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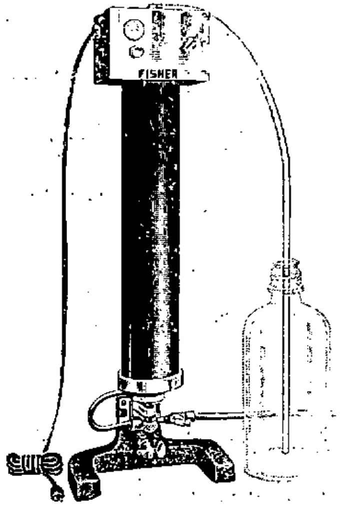
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JOURNAL OF THE
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VOLUME XII DECEMBER, 1948 No. 4

SCIENTIFIC ORGANISATION IN NEW ZEALAND

By HON. T. H. McCOMBS, M.P., M.Sc., A.N.Z.I.C.

Address delivered to the Wellington and Canterbury Branches, 1948.

I am very diffident about talking to an audience such as this on the subject of scientific organisation in New Zealand because somebody or other in the audience will know more than I do about each point with which I will deal.

Perhaps before we start to discuss scientific organisation we had better decide just how research itself can be subdivided. We know, particularly in an academic atmosphere such as this, that there is pure research. The next obvious division is applied research followed by development research of the idea discovered in applied research, and finally research from the point of view of the user as to how to make the best use of the product which has been developed as a result of the previous processes. Each of these four phases of research has its appropriate place in various parts of our research organisation and this has to be arranged to suit. There is no sharp distinction between pure research, applied research, development research and user research. For instance, we can quite well imagine academic researches taking place on the various phenomena arising from the mixing of certain metals. That same piece of research could very well be conducted by a chemist, employed by a big industrial firm, to work out the best constituents of a particular alloy that he wants. But having found a series of alloys, he wishes to develop an alloy for one commercial purpose. The same piece of research can be pure, applied, or development according to whether or not there is a prospect for an immediate financial gain on somebody's part, and I think that no clear distinction can be made between them.

Pure research is research conducted with the idea of extending the boundaries of knowledge. Obviously the University is the best possible place for the establishment of research such as that. In New Zealand it would be necessary, I think, for the cost to be met by the State. The economic set-up of this small country differs considerably from that of large older countries where research institutes and universities have considerable endowments behind them, and it has not yet become the custom for very wealthy men to leave large estates for the enrichment of research. Until that takes place, the great bulk of the cost of pure research will have to be met from State funds. This would be done, presumably, by the University providing the staff and accommodation and the Research Council providing grants for apparatus, equipment and travelling, and perhaps even purchasing expensive pieces of apparatus and lending them to the Universities. The other classes of research would be financed in various ways, partly by the State, partly by industry—in some cases wholly by the State, in other cases, wholly by industry.

The history of research work in New Zealand goes back a long way because scientific research was carried out here by Charles Darwin, by Banks and by others who visited here on various expeditions, and a considerable amount of work was done. Figuring largely in the early days were amateur scientific research workers, including clergy, teachers, and other part-time scientists.

By 1916, people here began to take an interest in administrative developments that were taking place in England. There the Scientific and Industrial Research Council was being established and the suggestion that we should take a similar step is recorded in the same year, but nothing was done about it until, in 1919, the Industries and Commerce Committee of the House of Representatives recommended the establishment of a central Board of Science and Industry. The next major development was the Cawthron bequest of £240,000 for the purpose of carrying on research in the Nelson district. In 1924, the New Zealand Manufacturers' Association submitted proposals to the Government for scientific research to help manufacturing industries. In 1926, the Scientific and Industrial Research Act was passed by Parliament, setting up the Council and the Department as we know it to-day, and there have been very few changes in the Act since. That is unusual, but the Act was reasonably soundly based, as I hope to show later. It was established on the British model after a visit in 1926 by Sir Frank Heath, who was then in charge of the United Kingdom Department of Scientific and Industrial Research, and it was largely as a result of his report that we set up here an organisation similar to the British one. The only other advisers that we have had here from overseas were Dr. Hammond on Animal Research, in 1938, and Sir Reginald Stradling on Building Research, just towards the end of last year.

I think I can say here that a study of the previous experience of, visitors coming to New Zealand and the advice that they offer us seems to indicate that we can decide beforehand what sort of advice we will get because every one of these gentlemen whose reports I have examined has recommended us to set up here an organisation of the type in which he worked overseas. We would invite to advise us only a man who was successful, and it is natural that he should recommend what he has found to work well. Sir Frank Heath therefore, recommended that we should set up a Department of Scientific and Industrial Research and an advisory Council.

