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## EDITORIAL.

"The general economic position of our scientists must compare with that existing elsewhere if we are to have available our best brains in the solution of our problems," said Dr. J. C. Andrews in his presidential address to Conference. With this in mind, we can only view with strong disapproval the failure of the recent regrading of the Public Service to provide a satisfactory scale of salaries for scientific officers. The new scale, which does little more than confirm the cost of living adjustments of recent years, compares unfavourably with those granted to university staffs, and to primary and secondary school teachers. Few of the senior scientific officers are paid more than £825 per annum, the present maximum for university lecturers, which is substantially below what the university authorities considered necessary.

A flow of scientifically trained men and women between the Public Service on one hand, and industry and teaching institutions on the other, is sound enough if it is a two-way movement. But it will be a serious matter if it becomes a one-way flow of first rate senior workers out of the Public Service. It will also be serious if the idea is entertained by those who frame state policy, that losses will be readily made up through the increased number of science students in the university. Our experience of one university college does not show that the large influx of students has brought any significant increase in the number of first rate science students. What it has done is to reduce the chances of the really able minority to get the attention they need, and of the university departments to equip themselves adequately with apparatus used in modern research. The importance of this lies in the fact that the ideas and methods which make for scientific progress are the products of the small minority of really first rate minds. We can afford neither to give that minority anything less than the best of educational opportunities, nor to see them turn, dissatisfied from the scientific institutions of the state.

The British Government has recognised the vital importance of these problems by providing the opportunity for outstanding scientists to reach the grade of Principal Scientific Officer, with a salary up to £1,100, in their early thirties. A parallel scheme is needed in New Zealand if research in state departments is to flourish.

## THE ANNUAL CONFERENCE.

The 1946 Conference at Wellington was welcomed by the Minister for Scientific and Industrial Research (the Hon. D. G. Sullivan) and the Deputy Mayor (Mr. M. F. Luckie). The former paid tribute to the service rendered to the country, both at home and overseas, by young scientists during the war years. Mr. Luckie spoke of science's civilising mission, and the burden laid on the shoulders of scientific workers to see that the march of science was in the direction of civilisation and not destruction.

In addition to the full programme of papers, which were abstracted in the August Journal, successful visits were paid to the Wallaceville Animal Research Station, Karitane Products Ltd., British Australian Lead Manufacturers, Wellington Municipal Milk Department, the Dominion Laboratory and the Soil Bureau.

On August 28th, members were guests of the Royal Society (Wellington Branch) at a Conversazione at Victoria University College, where an impressive display of scientific progress was available.

A highlight of Conference was the announcement of the election of two Honorary Fellows, Dr. W. P. Evans now being joined, in holding this distinction, by Sir Thomas Easterfield and Mr. W. Donovan. These matters are referred to below.

## ANNUAL GENERAL MEETING, 29/8/46.

Dr. J. C. Andrews presided over a meeting of about 100 members.

In his outline of the year's activities, the President announced the election of Honorary Fellows, and the award of the 1946 Industrial Chemical Essay Prize. The latter was awarded to Mr. W. A. MacGillivray, Associate of Massey College, for his essay on "The Drug and Cosmetic Industry in New Zealand."

It was announced that Council has appointed Mr. Hugh Palmer, of the firm of Watkins, Hull, Wheeler and Johnston, to be Registrar of the Institute for twelve months, as from 1/11/46.

Subject to the approval of the R.I.C. (N.Z. Section) the 1947 Conference will be held in May, at Wellington, as the Chemical Section of the Royal Society (N.Z.) Congress.

Dr. S. N. Slater put forward a number of suggestions regarding Council Meetings, the reduction of detailed work, and the procedure by which members are elected. It was agreed (a) that provision should be made for an Annual Meeting of the Membership Committee and (b) that this Committee be given power to co-opt.

Mr. R. E. Grimmett reported on the work of the Committee on standard methods of analysis.

A motion was carried urging on the Government that a complete overhaul of salaries in the research institutions of the Public Service is necessary to attract and retain the better men in the service.

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The Institute as a whole is not responsible for statements and opinions appearing in this Journal.

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NEW ZEALAND INSTITUTE OF CHEMISTRY.

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**Presidential Address, 1946.**

## THE SCOPE OF SCIENCE IN NEW ZEALAND.

J. C. Andrews, M.Sc. Ph.D. F.R.I.C. F.N.Z.I.C. A.M.I.Chem.E.

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When viewed in relation to the rest of the world, New Zealand occupies a unique position, being the most southerly group of islands constituting an appreciable land mass. Before the days of rapid transport its isolation from contact with the rest of the world lead to development peculiar to its environment. Its contact with the white man began as the result of the colonisation of Australia, whaling and the kauri forests of the North being the main incentives for the white man to approach its shores. After this came the colonisation schemes leading to the various settlements in New Zealand, followed later by the gold rushes in the Thames and Otago areas. No doubt early visitors to these shores were impressed by the luxuriance of the vegetation and the ample supply of good water. This, together with the discovery of gold, must have made the country appear very attractive to those seeking new habitation. Apart from gold and coal, no other sources of mineral wealth had been discovered, but the discovery of gold, had no doubt attracted geologists and mining engineers to the country. After the initial fever for gold had abated, agriculture became a more certain source of a livelihood and in the years that followed, history records the rapid development of New Zealand as one of the most productive agricultural areas in the world. This development was only made possible by the courage and initiative of our forefathers. Their problems were many, but ultimately a solution was found in nearly every case. Both pakeha and Maori contributetd to the development of the potential resources of the country. This initial struggle of the pioneers may have something to do with the independence of thought which this community has developed. In science as in many other spheres the New Zealander has shown this courage and ability. I doubt if any country can show a better per head achievement in the field of scientific research. Many famous names must flash before those who think back over the years, and it must have been most gratifying to all present when a Knighthood was recently conferred on our outstanding Maori scientist of to-day, Sir Peter Buck. A great deal of the development of scientific thought in New Zealand has undoubtedly been due to those pioneer professors of the Colleges of the University of New Zealand, and New Zealand owes them a great debt of gratitude. Later came the bequest which founded the Cawthron Institute, the reputation of which is now world wide as the result of its research into some of the fundamental problems of agriculture.

In the early days of New Zealand the main Government investigations naturally centred round the acquiring of knowledge concerning the native flora and mineral deposits of the Colony. From this developed the Geological Survey and the Dominion Laboratory, while investigations in agriculture were carried out by the Department of Agriculture. The stark necessity for more energetic and co-ordinated research by Governments was demonstrated by the 1914-1918 war when scientific warfare may be said to have started. This led the Government of New Zealand to follow Great Britain and other Dominions so that in 1926 the Department of Scientific and Industrial Research was formed under the Coates Government. From its inception until the beginning of World War II this Department can be said to have pursued research into agriculture as its main line of attack. This was undoubtedly sound as at that time there were many serious problems facing agriculture, which if left unsolved would have retarded our progress very greatly. I have only to mention the improvement in the varieties of wheat grown in the South Island and the development of the better pastures in the North Island to make clear how important this work was to the national income. Other examples no doubt will occur to you. With approach of the war in 1939, however, the Department of Scientific and Industrial Research under the able leadership of Dr. E. Marsden applied the scientific resources of the Dominion to supplement this country's war effort. This immediately brought the physicist and the chemist into more intimate contact with industry, with the result that to-day there is available an organisation capable of assisting industry. It stands to the credit of the present administration that much progress has already been made in this direction. Medical science was catered for at the University of Otago and the outstanding achievement in this field is undoubtedly the Plunket Society and all that this means, due largely to the efforts of the late Sir Truby King. In many respects medical research is dependent on research in other fields, and one looks forward to the day when the Medical Research Council can operate on a more generous scale. This then is the picture in retrospect. Much has been omitted, only the main lines being drawn, but it should be sufficient groundwork upon which to discuss the scope of science and its future in the development of New Zealand.

One of the first questions to consider is whether or not there are limitations to the scope of science in New Zealand, and one is forced to admit that there are several, though some may, no doubt, disappear with time. As I see it the limiting factors are:—(1) Finance with particular reference to salaries and equipment. (2) Opportunities. These are more limited in a small country than in older countries with larger populations. (3) Facilities. The facilities available are often limited and preclude certain lines of investigation being taken up. (4) Stimulus. This is lacking in as much as there are rarely more than one or two workers in any field. Since research is stimulated by criticism and competition in a given field and by personal contact between the workers, this country cannot be said to be by any means ideal from this point of view. (5) Scientific Approach. As yet a large number of those persons responsible for our production and public facilities have not acquired this approach to their problems. In applying scientific method three steps are involved—observation and collection of data, reflective thought and development of a plan or theory from the observed facts, test of theory in practice to establish its soundness. (6) Public Recognition and Support. Unless the community as a whole is interested in science and is prepared to give it adequate support, it cannot flourish and give that service which has now become such an integral part of civilisation. (7) Natural Resources. New Zealand has few mineral deposits and this fact precludes the possibility of our producing industrial raw materials. The result is that there is a very restricted scope for the metallurgist.

The above limitations constitute our problem and no doubt some can and will be reduced in various ways. The general economic position of our scientists must compare with that existing elsewhere if we are to have available our best brains in the solution of our problems. As is well known one of our main exports is brains and this country has lost many who could have contributed a great deal to our development and progress. On the other hand there have been some such as Lord Rutherford who could never have been kept within the confines of these small islands and whose work has placed the world in the position of being ever indebted to New Zealand where he was born and received his early education. A greater population should mean a correspondingly greater scientific effort and would help to overcome the lack of opportunities and facilities and would also provide more stimulus amongst workers in any field of science. Better travel facilities are on the horizon and these should help to reduce the feeling of isolation which exists at the present time. There is some hope that one of the findings of the Empire Science Conference recently held in London will result in a greater interchange of thought on Empire problems, as the result of more frequent visits by scientists to opposite numbers in other parts of the Empire. With increasing general knowledge and appreciation of the scientific approach there should develop in the community a greater utilisation of science. As the result of the war there has been exhibited a greater appreciation of the use of science in industry but this is still almost a virgin field and it is to be hoped that New Zealand industries will pay increasingly more attenton to this aspect of their business since the future of New Zealand's prosperity must depend on it. Active and sympathetic co-operation of industry with science must result in an ever increasing utilisation of our resources to the ultimate benefit of the community.

At this stage it is perhaps desirable to discuss some aspects of the major lines along which development may take place in the future and those natural resources which still seem capable of development. In the first place I should like to consider the mineral position. The lack of certain mineral resources necessarily imposes some restrictions on the scope of science in New Zealand. There is a very definite lack of any appreciable ore deposits of the more common metals such as iron, copper, zinc, etc. There has been some speculation regarding the utilisation of Taranaki iron sand but it would seem that if it is worked the main product might well be titanium or vanadium rather than the iron. The extent of the iron sands is not as great as some believe and numerous problems would be associated with any industry developed for their utilisation. However, this does not mean that a good case cannot be made out for a much fuller investigation than hitherto. A cheap and simple method whereby the iron, titanium and vanadium could be separated would be of considerable value to New Zealand. Apart from gold no other metals have been consistently mined in New Zealand, though copper, manganese, mercury, and tungten ores have been mined from time to time.

