------------------------------------|---------------|---------------|-----------------------|----------------------------|-------------------------------------------------|
|                 | North Island.                        | South Island. | Both Islands. | Whole of New Zealand. |                            |                                                 |
| January .. ..   | 6                                    | 2             | 0             | 8                     | 8                          | Near Taneatua.                                  |
| February .. ..  | 5                                    | 8             | 0             | 13                    | 6-7                        | Lake Coleridge.                                 |
| March .. ..     | 3                                    | 6             | 0             | 9                     | 4                          | Farewell Spit.                                  |
| April .. ..     | 7                                    | 6             | 1             | 12                    | 6                          | Northern part of South Island.                  |
| May .. ..       | 9                                    | 4             | 0             | 13                    | 6+                         | Southern Hawke's Bay.                           |
| June .. ..      | 6                                    | 5             | 0             | 11                    | 5-6                        | Otira.                                          |
| July .. ..      | 8                                    | 7             | 5             | 10                    | 5                          | Northern part of South Island.                  |
| August .. ..    | 4                                    | 5             | 1             | 8                     | 6                          | Lake Wakatipu region.                           |
| September .. .. | 1                                    | 3             | 0             | 4                     | 6                          | Lake Waikaremoana region.                       |
| October .. ..   | 2                                    | 2             | 0             | 4                     | 3                          | Gisborne region, southern part of South Island. |
| November .. ..  | 2                                    | 2             | 1             | 3                     | 5                          | Wanganui, Manawatu.                             |
| December .. ..  | 8                                    | 5             | 1             | 12                    | 5                          | Waipawa, Takaka region.                         |
| Totals .. ..    | 61                                   | 55            | 9             | 107                   | ..                         |                                                 |

As in the past, non-instrumental reports have been furnished by officials at post-offices and light-houses, and by several private observers.

Particulars of the most important earthquakes in 1941 are as follows :—

| 1941.        | Time of Shock<br>(G.M.T.).* | Approximate Epicentre. |                        | Focal<br>Depth<br>(km.):<br>N = Normal. | Instru-<br>mental<br>Magni-<br>tude. | Maximum<br>Felt<br>Intensity<br>(R.-F.). | Remarks.                                                |
|--------------|-----------------------------|------------------------|------------------------|-----------------------------------------|--------------------------------------|------------------------------------------|---------------------------------------------------------|
|              |                             | Latitude S.<br>(Deg.)  | Longitude E.<br>(Deg.) |                                         |                                      |                                          |                                                         |
| January ..   | d. h. m.<br>9 02 39.4       | 38.1                   | 177.1                  | 10                                      | 5                                    | 8                                        | Bay of Plenty, northern Hawke's Bay.                    |
| February ..  | 6 18 20.6                   | 43.2                   | 171.4                  | N                                       | 5                                    | 6-7                                      | Canterbury and parts of Westland.                       |
| February ..  | 11 23 11.2                  | 40.2                   | 174.7                  | N?                                      | 4½                                   | 5                                        | West of North Island from New Plymouth to Wellington.   |
| April ..     | 6 18 46.8                   | 41.6                   | 172.9                  | 80 ca.                                  | 5½                                   | 6                                        | From Taumarunui and Hastings to Queenstown and Dunedin. |
| May ..       | 29 11 17.1                  | 40.5                   | 176.8                  | N                                       | 5                                    | 6+                                       | Parts of southern Hawke's Bay.                          |
| June ..      | 9 18 13.8                   | 42½                    | 171½                   | N                                       | 3                                    | 5-6                                      | Otira.                                                  |
| July ..      | 17 01 39.9                  | 41.6                   | 173.3                  | 80-100                                  | 5                                    | 5                                        | Cook Strait and northern parts of South Island.         |
| August ..    | 10 10 05.2                  | 45                     | 168                    | ?                                       | 5                                    | 6                                        | Southland, parts of Otago.                              |
| September .. | 24 11 39.5                  | 38.6                   | 177.1                  | 150 ca.                                 | 5?                                   | 6                                        | Opotiki to Wanganui and Waipawa.                        |
| November     | 21 10 05.9                  | 40.3                   | 174.3                  | N                                       | 4½                                   | 5                                        | New Plymouth, Taihape, Cook Strait region.              |
| December ..  | 17 11 51.3                  | 41.7                   | 173.7                  | N                                       | 4½                                   | 3                                        | Central districts.                                      |

\* To obtain the corresponding New Zealand mean time, add 11 h. 30 m., and to obtain New Zealand summer (or daylight saving) time, add 12 h.