What is the present Scientific and Industrial Research Council and Department? The Council is an Advisory Council. The Department is an administrative Department, carrying on scientific research work. The Council is advisory both to the Minister and to the Department, and I can assure you that it is extremely desirable from the point of view of the Minister that such a Council should exist. The ramifications of scientific research work in New Zealand are now very wide indeed and nobody, no matter how widely he be trained as a scientist, could follow all the work that is being carried out, and so it is therefore desirable that disinterested advice should be offered to the Minister and the Department.

The Department's duty is administration, but the Department also advises the Government. The officers of the Scientific and Industrial Research Department are civil servants in the full sense of the term and the Council of Scientific and Industrial Research is not the employer.

Other parts of the British Commonwealth of Nations have a different system. Canada, South Africa and Australia all have a Council of Scientific and Industrial Research which employs some of the research workers. In each of these Dominions, some scientific work is carried on by other Departments outside the control of the Council. Some jealousies and frictions have been caused by the fact that there are two different employing authorities and two different scales of pay in each of these Dominions. It is early yet to comment on the new Dominion of India, but India has set up an Advisory Council.

In New Zealand we have research carried on in a number of institutions. The major agent of research is the Scientific and Industrial Research Department. There are some 20 sections of that Department each conducting research into one particular phase of work, mainly applied research. There are two research institutes proper. Both of these—the Dairy and the Wheat Research Institutes—serve a whole industry. A contribution is made in both cases by what could amount to a levy on the product and that levy is subsidised by the Government to pay the cost of the research and other scientific work done. The results are available to the whole industry. There are five other research associations. These are organisations of the Government and the industry involved, in which certain members only of an industry decide to become subscribers who between them pay roughly half the cost of the work, the Government paying the other half. The results of that research are not available to that industry as a whole, but only to those firms which subscribe to the service.

Then the Agriculture Department carries out research work at its Animal Research Station, at Wallaceville, at the Seed Testing Station and other establishments. The Marine Department carries on Fisheries research. The Cawthron Institute performs research work on Soils, in Entomology and many other problems. Work is also done at the main Museums. The Air Department does research work on Meteorology. The various Colleges of the University also do research work. Some 124 private firms employ some 240 graduate scientists, and they also do a little research work. The Royal Society of New Zealand, the N.Z. Institute of Chemistry, the Royal Institute of Chemistry, the N.Z. Institute of Forestry and the Royal N.Z. Astronomical Society encourage research work, and very valuable research work, too, by part-time workers, so that there is very widespread organisation for scientific research in New Zealand.

The problem is—how are we to co-ordinate? What is meant by co-ordination? In New Zealand I think the greatest single method of co-ordination of research work and the method of prevention of overlapping in various fields lies in the very fact that we are a small country and that every research worker likely to be engaged on a particular problem knows personally the others who will also be working on that problem. Co-ordination may also be interpreted as the planned distribution of research to ensure that the best attack may be made on the many problems awaiting solution. A study of the internal organisation of the Department of Scientific and Industrial Research will show how this is being attempted.

Inside the Scientific and Industrial Research Department itself there are some 20 different sections. These sections are in many cases managed to a large extent by Advisory Committees. The Research Committees which are in existence are the Manufacturers' Research Committee, and Committees for Building Research, Coal Survey, Industrial Psychology, hops, fruit, tobacco, Soil Bureau, Plant Research, Biometrics, Wild Life, Atomic Physics, Fats, Agronomy, Botany, Grasslands, Plant Diseases, and Entomology. Then, administered purely within the Department, though in some cases with local committees, but without any major committee, there is the work of the Dominion Laboratory, the Dominion Physical Laboratory, the Geological Survey, the Dominion Observatory, the Auckland Industrial Research Laboratory and until recently, the Canterbury equivalent of the Auckland Industrial Development Laboratory, the Magnetic Observatory, the Apia Observatory, and the Defence Development Section, so that you can see that there is a very wide range of activities being carried on. I should mention here that it is proposed that the Canterbury Industrial Development Laboratory should be managed by Canterbury University College with the help of a grant from the Department of Scientific and Industrial Research.

There has been very rapid expansion of late and that expansion itself has made administration a little more difficult than it should be. The expenditure of the Department of Scientific and Industrial Research has risen from £30,911 in 1926 to £743,000 in the financial year that has just ended. If we add together the £743,000 from the Department of Scientific and Industrial Research, £210,940 for research under the Agriculture Department, the £10,000 that is given by the Education Department to the University, Fisheries Research £1,000 and Medical Research £19,000, the total amount spent for the year 1947-48 on research work in the Dominion was close on £1,000,000. That is a very considerable advance when compared with the £30,000 that was spent in 1926, only 20 years ago.