Basic to the welfare of any country is coal, but when a survey of our position in this regard is made there is found to be very little high grade coal available. For many purposes a high grade coal is at present necessary, and the question arises as to whether or not more active investigations should not be initiated in connection with this vital material. The Coal Survey is carried out by the Geological Survey and the Dominion Laboratory but its work is handicapped by lack of staff and facilities and it has been unable to undertake much work of an investigatory nature in regard to the possibility of devising means of overcoming the handicap of our lack of high grade coal such as exists in other countries. Our deposits are not relatively large and in the national good the greatest possible conservation of this raw material is necessary if posterity is to participate in its utilisation. The day is not so far off when the use of coal as a source of heat and power must be restricted to conserve it for its more important use as a raw material for the synthesis of important organic substances.

Though lacking in abundant ore bodies, there are many deposits of clays and such like material in New Zealand which may be utilised for the production of many types of useful articles. During the war a number of factories interested themselves in the production of articles made from local clays. While some of these still require a great deal of investigation, remarkable success was achieved in certain cases, e.g. electrical insulators at Temuka. A Ceramics Research Association has now been formed under the aegis of the Council of Scientific and Industrial Research and there is promise of development in this field.

When one turns to the heavy chemical industry one is again faced with a lack of local raw materials. Sulphuric acid is certainly produced in large quantity for the fertiliser industry but is dependent on imported sulphur due to the fact that there are no appreciable supplies of either sulphur or pyrites in this country. While the tonnages of sulphuric acid produced here are quite large, it should be pointed out that so far only acid of a strength required by the fertiliser industry is produced in any quantity. However, if a demand for strong sulphuric acid were to develop, the present fertiliser industry could very readily change over to the production of strong acid. While speaking of the fertiliser industry it is also appropriate to mention that this country has no deposits of phosphate rock with the exception of a small poor quality deposit at Clarendon in Otago. While this deposit was worked to some extent during the war it is unlikely to prove an economic source of phosphate rock. Normally New Zealand receives her phosphate rock from Nauru and Ocean Islands, where a high quality material is quarried by the British Phosphate Commission. Alkali is the other heavy chemical fundamental to the chemical industry and is dependent on a cheap supply of salt. Unfortunately this has to be imported and it is somewhat doubtful whether the production of salt from the sea is ever likely to be economical in this country as the climatic conditions do not allow of a satisfactory evaporation of the water. No useful deposits of salt have been found in New Zealand. However, it is just possible that some solution of this problem may be forthcoming and if caustic soda could be cheaply produced it would open up numerous possibilities in chemical industry. At the same time some consideration should be given to potash. This is one of the three major fertiliser ingredients but so far New Zealand soils can be said to have been reasonably well supplied. However, it must be appreciated that sooner or later this reserve will be used up and it will be necessary to supply potash. It has been derived from the sea by precipitation with dipicrylamine and should this method prove satisfactory it would solve the problem of supplies in the future.

A chemical industry which has thrived in New Zealand for some considerable time is the cement industry and good quality cement has been available to the community. This industry depends on coal and either argillaceous limestone or limestone and a supply of suitable siliceous material. New Zealand has a number of reasonably satisfactory deposits of limestone so the future of the cement industry is secure and it is also certain that the use of cement will increase as New Zealand progresses.

Nitrogen has not been fixed in this country and it is questionable whether the fixation of atmospheric nitrogen in the form of ammonia would be economical here, at any rate, for some considerable time. It is generally found that the synthetic ammonia process depends largely for the disposal of its product as a fertiliser and, since the economy of New Zealand farm practice makes the demand for nitrogen products very small relatively, it is unlikely that a synthetic ammonia plant could operate economically in New Zealand unless some other outlet could be developed for the product of a magnitude which would justify the installation of a plant. If and when synthetic ammonia is produced in New Zealand it is an easy step to produce nitric acid and its derivatives. Some consideration has been given to the production of calcium carbide and this may be a marginal type of industry. With the increasing use of welding, the demand for acetylene is continually increasing and it may be desirable to consider the installation of a plant for the production of carbide in the near future. Again, one limitation in this field lies in the fact that the quality of our coal supply is not entirely satisfactory. Mention should be made of the fact that certain sulphates are being produced in commercial quantities by one of the fertiliser companies, in particular aluminum sulphate mainly for purification of water supplies, copper sulphate and ferrous sulphate.

In any discussion on modern chemical industry one cannot neglect the organic side. Perhaps the raw material with the most varied use is petroleum. Considerable investigations in this country have so far failed to reveal any worthwhile deposits, though further search may well be warranted. From petroleum oil has been built up a vast chemical industry which is almost indispensable to modern civilisation and though motor spirit still occupies a pre-eminent position the by-products of petroleum oil are rapidly becoming more and more important. Even though no petroleum deposits are found in New Zealand, the possibility of importing the crude oil and establishing a refinery here at some future date should not be entirely overlooked. It is of interest to note that Taranaki oil has a high toluene content and this was distilled off during the war. The recent synthesis of certain petroleum products including a satisfactory motor spirit from natural gas in the U.S.A. opens up possibilities for the future if a cheap source of methane could be found. Such a source might be coal or some plant material. The by-products of coal cannot be neglected. In this country the gas industry is not as well developed as in larger countries, due to the fact that most of the gas producing concerns are very small. In the main centres, however, reasonably sized units operate and some further recovery of by-products should be anticipated. Apart from the gas industry, however, consideration should be given to the possibility of deriving useful organic substances from coal by other methods. For example, hydrogenation of coal has been successfully achieved elsewhere and one wonders whether a process suitable to our local coals might not be eventually worked out. Another organic chemical of basic importance is alcohol. This is produced by the fermentation of plant material but the cost of production has so far been too high for it to enter as fully as it should into chemical industry. The production of synthetic rubber gave rise to a substantial outlet for this chemical with the result that active research as to its production is now being pursued and there is always a chance that it may be an economic possibility in New Zealand. Imagine the possibilities for development if some basic organic chemical such as methane or alcohol could be produced very cheaply from grass or forest trees.

While by no means exhaustive the above remarks give some idea of the present state of chemical industry but it should be always remembered that new discoveries in science may create conditions which will usher in new possibilities for the utilisation of local resources. A constant review of the potential position is necessary if this country is to make the best use of its resources. It has always been recognised that New Zealand owes its development mainly to agriculture and it is well known that agricultural production in New Zealand is both efficient and considerable. A very large percentage of the money spent on research has been in connection with agriculture. Dairy products, wool, and meat are the main sources of the national income and they loom so largely in the national economy as to constitute almost a menace to our standard of living. For example, should either wool or butter be replaced by synthetics, and there is every likelihood of this occuring to at least some extent, it would be a serious matter in so far as New Zealand is concerned. Our economy should thus be shaped on a broader basis and it may be profitable to consider our agricultural industry from this point of view. In the first place let us consider our existing position. Dairy products offer an interesting study. At the present time production of butter offers the major outlet for milk. If butter is menaced by synthetic material it should be possible to develop still further either our dried milk or our cheese production. If a perfectly satisfactory full cream milk powder could be placed on the world's markets it should prove a boon to the industry. There is every possibility with advancing scientific knowledge that this result could be achieved and it is surely worth some serious study. Wool as a textile raw material, while possessing many outstanding qualities, does not possess the pleasing finish of many of the newer textiles. It is now known that wool can be modified to give a better finish and shrink can be avoided. However, it also suffers from the defect of uneven fibre length and width. A method whereby wool could be modified to give a long even fibre would enable it better to compete with existing synthetics.

Until recently the meat industry has relied largely on the quality of the New Zealand grown lamb. Of recent years it has been shown that good porkers and reasonably good beef cattle could be raised here. There is, however, still considerable room for improvement in both these products, and it is here that the agricultural scientists can render good service. In addition, the aged ewe has always been a problem in the meat trade and a solution of this problem would add materially to the national prosperity of the future, as it is certain that its export as meat will be restricted when the food supply of the world again becomes plentiful. There is still opportunity for the growth of our poultry industry at least to meet our own requirements. The main obstacle seems to be the lack of suitable feeding material at a sufficiently low price. The solution of this problem merits some attention since a plentiful supply of eggs and poultry are a very useful addition to our diet as an alternative source of first class protein.

Turning now to other products, there is a great opportunity for the development of orchards. Fruit has always been in short supply and will remain in short supply in most parts of the world for a considerable time to come. With better methods of handling and storage there is no reason why we should not develop a fairly extensive export trade in certain types of fruit. To date our export of fruit has been mainly restricted to the apple and saturation has not been reached as regards this product. There is a large demand for apples in England which is likely to continue for an indefinite period. Again one can forsee the possibility of the development of vegetable production on a scale allowing of an exportable surplus. With present and future methods of canning and quick freezing of vegetables there does not seem to be any valid reason why New Zealand should not be able to export vegetables provided they are efficiently produced. Another product which has had a very checkered career is Phormium Tenax. One does not feel, however, that the last has been heard regarding this product. The fibre is strong and certainly makes a satisfactory cordage, but further investigations may make it possible to work this material into products of a muchfiner nature than the general utility cordage. Some work has been done regarding the cultivation of flax as a crop with a fair amount of success. It would seem possible, therefore, that if a new outlet could be found for the fibre, there is no reason why flax might not become a profitable crop to grow in certain parts of New Zealand. A contentious crop in many parts of the world is that of sugar beet. Generally speaking, it cannot, without some type of subsidy compete with the cane product. However, trials in New Zealand have shown that a very good yield of sugar is procurable from beet grown here and it may be that some change in world economy or some improved methods of production or extraction of the sugar beet may result in it becoming a possible industry for New Zealand. Many commercial crops of other countries have been tried out in New Zealand without great success such as soya bean, tung oil, etc., but careful investigation of the production possibilities of many overseas crops is still desirable. To achieve success in any agricultural enterprise control of disease and insect pests is necessary. While much work along these lines has been done in New Zealand it must go on, since the introduction of new diseases or insect pests is always possible and the control of those present in New Zealand is as yet far from perfect. Disease of livestock causes great monetary loss each year, and work is required to gain control of and eliminate if possible from our livestock the various diseases to which they are subject.

Much work still requires to be done to control soil losses in the form of erosion, to improve our soils and to maintain our pastures. The land is our prime asset and we would be guilty of national suicide if we knowingly handed a wasting asset to posterity. One of the outstanding opportunities for development in New Zealand seems to lie in the production of timber and timber resources. It has been shown that certain exotic timbers grow remarkably well in New Zealand and the large plantations of pinus radiata put down both by private industry and the Government have developed remarkably. There is now a good supply of this type of timber. Unfortunately, it is not particularly suitable for building purposes in its present state and one feels that there is a great opportunity for research and investigation into the processing of this material to produce satisfactory building timber from it. Admittedly it is being used to-day but it cannot be said that it is a perfectly satisfactory timber for the purpose for which it is being used. There is also a great opportunity for the processing of timber products into boards and papers and it may be possible to utilise this type of timber for these purposes though at the present state of our knowledge the high resinous nature of the timber introduces complications into the processing. Serious consideration should be given to the rate of growth in New Zealand of various other classes of exotic timbers which might prove to be more satisfactory from the point of view of building. The timber resources of the world are rapidly being depleted and it is likely that the price of timber will remain at a high level and consequently timber may prove an even more useful alternative primary product for this country. Again, some further consideration should be given to the cultivation of certain of our indigenous varieties. There are not many stands of native timber remaining and unless some attempt is made to conserve and reproduce these species they will rapidly disappear from the market.