Early in 1941 a system was devised for indicating the accuracy of epicentre determinations. This is employed in published reports and bulletins.

*Seismograph Stations.*—The seismograph stations operating on 31st December, 1941, were as follows, the types of seismograph being given in parentheses: Auckland (Milne-Shaw), Arapuni (Milne) Rotorua (Jaggar), Tuai (Wood-Anderson), New Plymouth (Wood-Anderson), Hastings (Jaggar), Bunnythorpe (Jaggar), Wellington Central Station (Galitzin-Wilip, Milne-Shaw, Wood-Anderson, Jones, Imamura), Takaka (Imamura), Greymouth (Jaggar), Christchurch (Galitzin three components, Wood-Anderson), Monowai (Jaggar).

Milne-Shaw seismograph No. 36 was installed at the Auckland Museum early in April. However, it was not until November that the necessary apparatus was obtained for maintaining accurate time.

Progress was made with the establishment of a Wood-Anderson station at Kaimata, near Greymouth, but there has been considerable delay in this project owing to the war.

The Public Works officials at Rotorua have developed an improved method of producing Jaggar seismograph records. The method results in blue-print paper records instead of smoked cardboard ones.

The seismograph at Chatham Islands has been temporarily suspended owing to the war.

*Research in Seismology.*—Research work has been extremely restricted owing to circumstances. However, some work was done on the revision of local earthquake epicentres for the period 1931-40, and a paper on the subject was prepared for publication. A revision of the distribution of earthquake effects in various parts of New Zealand was also carried out, and a paper on the results prepared for publication.

MAGNETIC OBSERVATORY, CHRISTCHURCH.

Director : H. F. BAIRD.

SUMMARY OF OPERATIONS FOR THE YEAR ENDED 31st MARCH, 1942.

The usual programmes of terrestrial, magnetic, seismological, atmospheric electric, cosmic, radiation, and climatological observations have been maintained. Considerable extra work arose from occupation of sixty-two points throughout New Zealand in connection with a magnetic resurvey of the Dominion.

TERRESTRIAL MAGNETISM.

The three types of photographic variometers by Eschenhagen, Adie, and La Cour gave continuous record of magnetic elements at our substation in Amberley Domain. Absolute observations and determination of scale-values there were made regularly as usual. The sensitivity of the Adie variometers was reduced so that little or no trace would be lost during large magnetic storms. Tabulation of mean monthly values of magnetic declination, horizontal force, and vertical force is well forward.

Local data of international magnetic character figures have been prepared quarterly and forwarded to Carnegie Institution, Washington. Similarly, further "K" values, or the three-hour range index of geomagnetic activity, have been sent to the International Association of Terrestrial Magnetism and Electricity at Washington, D.C., United States of America.

MAGNETIC RESURVEY.

So far, twenty-five points in the North Island and thirty-seven in the South Island have been either reoccupied or established. In improving communication services, navigation, preparation of charts, and geological investigation, modern knowledge of the degree of magnetic variability over a country is always important. During war, up-to-date knowledge of magnetic elements is important in many directions. With the lapse of time, magnetic elements at any place go through what is known as a secular variation whose rate is accelerated in some years and decelerated in others. Until a year ago, when instruments lent by the Carnegie Institution of Washington were put into field use, this country lacked any systematic knowledge as to what was the rate of secular variation at increasing

