CHEMISTRY IN THE DEVELOPMENT OF NEW ZEALAND INDUSTRY - 1940

This article is a copy of a joint publication of *The New Zealand Section, Institute of Great Britain and Ireland* and *The New Zealand Institute of Chemistry,* entitled "Chemistry in the Development of New Zealand Industry", published in 1940. The contents of the 1965 DSIR publication "One Hundred Years of Chemical Research" is also given.

INTRODUCTION

The history of chemistry in New Zealand, and the role it has played in the development of the country, is admirably presented in the 1981 NZIC publication "Chemistry in a Young Country", edited by P.P. Williams, and produced on the occasion of the 50th anniversary of the foundation of the New Zealand Institute of Chemistry.

Two years ago Jenny Butcher, then teaching at Auckland Girls' Grammar School, came across, and rescued from being thrown out in a periodic clean up, a little booklet entitled "Chemistry in the Development of New Zealand Industry". She thought it might be of interest and gave it the editor of this publication who initially could not find anyone who knew of its existence. Surprisingly there is no reference to it in "Chemistry in a Young Country", so presumably none of the many contributors to that publication were aware of its existence. We have now been told that this was produced in 1940 for the New Zealand centenial celebrations of that year.

We believe it to be an important publication in the history of the NZIC, and in hind sight could be regarded as the true first edition of "Chemical Processes in New Zealand". As the copy rescued by Jenny Butcher is the only one we know of for sure, (there are probably a few others in unknown collections) we have copied it and reproduce it in its original form as the final section of this publication. This should ensure it is not lost for ever.

Another rich source of historical information is "One Hundred Years of Chemical Research" produced by Chemistry Division, Department if Scientific and Industrial Research, in 1965, (NZ DSIR Information Series-No. 46). This was produced to celebrate the centenary of the setting up of a Colonial Museum and Laboratory in Wellington. The 126 page book has a history of Chemistry Division followed by 1-2 page articles on past and current (1965) research projects. The list of these projects is given at the end of this section.

The establishment of Crown Research Institutes in the 1990's resulted in the disestablishment of Chemistry Division and the DSIR, and New Zealand no longer has a single chemical research organisation. Its "Government research chemists" are now spread throughout the various CRI's and other industry research institutes.

CHEMISTRY

in the Development of New Zealand Industry

A Review of the Influence of the Chemist in the First Hundred Years of New Zealand's History

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CHEMISTRY IN NEW ZEALAND

SIR THOMAS EASTERFIELD

I have been asked to write an introduction to this booklet in which different aspects of chemistry are dealt with by different chemists. Such a publication should appeal to an educated but not chemically minded public and also to the scientific and technical chemist.

In the third decade of the last century the position of chemistry in England appears to have been at a low ebb, though individual chemists, notably Faraday and Thomas Graham, were publishing the results of researches still regarded as of fundamental importance.

The teaching of chemistry in London appears to have been mainly conducted by lectures in the various medical schools and the teaching of practical chemistry is believed to have been very meagre. Englishmen with an urge for chemistry were being attracted in considerable numbers to Germany, where Liebig, in the University of Giessen, had established a unique school for instruction in research methods and their application to the explanation of natural phenomena and to the development of the resources of nature for the good of mankind.

At the time when the New Zealand Company was sending out the early colonists to this country there can have been few, if any, trained chemists amongst them, though the medical men and druggists must have had some slight knowledge of the properties of the medicines which they dispensed. Whether this knowledge induced them to separate the wheat from the chaff in the medical lore of the Maoris is doubtful.

The Chemical Society of London, now known as the Chemical Society, was founded in February, 1841, at a meeting of twenty-five gentlemen "interested in the promotion of chemistry." Five weeks later seventy-five original members drawn from all parts of England and Scotland had indicated their intention to join the Society, and a Constitution was adopted. Amongst the objects of the society were: (i) The advancement of chemistry and those branches of science immediately connected with it; (ii) The holding of periodical

meetings and the communication and discussion of such discoveries, and the publication of the same in the form of proceedings and transactions; (iii) The formation of a library and the establishment of a research laboratory and museum.