The fish frequenting the shores of New Zealand are of good edible quality, but a great deal remains to be done before this source of food has been properly exploited. Over-fishing brings about depletion of the supply and under-fishing constitutes an economic waste. Any exportable surplus would find a ready market in Australia. Considerable speculation was recently raised by the deliberate fertilising of isolated bodies of water for the growth of food for fish. This is a new line of attack on the problem of fish supplies and may have far reaching results in certain localities. In any event this development should be closely watched to see whether or not we can turn it to good account. Fish livers are now being utilised to produce vitamin A and D concentrates largely as a result of the work of Dr. Shorland and his colleagues. While speaking of marine products some utilisation of our seaweeds for the production of agar has been achieved but there are other possibilities waiting further investigation. The sea has been described as a chemical storehouse. Indeed certain chemicals such as salt, bromine, etc., have been obtained commercially from sea water and it is just possible that at some future date the sea may prove to be a local source for some useful chemical substance for this country.

The industrial potential of a nation must be related to the power available in that country. In New Zealand the two sources available are coal and water power. While the water power potential is by no means fully developed especially in the South Island, it should be remembered that some of this potential power is in relatively inaccessible locations a considerable distance from the point of consumption, circumstances which will render its exploitation expensive. From time to time various attempts have been made to tap other sources of power such as solar energy and the movement of the tides. So far neither of these sources has been successfully exploited, but to-day a new source is suggested by the release of atomic energy. Power is not only fundamental to our industrial but also to our agricultural development. It is quite clear that power may set a limit on our industrial development unless a new source is eventually developed. At this stage it is perhaps competent to discuss briefly the industrial situation and the scope of science in this field. To date it may be said that science has had a very limited application in New Zealand industry. This is largely due to the relatively small size of the industrial units and the inability of a small firm to employ good technical men. However, there is to-day a greater realisation of the value of science in industry and there is considerable opportunity for a much greater application of science to the industries which are developing here. The appreciation of this fact by the Government and individual firms has become evident in several ways. The recently formed Manufacturers Research Committee with Government and manufacturers representatives has already helped materially in this direction and the extent to which the resources of the Department of Scientific and Industrial Research are being utilised by industry is already encouraging. Furthermore the rapidly increasing number of members of our Institute who are now engaged in industry is another indication of this desirable trend. While one is anxious to see industry in New Zealand flourish, it is, perhaps, opportune to suggest that there are certain industries, the development of which in this country is relatively unsound and not in the national welfare. Again no amount of technical knowledge will produce a good article if the factory employees producing the goods do not take a pride in their work. Examples of poorly finished goods are not hard to find, and one looks to the day when such defects are hard to find in goods manufactured in this country. 'Well made New Zealand' should mean well made New Zealand. Industry makes call on practically all sciences particularly those of chemistry, physics, engineering and biology and it is necessary that the industrial chemist should appreciate the fact that one or more other branches are necessary to the solution of a given industrial problem and he should not be above turning to these sciences for the necessary assistance. Man cannot live by bread alone and neither can industry be perfected by pure chemistry though it must occupy a very important place in the solution of many industrial problems.

The above remarks have suggested the need for research in the solution of industrial problems but it should also be realised that the so-called routine testing and control in the factory occupies quite as important a place in the application of science to industry and should never be overlooked. In this way an article of even and standard quality is produced, and the consumer gains confidence in the article to which such control has been applied. Time does not permit to discuss the various types of industry which might profitably be developed but it may be said that any industry which largely uses local materials, if properly exploited should be of value to New Zealand. Some local raw materials may be profitably processed to a certain stage before export from this country. For example, it may ultimately be desirable to pre-process wool up to the stage of spinning tops. On the other hand, the final processing of imported intermediates may be desirable. For example, this is already being done in the case of certain plastics. Each and every commodity requires study before a definite conclusion can be reached but it must always be borne in mind that New Zealand must import manufactured goods if she expects to maintain her position in the world's markets for her primary exportable surplus.

Fortunately, New Zealanders as a whole are a relatively healthy nation, a fact which has been demonstrated in a number of different ways both in war and on the playing fields. This does not suggest, however, that there is no work to be done in Medical Science. Many baffling problems still face medical science and at this season it is perhaps superfluous to mention the common cold as an example. Considerable sums are now being spent on so called Social Security, but can it be really termed Social Security if a reasonably useful sum is not devoted to medical research. So successful have been the results of research into agricultural problems that an adequate provision of proper facilities and men for medical research must be at the basis of future security for the nation. Great strides were made in medicine during the war and many valuable therapeutic substances were developed. As a nation we should apply these so as to get the fullest possible benefit. We should endeavour to solve outstanding problems. So far cancer is the only disease which has received much public support in so far as research is concerned and even that is really inadequate. Surely we must look forward to the day when, apart from misadventure, medical services are mainly preventive and not curative. This can only be achieved by the fullest possible knowledge of the diseases to which man is heir, and in medicine as elsewhere knowledge is power.

Considerable peace time development is required in the case of the various scientific discoveries and applications of the war. Radar which was so valuable during the war has many obvious applications for peace which require development and there is scope for work of this nature to be carried out here. One can foresee great improvement in the certainty of navigation of ships and planes. Television is now a practical proposition and may be developed here in the near future. Great advances have been made in weather forecasting and the accuracy of the forecasts is becoming more certain and one looks forward to the day when the public will no longer couple the weather report with one of Grimm's fairy tales. The success of penicillin has opened up the new field of antibiotics and it is pleasing to know that work in this field has now been started in New Zealand. So far these substances have largely been applied to human disease but one or more may have application in the solution of some animal or plant disease.

And what of atomic energy? It would be impossible not to discuss the possibilities of the development of atomic power and its likely effect upon New Zealand's economy. In spite of all that has been said concerning it, its application must essentially have certain limitations. Production at the present stage is expensive and furthermore it is an extremely dangerous source of power except in the hands of those who are trained in its use. This suggests that it must be developed at some central station and distributed either in the form of electricity or steam. Such a development would undoubtedly open up a large number of possibilities and would be particularly useful in the North Island when the hydro-electric resources of the country have been fully developed. It would then be possible to prohibit the use of coal as a fuel in the ordinary sense and our resources of coal could be reserved for the production of valuable organic chemicals.

So far this discussion has been restricted to New Zealand but New Zealand science can really know no borders and to be really healthy must permeate the world. To this extent some New Zealand scientists must inevitably leave our shores, but apart from this aspect of the question there is surely work to be done here which has either Empire or world significance. Should not some responsibility for the development of say the Pacific Islands be borne by us? We have many scientific facilities which communities in these Islands can never hope to possess and surely it is proper that we should assist in the solution of their problems. Apart from material benefit to this country in trade, etc., there would be the satisfaction that we have contributed something to the general betterment of mankind. There is undoubtedly plenty of scope in this field and though some little has been done, there is still a great deal waiting solution. For example, if certain tropical crops had received the attention that has been given to New Zealand pastures the production in these areas would be materially increased to the benefit of all.

All applications of science bring with them social implications. While as scientists we concern ourselves with the material problem, and leave it to the politician and others to deal with the social problems involved, we should never forget the social angle, and should if possible try to assist in getting each new application of science in the community adapted with the minimum of social disturbance. We can all do a great deal in this direction if we take the trouble to visualise beforehand the social problems likely to arise. Very many of those charged with the responsibility of our social well being are often poorly informed on scientific matters. In England this fact is realised to the extent that a Parliamentary Scientific Committee has been in existence for some time. It is composed of members of parliament and representatives of the various scientific bodies. Its purpose it twofold—namely, to inform the legislator of the implications and trends of science and to keep the social aspect continually before the scientific organisations. It may well be that the time is now ripe to consider some such committees in this country. Furthermore, apart from any personal beliefs or disbeliefs, religion has always been a powerful social force in the community. Indeed any ethical code the community possesses is largely due to the influence of religion, and if science and religion can co-operate in the solution of the day to day problems much could be achieved for the benefit of all.

For science to thrive it is necessary that it be taught by inspired teachers, not only in the Universities but throughout our educational system. It is at the University stage, however, where the main responsibilities in the teaching of science rest. It is here that the student first is able to exercise his capacity for independent thought and achieves that discipline of the mind which is essential to the scientific method. Such development of the mind must be relatively sterile if it does not receive the stimulus of a research atmosphere. For this reason it is essential that research should always be part of the equipment of every scientific department of a University. Properly blended with teaching it gives the student that stimulus which will carry him through life with an alert mind and make him a more useful member of the community. More generous support to the University is necessary if this object is to be fulfilled and one looks to the University as the home where fundamental scientific knowledge and research can be found. At the same time, some thought should also be given to education along more applied lines. This phase of our educational system is at present provided for by our technical colleges, but the standard achieved in science in these establishments is inadequate for some requirements and there may be made out a case for a college along the lines of the Imperial College of Science and Technology. Applied research into the major industries and problems of the community are best carried out in special research organisations formed for the purpose. The present system of Research Associations under the Council of Scientific and Industrial Research most satisfactorily fulfills this requirement. Applied problems of a general national character are best undertaken by the Government through the Department of Scientific and Industrial Research or through some appropriate department of State. To leave such problems to the University must mean a slower solution of the problem in as much as the University staff have other responsibilities. However, one expects to see the closest possible co-operation between the University staff and the research workers in the applied field. For this reason it is often desirable to establish a research unit in close proximity to a University. Perhaps the most fruitful outlet for science to-day is in industry, but it requires a somewhat different outlook on the part of the worker if it is to be a satisfying career. In the first place, the individual must be prepared to devote a good deal of his time to routine control of factory processes. Viewed in the right light and helped by sympathetic management such work can be stimulating to the individual worker since it often provides a sound basis upon which some worthwhile investigation may be undertaken. New Zealand factories are nearly all too small to be able to embark on planned research in addition to scientific control and consequently there appears to be much to be said for the individual factories of an industry combining to form Research Associations.

This address has been rather rambling in nature and cannot be said to be exhaustive. Many of the views expressed have emerged as the result of discussion with members of this Institute and others. That there is scope for science in New Zealand is without question, but it remains for us as members of the scientific community to see that the best possible use is made of the opportunities that present themselves. In closing these remarks I am reminded of a statement made by Sir Edward Appleton when discussing the future of scientific research in England in which he states: "If you go fishing you may catch fish, but if you don't go fishing you cannot catch fish." Let us hope that New Zealand will go fishing to some purpose.

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THE ROYAL INSTITUTE OF CHEMISTRY OF GREAT BRITAIN AND IRELAND. (New Zealand Section).

## PRESIDENTIAL ADDRESS.
**August 27th, 1946.**

### "The application of scientific principles to Practical Farming in New Zealand."

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In the early days the agricultural scientist lagged behind the practical farmer. His work largely consisted in showing why certain practical farming methods were successful because at first he naturally had to investigate actual farming practice. Latterly however science has made many discoveries and the difficulty now is to acquaint the farmer with these discoveries and to get them put to practical use. Every branch of science has contributed to this advance the chemist, physicist, botanist, bacteriologist, zoologist, veterinarian, geneticist, physiologist and even the mathematician. It is obviously impossible within the scope of this paper to deal with all this work Although this is a chemists' conference I propose to refer briefly to some of the results obtained in other branches of science so far as they have a bearing on agricultural practice.

The successful farmer has to be a highly skilled man. He has to be a good judge of cultivation methods, have a wide knowledge of cropping and of animal management and be a good organiser of labour. Moreover among other things he also has to be a born optimist and a successful gambler with weather and market conditions.