Research is carried on in the various agricultural colleges utilising grants recommended by the Council of Scientific and Industrial Research. These grants are included in the gross expenditure I have just mentioned. The largest grants go to Canterbury and Massey Agricultural Colleges. The next largest grant is to the Cawthron Institute. Other grants are made to the Royal Society, the Carter Observatory and the University Colleges.

In addition there is the direct grant by the Education Department for research work in University Colleges. Some of these grants are used for the employment of scientists and others for equipment and materials. In addition, research work is carried on through a system of scholarships and fellowships. The total amount of money available each year to New Zealand students is just short of £10,000 (£9,900) without counting scholarships of less value than £100 a year. Of these, 17 are really valuable and I regret to say that the great majority of these are held overseas.

One of the first disappointments I had as Minister was to find that the Six National Research Scholarships which are awarded on the recommendation of the Council of Scientific and Industrial Research are now held overseas. If we are to develop research at our New Zealand Universities, then we must have Research Schools here with students to work in them. For this reason, I would be very pleased indeed to see a much greater proportion of scholarships held here in New Zealand. Many of these scholarships could be held here with benefit both to the student and to the country. I asked why National Research Scholarships were now being held overseas when it was originally laid down that they must be held in New Zealand. I was told that the University Colleges said they could not offer the facilities to do the research work. I would very much like to help the University Colleges to do just that thing and until it is done I am confident that the calibre of research work at our Universities will not be as high as we would like it to be.

A great deal of our research work is done at the two agricultural colleges—much more than at the remaining four colleges. The tendency in New Zealand has been to give money for research into primary industry perhaps more generously than into other industries. Lincoln College gets grants for animal husbandry investigation, including pig breeding trials, trials of new insecticides in sheep dipping, various soil and fertiliser research, etc. Massey Agricultural College is carrying out pasture grazing trials, biochemical research, etc. Apparently all those problems are not what might be called fundamental research, but a great number call for fundamental investigation because knowledge must be based on facts which are not yet known.

We are told from time to time that we ought to spend certain sums on research work. Personally, I think it is the wrong approach. Stradling, for instance, when he visited New Zealand, suggested that we ought to spend 1 per cent. of our turnover on research work. Other people indicate that it ought to be 1 per cent. of our national income, and various quotations are made. Sir Harold Hartley in 1943 quoted the expenditure on research as a proportion of national income in Russia as 1 per cent., the United States of America .3 per cent., and in the United Kingdom .1 per cent. That leads us on to a very interesting problem, as to what is research in the first place and what is national income. For example, it would not be easy to say that any worker in the Dominion Laboratory is on straight service work the whole of his time and research work none of his time. It is very difficult then to say exactly what research expenditure is to include. Does it include expenditure on all types of scientific services?

Then there is the question of the national income. Here in New Zealand the figure that we quote is what is called "aggregate private income" and this is the total sum of money paid to all individuals. It does not include company incomes. It is all money which we receive including what is paid out forthwith as taxation, which in turn is redistributed to others as income. Sir Reginald Stradling used the phrase "one per cent. of turnover." What is turnover? Is it the total value of production at the point it reaches the consumer? — at the factory gate? — or is it merely the "added value" of that production? By "added value" is meant the difference between the raw material cost and the cost of the finished article. I am trying to indicate that this picking of an arbitrary figure is not at all easy. I think added value would apply to manufacturing industries but would not apply to primary industries. The only figure that I can get which includes both is the total value of production at the factory gate and at the farm gate—it worked out at 201.3 millions in 1946. On that basis we would need to spend £2,000,000 a year. We come to comparison with other countries. Russia, for instance, shows an expenditure, on Sir Harold Hartley's figures, of 1 per cent. of the national income. One can understand how research no higher in proportion than we have here would produce a figure of 1 per cent. of the national income when one considers that the average wage of the Russian worker calculated in New Zealand currency would be something less than £10 a month. If we increase wage rates the percentage falls without the amount of research work falling.

I have come to the conclusion that it is not desirable or possible to work out an arbitrary figure. What we should do is to have a stocktaking of the resources at our command—the equipment, the buildings and the human beings who are going to do the work. We can do here in New Zealand certain research work with these men and women. We have to see that our limited resources, mainly in men and women, are used to the best possible advantage. In that way I am sure that we will arrive at a better conclusion than if we simply say we must have research work to the value of 1 per cent. of our national income and set out to spend £3,500,000 a year regardless of what it is spent on.

