The Cawthron Institute,

NELSON, NEW ZEALAND.

THOMAS CAWTHRON CENTENARY LECTURE,

OCTOBER 10th, 1933.

The Achievements of the Cawthron Institute

— BY —

T. H. EASTERFIELD, M.A., Ph.D., F.I.C., F.N.Z. Inst.
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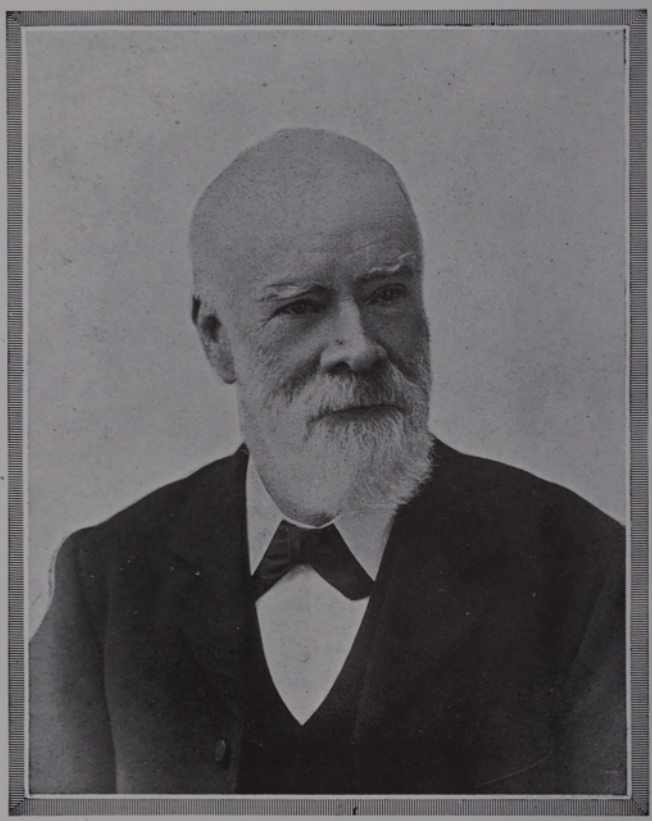

THOMAS CAWTHRON.

Born at Camberwell, May 26, 1833.
Died at Nelson, N.Z., October 8, 1915.

The Achievements of the Cawthron Institute.

BY T. H. EASTERFIELD, M.A., Ph.D., F.I.C.

Director of the Institute.

The year 1833 will always be remembered in scientific circles as the date of the appointment of Michael Faraday to the Fullerian Professorship at the Royal Institution, where he carried out those fundamental experiments upon which modern electrical science is based. To the people of Nelson the year is of importance in that 1833 was the date of the birth of Thomas Cawthron, who like Michael Faraday, was born in London. To the fact that during his life Mr Cawthron gave freely to public objects in this City I need scarcely refer, for Nelson abounds in material evidence of his generosity. Under the terms of his will the greater part of his estate was left for the foundation of the Cawthron Institute and the Trustees had a difficult task before them in that they did not know the nature of the Institute which the testator desired to establish. They wisely set up a scientific advisory Commission under Sir James Wilson, one of the founders and for 20 years the President of the New Zealand Farmers' Union, and it was upon the recommendation of this Commission and with the approval of the Supreme Court that the Institute became a research institute for the investigation of agricultural problems. In 1917 the Cawthron Trustees asked me to deliver the first Cawthron Lecture. That on the eve of my retirement I should be invited to give the Centenary Lecture is an honour which I deeply appreciate. The first Cawthron Lecture was entitled "The Aims and Ideals of the Cawthron Institute," and it is fitting that to-night's lecture should be upon "The Achievements of the Cawthron Institute"—the best testimony that can be borne to the value of Thomas Cawthron's gift to the people of New Zealand. To-night's lecture may indeed be regarded as a sequel to the lecture delivered sixteen years ago. May I, therefore, begin by quoting the last sentences of my former lecture; they were as follows:

> **"I foretell a brilliant future for this Institute. The problems solved in it will lead to results of the greatest value to this City, to the Dominion, and to the human race. And the Institute itself is destined to become a**

centre of light, learning and culture, honoured throughout the civilised world, and a lasting tribute to the memory of Thomas Cawthron."

At the time that these sentences were uttered, I certainly did not expect to become the Director of the Cawthron Institute. The position was accepted with much diffidence, but with the resolution that God willing, my prophecy with regard to the Cawthron Institute should be fulfilled.