As educational facilities increased greater opportunities arose for people to enter other professions than farming and large numbers of young men from farming stock were lost to the industry. Moreover once the educational qualifications for other walks of life were obtained young men could launch into a career without further capital. Many of those who took up farming had far too little capital and even in New Zealand to-day lack of capital handicaps agricultural production. It is outside the scope of this address to suggest methods of overcoming the difficulty of financing young men who wish to enter farming as a career but there are undoubtedly ways in which this can be done.

The number of farmers in New Zealand remains fairly constant and of recent years we have had the same picture as in England of farm workers being attracted away by higher wages to industrial pursuits. Conditions in New Zealand are different from those obtained in England or Europe in that we are a sparsely populated country and there are large areas still available for development. With her wonderful climate and with the general world shortage of foodstuffs New Zealand has a wonderful future in the field of Agriculture. Her mineral resources are so poor that her industrial future lies mainly in those industries ancillary to agriculture.

Science would appear to have a bigger field in New Zealand agriculture in the future than in European countries. The way is already being prepared. The work of the soil survey division will prove invaluable for we shall have information concerning the best use of various types of soil before they are settled. We shall have the opportunity of reafforesting land which should never have been farmed in the first instance. The soil survey of the areas suitable for tobacco growing carried out by the Cawthron Institute is typical of the value of this type of work for immediate farming practice.

Farming is becoming more and more a matter of applied science. Scientific workers in New Zealand have a record to be proud of but the results of their work are far too little known among the farming community. There is need for an even greater extension of agricultural advisory activities.

The farmer of the future has to be something of an engineer with an appreciation of chemistry, botany and physiology. He has moreover to be a skilled craftsman. The wider his education the better it will be for agriculture. Each farm offers its own problems in management and many a successful farmer owes his success to his foresight in developing some particular sideline. There can be no doubt that in the future the farming industry will have need of the best brains in the community.

In the early days of agricultural improvement, taking say the last 200 years, the main advances were made by landowners or practical farmers themselves. Thus Lord Townshend of Norfolk over 200 years ago combined turnips and clover with wheat and barley into a crop rotation system which became famous as the Norfolk rotation of crops. This revolutionised English farming because it enabled animals to be kept through the winter. Previously a large number had to be killed in the autumn and salted down as there was no winter feed for them under the old system. Other farmers introduced potato growing into Lincolnshire, market gardening in certain areas and fruit growing in others. The development of our breeds of livestock was also the work of practical men with none of our present knowledge of genetics. Some of our most useful varieties of crops were also discovered by practical men.

In more recent years all branches of science have concentrated on agricultural problems. The practical man often scoffed at the unpractical nature of scientific work in its relation to practical farming. But in all branches of science a large amount of knowledge has been built up which has proved of immense value to farmers. It is quite unfair to condemn scientists for working on matters which seen to have no practical importance.

Science gave the farmer artificial fertilisers, the internal combustion engine, the electric motor, and means of controlling animal and plant diseases. Science is working on hormone control of lactation and auximone control of plant growth and on elusive diseases such as those due to virus. In the course of this work much knowledge which at first appears useless is accumulated but at some future time the knowledge so gained may be applied to great practical advantage.

Most Government Research departments have funds allotted to them which are earmarked for certain specific projects. We are however dependent for future progress on foundation research which establishes laws and principles. Many of our best scientific workers have no inclination for applied scientific work yet their work on purely scientific aspects has often proved of extreme value in practice and this will always continue to be so. Much experimental work was done in order to control potato diseases by varying the time of planting, by special cultivation methods and by fertilisation. Yet varieties continued to run out. Fundamental work on viruses however proved that these could cause diseases in potatoes and other plants and also in animals and human beings. Methods were then developed for curing many of these diseases. Scientific work discovered vitamins and has gone on to show how many of these can be made synthetically. These have proved of great value in combating human and animal disease. Their discovery explained the difference in feeding value of white and yellow maize, the value of fresh pasture for stock and the value of properly made hay. Osborne and Mendel's work on the feeding value of proteins from different sources showed why some plant proteins, such as those of maize, were not an adequate source of protein for the animal because they lacked essential amino-acids such as tryptophane, which cannot be synthesised in the animal body. Fundamental work into the constitution of fats and sugars has given results of great value in the feeding of animals and human beings.

In the field of genetics, Morgan and his co-workers made a monumental study of the chromosomes of the fruit fly, Drosophila. This was pure research yet his results have formed the foundation for our present deep knowledge of genetics. To a certain extent resistance to disease is a genetic character the factors for which may be inherited. This discovery has already borne much fruit.

Genetical knowledge has made possible the production of superior plants and will be increasingly used for the improvement of farm animals. Chemical investigations on photo synthesis of plant substances is a purely fundamental research problem but of a very difficult order. By medium of the radiant energy of the sun, plants transform carbon dioxide and water with the aid of chlorophyll and other related pigments, into carbohydrate material. Subsequent transformations convert these primary products into fats, proteins, terpenes, alkaloids, perfumes and pigments. Yet the role of chlorophyll in photo-synthesis is still largely unknown. It takes 100,000 calories of energy to produce an ounce of sugar from carbon di-oxide and water, and yet plants produce many ounces. How do plants perform this miracle without using enormous pressures, high temperatures and all the aids of the modern chemist.

**Genetics.**

Hybrid corn, or maize as we call it, has been developed in America as a result of researches in genetics and is perhaps the most outstanding example of the influence of scientific research in revolutionising the productive capacity of an agricultural crop. Hybrids already produced have established their superiority in yield, and in resistance to wind, disease, and other unfavourable conditions. In this work intensive inbreeding is practised with different lines of corn. During the in-breeding process the good and bad traits of the parents become fixed in the different inbred progeny. Those which receive an overdose of bad traits are unable to survive, others which receive a preponderance of good traits are preserved.

With all the inbred lines so far developed, yield has dropped rapidly with the continued inbreeding, from say an original 60 bushels per acre to 20 or 30 bushels or less by the 5th or 6th generation of the inbreeding. The plants in a given inbred line are however then essentially alike in their inheritance. When these inbred lines are crossed, and the hybrid seed is planted, remarkably uniform highly productive plants develop. Lines which produced 20 to 30 bushels per acre, when crossed yield 70 or more. However these results only hold good for the first hybrid generation. G. H. Shull and also E. M. East began inbreding corn in 1905 for the purpose of studying certain inheritance factors. The result of their studies in crossing inbred lines led them to suggest the raising of hybrid corn.

Some years passed however before the difficulties of raising inbred lines on a sufficiently large scale for commercial use was overcome. The farmer must be able to buy this hybrid seed every year. Henry A. Wallace, later Secretary of Agriculture, started to produce commercial hybrid seed in 1913 and by 1919 had the work well in hand. He has now become the largest producer of hybrid corn and his work has meant a great deal to the corn producers in America.

It seems that unconsciously in New Zealand our farmers have been making use of this hybrid vigour, or heterosis as it is called, in some of their breeding processes. Thus our best fat lambs are Southdown-Romney cross and in pig breeding the Tamworth-Large White or Berkshire cross produces excellent pigs. It might be that this should be followed up further on the line of Wallace's work on hybrid poultry, by producing inbred strains of the original breeds for the purpose of producing the cross. At present lethal factors are carried in many strains of all animals. These would be eliminated by inbreeding. Many young pigs are born dead and many do not develop from the egg. This may be closely connected with the inheritance of lethal factors. An apparently normal animal can carry these factors and transmits them to half his offspring. Whenever such a character is received from both parents the trouble arises. At present such lethal characters are being spread among our herds and it is surely worth while to eliminate them by the inbreeding process.

Plant breeders have given us many new varieties of crops. Selections and hybrids of wheat, cotton, rice and sugar cane etc., introduced into India have added many millions of pounds to the income of the Indian cultivator. Similar work has been carried out in many other countries.

Genetical principles when applied to animal production will work similar revolutions but this can hardly be done till the present generation of breeders with antiquated ideas have died out.

**Veterinary Science.**

Nearly 3% of animals are culled from New Zealand dairy herds for abortion. In fact about one out of every three cows lost from the herds is culled because of this disease. Work in America developed a Brucella abortus vaccine strain 19. This organism is the cause of the disease. The vaccine gave such excellent results that similar methods have been used in the past few years in New Zealand. Nearly 20,000 calves were vaccinated in 1943. Only 3% of these aborted at their first lactation whereas the abortion rate in unvaccinated calves was 22%. Over 35,000 calves were vaccinated in 1944 and 110,000 in 1945. The results have been outstanding and the control of this disease alone would soon pay for all the cost of our veterinary services in New Zealand to date.

Some years ago there were severe outbreaks of blackleg among young cattle in New Zealand. This disease has been effectively controlled by the use of vaccine from the Wallaceville Laboratory, which distributes it to field officers in the affected areas.

Much could be added here concerning contributions of veterinary science to agricultural practice. Apart from disease problems work on artificial insemination promises great things for agriculture.

**Entomology.**

In many directions the work of the entomologist is providing benefits for the farmer. Woolly aphis or American Blight lives in the bark of apple trees and produces gnarled swellings and cracks. It used to be much more common in New Zealand than it is to-day. Dr. Tillyard of the Cawthron Institute introduced to New Zealand a small chalcid fly which is parasitic to the woolly aphis and this has resulted in the almost complete disappearance of the woolly aphis.

The caterpillar of the white butterfly took a heavy toll of our cruciferous crops, frequently completely destroying crops of turnips and cabbages. The introduction into New Zealand of the larval parasite Apanteles glomeratus is however exercising good control over the pest wherever it has been distributed. The introduction of two parasites of the larva of the diamond back moth is giving promise of the control of this other great pest of cruciferous crops.

**The Mathematician.**

The aid of the mathematician was obtained at the Rothamsted experiment station soon after Sir John Russell took over the Directorship.

R. A. Fisher first took up this work and he and co-workers have done work of great value to the science of Agriculture. As a result we have (1) the development of exact 'small sample' theory, (2) better design of field experiments giving more precise and comprehensive information from the use of a given amount of experimental material, and the accuracy of the results can be assessed from internal evidence, (3) improvement in methods for sampling biological material of all kinds.

All worth while field trials in agriculture to-day are laid down on lines governed by statistical methods arising out of this work. The same methods are now being adapted to experiments in animal nutrition, medical experiments and industrial processes.

**Physics.**

The physicist now tells us that all our old ideas concerning the effect of hoeing, rolling and ploughing are wrong. We used to understand that water moved about in the soil by capillary attraction. We considered the soil as it were to be a mass of capillary tubes and water moved about in them rather as water soakes into a piece of bread. The action of rolling was supposed to bring water to the surface by making the capillary tube smaller thus enabling water to climb higher. Hoeing was supposed to conserve moisture by forming a mulch of loose soil on the surface thereby breaking the connection of the capillaries with the air. Keen at Rothamsted showed that there was no such capillary force acting in soils and after the actual drainage of excess water following heavy rain the water in the soil largely 'stays put' as films on the soil particles if it can. In other words water is not drawn up to the roots but the roots go wherever water is most plentiful. Rolling packs the particles together more closely and so the films of water on the particles become thicker. Roots can then get more water from these thick films and so move towards them. The main effect of hoeing is said to be to kill weeds but in the early stages of plant growth hoeing produces a marked increase in yield on poor soils but seems to have no such effect on fertile soils. Keen also claims that once the soil is worked sufficiently with the minimum of ploughing further ploughing is of no advantage.

Faulkner in his book "Plowman's Folly" which made quite a stir in farming circles a few years ago, condemns ploughing altogether. Most farmers however would hold that this is going too far. The idea has a certain amount of truth in it, which is the danger of all such cranky theories.