The Chemical Society is the first Society established for the promotion of Chemistry. France, Germany, the United States and Russia later founded societies on the English model. The Chemical Society now has approximately 4,000 members, and the annual cost of the production of the various publications of the Society exceeds £10,000. In addition, other societies have naturally arisen each with its own journal devoted to special chemical interests such as Chemical Industry, Analytical Chemistry and Biochemistry. Each performs a useful function and there is comparatively little overlapping in the work of the societies.

At the Jubilee of the Chemical Society in 1910 reference was made to the improbability of the atom of Dalton being really indivisible and it was suggested that by the time the 100th anniversary was held some chemists might have broken the chemical atom into something smaller, and brought under one general law the motions of the atoms. That the main discoveries in this field should have been made by our own Ernest Rutherford, Lord Rutherford of Nelson, and his associated workers, "the atom-smashing brigade," as the late H. E. Armstrong called them, in the Cambridge laboratories should surely act as a stimulus to all New Zealand experimentalists. Though Rutherford is generally spoken of as a physicist he was awarded the Nobel Prize for chemistry in 1908.

The development of chemical manufacture in New Zealand has been slow, largely no doubt, on account of the small population, the lack of raw materials, the high cost of transport and the distance from an assured market. A notable advance was made by the establishment by Kempthorne, Prosser & Co., of the Burnside Sulphuric Acid Works, for Sulphuric Acid is a key industry upon which so many other chemicals, e.g., superphosphate, are dependent. The same company subsequently established works at Westfield (Auckland), Hornby (Christchurch), and Aramoho (Wanganui).

Notwithstanding the fact that chemical works in New Zealand are few, there are many manufactures which for their operation require the constant control of expert chemists in checking the quality of the raw materials and maintaining a uniform standard in finished products. Chemical control is exercised in all the larger breweries, gas works, dairy factories, sugar factories, meat works and cement works. Chemists are

now attached to several of the Government departments, notably the departments of Agriculture and Public Health, and the annual report of the Dominion Analyst is of great interest to those who are able to read between the lines. Research work is also being carried out in the chemical laboratories of each of the University Colleges and at Massey and Lincoln Agricultural Colleges. Finally should be mentioned the wider scope and practical value of the investigations undertaken by the chemists at the Cawthron Institute. With increase in population and development in hydro-electric power, well-trained chemists will be more and more needed and their effectiveness will be largely dependent upon the breadth and efficiency of their training in science.

May there never be lacking amongst us, teachers with enthusiasm, skill and judgment, the influence of which will lead to a truly scientific outlook on all the material and social problems with which not only New Zealand but the whole post-war world is certain to be faced.

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CHEMISTRY AND GOLDMINING IN NEW ZEALAND

G. S. LAMBERT

Wherever one searches into the history of goldmining in any country there is invariably unfolded a story of romantic interest, full of grim struggles, bitter disappointments, unexpected successes and enduring achievements—a tale in which daring adventurers have spent brain and brawn in the search for the precious yellow metal which, while in itself of so little intrinsic value, plays such a vital part in national and international affairs.

In this, New Zealand is no exception and goldmining has played no small part in the development of the Dominion. Measuring its value in terms of money alone, it has enriched the country to the extent of over one hundred million pounds during the eighty-five years over which official records of production have been kept, while its contribution to the development of other industries and to the opening up of new country, though less easily reckoned, has perhaps been of even greater importance.

From its earliest beginnings in New Zealand this industry has received valuable assistance from the science of chemistry, and it says much for the wisdom of the pioneers in the industry that their appreciation of the value of scientific methods was shown not only by the ready adoption of new discoveries, but also by the early establishment of educational institutions for the advancement of scientific knowledge.

The earliest discoveries of gold were alluvial deposits which naturally offered little difficulty in the extraction of the values, but it was not long before rich quartz reefs were located in both the North and South Islands. The first method of treatment of the quartz was by simple amalgamation. This method gave highly satisfactory results with the oxidised free-milling ores at first encountered but as these later gave place to deposits of a much more complex nature, large quantities of good ore were wasted through ignorance, either of its value or of suitable methods of treatment .