APPOINTMENT OF STAFF.

After very careful enquiry a staff was chosen. The first appointments were: Mr Rigg as Agriculturist, Dr. Tillyard as Entomologist, Dr. Kathleen Curtis as Mycologist, and Mr Davies as Curator and Photographer. These appointments could not have been improved upon, for the foundation work of the new Institute. Upon Dr. Tillyard's appointment as Chief Entomologist to the Commonwealth of Australia in 1927, he was succeeded by Dr. Miller who has continued the work with equal effectiveness. Each senior officer has been allowed to nominate the assistants in his or her own department—a system which has been found to lead to great efficiency.

I cannot speak sufficiently highly of the loyal service given by the staff. The one desire from the senior down to the most junior officers has been to forward the best interests of the Institute, without consideration of personal benefit or advancement. That financial needs have forced the Trust Board to curtail this excellent staff by one-third and drastically to reduce all salaries is a matter of very deep concern.

BUILDINGS.

In 1920 the Trustees had the good fortune to secure, as a home for the Institute, a commodious private house of fifteen rooms, standing in three acres of ground. The building was converted into laboratories, a library and a museum, and was officially opened in 1921 by His Excellency Viscount Jellicoe, Governor-General of New Zealand. An additional chemical laboratory was added three years later and in 1927 a special entomological laboratory for the study of the control of noxious weeds by insects was erected with funds provided by the Empire Marketing Board. In 1930 the whole of the entomological work was transferred to new quarters adjoining the noxious weeds control laboratory, thus liberating rooms for the expansion of the chemical and mycological departments.

The grounds surrounding the Institute have proved invaluable to all departments for carrying out small scale field experiments under the daily observation of the research staff.

THE CAWTHRON INSTITUTE.

THE INITIATION OF THE WORK.

When the staff was first brought together in February, 1920, the question arose—On what problems to begin? Mr Rigg had already done excellent work in conducting a soil survey of the Market Garden District of Bedfordshire, England, and it was natural that he should at once initiate a similar survey of the Nelson district, simultaneously paying particular attention to the needs of the fruit industry. In this work he was helped by his assistant, Mr J. A. Bruce. In connection with the soil survey, maps were prepared showing the distribution of the various soil types in the Nelson province, and the special characteristics of each soil were studied. The information thus gained has formed a most useful basis for the study of many later problems. In the 1917 lecture, attention was drawn to the statement in the Cawthron Commissioners' report that unless the problems of the fruit industry received careful investigation, there was a risk of the industry dying out. The large area planted on the Moutere Hills in particular was not giving results in accordance with expectation, and such biological problems as bitter pit, black spot, woolly aphis and codlin moth were being discussed by all fruit-growers. Mr Rigg attacked the problem of the poverty of the Moutere soil; Dr. Tillyard was sent to England to attend the Conference of Imperial Economic Entomologists with instructions to obtain all possible information with regard to the wolly aphis; Dr. Curtis took up the special study of black spot. The researches of each of these investigators have been of great value to the fruit industry. The recommendations made with regard to soil treatment and cover crops have led to great improvement in the vigour of the trees, and in the quality and yield of fruit. The yield of Jonathan apples in orchards on the Moutere Hills under the Institute treatment has increased by 1½ bushels per tree above that of the trees on the control plots. Furthermore, the improvement of the keeping quality of the fruit in cold storage has been most marked. Under the well-balanced system of soil treatment the whole tone of the trees and their crops has strikingly improved, and orchardists have stated that but for the benefits received from the advice given, they would certainly have abandoned their orchards.

No less marked was the success of Dr. Tillyard's enquiries, at the 1920 Conference, with regard to woolly aphis. Acting on advice received he visited the United States, and was supplied through the courtesy of Dr. Howard, of the U.S.A. Bureau of Entomology, with shipments of two different kinds of insects. One, a giant lady-bird, was unable to establish itself under New Zealand conditions; the other insect, Aphelinus mali, has given results of outstanding value. The insects were reared with meticulous care by the late Mr Alfred Philpott, our first assistant entomologist. The Cawthron Institute has distributed more than

250,000 of these insects amongst orchardists in all parts of New Zealand, and they are now so well established, that in most orchards it is difficult to find a patch of woolly aphis, whereas in 1920 the woolly aphis was in such abundance that apple-picking and grading was often a most distasteful business. It is no longer necessary to spray for woolly aphis, and the annual benefit to the New Zealand apple industry from this source alone has been stated by growers to be probably equal to the total income of the Institute. Nevertheless, the introduction of Aphelinus without a simultaneous introduction of a scientific system of soil treatment could scarcely have saved from failure the Moutere orchards —our main source of apples, now exporting more than 500,000 cases annually.