The power with which a soil holds its moisture is now regarded as a suction pressure. Schofield adopted methods for measuring this over its whole range from air dry conditions to saturation. If a sol is so nearly dry as to be in equilibrium with air of 50% relative humidity, the moisture is held with an intensity expressed by a suction pressure of 1,000,000 centimetres (higher than Mount Everest). If the soil is saturated with water so that the excess can start to drain away, the force of retention is only of the order of a column of 100 centimetres. In view of the magnitude of these numbers Schofield expresses them on a logarithmic scale which he calls "pF" by analogy with the "pH" scale.

W. L. Bragg and others applied X ray analysis to determine the structure of complex silicites and the results are being applied by others to work on clay. As a result we now have a much more intimate knowledge of base exchange which plays an important part in soil chemistry. This in turn is helping us to understand the formation of crumb structure which is so desirable for a fertile soil. Normal calcium clay readily forms grains or crumbs when it is first wetted and then dried. The crumb structure is necessary for the production of a good tilth in soils. Soil under grass or clover takes on this desirable crumb structure to a greater extent than soil under other crops. Howeve we still do not have a complete understanding of the mechanism of crumb formation. Recent work indicates that crumb structure is largely due to products of excretion and decomposition of bacteria and fungi e.g. polysaccharides, waxes etc.

**Geology and Soil Surveys.**

In recent years the Russian workers have revolutionised our ideas concerning soil formation and classification. Previous to the Russian work agricultural chemists classified soils either geologically or from physical characteristics, e.g. humus, calcareous or mineral soils. It appeared reasonable to suppose that since oils are formed from parent rocks that different geological formations would give rise to different types of soils. It became evident however that the same rock undr different weather conditions will give rise to different soils.

Sibirtzev in Russia argued that when the soil formation processes have gone on to the utmost, the kind of rock from which the particles were formed would have little, if any, influence on the product. In other words the mature fully developed soil would be the result of the processes and conditions involved in its making. In the majority of Russian soils climatic conditions have had full play and Sibirtzev showed that the soils can be grouped according to the climatic conditions under which they were formed. Glinka developed this work and drew up a new soil classification which forms the basis for soil survey work in most countries. Our soil surveys now study the soil profile.

In New Zealand Soil Surveys have been made on a large and detailed scale and have been linked with information gathered by the Department of Agriculture on local agricultural practices. Special surveys have been done for special purposes such as a survey of the pumice showers in the North Island to delineate the boundaries of bush sick areas. In Nelson and Southland demarcation of soil types associated with stock ailments was made possible by soil surveys carried out by the Cawthron Intitute and by the Soil Survey Division of the Department of Scientific and Industrial Research. Soil Surveys have been carried out to determine the areas suitable for special crops such as tobacco, tung citrus and phormium which, either for quality or yield considerations should only be grown within a limited range of soil types and climatic conditions. Soil survey work is essential for a study of the soil erosion problem. Thus it has been shown that in the high country of New Zealand 623,000 acres have lost 73% of their topsoil, 1,500,000 acres have lost 50-75% and 3,000,000 acres have lost 25-30%.

**Agrostology.**

Pasture plays a very large part in agricultural production in many countries. During the past 20 to 25 years a vast amount of study has been given to pasture improvement throughout the world. The work at Aberystwyth under Sir George Stapledon is world famous. 90% of the cultivated land of New Zealand is devoted to the grass crop and grassland products account for 94% of her exports. Further our grassland workers have done invaluable work for the farming industry. It is pardonable therefore to deal here with some of their achievements. Space permits but brief reference. Dr. Hilgendorf did excellent work at Lincoln in pioneering the production of improved strains of grasses. Our Grassland Division made a detailed survey of 2,000 square miles of pastures in Hawkes Bay. This was conducted in association with soil surveys and farm management studies. The published report is an invaluable aid to the farming community. It was from Hawkes Bay that the true perennial rye grass strain was obtained for distribution over such large areas in New Zealand. During the survey the opportunity was taken of collecting any grasses or clovers which exhibited desirable characters. At the Grassland Research Station large numbers of selections of grasses and clovers have been grown for trial in order to provide the best material for distribution to farmers. The best of these were handed over to the Department of Agriculture for further multiplication. The Department by their method of seed certification made it possible for farmers to buy desirable types. As a result of this work there are available to farmers certified lines of rye-grass, white clover, red clover, cocksfoot, brown-top and lotus seed. New Zealand has built up a service in this direction which is almost unique. The work is still beng developed and even better strains are being evolved. True perennial rye-grass suffers from the fact that, although it is a permanent and heavy producer, it is relatively unpalatable. Crosses have therefore been made between perennial rye-grass and the highly palatable and prolific Italian Rye-grass. From this cross has been evolved a short rotation rye-grass type H 1 which lasts for 4 or 5 years and is highly palatable and more prolific than the perennial rye parent. If further trials prove satisfactory its introduction into our pastures should bring about a large increase in production from our grasslands.

**Fertilisers.**

The Chemist, in the person of Lawes of Rothamsted fame, gave the farmer superphosphate. Its discovery has proved of incalculable value to the farming industry and is the greatest boon that science has conferred on the farmer. The chemist went on to show the value of potash and nitrogen fertilisers. Further when it appeared that supplies of nitrate of soda found in Chile would prove insufficient for world's need he discovered how to make nitrogenous fertilisers from the air so that we are now independent of natural deposits. Numerous new fertilisers were also used as a result of chemical researches such as urea, cyanamide, ammonium nitrate, ammonium phosphates, etc. Basic slag which has shown itself to be a most valuable fertiliser is a by-product of chemical industry.

Recent claims concerning the value of compost need reference here. All farmers and agricultural scientists admit the value of organic matter. However anyone who considers facts must admit that mineral fertilisers such as phosphates, potash and nitrogen compounds, when wisely used, are essential aids in keeping up crop production. Sir Albert Howard would have us believe they are poisons and claims that plants grown with humus compost have special health promoting and disease resisting properties. He is such a convincing writer that many laymen accept his statements as a creed. However he offers no evidence of any scientific value which supports these two claims. Evidence available can be quoted to prove the contrary. Decrying the use of so-called artificial fertilisers can only do a great disservice to farming. The truth is that while the use of organic matter should be encouraged to the full, the mineral fertilisers wisely used provide one of the biggest aids to production which the grower can make use of. It must be admitted in fairness however that work is needed on the rôle of earthworms and of saprophytic bacteria and fungi in reducing the population of pathogenic or parasitic organisms in the soil by antibiotic production or other means. Recent work by Neilson-Jones has shown that in certain pine forest soils in England substances accumulate which inhibit the action of normal soil organisms and that addition of normal soil destroys the toxic factor.

**Trace Elements.**

We now know that soils can suffer from a deficiency in elements other than phosphorus, potassium, nitrogen and lime. The chemist working with the plant physiologist, veterinarians and others have made their contribution in this field of minor element deficiency. New Zealand with its high rainfall and free draining soils might be expected to be prone to such diseases. Further superphosphate gives such a great response over most of the country and has been used alone so frequently that there must be a drain on the minor elements which are not supplied by this manure. Large areas in New Zealand are deficient or low in magnesium and this has been considered a possible factor in relation to the incidence of such animal diseases as grass staggers. This is one argument for the use of serpentine superphosphate which is made by the addition of magnesium silicate to superphosphate. More recent work by Walsh and O'Donohoe indicates that a high ratio of potash to magnesia interferes with the plant's capacity to take up magnesia even though it is in plentiful supply.

Dr. Brenchley at Rothamsted showed many years ago that boron plays an essential part in plant nutrition. It has been definitely established that many, if not all, plants cannot develop properly without a trace of boron.

Copper deficiency has been recorded in peat and swamp lands in America and elsewhere. Peat scours of stock which ocurs on similar land in N.Z. has been shown to be connected with a deficiency of copper. It can be corrected by a dressing of 5 lbs. per acre of copper sulphate.

Cobalt deficiency and its control provides one of the most spectacular contributions of science to farming. Chemistry and veterinary science worked together on this problem. For many years the pumice areas in N.Z. were known to be associated with a pining disease of cattle and sheep known as bush sickness. Messrs. Aston and Grimmett and others pioneered in investigating the cause. It was found to be controlled by the use of limonite licks. Originally Aston and Grimmett considered that bush sickness was caused by an iron deficiency. Underwood and Filmer's work in Australia led to the recognition of the fact that the disease was associated with a deficiency of cobalt in the soils and pastures concerned. It must be emphasised however that this discovery in no way detracts from the value of Aston and Grimmett's great pioneering work. Their recommendation to use limonite licks worked in practice and after all the farmer needs a cure and is not much concerned about the underlying science.

The chemist is now being called upon to investigate the role of other element traces of which seem necessary for plant nutrition. These include zinc, molybdenum, manganese among others including some of the very rare elements.

**Dairy Science.**

In this branch our own Dairy Research Institute has built up a reputation which stands high overseas. An account of progress in this field could not be dealt with even as a subject for a whole address. The value of New Zealand Dairy exports during the war years has been about £28,000,000. This surely justifies a large expenditure on research as it is imperative that we maintain the highest possible standards of quality in our produce.

**Refrigeration.**

The discoveries in refrigeration led to economic revolution in the farming and trade of Australia, New Zealand and South America. In January 1939, Great Britain imported enough meat to give every man, woman and child a weight of 4 lbs., enough butter to give everyone a pound and a half, enough oranges to give everyone a dozen and in addition large quantities of eggs, bananas, grape fruit, lemons, grapes, pears, plums, peaches and apples.

Scientists showed the effect of carbon-dioxide in cold storage. Up to 12½% in the atmosphere slowed down ripening but above this amount apple cells died and the apples became diseased.

**Virus Diseases.**

Mycologists and bacteriologists naturally assumed that virus diseases were caused by ultramicroscopic organisms. It has been left to the chemist to show that this is not the case for he ha been able to isolate certain viruses in a pure crystalline form and has shown that these at least are nuclear-proteins. However we are confronted with a new idea for it seems that the virus agent can only exist in association with living tissue.

**Chemical Control of Weeds and Insect Pests.**

A number of growth promoting compounds, chemically allied to alpha naphthyl-acetic acid have a powerful effect in the contrary sense when applied at greater concentrations. One of these substances 2-methyl-4-chloro-phenoxy-acetic acid known for short as "methoxone," has now been developed commercially. Applied at ½ to 2 lbs. per acre it has proved of great value in freeing cereal crops, which are almost unaffected by it, from weeds such as charlock. It is now under trial in New Zealand.

Pyrethrum and Derris are poisons derived from plants and they have a specific action against insects. Using contact dust based on veratrin or rotenone from roots of Derris robusta, an Indian plant, an area of 150,000 acres of forest in Brandenburg attacked by pine looper was successfully sprayed from the air, in 1931-32.

In 1932 pyrethrum was added to the dust with great increase in effect. The autogyro proved better than the aeroplane as a means of distribution. Chemists have played a great part in this work in working at the chemistry of pyrethrum and derris.

Then recently the synthetic substances D.D.T., di-chloro-di-phenyl trichloroethane, and "gammexane" which is the gamma isomer of benzene hexachloride have been of great value in insect pest control. They are not very toxic to animals and have almost no effect on the leaves of plants but have proved to be among the most powerful insecticides known. Chemists showed that the beta form of benzene hexa chloride is however hardly toxic at all and the alpha and delta isomers showed little toxicity. This is an example of the application of the chemist's work, and purely chemical work on the constitution of related substances may confidently be expected to produce results of great practical value in the control of weeds and insect pests.