Undoubtedly one of the greatest individual contributions to the benefit of the industry was that rendered during the late "eighties" by the late Dr. J. G. Black, Professor of Chemistry at Otago University. Realising that a great deal of the loss of valuable ore was due to lack of knowledge on the part of the miners and battery men themselves, he

emphasised the need for education of these men in simple methods of assaying and analysis in order to enable them to identify the various types of minerals encountered in the course of their work. Dr. Black placed before the Government of the day proposals for the establishment of the necessary means of education in the various mining centres. His proposals were enthusiastically sponsored by the Hon. W. J. M. Larnach, C.M.G., then Minister of Mines, and in 1885 Dr. Black was authorised to undertake the work of organising the Schools of Mines. He was a man of amazing energy and possessed to an unusual degree the ability to impart his knowledge in a manner which never failed to arouse interest and enthusiasm in practical men. In 1885 he personally toured the mining districts delivering a series of lectures and conducting practical classes on metallurgy and on the identifying and assaying of minerals. The reports on this remarkable tour (subsequently presented to Parliament by the Minister of Mines), the enthusiastic reception he was accorded everywhere, and the subsequent development of the work he so ably began, all bear eloquent testimony to his outstanding zeal. As a result of his efforts twenty-eight Schools of Mines were formed in the chief mining centres. These were to prove of inestimable value in future years. In addition to giving sound scientific training in analytical, metallurgical, and mining work, the Schools also undertook research work in connection with ore treatment methods; their assistance in these matters was of considerable value at a critical period in the development of the gold industry.

As the richer alluvial deposits and more easily treated bodies of ore began to show signs of rapid depletion, increasing attention was paid to the treatment of the more refractory ores. Numerous modifications of the amalgamation process were attempted and various types of smelting furnaces were tried in different fields, but with few exceptions, these proved unsuitable or too costly in operation. The Chlorination Process, a chemical process which was operated with considerable success in other parts of the world towards the close of last century, was also tried here for a time in the Hauraki and Reefton districts. In the latter locality it was successfully operated for some considerable time.

The greatest triumph of the metallurgical chemist, however, was the evolution of the Cyanide Process, and New Zealand can be justly proud of the contribution of her metallurgists in the early development of what is today the most important method of gold recovery in the world. Many men

connected with the Schools of Mines or associated with mining companies did valuable work in developing and applying the process in this country, but undoubtedly the most outstanding was that of the late Dr. J. S. Maclaurin. As is frequently the case with a new method, the technical development of the cyanide process at first outstripped the theoretical knowledge of its mode of operation and it was to this problem that Dr. Maclaurin turned his attention. The publication of his classical researches in the early "nineties" threw considerable light on the chemistry of the process and assisted in no small way the remarkable advance of cyanidation practice.

It was undoubtedly the development of the cyanide process which was responsible for the second gold boom in New Zealand in the first decade of this century when production again approached that of the peak years of the "sixties." Using this process it was found profitable to treat much ore previously passed over as worthless, while the retreatment of many old tailing dumps gave highly payable returns. At this time the high standard of cyanide practice in our country had world-wide recognition and the registers of the Schools of Mines contained the names of many men who subsequently left our shores to take up important positions as metallurgists on gold fields in all quarters of the globe.

It is unfortunate that owing to the exhaustion of profitable ore-bodies the gold-mining industry today does not occupy the prominent place it once did in our national economy. It has however, made many contributions of permanent value to the community, not the least of these being the demonstration of the benefit and necessity of the wise application of the science of chemistry to the problems of industry.

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CHEMISTRY IN AGRICULTURE.

R. E. R. GRIMMETT

During the first six decades of European settlement in New Zealand, chemical services in connection with agriculture were performed by any chemists available. These included the Professors of Chemistry in the University Colleges, of whom the late Professor J. G. Black of Otago was a notable figure, lecturers at Lincoln Agricultural College, and the colonial and public analysts. In 1899 consolidation of such services was achieved by the appointment of Mr. B. C. Aston as Agricultural Chemist, and during the next decade some remarkable progress resulted.