Simultaneously with the work just described, the mycologist was studying the black spot—the main fungal trouble of the pip fruits in this district. Dr. Curtis was able to demonstrate that the main spring infection was due to ascospores ejected from the fallen leaves of the previous year. Notice is now given in each year of the date at which the spores are about to be ejected—a date which varies according to the season—so that the orchardists learn definitely when spraying for black spot must commence. The conditions for black spot development have also been studied in the other main commercial districts of New Zealand. Eye rot in apples and Botrytis disease in the blue lupins used for cover crops also received great attention. I lay stress on the pip fruit investigations, for the work done by the Cawthron Institute is a typical example of what combined effort can do when a very serious problem has to be faced.

All the departments are still at work on apple problems and much information has been collected in connection with apple stocks, and with insect and fungal troubles. Fruitgrowers will certainly be relieved to know that a parasite for the codlin moth has been introduced and successfully propagated through two generations. It has been liberated in certain orchards, and there is evidence that it is establishing itself successfully.

COOL STORAGE OF APPLES.

A problem of great importance to the orchard industry was the cold storage of the apple. The Nelson fruitgrowers approached the Institute in 1920, and asked that the problem be made a subject of comprehensive study. Accordingly in the following season a few preliminary experiments were made. The results were sufficient to justify the appointment first of Mr N. McClelland, and later of Mr L. W. Tiller, to this work as practically a full time study. The findings have been published in a series of bulletins, and in 1931 the Canadian Cool Store Commissioner asked to be allowed to reprint one of these reports as a special Cool Storage News Letter for distribution throughout Canada.

Much information of great value to the industry has been gained as a result of these investigations, and some of the main conclusions may be summarised as follows: (1) Internal breakdown and deep scald, two of the most serious cold storage diseases, are largely avoidable by storing at temperatures not lower than 38 degrees F. (2) For each variety of apple there is a special optimum temperature at or near which the fruit should be kept, in order to reduce losses to a minimum. These temperatures have been determined for all the main export varieties, and the temperatures adopted for the overseas carriage of our export fruit are now being brought as far as possible into line with these findings. (3) The humidity of the storage atmosphere must be carefully controlled. (4) Strict attention must be paid to the stage of maturity of the fruit at time of picking if certain diseases such as bitter-pit are to be avoided. (5) Ventilation of the storage chambers is particularly necessary at low temperatures, as the presence of even 5 per cent. of carbon dioxide accelerates the onset of breakdown. (6) The keeping quality of the fruit is strikingly dependent upon the manurial treatment of the orchard. (7) The rootstock on which the variety is grafted may affect the storage quality. (8) Early picking and low-temperature storage are safeguards against a superficial spotting disease to which the Lord Wolseley, Cleopatra, and certain other varieties are susceptible.

Grants in aid of the cool storage investigations have been made by the fruitgrowers, the New Zealand Institute and more recently by the Department of Scientific and Industrial Research.

PEACHES.

In 1920 the opinion was general amongst orchardists that there was no future for the peach industry in this district, on account of the prevalence of brown rot. As a consequence many growers were cutting out their peach trees. Experiments were made on the soil treatment from the point of view of increasing production and resistance, and the problem of brown rot control was very fully gone into on a badly affected commercial orchard at Umukuri. The results obtained were remarkable. Dr. Curtis found that by the careful removal of mummied fruits, the cutting out of infected blossoms and spraying at well defined periods in the development of the crop, a complete control of brown rot could be effected. This knowledge has been an important factor in the development of peach growing in the Nelson area. Several hundred tons of peaches are now canned annually and the industry gives employment to a very large number of workers. Were strict attention paid to the advice given and particularly to the cutting out of infected blossoms, brown rot losses in this district could be reduced to a negligible amount.

A detailed investigation has been carried out on the morphological structure of stone fruit tissues in relation to brown rot resistance as exhibited by the common commercial varieties of peach, apricot, nectarine, plum and cherry.

SMALL FRUITS.