It seems obvious that as I said earlier that the farmer of the future, if he is to be able to use these newer methods must be well educated for his profession.

I cannot conclude without paying a tribute to the New Zealand Journal of Agriculture which, in its new form, is surely among the best farmers publications of the kind issued in any country.

## COUNCIL MEETING, 28/8/46.

The following decisions were taken:—

It is to be recommended to the Royal Society (N.Z.) that the joint Presidents of the Annual Conference act similarly for the chemical section of the Science Congress.

The printed list of members will be supplied to the Association of Scientific Workers.

The Editor reported that the free list of the Journal now amounts to about 70, and the membership list to about 300. It was agreed that advertising could be increased.

The teaching of Chemistry in schools will be accepted as practical experience for applications under rule 8. Teachers must supply full details of their teaching experience.

## ELECTION OF MEMBERS.

### Honorary Fellows.

Sir Thomas Easterfield, Honorary Fellow, was a foundation Professor at Victoria University College, occupying the Chair of Chemistry till his appointment in 1919 as Director of the Cawthron Institute. His work was the subject of an appreciation in this Journal, Vol. 3, No. 3, 1938. His career is a noteworthy one in the history of New Zealand Chemistry, both for its influence on many other chemists who were trained by him during his years at Victoria College, and for the role the Institute he developed has played in scientific agriculture. He was Knighted in 1936 for his services to New Zealand, and was the second President of the Institute.

Mr. W. Donovan, Honorary Fellow, joined the staff of the Dominion Laboratory in 1905, and succeeded Dr. J. S. Maclaurin as Dominion Analyst in 1930. His particular interests were in mining and fuel problems, his contributions in the latter field to our knowledge of the country's resources and the methods of best using them, being outstanding. Of his many services to the Institute and the profession, mention should be made of his work on the Membership Committee. Mr. Donovan retired in 1941. His appearance at the Annual Meeting, when the election of Honorary Fellows was announced by the President, was a great pleasure to his many friends.

**Fellow.**

Dr. I. Reifer of the Plant Chemistry Laboratory has been elected a Fellow. Dr. Reifer is well known as a specialist in microchemical technique.

**Associates.**

L. C. Baker M.Sc. (Otago) spent two years with the D.S.I.R. and two years with the Air force before taking up his present position with W. Gregg and Co. Ltd., Dunedin.

Miss E. R. Weeber (Otago) graduated M.H.Sc. with first class honours in nutrition, and is now engaged in research at the Medical School.

**Obituary.**

We regret to record the death of Graham Thomas Aitken, Associate 1946, from exposure on the Tararuas.

## PROFESSIONAL CHEMICAL INSTITUTES IN THE BRITISH EMPIRE.

Advantage was taken of the presence in London of representatives of the Australian Chemical Institute, the Chemical Institute of Canada, the New Zealand Institute of Chemistry and the South African Chemical Institute, at the time of the Empire Scientific Conference, to arrange a meeting of these representatives with the officers of the Royal Institute of Chemistry of Great Britain and Ireland in order to discuss means of achieving a greater measure of co-operation among these five professional chemical institutes in the British Commonwealth.

It was recognised that at this meeting it would hardly be possible to consider matters of detail, but that a valuable initial step would have been taken if the representatives of the overseas institutes indicated their views in general terms, leaving it to their individual officers to discuss ways and means with the executive officers of the Royal Institute of Chemistry at a later date.

On this understanding, the representatives first outlined the constitution, range of activities and aspirations of their respective institutes drawing attention to special aspects of their work in relation to the development of the profession in their several countries.

From this general survey and a statement that had been circulated on the organisation of services to chemistry and chemists in Britain, it became clear that, whilst the five institutes differed greatly in size and to some extent in constitution and administration, they were all pursuing closely similar paths towards essentially the same ends. This conclusion, which was supported by the immediate recognition of a real community of interests among all the representatives, provided an assurance that any discussion of means of achieving closer co-operation could be pursued in an atmosphere of understanding and friendship, and might lead eventually to the emergence of some form of association of chemical institutes within the Commonwealth. In any event, each institute had much to learn from the experience of the others, and the immediate need was for a fuller interchange of information and ideas so that all might contribute towards the development of a common policy.

Among the suggestions put forward as to methods that might be adopted, the following received a large measure of general support:—

(a) By improving the present system of notifying an institute of impending visits to its country by members of other institutes and by providing such members with letters of introduction.
(b) By the exchange at regular intervals of special "news letters," which would include information on each institute's activities for the advancement of the profession.
(c) By working towards standards of admission that would be mutually acceptable.
(d) By occasional visits of eminent chemists from one country to another (or others) primarily for the purpose of lecturing.
(e) By arranging conferences of chemists at intervals of years in the various countries, not only Great Britain.
(f) By arranging for delegates to attend celebrations of important events in the history of each institute, such as Jubilee celebrations.

It was recognised that, whilst suggestions (a) and (b) could be implemented forthwith by administrative action, (c) pointed out a path to be followed in the ensuing years as the policies of the various institutes developed—a path along which, however, some useful initial steps could be taken immediately. Giving effect to the last three suggestions would generally involve collaboration with other organisations in the various countries, especially in Great Britain, but they were all matters in which the influence of the professional chemical institutes could be usefully exerted.

In the general discussion that followed, many of the representatives stressed the importance of personal contacts between chemists in their several countries as a means of securing a broader basis of mutual understanding on which co-operation could develop naturally. More visits by chemists from Britain to the Dominions would be particularly welcome.

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## THE CENTENARY OF THE CHEMICAL SOCIETY.

The Chemical Society is to celebrate the centenary of its foundation in July 1947. But for the war the celebrations would have taken place in 1941, for it was "on the 23rd February, 1841, that twenty-five gentlemen interested in the prosecution of chemistry met together at the Society of Arts to consider whether it be expedient to form a Chemical Society." These twenty-five gentlemen did deem it expedient and so the Chemical Society was born. It was the first Society formed solely for the study of chemistry and although there had been small private chemical societies before 1841 none lasted for any great length of time. Thomas Graham, the most distinguished chemist of his time, the pioneer of colloid chemistry and a discoverer of much important new chemical knowledge, was elected the first President.

The Fellowship of the Society has grown from those twenty-five gentlemen in 1841 to over 6,000. The study of chemistry as a whole has remained its object; because of this the Society has always maintained a special place in the world of chemistry. It has not pursued the purely professional nor has it specially fostered industrial chemistry although many great industries have been based on fundamental discoveries made by its Fellows.

Success has from the first attended on the Chemical Society and has been due almost entirely to the ready means it has provided chemists of publishing their discoveries and affording them a place for discussion and mutual interchange of ideas. The Society has been the model and the older sister of similar chemical societies set up in other countries, particularly those of Germany, France and the United States of America.

Innumerable instances of benefits to mankind from the discoveries made by the Fellows in their original researches can be cited from the rich proud history of the Society. With such a history and with its present day virility the Society is clearly justified in planning to make the celebration of its Centenary an important event. The importance was indeed internationally recognised in the decision taken in Rome in 1938 by the International Union of Pure and Applied Chemistry to hold its next International Congress in London at the time of the Centenary of the Chemical Society. This decision is to be implemented next year and immediately following the celebrations on July 15th to July 17th, 1947, the Eleventh International Congress of Pure and Applied Chemistry will also take place in London.

An international outlook has always been characteristic of the Society and this will be reflected in the series of social and scientific events which will constitute the three days of celebrations. Many distinguished overseas delegates are to be invited. These will include the Honorary Fellows of the Society, among whom are the world's greatest chemists of to-day. If those invited are able to accept we shall see in London in July 1947, perhaps the greatest international gathering of chemists that will ever have taken place. One of these distinguished visitors will be invited to follow in the line of Dumas, Cannizzaro, Wurtz, Mendeleef, Ostwald, Fischer, Richards, Arrhenius, Bohr, Debye, Rutherford and Langmuir as the Society's Faraday Lecturer. The Faraday Lectureship was founded in 1867 to commemorate the name of Michael Faraday, who was elected a Fellow of the Society in 1842 and was one of its Vice-Presidents. In addition to the Faraday Lecture, it is intended that there should be a centenary address and a formal ceremony for the presentation of addresses. It is also hoped to arrange a number of scientific lectures, visits to places of interest in the London area and an exhibition which will be at the Science Museum during the period of the celebrations and the International Congress.

# BRANCH NOTES

## AUCKLAND BRANCH.

At the meeting on May 14th, the Chairman, Mr. R. Stansfield said that this year was the 21st Anniversary of the founding of the Auckland Chemical Society, and on his invitation Professor Worley, one of the original members, read the minutes of the inaugural meeting held in March, 1925, and spoke briefly on the history of the Society and the subsequent founding of the New Zealand Institute of Chemistry.

Dr. J. C. Andrews, of the Challenge Phosphate Co., and President of the Institute, then gave an address on "Chemical Industries Overseas," in which he described some of his experiences during a recent trip to the United Kingdom and the Union of South Africa. Various methods of drying were examined at the works of the Kestner Evaporating Co. Here milk was dried in a spray drier in an inert atmosphere to a damp powder. Infrared heat was then used to drive off the final traces of moisture. Blood serum was dried by high frequency heating. Other plants visited included: the Metropolitan Gas and Coke Co., where 90,000 tons of ammonium sulphate were produced annually; Rothamsted Experimental Station; the New Zealand Co-operative Dairy Co.'s butter-patting factory in London; the Food Manufacturers' Research Association; George Kent and Co., manufacturers of water meters; and Imperial Chemical Industries Ltd.'s plant at Billingham. Dr. Andrews described in some detail the layout and operations of the I.C.I. plant, and enumerated some of the amazing range of products—explosives, fertilisers, dyes, plastics, drugs, liquid fuels, and chemicals—all produced from a very limited number of raw materials. Gypsum was mined on the property; phosphate rock, coal (2000 tons daily), and water (10 million gallons daily) had to be brought in.

In South Africa, Dr. Andrews visited the works of the African Explosives Co. at Modderfontein which covered four square miles. The products included high explosives for mining (70,000 tons annually); sulphuric acid from pyrites; aluminium sulphate from bauxite; zinc sulphate as a wood preservative for mine props; and lead nitrate for use in the extraction of gold. Other plants visited were in Cape Town and Durban, producing DDT and other insecticides, fertilisers, and glycerine.

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On June 18th, Mr. A. M. Mackney, M.Sc., of New Zealand Forest Products, Ltd., addressed the branch on, "Wood and Wood Products." He first discussed the composition of both soft and hard woods, indicating the nature and location in the cell walls of the various constituents—cellulose, cellulosan, hemicellulose, lignin, and extraneous materials. He then went on to describe the uses to which wood and its components were put. The main outlet for cellulose—approximately half of the dry weight of wood—was in paper products, but cellulose or its derivatives also formed the basis of such products as artificial silk, cellulose plastics, and explosives. All methods of production of paper, paper-board, wall board, etc., involved the use of cellulose in a more or less unchanged state, except that there was some tendency towards shortening in chain length due to hydrolysis. But, chemically, cellulose was an alcohol and thus able to form esters and ethers; this fact formed the basis of the artificial silk and cellulose plastics industries.

The utilisation of lignin had been seriously hindered by the fact that its chemistry was not yet well understood. It was considered at present that lignin consisted of units of the phenyl propane type but little success had been achieved in the conversion of lignin into this primary unit or to chemicals closely allied to it. Probably the only major conversion of lignin to a pure chemical substance was that in which vanillin was obtained from sulphite waste liquor. The demand, however, was small, and enormous quantities of materials containing lignin were still being merely used as fuel or wasted entirely. Recently some success had been achieved in modifying lignin for use in plastics.