Among notable features may be mentioned preliminary survey and investigational work on soils, especially the West Coast pahiki soils, bush sick soils of the pumice areas, and the mica schist soils, and studies on the lime and phosphate and potash status of many soils from field experimental farm areas which were established largely under Mr. Aston's guidance; studies on the toxicology of native plants, including the discovery of the poisonous glucoside tutin of the tutu plant (Coriaria ruscifolia); studies on the composition of sugar beet, and other crops under different conditions of soil and fertiliser treatment*; the search (partially successful) for rock phosphate deposits, and survey of limestone resources; review of fertiliser use and trade in New Zealand leading to the institution of the Fertilisers Act, 1905; the testing of water supplies, milk, butter, cheese, apparatus, and the development of methods of testing for dairy factory use, leading up to the establishment of systematic testing of all dairy export produce; studies on the composition and physical constants of pure milk from different breeds of cows in connection with methods for the detection of adulteration; and preliminary studies on the mineral content of pastures and animal organs in connection with the then quite mysterious disease of ruminants known as bush sickness.

During the second decade of this century administrative changes, the War, and the establishment of private laboratories by several industries including dairy and fertiliser companies, and finally of the Cawthron Institute, led to develop-

*It is interesting to note that in his 1907 report, Mr. Aston drew special attention to the high sugar content of beet grown in New Zealand, and to the possibilities of a beet sugar industry and of asparagus grown on salty estuarial or reclaimed land near Napier, both of which projects are now receiving special attention.

ments of chemical research and organisation, which are covered by other contributors. So far as the Department of Agriculture was concerned, chemical work was intensified on certain research problems. Experimental work was carried out on bush sickness which was pronounced to be a deficiency disease, and the first practical though somewhat expensive and tedious remedy, the drenching of the animals with soluble iron compounds, especially iron and ammonium citrate, was discovered. Indications of benefit to stock were also obtained from top-dressing pastures with crude iron compounds.. Extensive services to farmers were instituted for testing soils for lime requirement, and fertilisers for quality. A reconnaisance soil survey of the Manawatu was carried out and attention drawn to the great richness of soils of the Poverty Bay Flats.

Other investigations concerned the composition of the ash of New Zealand trees and plants such as bracken fern, and the native plant tans and dyes.

The period 1920 to 1930 saw great expansion in agricultural chemistry in New Zealand. Notable contributions of the Cawthron Institute included the detailed soil survey of the Nelson district by T. (now Sir Theodore) Rigg, and co-workers, the discovery of xanthine calculi in sheep by Professor T. (now Sir Thomas) Easterfield, and J. A. Bruce, and the experimental work on bush sickness in the Nelson district, of which however, the full implication did not appear until later. The Soil Survey Division under Dr. L. I. Grange, carried out valuable studies on soil types and their relation to deficiency diseases, especially bush sickness, which was now being attacked from numerous angles. Expansion continued in laboratories connected with agricultural industries or institutions, especially Massey Agricultural College, the Wheat Research Institute, and the dairying, meat products and fertiliser industries.

Biochemical work was initiated at the Wallaceville Veterinary Laboratory, and the Dairy Division established a chemical laboratory for research purposes, and testing laboratories for dairy produce. The Dairy Research Institute was established and a chemist appointed to the Plant Research Institute. In the Chemistry Section of the Department of Agriculture deficiency diseases of livestock, especially bush sickness and Waihi disease (connected with deficiency of phosphorus) received major attention. Extensive studies were made on the composition of soils and pastures where these ailments occurred. Iron and ammonium citrate became widely used as a cure for bush sickness in cattle, and a search began for a cheap and more easily administered substitute. Limonite

(hydrated iron oxide) proved successful. Numerous pasture analyses were made in connection with "pulpy kidney" in sheep, grass staggers and sterility in cows. This work, and that of the Cawthron Institute on mineral contents of pastures and their connection with livestock health, was greatly assisted by grants from the Empire Marketing Board.

Other studies included a survey of iodine available to livestock throughout New Zealand from the analysis of sheep thyroid glands (initiated by Miss B. Simpson, of the Rowett Institute, Aberdeen), investigations by L. D. Foster of the chemical composition and milling qualities of New Zealand wheats, including baking tests (work later undertaken by the Wheat Research Institute); surveys of pollards, meat meals and other stock foods; and investigations of submerged and marginal lands for reclamation.