Nelson has always had a reputation for its raspberries, and during the conduct of the soil survey, enquiry was made as to the manurial programmes of the different growers. In many cases it was found that the programme was ill-balanced and uneconomical. The treatment recommended by the Institute has been widely adopted and has led to a great increase of yield. The extraordinary increase in production in 1926 was stated by the late Sir Henry Jones, a recognised Australian authority on commercial fruitgrowing, to be the greatest in the history of the trade.

The entomologists and mycologists have given a great deal of study to the insects attacking raspberries and strawberries, and the relative resistance of different varieties to fungal attack. Such study is of fundamental importance in solving the problems involved.

TOMATO INDUSTRY.

The value of this industry to Nelson is estimated at some £50,000 per annum. When the Cawthron Institute was first established it was found that the yield of tomatoes in many of the glasshouses was very disappointing, and that intensive manuring was no remedy. Mr Rigg made a number of experiments on the comparative value of chemical and steam sterilisation, and in conjunction with Messrs Vitetta Bros., demonstrated the value of steam sterilising to a depth of 9in, and still better to a depth of 18in. It is interesting to note that the method is finding more and more favour amongst the tomato-growers, who can now keep plants in vigorous bearing from spring until the late autumn. One word of warning, however. The manurial treatment in a steam sterilised tomato house must be watched with great care, for the plants on a steam sterilised soil are found to be peculiarly sensitive to any excess of nitrogenous fertiliser. The fungal diseases of the tomato house have of course received study, especially mildew under glass and leaf spot in the open. In connection with these diseases a great deal of work has been done by Dr. Curtis, and her former assistant Miss Parlane, on varieties of tomatoes reputed to be resistant to leaf disease.

TOBACCO CULTURE.

The soil maps and the experience gained by the Institute in the manurial treatment of Nelson soils have been made available to the companies interested in tobacco culture in the Nelson

district. The success which has been obtained is due in no small measure to the care exercised by the tobacco companies in the selection of soils suitable for high quality leaf production. At the request of the Marlborough Progress League a survey was made of soils in the Wairau Plain with a view to the establishment of tobacco culture in that district. A study has been made by the mycologists of the diseases attacking tobacco plants. In some instances leaf-spotting has been shown to be associated with insufficiency of potash. A special survey to determine the distribution of mosaic disease, which invariably makes its appearance in countries where tobacco growing has been long established, was carried out in 1932 at the request of the Tobacco-growers' Association. Information was supplied to growers concerning the best methods of prevention and control of the disease. Special attention has been paid to the insects attacking tobacco, and a pamphlet has been issued, giving information with regard to their control.

So far I have drawn attention to the work of the Cawthron Institute as team work in which co-operation between departments is invaluable. There are, of course, special pieces of work in which a single department has been mainly concerned, and for the rest of the lecture investigations of this class will be considered.

LUCERNE.

In 1920, at the request of the Chamber of Commerce, a pamphlet was published on the growing of lucerne in the Nelson district. Mr Rigg had already conducted a flying soil survey of the district, and made preliminary determinations of the lime requirement of the different soils so that it was possible to indicate where lucerne could be expected to succeed, and what treatment would be required. A large increase in the area in lucerne in the Nelson district resulted. This was important, for the value of a stand of lucerne to a dairy farmer in the dry conditions of a Nelson summer is extraordinary. Strangely enough, though the pamphlet was asked for by many New Zealand farmers, the largest request came from Tasmania, where the Department of Agriculture expressed the desire to place a copy of the pamphlet in the hands of every farmer in the State.

BARLEY.

Barley has always been grown in certain parts of Nelson, notably on the Waimea Plain, but in the Hope district the yield was often disappointing. The Cawthron Institute experiments shewed that the low yield was connected with deficiency of both nitrogen and phosphorus. The application of a mixture of ¾ to 1 cwt. per acre of ammonium sulphate with 1½ to 2 cwt. of superphosphate was found to give very successful results

throughout the Waimea area, the increase in yield in many cases amounting to 50 per cent.

HOPS.

The identity of the fungus causing black rot in certain hop-gardens has been established and its life cycle traced under New Zealand conditions. Experiments in the field have led to a partial control of the disease, resulting in an extension of the life of the hop plant when in infected soil.

MINERAL CONTENT OF PASTURES INVESTIGATION.