The speaker then described the Scholler and Bergius processes for the saccharification of wood, and the utilisation of the products obtained for the production of alcohol, food yeast, furfural, stock fodders, and pure glucose. In Germany during World War II sugars from the Scholler process were converted into 1,500,000 gallons of alcohol per year. In addition 6,500,000 gallons per year were produced from the waste liquor from sulphite mills. About 16,000 tons of food yeast were produced in 1944 in Germany, about half from sulphite waste liquor and half from wood sugar obtained by acid hydrolysis. In America also, especially during the war, much experimental work had been done on the hydrolysis of wood for the production of alcohol for the synthetic rubber programme.

After referring ot the destructive distillation of wood, Mr. Mackney concluded by mentioning work that had been done on the production of wood plastics, and the treatment of wood to increase its strength and durability as a structural material.

## PERSONAL.

Dr. R. A. Robinson, Fellow, has been appointed Associate Professor of Chemistry at Auckland University College with effect from March 1st, 1947.

## WELLINGTON BRANCH.

At the June Meeting, Dr. J. Melville, who last year visited the U.S.A. to study the latest methods of producing penicillin, spoke on "Antibiotics," and said that the ability of one micro-organism to inhibit or suppress another organism growing in association with it is termed antibiosis, in contradistinction to the better known phenomenon of symbiosis. Antibiotic agents are therefore restricted to metabolic products of micro-organisms and are not to be confused with disinfectants which in the main are protoplasmic poisons, or with the synthetic antibacterial substances such as salvarsan and the sulphanilamide drugs.

Microbial antagonisms have been recognised for almost as long as there has been a separate science of microbiology. At first they were considered to be an expression of the competition for nutrients which exists in any mixed microbial population, but this theory, although it explained the majority of cases of inhibition, did not cover the case of **Pseudomonas** spp. which exerted a depressing effect on associated organisms long before the medium was exhausted.

A period of sixty five years was to elapse from the first observation of inhibition till the full significance of the antagonisms existing between micro-organisms was realised. The credit is divided between Dubos in America and Fleming and Florey in England. In 1939 Dubos announced the isolation, through the deliberate exploitation of microbial antagonisms in soil, of the organism **B. brevis** which elaborated the antibiotic substances granucidin and tryocidin. In the same year Florey's group at Oxford re-investigated the culture of **Penicillium notatum** discovered by Fleming some ten years previously as a contaminant on a routine plate. From that study came the first usable sample of penicillin and the present wide spread interest in antibiotic substances.

Despite wartime shortages of manpower and materials the English pharmaceutical industry had by 1943 established penicillin production on a large scale and these plants operated with great efficiency throughout the war. They were however quite unable to cope with the enormous demand from the Armed Services and American help was enlisted. To American pharmaceutical firms must go due credit for a scale of production which, before the end of the war, was satisfying internal civilian needs in addition to providing the bulk of penicillin for the Allied Armed Services.

An intensive study has been made of the chemistry of penicillin, but for security reasons very little of the work has been published.

Brief mention was also made of the structure of the complex polypeptides gramicidin and tryocidin which have hardly fulfilled their promise as chemo-therapeutic agents. Streptomycin from one of the **Actinomycetes** is of particular interest, in that it is active **in vivo** against a number of pencillin-resistant pathogens and, in vitro at least, against tuberculosis bacillus.

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## MELLOR MEMORIAL LECTURE.

The Mellor Lecture for 1946, was delivered at Victoria University College, on July 3rd, by Mr. L. R. L. Dunn, M.Sc., F.N.Z.I.C., Director of the Pottery and Ceramics Research Association.

The speaker said that he had been very deeply impressed, in a recent study of the ceramics industry in New Zealand, by the extent to which recent advances in chemistry and physics were being applied.

After outlining the scope of ceramics, which included such industries as cement, glass, pottery and enamelware,—all successfully operating in New Zealand—the lecturer went on to give some typical instances of the way in which the scientific method was being applied in the pottery, whiteware and refractories industries.

The most outstanding scientific development in the last 20 years had been the introduction of the clay-mineral concept, according to which clay particles, previously thought to be amorphous, were now known to be crystalline substances of platelike shape. This concept based on the X-Ray diffraction technique and electron microscope studies, had profoundly affected not only ceramics but also soil science.

The speaker then dealt with some of the methods used for the treatment of clays to remove impurities harmful in fine-pottery manufacture. Continuous processes such as the electrophoresis method used in Czechoslovakia, were worth study, as they could be used on a small scale suitable to New Zealand requirements.

This was followed by an account of the development of stabilised dolomite refractories in England, the introduction of which had prevented a crisis in the vital steel industry during the war. After making reference to other advances in refactories, the speaker stated that if the steel industry ever developed in N.Z. the need for refractories would increase enormously and the success of such a project would depend not only on the quantities of iron ore and suitable coal available, but also to an equal extent on the ability of the ceramic industry to supply the necessary refractories.

The speaker then dealt with the problem of "glaze fit" and the methods used to determine the physical properties of glazes that determined their resistance to crazing and other types of failure.

This was followed by a discussion of the methods used for forming ceramic articles in the potteries, with particular reference to the "casting process," which was quoted as a good instance of "Science in Ceramics."

In referring briefly to "decoration" of whiteware for the production of hand-painted ornaments and beautiful tea-sets, the speaker stressed the importance of the amateur in this field. Some of them had produced work of high artistic merit and the movement, he thought, should be encouraged by our educational institutions.

The lecture which was illustrated throughout by lantern slides, ended with reference to recent work on newly introduced bodies containing talc which had become very important during the war for high-frequency electrical devices for radio-communication work.

## CANTERBURY BRANCH.

At a meeting held on the 24th May, the Branch was addressed by Mr. S. R. Siemon who took as his subject, "The Meat Industry."

Meat has become an essential dietary constituent of a large section of the world population because it is the best source of protein of high biological value, and as well an excellent source of vitamins of the B complex. The function of the industry is to produce this food in a hygienic state with the maximum economy.

The raw material of the meat industry consists of animals bred and fattened on grazing establishments, the initial problem of the industry being the production of animals with a high ratio of meat to bone. Graphs were shown illustrating the changes taking place in the carcase composition on fattening. More rapidly matured animals tend to have a greater proportion of protein in the carcase, which gives New Zealand and Argentine an advantage over Australia in meat production.

In the Meat Works the aims should be to preserve the attractive appearance, palatability and food value of the meat, as well as to prevent deterioration to a poisonous state. The changes involved are chemical and microbiological. Control by the use of low temperature (chilling and freezing) or by canning is not enough, speed and bacteriological cleanliness are essential, perhaps combined with the use of ozone or ultra-violet in certain processing rooms or chillers. The results of measurements made by Empey, Scott and Vickery in Brisbane were shown, and the steps taken to reduce the microbial attack were indicated. The speaker also stated that most of the control measures were retained for domestic production also, as considerable advantage was found thereby, particularly in the hot humid summer.

Finally, there was indicated the importance of by-products in the economy of the industry, and the place of the chemist in relation to this section. Further, it is evident that the whole industry both in Australia and New Zealand would benefit by an extension of technical control and research activity.

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The speakers at the June Meeting were Professor J. Packer and Mr. E. R. Hounsell, who discussed the teaching of chemistry.

Professor Packer outlined changes which have occured in the last 20 years in the university degree courses and examining system, leading to greater internal control of prescriptions and examinations. These changes have been assisted by the abandonment of overseas examining, which has led, in his view, to a raising of standards.

First year classes provide a number of problems. The varying standard of entrants in chemistry has been met, at Canterbury College, by provision of two groups, one more advanced than the other being given a rather more advanced treatment of the subject. This is a partial solution only, and more complete solutions are needed, such as special honours courses for selected students, leading to an Honours B.Sc. Exemption of selected students from first year work was not favoured. The varying requirements of different classes of students taking chemistry I for different purposes, require, ideally, different courses. This has never been practicable so far. The problem presented by very large classes could be met by multiplication of classes, involving more staff and space, or by transferring stage I work to selected schools in a Form VII, or by setting up Junior Colleges.

Professor Packer discussed the advances made in stage II and III courses, and particularly the Honours course, which is now a very difficult year. He supported the scheme for awarding Honours to the B.Sc. degree on the result of the three general papers of the present M.Sc. examination, taken in the fourth year with an intensive practical course, followed by a thesis for M.Sc. in the fifth year.

Other problems considered were those involved in practical work and methods of teaching (lectures and tutorials).

While the first universities were professional schools, they very early became more—they became places for the "cultivation of the intellect" and for the "birth of new ideas." This has become their most important function. Chemistry is a living and growing branch of knowledge, and this should be reflected in the teaching. "Those who guide the learners of chemistry must themselves be learners," (J. C. Earl).

Mr. Hounsell sketched the rise of chemistry teaching in English schools from 1850 on, referring especially to the influence of the committee set up in 1889 by the British Association, and of Professor H. E. Armstrong's vigorous advocacy of the "heuristic" method. This involved "placing students as far as possible in the attitude of the discoverer—a method which involves their finding out instead of being told." However difficult the method is in teaching practice the spirit behind it has been invaluable.

W. H. Perkin advocated the historical method, Newth published a book of the experiments of Faraday Frankland and Hofmann, while in America, Alexander Smith's text became the basis of school chemistry.

From 1900 on, systematic chemistry based on the Periodic Table was taught in most of the leading schools. Ostwald's "Principles of Inorganic Chemistry" (1900) was the basis of the "Modern Method," in which chemistry is presented as a series of related phenomena, not a mass of isolated facts. "It is essential," said W. D. Bancroft "that the teacher of general chemistry should know his physical chemistry but it is not essential that he should put all he knows into the introductory course."

In 1919 the Science Masters' Association was founded and the chemistry syllabus was radically changed under its influence, in the direction of a less academic approach, suitable for the majority of pupils. Changes in New Zealand have run parallel. Mr. Hounsell said that the new school certificate syllabus appeared to exaggerate the importance of mere information, that is the knowledge of facts rather than the ability to use them. The matriculation syllabus has been improved and changes will occur in the future, which might well be guided by a permanent small group of school and university teachers.

The speaker discussed the role in teaching of such generalisations as the Periodic Law, Modern Valency Theory, the electro-chemical series, and the concept of oxidation states.

[Admirers of the late Professor H. E. Armstrong will appreciate the story told of him by a recent visitor, Mr. J. A. Lauwereys. H.E.A. opened an address to a Headmaster's Conference with the question, "What is wrong with education?" He provided the answer, "Headmasters." Has this a wider application? Ed.]

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The July Meeting took the form of a demonstration of experimental methods and instruments. The Spekker Absorptionmeter was shown by Mr. M. L. McGlashan and Mr. J. Urlwin, and some applications of it discussed by Mr. W. L. Dearsley. Mr. L. H. Bird and Mr. E. W. Hullett described some fluorimetric methods and showed a photo electric fluorimeter contructed at the Wheat Research Institute. Mr. T. G. Macartney explained the basic ideas of polarography.

The August Meeting was addressed by Dr. H. N. Parton, who gave a sketch of research in the physical sciences in New Zealand.

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## OTAGO BRANCH.

At the May meeting of the Otago Branch, Mr. G. Maskell-Smith of the Dominion Laboratory, spoke on the Measurement of Temperature and Humidity.