In the present decade many new lines of investigation have been initiated. At Wallaceville, Dr. I. J. Cunningham has introduced to New Zealand a colony of the Wistar strain of experimental rats, and carried out valuable studies on magnesium assimilation in connection with grass staggers, the effects of high protein rations on fertility, etc. At the Cawthron Institute Sir Theodore Rigg, Dr. H. O. Askew, Dr. J. K. Dixon, Miss E. Kidson and others have perfected a technique of analysis for traces of cobalt, and have established the fact, first announced by Marston and by Filmer and Underwood in Australia, that bush sickness is due to a deficiency of the minute traces of cobalt frequently associated with iron compounds. Concurrent work by K. J. McNaught of the Department of Agriculture has demonstrated that the bush sickness endemic to the areas where it was first described in the pumice lands of the North Island, is also cobalt deficiency, and has lead to the development of pasture and liver analysis for cobalt as diagnostic measures.

Other recent advances are: the demonstration by J. D. Atkinson and chemists at the Cawthron Institute that internal cork in apples is due to boron deficiency; soil surveys, with chemical work by J. K. Dixon, Miss E. B. Kidson, K. S. Birrell and others; investigations of honey flavour by R. H. K. Thomson; of fruit ripening by J. B. Hyatt and O. H. Keys; of pampas grass composition and use as stock fodder by B. C. Aston and F. B. Shorland; of vitamin A content of New Zealand fish liver oils by F. B. Shorland; of zinc poisoning in pigs fed skim milk through galvanised pipes, and of arsenic poisoning in cattle from naturally arsenical waters and soils by a group of workers including C. S. M. Hopkirk, L. W. N. Fitch,

Miss E. M. Wall, I. G. McIntosh and the present writer; of pasture and soil composition under different manurial systems; of glucoside content of clovers by B. W. Doak; and work on pakihi soils by Sir Theodore Rigg, resulting in waste land being converted to dairying pasture.

Recently established laboratories at Palmerston North under Dr. J. Melville and at Ruakura, are concerned with the composition of pastures and crops and their effect upon animal health. Dr. E. B. Davies of the Department of Agriculture is studying soil nutrients and their effect upon crop yield, pasture composition, etc. Toxicology is receiving special attention at Wallaceville.

Never previously in the history of New Zealand have so many chemists, both in private and public laboratories, and from so many angles, devoted their attention to attempting to solve the problems of agriculture. Such efforts have already well repaid the country even if one recalls only the immediate cash benefits resulting from such findings as a certain and economical means to prevent bush sickness, or internal cork in apples, but of equal value are the less conspicuous results of the chemist engaged in routine analysis.

Among agricultural chemists in New Zealand the name of B. C. Aston will always hold a unique and distinguished place. In considering those early years when lines of study that have later become prominent were being established, it is also fitting to recall the late Mr. F. T. Leighton who was for long senior chemist in Aston's laboratory, and helped to train a number of those now engaged in agricultural chemistry.

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THE MEAT FREEZING INDUSTRY

J. C. ANDREWS

One of the outstanding milestones in the development of New Zealand was the practical application of refrigeration to the transport of perishable foodstuffs and the subsequent growth of the meat industry which, with its by-products and its impingement on the economy of other industries, can with justice be termed one of the Dominion's most important industries. Reference to the New Zealand Year Book for 1939 gives the following information for the year 1937:—

Total value of exports	£66,713,379
Exports of frozen meat (including chilled)	£14,689,616
Value of output of Meat Freezing Industry	£20,769,869

From the above it is seen that more than one-fifth of the total value of exports from New Zealand is accounted for by frozen meat. The difference between the value of the frozen meat exported and the value of the output of the industry, some six million pounds, relates to the various by-products of the industry, and it is safe to assume that at least two-thirds of this amount is exported. These figures indicate the importance of the industry in the Dominion's economy, and it is of interest to trace very briefly its development and the part that has been played by the chemist.

Prior to the application of artificial refrigeration to the preservation of foodstuffs, sheep were raised in New Zealand for the production of wool. The colony was found to be well suited to pastoral production and wool became one of its main exports. In the latter half of the 19th century, Great Britain was faced with a shortage of meat for her rapidly increasing population, while in New Zealand large flocks of sheep were being raised solely for the production of wool. Consequently the historic shipment of frozen meat from the colony by the "Dunedin" in 1882 was singularly opportune. With a ready market available in Great Britain the development of frozen meat as an export was rapid and freezing companies became established in various parts of the colony. The meat shipped consisted almost entirely of mutton and lamb, and it was not until dairy products also became valuable exports that other classes of meat became at all important.