The Empire Marketing Board has supplied for five years, through the Department of Scientific and Industrial Research, the finance for the investigation of Nelson pastures, with the object of obtaining accurate knowledge with regard to growth, composition and nutritive value of the pastures under different treatment throughout the year. Several thousand samples of pasture have been collected, and their examination by Dr. Askew in the chemical laboratory is being conducted with energy and skill. The data already recorded promise to have a very marked effect upon the agricultural practice of the future and emphasise the absolute necessity for the increase in the production of supplementary fodder if the health of the stock is to be maintained throughout the winter. Much of this work will in the future be carried out on the Marsden Research Farm at Stoke. In 1917, the Nelson Provincial Farmers' Union approached the Cawthron Trustees and asked them to provide an Experimental Farm for Nelson. A bequest to the Institute by Mr James Marsden has provided such a farm, together with a monetary endowment, and Mr Rigg has already drawn up a scheme of research to extend over a period of years. At the demonstrations held upon the farm, the members of the Farmers' Union have expressed enthusiastic appreciation of the value of the results already obtained.

NORTH ISLAND SOIL SURVEY.

There is much land in the volcanic area north of the line joining Napier to Wanganui, which should be capable of close settlement, but it is known that the agricultural value of this land is variable. In particular large areas are subject to Bush-sickness—a stock trouble which the Government Agricultural Chemist, Mr B. C. Aston, has shown to be intimately associated with iron deficiency.

At the request of the Department of Scientific and Industrial Research, the Cawthron Institute has collaborated with the Department in the conduct of a recnonaissance soil survey of the above area. The work has been financed by the New Zealand Government. Mr Rigg was placed in charge as Director; Messrs

MARSDEN RESEARCH FARM.
Stoke, Nelson.

L. I. Grange and N. H. Taylor of the New Zealand Geological Survey were seconded for the identification and mapping of soil types, and Miss E. B. Kidson was seconded to the Cawthron Institute for the chemical analysis of soil samples. The striking differences in the nature of the soil in the different districts has been shown to be largely due to the great difference in the composition of the ash and scoria thrown out by the different volcanoes. Thus the soils at Mamaku, north-west of Rotorua, derived from Taupo and Kaharoa rhyolitic ash showers, carry bush-sickness, but to the south-east of Rotorua, where the andesitic ejecta from the Tarawera eruption overlie the earlier showers, the carrying capacity of the farms is high, and bush-sickness is unknown.

BUSH SICKNESS INVESTIGATION.

The mention of bush-sickness recalls that this trouble has been known upon limited areas of Nelson soils for many years, particularly in the upper reaches of the Sherry Valley and in the Hope Valley from Glenhope upwards. Examination of pasture grown on the bush-sick paddocks and on healthy areas indicated that the difference in iron content of the grass was insufficient to account for the trouble. Nevertheless the administration of ferric ammonium citrate was found to be a palliative. Again it was found that the actual iron content of some bush-sick soils was not remarkably lower than that of some healthy soils. Cawthron Institute experiments have shown, however, that on the healthy soils the iron is much more readily soluble in dilute organic acids than is the case with the bush-sickness soils. It is inferred that the stock derive much of the required iron from soil which is swallowed during close grazing. It is interesting to find that the sheep which have been fed on bush-sick areas, but provided daily with a dose of iron rich soil taken from the Cawthron Institute grounds have remained healthy, have put on weight and have improved in the quality of their wool. Not a single sheep receiving the soil ration has died. In the case of the other groups only 4 sheep out of 19 now remain, and these show symptoms of bush-sickness. These facts appear to throw light upon the observations made by Hogg, the Ettrick shepherd, more than 100 years ago. He stated that in his opinion, pining sickness, a disease very similar to New Zealand bush-sickness, first appeared in the South of Scotland when moles were exterminated. The connection has not hitherto been obvious, but is now quite clear. The moles throw up numbers of small hillocks of fine subsoil, which act as a top-dressing, and it is common knowledge that through this soil a striking growth of deep green grass rapidly appears. The sheep cannot graze this grass without taking up a good deal of the subsoil at the same time, and as subsoil is usually richer in iron than the topsoil, the sheep

obtain their extra iron ration and are protected from the deficiency disease.

XANTHIN CALCULI IN SHEEP.