There are 4 types of expansion thermometer:—(a) Hg in glass; (b) Hg in steel; (c) vapour pressure; (d) bimetallic. Type (a) has several disadvantages. They are hard to read, fragile, must be read on the spot, and measure only up to about 600°. Type (b), too, has its drawbacks. The capillary tends to block; the instrument is sensitive to the relative levels of the ends; finally, friction in the recorder may cause a lag of several degrees. The main disadvantage of type (c)—that the calibrations increase in size as one goes up the scale—may be an advantage. In type (d), the two strips of metal unfold as the temperature increases and thus move the dial. With this type there is danger of corrosion.

Electrical methods of recording temperature are mainly the resistance thermometer and the thermocouple. For lower temperature, resistance thermometers are preferable to thermocouples. The advantage of the resistance thermometer is its suitability for remote reading; its disadvantage is the large bulb needed to hold the resistance element. The normal-temperature thermocouple is copper-constantan. For higher temperatures the platinum-rhodium combination is used. A difficulty with electrical methods is the translation from electrical energy to temperature.

Control of Humidity is important in handling dried products and in the prevention of drying in a cool store. The three types of humidity are:—

(a) Relative—$\frac{\text{V.P. } H_2O \text{ in air.}}{\text{V.P. water at that temp.}}$

(b) Percentage—$\frac{\text{Wt. } H_2O \text{ in given wt. of air.}}{\text{Wt. } H_2O \ O_2 \text{ at wt. air would hold if saturated.}}$

(c) Absolute—Wt. $H_2O$ in given wt. of air.

Three types of instrument are used:—(1) Wet and dry bulb thermometer. The rotating type is more accurate than the wall type. (2) Fibre cone hygrometer. This is more satisfactory with a constant humidity. (3) Lithium chloride hygrometer. The element is surrounded by two metal spirals immersed in an LiCl jelly. As the humidity rises, the LiCl absorbs more $H_2O$. The altered resistance is measured by a Wheatstone Bridge.

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At the June Meeting Mr. J. Murray discussed "The Chemistry of some New Zealand Plant Products."

When working on the chemistry of our plants, it is necessary to have some knowledge of botany and of the classification of the flora in particular. The botanical classification is founded mainly on the characteristics of the flowers, since these have not changed much as the plants have evolved. Thus plants such as Kowhai and Clover although very different in general appearance are actually closely related. Another such example is that of ragwort and daisy-trees.

A brief account was then given of the botanical classification, with some examples.

The chemical constitution of plants generally follows the botanical classification fairly well, but only a few groups of plants have been sufficiently studied. Two such groups are the Australian Eucalypts and the New Zealand pines, and interesting facts have already emerged. For example, two closely similar trees, Podocarpus totara and P. Hallii are found to produce oils containing two different diterpenes, rimuene and phyllocladene respectively.

The different types of chemical compounds found in plants were then considered. In the carbohydrate group, some work has been done on the hemicellulosex of N.Z. flax (Phormium tenax), and also on the plant gums. In the last few years the N.Z. sea-weeds have been shown to be good sources of agar-agar which is better than the overseas products. N.Z. agar now commands the world's highest price. Alginates, also present in N.Z. sea-weeds, are being used overseas in synthetic fibres.

Some of our plants are known to contain tannins, but they have apparently not been studied.

One field which has hardly been touched in our country is that of colouring matters; some of the fungi and lichens are very brightly coloured and should prove interesting. Perkin about 1900 extracted the dye **vitexin** from the bark of Puriri, and the structure of it has recently been conclusively proved. Some interest has recently been shown in th pigments of the Coprosmas.

A number of New Zealand plants have been shown to contain alkaloids and poisonous principles, and no doubt there are others as yet undiscovered. Much of the earlier work was done by Aston and Easterfield at the beginning of this century, and continued since 1930 at Otago and Auckland Universities. Some of the plants which have been studied are Pukatea, containing three closely related alkaloids, Poro-poro containing the complex alkaloid solasonine, and Kowhai which contains the alkaloids matrine and cystisine found also in other members of the Leguminosae family. Two poisonous principles which have received attention are tutin from Tutu, and karakin from the Karaka. The former is a lactone, apparently similar to picrotoxin, which it also resembles in physiological activity. The latter is a glycoside, which hydrolyses to hiptaginic acid previously obtained from an East Indian tree. Hiptaginic acid has now been synthesized.

Some other classes of compounds such as saponins and fixed oils occur in N.Z. plants, but little published work has appeared in the literature. Resinols and lignins were also mentioned in the lecture.

Most of the investigation of the native plants has been directed to a study of the essential oils, present in 30 or more of our trees and shrubs. Although these oils are quite widely distributed among the plant families, some of them are specially notable in this regard. The two of most interest in New Zealand are the Podocarpaceae which includes most of the pines, and the Myrtaceae which includes the ratas and manuka. The rata oils have been studied by Gardner, but the composition of various oils seemed to have little relation to the botanical classification. Before considering the N.Z. pines in more detail, a brief account was given of other oils including Kawakawa, Pepper-tree, Ngaio, Tarata and Olearia. The concluding portion of the lecture dealt with the diterpenes and related compounds which have been isolated from the oils and woods of the pines (Gymnospermae). The complex relationships of these compounds and their occurrence (with notable exceptions) in the related species were discussed.

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At the August Meeting of the Otago Branch, Dr. C. O. Hutton, Lecturer in Geology at the University, spoke on "Some Mineralogical Transformations."

The endeavours of the industrial chemists often appear to be of great magnitude, but their greatest efforts are dwarfed by comparison with the chemical changes wrought by nature. Most important of the mineralogical transformations herein are those due to weathering, hydrothermal alteration, and metamorphism.

If the results of weathering under New Zealand climatic conditions are considerable then the results brought about in tropic countries with high rainfall and great heat, are stupendous. Weathering involves the destruction of the feldspars and ferromagnesian constituents with concomitant leaching and removal of $K_2O$, $Na_2O$, $CaO$, $FeO$, and $MgO$, leaving a stable, insoluble residue of clay minerals, silica, and sericite. The results of weathering are very obvious in the uppermost few feet of the rock surfaces but traces of incipient alteration and decay can usually be detected at the bottom of deep cuttings or rock tunnels of considerable depth. Briefly then, the complete weathering of one square mile of average rock to a minimum depth of six feet would mean the removal of approximately 100,000 tons of $K_2O$ alone—consider the chemical changes in tropical countries where the zone of weathering descends to more than 200 feet.

An excellent example of hydrothermal alteration is to be found in the Hauraki Peninsula where, perhaps one thousand square miles of rhyolite, dacite, and andesite lavas have been propylitized to great depths. The chemical changes involved herein are:

plagioclase and orthoclase = kaolin + sericite
with $Na_2O+CaO$ & some $K_2O$ removed.
hornblende and augite = chlorite with $CaO$ removed.
Kaolin = diaspore with $SiO_2$ removed.
kaolin + $H_2SO_4$ = alunite with $SiO_2$ removed.

In addition there has been an introduction of enormous quantities of sulphides in the Hauraki area.

The processes of metamorphism were illustrated and considered under two main headings:

(a) Contact metamorphism.

(b) Progressive dynamo-thermal metamorphism.

Under (a) the effects of temperature on a varied series of rocks, both sedimentary and igneous, were discussed on the basis of the phase rule, and in the simple case of dolomitic limestones it was shown that dissociation of magnesium carbonate and not calcium carbonate occurred under the conditions of temperature and pressure prevailing in contact aureoles to give pencatite and predazzite; these rocks as a result of subsequent hydration gave rise to brucite marbles.

In the second case it was shown that very extensive areas of the earth's crust have recrystallized under conditions of intense stress and low to moderate temperatures. The enormity of the mineralogical reconstitution that has occurred under these conditions was illustrated by a number of cases; for example it was shown that the entire area of the Otago schist belt, of approximately 12,000 square miles has been derived from a thick series of mudstones, sandstones, lavas, and tuffs by recrystallization and reconstitution under conditions of intense stress, low hydrostatic pressure and moderate temperature. These pressure-temperature conditions resulted from low-angled shearing and the intrusion at depth of a granite magma.

## CORRESPONDENCE.

Sir,

My excuse for asking for some of your space is that I was not able to be present at the General meeting held during the recent conference to hear the whole of the discussion on the question of direct election to the Fellowship. Although I think that there should be a clause in the Rules giving power to Council to elect persons direct to the Fellowship and this appears to be already adequately covered by Rule 9 (111), I also think that such power should be used only on very special and rare occasions. I think I am correct in saying that when we framed the original rules provision was made (See Rule 9 (11)—) for Fellows of Kindred Institutes to be elected direct to the Fellowship. Applications under Rule 9 (1) and (11) are entitled to be made on a Fellowship application form but it seems to me that all other applications should be made on the

Associate form, it being the sole right of the membership Committee and the Council to decide whether the case is of sufficient merit for direct election to the Fellowship. There may be exceptional cases where chemists from overseas countries are not already members of a kindred Institute who may regard themselves of Fellowship standard. In such a case the application can always be accompanied by a covering letter asking for special consideration. Apart from such cases I cannot think of any circumstances where chemists in New Zealand should now be entitled to direct election and I think that direct election to the Fellowship if treated lightly is likely to cause dissatisfaction among members who have started as Associates and ultimately made the grade to the Fellowship. Take the hypothetical case of A and B who graduate equal the same year. A joins up as an Associate and throws his lot into the work of the Institute and pays his fees for say 10 years when he is raised to the Fellowship. B on the other hand does not join up and takes no particular interest in the welfare of the profession as a whole but who, makes such progress in his own field that in 10 years time he feels he is of Fellowship standard and therefore makes application. I submit, sir, that it is unfair to A if B is elected direct to the Fellowship because A has made material, contribution to the cause of the profession in both time and money, while B has in all probability done little or nothing. A joins up quietly in his fledgling days when only passing mention is made of his joining while the direct election of B to the Fellowship is accompanied by a fanfare of trumpets. If for special reasons a person is afforded the opportunity of sitting for the examination direct to the Fellowship and is successful the election is justified but in other circumstances I cannot see that a probationary period as an Associate is derogatory to anyone's dignity. Perhaps it is worth while calling to mind that when the Institute was formed all members joined as Associates and although many foundation members were Fellows of the Royal Institute and there was a clause in the rules giving power for such persons to be made Fellows, if my memory serves me right no Fellowships were conferred for a period of two or more years. I do not recall that any of the Fellows of the Royal Institute thought it an affront to their dignity to serve a period as Associate of the New Zealand Institute. in fact, I could name several members who were entitled to elevation under Rule 9 who deliberately withheld their own application because they were entrusted with dealing with fresh application to the Fellowship and felt that impartiality was best served by themselves remaining as Associates for the time being.

While on the subject of direct election to the Fellowship there is another point which I wish to mention in passing and that is press announcements. I have on several occasions noticed that notices are put in the press (perhaps the fault is sometimes due to over zealous newspaper reporters) which tend to give the public the impression that the particular Institute has gone out of its way to request a person to become a Fellow because of some outstanding work in some particular field. As far as I am aware neither Institute does that nor is it the function of the Institute to go out seeking members in that way. One of the main functions of the Institute of Chemistry is that of a qualifying body, membership gives status in the profession and although it is nice to see the names of new members in the press (and I have yet to meet the person who does not like to see his or her name in the press) it should be done with due decorum and in the proper perspective.

Yours faithfully,

G. A. LAWRENCE.