Incidentally, just as a measure of how scientific work has increased in industry—in 1938 in England private firms were spending some £5,500,000 a year on research work. Sir Clifford Patterson, who was out here not so long ago, told me that the figure had now increased to £25,000,000 a year.

There is the question as to whether we can afford research work at all. I don't think one can fairly say that we can measure the cost of research and balance it against the benefits we gain with any reasonable yardstick, when one considers relatively cheap pieces of research work and the enormous benefits achieved. The research work to cure bush sickness cost less than £20,000 overall. The value to New Zealand farmers lies between £1,000,000 and £2,000,000 a year. By research into cold storage of fruit, wastage was reduced from between 10 to 20 per cent. to less than 2 per cent., which saves 65,000 to 100,000 bushels of apples a year —the value per annum £24,000 to £37,000. A little research work (and not very much) made possible an industry for the extraction of fish liver oils. The annual output of fish liver oil capsules is now between £300,000 and £400,000 a year. We are supplying to the United Nations Children's Appeal some 40,000,000 of them. The control of insect pests has its most spectacular phase with the white butterfly; the value of cruciferous crops is about £3,000,000 a year and without this work most could not be grown. During the war one quite short research resulted in being able to use 4,500 tons of whey butter for export as dried butterfat. There is a new variety of wheat—Fyfe-Tuscan—yielding 8 per cent. more than others, which means that this wheat is capable of increasing the annual value of the wheat crop by from £15,000 to £20,000. This in itself would pay the cost of Wheat Research with a good bit to spare. Research on wool can be very profitable to the people as a whole. It was estimated that in one contract alone, the increased life (estimated to be 50 per cent) of the woollen garments supplied to the Army saved the Government £100,000. The control of contagious abortion has been developed through a vaccine. It has reduced the incidence in some herds from 20 per cent to 3 per cent. The saving to the dairy industry is estimated at a quarter of a million pounds each year. Fuel conservation research work indicates that through the application of work already done here and overseas, industry as a whole could save in coal alone £200,000 a year and savings of that order have been demonstrated in many factories already. The seed certification scheme which is based on research work has increased the value of our export seeds from £500,000 to £2,000,000 a year. The control of dry rot in Brassicas benefits the New Zealand farmer to the extent of £250,000 a year. The increased incomes for one year from these items that I have quoted would be sufficient to pay the total cost of New Zealand research work for many years. The profits for the people from expenditure on research are much better than from an investment in a gold mine.

What we have to do is to aim at the best use of our resources. We are employing now in the Scientific and Industrial Research Department some 290 members of a scientific staff. We would employ, if we could get them, 46 more forthwith. There have been some discussions as to future development. If we carried out the research work that the Scientific and Industrial Research Department has been asked to carry out and most of which is justifiable, we would increase that 290 which we now employ to 645 by 1953. If we do what we ought to do—not just what other people would like us to do, but we think is completely justified and really must be done—we would increase that 290 to 425. I think I showed that financially it has paid New Zealand in the past to spend money on research work. It should pay New Zealand to expand the number of scientific research workers to the figure I mentioned.

That obviously means more training of scientists, but we are getting more scientists from our University Colleges. There has been an all-round increase in the number of students enrolled. The figures I have here are for 1939 and for 1947. The number of students enrolled in Arts rose from 3,250 to 7,013; in Pure Science from 587 to 1,516; Medicine and Dentistry from 698 to 1,100; Technology from 448 to 1,196; Agriculture from 171 to 461. The greatest percentage increase has occurred in Pure Science. It is a parallel increase here in New Zealand to the increase that has occurred in Great Britain. In Arts the number enrolled at the various Universities and Institutions in England has increased from 22,500 to 34,200, for the same period; in Pure Science from 7,700 to 14,500; Medicine and Dentistry, 13,000 to 15,000; Technology from 5,000 to 10,000; Agriculture, 1,000 to 2,000. Expansion in Agricultural trainees has been much greater than it has been here, but the greatest rate of expansion has occurred in scientific subjects.