In some parts of the Moutere Hills, the sheep suffer from gravel in the kidney. This fact has been long known amongst stockmen, and Dr. S. A. Gibbs has presented to the Institute a calculus brought to him in 1903. The malady is particularly bad at Pigeon Valley, near Wakefield, where losses as high as 25 per cent. of a flock of sheep during one winter have been recorded. Examination of the kidney calculi from a number of farms by the Cawthron chemists showed that they consist of a rare material, xanthin, closely allied on the one hand to caffein, the active constituent of tea and coffee, and on the other to uric acid, the cause of the concretionary swellings in chalky gout. Experiments to combat the trouble have shewn that by the encouragement of English grasses and clovers through suitable top-dressing, and the supply of supplementary feed, the trouble may be avoided. No similar case of a widespread occurrence of xanthin calculi in association with a particular soil type appears to have been reported elsewhere, and the whole subject is worthy of special investigation as a problem of animal nutrition. Incidentally, it may be mentioned that on the poor Danthonia vegetation on the area in question, a rare form of smut in epidemic form has been recorded by the mycologists.

MOUTERE FARM LANDS.

In illustration of what may be done in the way of improving the poor Moutere farm land it may be stated that on one farm on this soil type, formerly carrying less than a sheep per acre, the sowing of English grasses and clovers after treatment with lime and phosphate has raised the carrying capacity to four sheep per acre, and that this has been maintained during the last eight years. Simultaneously there has been a striking improvement in the health and vigour of the stock. Mr Davies has shewn that whereas soil bacteria are present to a very limited extent in the Moutere soil in its natural state, they are very plentiful in soil taken from the fertilised areas.

THE PAKIHI LANDS.

Some 200,000 acres of land in Golden Bay and on the West Coast is of the class known as pakihi—level or gently rolling land covered in its natural state by dwarf umbrella fern and small rush. The capital value of this land is usually stated to be five shillings per acre. With grants from the Buller County Council and Westport Borough Council, subsidised by the Department of Scientific and Industrial Research, a great deal of work has

Dairy Herd on Reclaimed Pakihi, Wood's Farm, Westport.

Jersey Heifers on Pakihi Experimental Plot, Sergeant's Hill, Westport.

been done on the bringing in of this land for dairy purposes. About 100 experimental plots have been put down near Westport upon land secured for the Institute at a peppercorn rental from the Railway Department by the Hon. W. H. McIntyre. It can now be stated that for a sum of £6 per acre the land can be rapidly and effectively brought into condition for dairy farming, and several farmers are now using the land for this purpose. Last year an area of 72 acres of pakihi near Onekaka was converted into dairy land under Mr Rigg's supervision, and the results so far obtained are very promising. The pakihi areas are all in mining districts which suffer from acute variation in trade conditions and the introduction of any form of profitable agriculture should have a stabilising effect upon the prosperity of these districts.

BLOWFLY PARASITES.

The blowfly causes great loss of lambs in certain parts of New Zealand. Eggs are laid in the fleece, and the maggots initiate sores which result in septic poisoning. After several unsuccessful trials in which the insects did not survive the long journey from England, Dr. Miller succeeded in introducing the parasite, Alysia. This insect lays its eggs in the maggot of the blowfly which then fails to develop beyond the pupal stage. Alysia has now established itself successfully and has been supplied from the Cawthron insectaries to the Australian Commonwealth.

FOREST TREE PESTS.

A study has been made of the insect pests attacking exotic trees and in some cases control has been effected. A parasite has been established for the golden scale which was particularly destructive of oak trees in Canterbury. The successful rearing of this parasite is due to the careful work of Mr Gourlay. Another serious pest now being controlled by a parasite is the gum-tree weevil which causes great damage to the shoots and foliage of eucalypts. The latest success is the establishment of a parasite which destroys the horn-tail borer of pine trees.

CONTROL OF NOXIOUS WEEDS.

The Empire Marketing Board and the New Zealand Government have contributed liberally to a scheme for the study of the control of noxious weeds by insects, and though the subsidy has now ceased the New Zealand Meat Board has taken the matter up, and is supplying the salaries of two assistants. The insects are largely obtained from the insectaries of the Imperial Institute of Entomology at Farnham Royal. In 1929 more than 50 per cent. of the insects sent out from Farnham Royal

came to New Zealand mainly for distribution by the Cawthron entomologists. In 1932 this had increased to over 80 per cent. The Department of Scientific and Industrial Research is very appreciative of the benefits received, and it is hoped that the New Zealand Government will make a substantial grant towards the upkeep of the Farnham Royal laboratories. Amongst the weeds which are at present under experiment the following are of special interest.

(a) Gorse.