With the establishment of freezing companies producing large quantities of meat for export there naturally arose the problem of dealing with the by-products to the best advantage.

Boiling-down works had been established prior to the export of meat and cullings from the flocks were boiled down for tallow. This business now became the concern of the freezing companies and tallow and fertiliser became important by-products. Various technical problems were encountered in this connection and eventually the assistance of the chemist was sought. As far as is known the first chemist to be associated with the industry was the late Mr. Alfred Carter, who came to New Zealand in 1890 to accept a position with the Gear Co. Ltd., at Petone. He retired in 1920, after 30 years' service, but was retained in an advisory capacity by the Company until his death in 1932. Born in 1840, had he lived to take part in the centennial celebrations, he would have celebrated his own centennial concurrently.

Ten years later, in 1900, the Canterbury Frozen Meat Co. Ltd., established a laboratory at Belfast and Mr. L. P. Symes was appointed as a part time chemist to deal with the matter of the Company's fertiliser products. The farmers cropping on the Canterbury plains were very chary of using organic fertiliser, many of them preferring to use guano and superphosphate. Mr. Symes was truly a pioneer chemist in the meat industry and it is particularly pleasing to be able to record that, not only is he still in practice, but also that he is still in the employ of the Canterbury Frozen Meat Co. Ltd., in charge of their laboratory and responsible for the chemical control of their products.

A few years later, in 1904, Mr. A. M. Wright was appointed chemist to the Christchurch Meat Co. (now the New Zealand Refrigerating Co. Ltd.) for the purpose of carrying out regular analyses of its products and developing the by-products of the industry. Mr. Wright applied his energy to the investigation of many of the fundamental problems connected with the industry and he published many original papers dealing with these problems. Apart from his absence at the War, Mr. Wright remained in charge of the laboratory of the New Zealand Refrigerating Co. Ltd. until his death in 1930, when he was succeeded by Mr. J. C. Forsyth. It can be truly said that no New Zealand chemist has contributed more to the progress of the meat industry in New Zealand than Mr. Wright.

In 1907, Mr. H. W. Lawrence established a consulting practice in New Zealand and was retained by Messrs T. Borthwick and Sons Ltd. With the increasing need for technical advice in connection with fertilisers and tallow, Mr. Lawrence extended his connection until, at about the time of the War, he was retained by every company operating in the North

Island, and by most of those operating in the South Island. A great deal of credit is due to Mr. Lawrence for his efforts in bringing to the notice of the farming community the necessity for the proper application of manure to the soil for the maintenance of their pastures. It is also pleasing to be able to record that Mr. Lawrence's practice, now carried on as H. W. Lawrence and Son, still retains a large consulting practice in the industry in spite of the development of laboratories by individual companies in the Auckland Province.

Shortly after the War period, which had stimulated the dairy and meat industries in the North, the companies operating in the Auckland Province established laboratories. In 1921 the Auckland Farmers' Freezing Co. Ltd., established a laboratory under the control of Mr. H. H. Edwards, in order to control the products of their works at Moerewa, Southdown and Horotiu. At about the same time, Messrs W. & R. Fletcher (N.Z.) Ltd. found that chemical control of their linseed oil plant was necessary and at the beginning of 1923 Mr. P. R. Parr took charge of their laboratory for the control of linseed oil, tallow and fertiliser. During the period following the War the industry in the Auckland Province expanded rapidly as all classes of stock became available and the Works took on a different aspect to that generally met with in the sheep raising areas. The handling of a great variety of products and the development of canning required considerable technical and scientific knowledge, with the result that these laboratories quickly became firmly established and their functions expanded. At the beginning of 1928 the remaining company operating in Auckland, Messrs R. & W. Hellaby Ltd. procured the advice of Mr. J. C. Walsh of London in connection with their meat canning business, and a laboratory was established in that year under the writer's charge.