distances from Amberley base station, where, alone in New Zealand, such data are automatically recorded. Consequently, with all these aims in view, observations at sixty-two places, mainly on coastal stretches extending from Cape Reinga in the North to Waikawa in the South, were completed. The work was pressed on as urgently as conditions permitted. Results to date show, within these geographical limits, that while the rate of secular variation is rather systematically different, it is, nevertheless, quite different from that recorded at Amberley. Present indications are that the rate of change appropriate to any place is a comparatively simple function of its latitude and longitude. That implies that the secular change at a magnetic survey point will need to take into account secular change at similar points established nearest thereto. In other words, the system found necessary in the United States of America of occupying all survey points at least once every five years is also necessary in New Zealand. The matter of having enough and sufficiently permanent survey points therefore becomes important. Certainty that a point will remain indefinitely suitable for reoccupation is impossible of attainment. However, some convenient scheme of co-operation between this Department and occupiers of land containing magnetic survey points could be evolved in order to cut station loss to a minimum, preferably by the occupier serving sufficient notice of contemplated changes which will destroy the usefulness of the point as a magnetic survey station. Original magnetic survey stations, particularly in the south of the North Island, have been lost mainly through building operations and reticulation within 200 ft. of these points by iron pipes for gas, water, and sewerage schemes. Electric haulage systems using direct current with earth return spoil magnetic survey points within twelve miles of them. In the interval between planning and provision of such amenities, there is almost always sufficient time for establishing a new point properly tied magnetically to the one to be destroyed. With another thirty-two points established or reoccupied in the North Island and eighteen in the South Island it should be possible for the Magnetic Survey Branch to be ever ready to supply the comprehensive information that progress will demand. While final evaluation of field results will require long and tedious computation, preliminary values have at all times been supplied promptly to accredited services requiring them.

#### RECORDINGS AT CHRISTCHURCH.

The full programme of earthquake recording was maintained. No really alarming earthquakes local to New Zealand were recorded, but there was sufficient background of minor local activity to remind citizens that sound building practice is needed in New Zealand. Recording by the cosmic-ray meter was again complete and satisfactory. The electrograph maintained its improved continuous recording of atmospheric electrical potential. During the year more record of potential than usual was measured, and the insulation was further improved by testing more frequently with an applied measured voltage. The climatological station programme was as usual carried out on every day of the year. The number of inquiries about weather conditions fell off as lesser use of motor transport brought reduction in traffic accidents, but the number of inquiries—both astronomical and astrological—concerning ordinary, and usually largely disregarded, phenomena in the skies showed an increase.

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#### METEOROLOGICAL BRANCH.

Consequent on the outbreak of war, the Meteorological Branch of the Department, together with the Apia Observatory, was transferred to the Air Department for the duration of the war.

The report of the Meteorological Branch during the past year is contained in the annual report of the Air Department.

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#### LIAISON OFFICE, LONDON.

During the year the office has continued to render most valuable service in respect to both civil and defence matters and has enabled a very close liaison to be maintained between a large number of research activities in Great Britain and New Zealand. Apart from defence scientific information, particular mention is made of the work of this office in connection with the following projects: Dehydration of foodstuffs—*e.g.*, dried butterfat, dried milk, and dried meat—processing of linen flax, tests of New Zealand pasture seeds, manufacture of linseed-oil, medicinal plants, agar, ergot, packaging of foodstuffs, and transport problems relating to the carriage of perishable foodstuffs. This list is not comprehensive, for in addition the staff has handled an immense number of inquiries on technical subjects and has been instrumental in conveying rapidly to New Zealand particulars of all advances made in a wide range of scientific and technical matters in Great Britain.

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#### RESEARCH SCHOLARSHIPS.

In view of the fact that applications were not up to M.Sc. standard, no National Research Scholarships were awarded during the year.

## IMPERIAL AGRICULTURAL BUREAUX.

The Imperial Agricultural Bureaux were established to act as clearing-houses for the interchange of information between research workers in various fields of agricultural science throughout the world, but more particularly within the various countries of the British Commonwealth.

In New Zealand co-operation with the Bureaux is maintained through the Department of Scientific and Industrial Research, for which purpose there is a special liaison officer. In addition, contacts with individual Bureaux and the appropriate fields of research are maintained by official correspondents, who deal with specific inquiries.

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## PUBLICATIONS.

The monthly publication of the *New Zealand Journal of Science and Technology* has been continued during the year, alternate numbers being devoted to two different classes of papers. Section A of the *Journal* is composed entirely of agricultural-science articles, while Section B deals with general subjects apart from agricultural, including papers on chemistry, physics, geology, seismology, economics, and industrial technology.

Apart from the *Journal*, further departmental bulletins have been issued during the year as follows:—

- No. 85: "The Economic Importance of Seaweeds," by Miss L. B. Moore.
- No. 86: "Mole Drainage in New Zealand," by A. W. Hudson and H. G. Hopewell.
- No. 87: "Wheat Research Institute: Eighth Annual Report."

*Approximate Cost of Paper.*—Preparation, not given; printing 790 copies, £55.

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By Authority; E. V. PAUL, Government Printer, Wellington.—1942.

Price 1s.]