A weevil, Apion ulicis, which destroys gorse seed in Great Britain, has been forwarded from Rothamsted and from Farnham Royal. The insect has now become established, and has been observed in numbers this spring in the gorse plantations on the Cawthron grounds. In South Canterbury and Otago it appears likely to be of great use. Unfortunately in Nelson and the North Island the gorse flowers freely during the cooler months when the insect is hibernating—a fact which reduces the chances of complete control in the warmer parts of New Zealand.

(b) Ragwort.

The Cinnabar moth, introduced for the control of ragwort, has disappointed the early expectations, owing to the fact that there is only one brood of this insect each year, whereas ragwort flowers throughout the spring and summer months. Dr. Miller has recently secured a seed-fly which works throughout the flowering period of the ragwort, laying its eggs in the flower and completely destroying the seeds. It is hoped that a permit for the liberation of this insect will be obtained during the present season. Permits are of course never issued until very satisfactory evidence is adduced that the insects to be liberated feed only on the weed which it is desired to control.

(c) Acaena (piripiri or biddy-biddy).

When Dr. Miller was in Chile he studied an insect which preyed upon the Chilian Acaena, a near relation of the New Zealand species. The pupae were brought to Nelson and the emerging insects fed upon New Zealand piri-piri which they readily devoured. The habits, food, and life-history of the insect are still under study in the Institute. If this parasite is successful it will be of great benefit to the New Zealand wool industry, as the value of the wool is reduced by the burrs which attach themselves to the fleece.

PLANT DISEASES.

The mycological work has already been mentioned in connection with pip fruits, stone fruits, tomatoes, small fruits and hops. Much useful work has also been done on the control of the diseases which attack trees, grasses, native plants and nursery-

THE ENTOMOLOGICAL LABORATORIES AND INSECTARIES.

men's stock. In connection with common diseases of garden flowers an advisory pamphlet has been issued. In much of this work Dr. Curtis received great assistance from Miss Murray.

OTHER INVESTIGATIONS.

Whilst attention has been mainly paid to the problems of agriculture and fruit-growing, many points in connection with other industries have been examined. With the help of a bequest from the late Mr Isaac Hopkins a preliminary investigation has been carried out on the improvement of inferior brands of honey. A report has been issued on the chemistry of the New Zealand mineral oils. The Nelson City Council has consulted the Institute from time to time in connection with the gas supply, more particularly with regard to the long-standing napthalene trouble, which was eliminated, and also in connection with the erection of the new retort house. Advice has been sought by paint manufacturers, flax millers, brewers, cider makers, ironmasters, coal-mining companies and many others. The staff has indeed attempted to give of its best towards the technical education and development of the Dominion in accordance with the known desire of the founder of the Institute.

THE MUSEUM.

The maintenance of a museum is specifically stated in Mr Cawthron's will as one of the objects of the bequest, and much thought was given by the Commissioners and the Trustees to the nature and scope of the museum. Mr Justice Chapman in his judgment warned the Trustees against substantial expenditure on acquisitions for the museum which are not within the Trust. He considered that the museum must grow up as an industrial and technical museum, which is in accordance with the desire of the Commissioners that the museum should illustrate in the widest sense the industries of the Nelson district and the research work of the Institute. In the hands of the Curator, Mr W. C. Davies, a very effective museum has been arranged. Of the seventy magnificent slides shown in illustration of this lecture many are from his photographs of the work of the Institute, as exhibited on the walls and transparencies of the museum. Many of these photographs have been hung at the Exhibitions of the Royal Photographic Society in London, and the authorities of the Royal Botanic Garden at Kew have recently made a liberal grant to the Institute in order that a representative set of photographs of the unique New Zealand native flora may be prepared. No museum can afford to neglect artistic effort, and gifts of very valuable china and pictures have been bequeathed by Frances Charters Marsden, Mary Rose Marsden and James Wilfred Marsden. Small as the museum is, it has been visited by 10,000

visitors, and has received commendation from distinguished authorities on museum matters. It is imperative, as a token of respect to the founder of the Institute, that not only the museum itself, but also the house and grounds shall be kept in an attractive manner. This object has certainly been attained.

THE LIBRARY.

From the date of the opening of the Institute a great effort has been made to build up a good library with complete sets of the leading scientific journals and periodicals which are essential to investigators as works of reference. The library of the late Mr David Sharp, said to be one of the finest private entomological libraries in Great Britain, was purchased in 1920. Valuable bequests of books were made by Mr McMurtry and Mr J. W. Marsden. As in the case of many research institutes in other countries the increased price of nearly all scientific literature, together with the enforced reduction in expenditure, have made it very difficult to maintain the library in a high state of efficiency.