From the above it will be seen that there are several laboratories established at different works, some of which service other works in addition to those where the laboratory is situated. Those works not serviced by such laboratories obtain chemical assistance from the practicing consultants. This use of chemical knowledge by the industry demonstrates that it is alive to the value of scientific control and analysis of its products, but it must be admitted that there is still considerable scope for much greater use to be made of scientific assistance than exists at present. Those who are actively engaged as chemists in the various works realise these limitations and find that if they can look after the routine control and analysis of the products, together with certain investigations

of methods as used in the works under their particular jurisdiction, it is as far as they are able to go in their service to the industry. Certain problems of a more general and fundamental nature to the meat industry have received little attention. It is in connection with these problems that some scheme is necessary if the industry is to reap the full benefit of scientific knowledge. It is of interest to note that Australia dealt successfully with this aspect by the formation of research laboratories at the Homebush Abbattoirs, Sydney, which service the industry as a whole in that country. If the industry in New Zealand could see its way clear to establish a control research station for the more fundamental problems, such a station could prove a very valuable national asset.

The meat industry in this country is undergoing a period of transition, as are its markets, and it should make every effort to meet these changes if it is to retain its place in the economic structure of the Dominion. There have been quotas placed on the export of mutton to Great Britain, and the opportunity of expanding this trade appears to be limited. The export of beef has grown considerably with the successful introduction of the chilled beef trade. The pork industry developed rapidly but has now fallen back with a reduction in the Dominion's pig population. Transport facilities and methods of operating are undergoing profound changes and there is a definite need for the industry in New Zealand to be in a position to take full advantage of these changes. Competition from other countries supplying the English market is very keen and, while distance from the market places us at some disadvantage, we have a country ideally suited to the production of fat stock of high quality, and every effort should be made to utilise our productive capacity to the full.

Looking back over the past hundred years, it is clear that the pioneer settlers in this country were quick to utilise the natural fertility of the country, and since the introduction of refrigeration, primary production has developed phenomenally. At our centennial year we find the meat industry one of our greatest assets, but an asset which will require constant attention in the light of changing world conditions, and it behoves us to guard it jealously and to apply our energy to its development if we are to maintain the standards set by the achievements of the early settlers of New Zealand.

With these thoughts, let us celebrate our centenary with due gratitude to the prudence of our pioneers, and conclude with a firm resolve that the second hundred years of our occupation of New Zealand will see its development fully maintained.

CHEMISTRY AND THE DAIRY INDUSTRY.

F. H. McDOWALL and M. S. CARRIE

The preparation of dairy products such as butter and cheese from the raw material, milk, was an art, unaffected by scientific discovery, until late in the nineteenth century. Dairy manufacturing as practised today is still very much of an art, but it has been possible and profitable to apply scientific principles in, and scientific testing for, control of many of the procedures. This has made possible the enlargement of the processing units, and conversely, the increase in size of the processing unit has necessitated further introduction of scientific control. In the application of science to the dairying industry the chemist has played a very important part.

The dairying industry in New Zealand is largely a growth of the last sixty years, i.e. from 1880 onwards, and is the child of refrigeration. While in 1880 chemists in New Zealand were contributing but little to the progress of the industry, it must be recognised that much of the progress was due to the work of chemists in other countries. The New Zealand dairy industry proved very receptive to new ideas and quickly adopted the findings of chemists overseas.

The Babcock Test for Fat in Milk.—In 1890 Babcock published his method for estimating fat in milk and cream (the Gerber method was developed independently, but was not published until 1892). Babcock's new method found a ready acceptance in New Zealand. Milk previously had been bought on a gallonage basis, both for buttermaking and cheesemaking. The purchase of milk or cream for buttermaking on the basis of its fat content is an obvious improvement, and it made possible a true standard of economy on the dairy farm. The attention of the dairy farmer has been directed to the true value of his farm production, and he has been able through the use of the Babcock or Gerber tests by Herd Testing Organisations to direct the choice of his animals towards butterfat production. The increased butterfat production per cow is evidence of the effect of the Babcock test on the dairy industry in New Zealand. The principal of home separation of cream, which was introduced to New Zealand in 1908—1912, would scarcely have been possible without the Babcock test as a practical means of measuring the fat content of the cream.

The chemical work of van Slyke, chemist in the New York State Agricultural Experiment Station during the years 1892—1896, on the relationship of yield of cheese to fat content of