CAWTHRON LECTURES.

In accordance with the recommendation of the Cawthron Commissioners an annual Cawthron Lecture was established in 1917. The lecturers, of whom a list is given as an appendix, have been carefully chosen on account of their recognised position as authorities on very diverse branches of learning and include men of outstanding eminence. The lectures have been extremely well attended and copies of the lectures have been asked for by research institutes in all parts of the world.

PUBLICATIONS AND ADVICE.

A very large number of papers dealing with pure and applied science has been produced by members of the staff and form a permanent record of the varied and important investigations of the Institute. Appreciation of the contributions to scientific literature has been freely expressed by the workers on allied problems in other countries and many applications for copies of the publications have been received.

Much of the effectiveness of the work of the Institute is undoubtedly due to the fact that the staff has endeavoured to study the problems of the primary industries by direct association with the farmer and fruit-grower. This contact has necessitated the giving of much advice and the identification of a large number of botanical, entomological and mineral specimens, work which has brought to light many problems which would otherwise have remained unnoticed.

This lecture has sketched the work which has been carried out by an enthusiastic band of research workers during the

fourteen years which have elapsed since the Institute was opened. The general effect of these labours may be expressed in the following statement:—

> **The work of the Cawthron Institute has raised the whole level of the Nelson agricultural and fruit-growing activities and given to the man on the land throughout New Zealand an increased confidence in the application of science to agriculture. The improvement in the agricultural status of the district has been no small factor in enabling Nelson to meet the widespread financial distress more successfully than any other district in the Dominion.**

May New Zealand never forget her indebtedness to Thomas Cawthron and may the devotion of Nelson's sons and daughters to the Cawthron Institute for ever keep his memory green.

CAWTHRON LECTURES.

1917: The Aims and Ideals of the Cawthron Institute, by T. H. Easterfield, M.A., Ph.D., Professor of Chemistry, Victoria University College, Wellington.

1918: Biology in its Relation to Agriculture, by W. B. Benham, D.Sc., F.R.S., Professor of Biology in the University of Otago.

1919: The Distribution of the Vegetation and Flora of New Zealand, by L. Cockayne, Ph.D., F.R.S.

1920: The Geology of Nelson, by P. Marshall, M.A., D.Sc.

1921: Radium and its Teaching, by E. Marsden, D.Sc., Professor of Physics, Victoria University College, Wellington.

1922: The Coming of the Maori, by Te Rangi Hiroa (Dr. P. Buck), M.D., D.S.O., Director of Maori Hygiene.

1923: The Crustacea of the Pacific, by C. Chilton, M.A., M.D., D.Sc., Rector of Canterbury College.

1924: Flame and its Mystery, by W. F. Worley, M.A., D.Sc., Professor of Chemistry, University College, Auckland.

1925: Matter and Electricity, by Sir Ernest Rutherford, O.M., President of the Royal Society.

1925: A Popular Account of Evolution, by P. Lotsy, Ph.D., Velp, Holland.

1926: Recent Advances in Astronomical Discovery, by J. T. Ward, Curator of the Wanganui Observatory.

1927: Athens, Florence and the Modern State, by A. J. Grant, M.A., Professor of History in the University of Leeds.

1928: The Work of the Rothamsted Station and the Influence of its Founders on the Development of Scientific Agriculture, by Sir John Russell, D.Sc., F.R.S., Director of Rothamsted Experimental Station.

1929: Goitre in the Light of Recent Research, by C. E. Hercus, M.D., D.S.O., Professor of Bacteriology and Public Health, University of Otago.

1930: How Coal Reveals its Past, by W. P. Evans, M.A., Ph.D., Professor Emeritus, Canterbury College, Christchurch.

1931: No lecture.

1932: A Conspectus of Recent Agricultural Research, by His Excellency Lord Bledisloe, M.A., D.Sc., P.C., G.C.M.G., K.B.E., Governor-General of New Zealand.

1933: The Achievements of the Cawthron Institute (Centenary Lecture), by T. H. Easterfield, Director of the Cawthron Institute.

Most of these lectures are now out of print. Lord Bledisloe's lecture is published by Whitcombe and Tombs, and obtainable through all booksellers.