We are told that we have taken into the Universities more students and therefore we must have lowered the average of ability. That is a statement which I think is correct as applied to our post-primary schools but not to Universities. We have increased the intake of our post-primary schools from about 40 per cent of the children to 80 per cent. That has lowered average ability. There does not seem to be any evidence of that tendency in the Universities, on the Science side at any rate. The percentage of students obtaining first-class honours has varied very widely, but shows no falling tendency. The figures starting from 1927 and in consecutive years up to 1946, which is the latest figure that I have, are—

Year	% of M.Sc. Graduates awarded 1st-class honours	Year	% of M.Sc. Graduates awarded 1st class honours
1927	33½	1937	24
1928	25	1938	38
1929	29	1939	42
1930	15	1940	29
1931	38	1941	35
1932	24	1942	39
1933	45	1943	26
1934	27	1944	29
1935	31	1945	45
1936	25	1946	29

DISPERSAL OVER THE YEARS 1927-1946

Subject	1927	1929	1931	1933	1935	1937	1939	1941	1943	1945	1946
Mathematics	8	7	3	5	11	5	6	3	1	5	10
Geology	2	0	2	1	1	1	3	0	3	1	4
Chemistry	8	11	15	15	26	24	12	13	10	19	30
Physics	2	1	4	10	9	11	5	3	1	8	23
Botany	2	2	2	1	5	2	5	3	0	6	0
Zoology	0	3	4	8	3	2	2	2	0	5	3
	22	24	30	40	55	45	33	24	15	44	70

If there is any trend it would seem that there are now more first-class graduates as a percentage of the students graduating than there were in the late 1920's. They are dispersed over the various science subjects, the greatest number in chemistry. Mathematics and physics follow very closely, and then Botany, Zoology and Geology. The most interesting thing that I find about the careers of students at the Universities is that the percentage of wastage among science students is lower than that among the Arts students. The percentage of failures (students who never complete their degree) in the Arts subjects rises and falls. The peak was 52 per cent. The highest that the science students ever reached was 42 per cent and it goes down to as low as 20 per cent. That is a good thing when considering the question of the supply of scientific personnel to meet future needs.

When science students graduate many of them go overseas, and that is as it should be, provided that a sufficient proportion of them come back. I believe that we can produce more brilliant scientists in proportion to our population than do other countries, and I think statistics will show that. We can also fairly say that New Zealand with its small population and because of its isolation, does not offer opportunities for our very best, such as Lord Rutherford. Research workers of his calibre must go to centres of higher learning than we have though it would be very nice to have them back to establish schools of research in New Zealand. While I think it would be difficult indeed to persuade our very best to return, we are not getting enough of our graduates back from overseas.

Here I would like to comment on one impression that seems to prevail in one or two groups of New Zealand students who have gone overseas. They have an impression that they would not have freedom here to do research work. I think that can be reasonably contested. Here in New Zealand there is a freedom at least as great as in any other country.

There are very few scientific workers who are of sufficient calibre to be employed by anyone either here or overseas to carry out scientific work without any direction whatever. When they are employed by Government Agencies in New Zealand their scientific work is to a large extent free and unfettered. Take the Soil Bureau for instance. Nobody in the various branches of the Bureau has directions issued to him except by the three scientists in charge. By and large they are restricted to work on soil survey. Inside that work on soil survey the direction of their work is by scientists within their particular section of the Scientific and Industrial Research Department. Scientific workers are given a free hand to work under the general direction of some Advisory Committee which indicates to them the problems which need to be solved. Every scientific worker anywhere in the world would voluntarily carry out research work as a member of a team under the general direction of somebody else.

Stradling made a big point of Intelligence Service. We in New Zealand have not sufficient means of letting people who are interested and the general public know exactly what scientific research has been carried out and what knowledge and services are available to the public as a whole. He suggests the development, particularly for the building industry which he was reporting on, and also for the Scientific and Industrial Research Department as a whole, of an Intelligence Service which collects and disseminates knowledge. This is very desirable and must be developed.

I have mentioned earlier organisation of research work in the Universities. I doubt if I could quote a higher authority than Lord Rutherford who, speaking at the Conference of International Scientists in 1938, said:

> "It is imperative that the Universities should be in a position not only to give a sound theoretical and practical instruction in the various branches of science, but, what is more difficult, to select from the main body of scientific students those who are to be trained in the methods of research. Experience has shown that the progress of science depends in no small degree on the emergence of men of outstanding originality of mind who are endowed with a natural capacity for scientific investigation and for stimulating and directing the work of others along fruitful lines."

Lord Rutherford was of opinion that the major benefit of research in the University is as a means of selection and training of future research workers.

What is the function of a University? It is the accumulation, conservation and dissemination of knowledge; the accumulation of knowledge from research work, the conservation of knowledge by scholarship and through libraries and the dissemination of that knowledge to the student body. The primary function of the University is to teach, to turn out qualified students taught in this case to do research work. The research work the University does then should primarily be an adjunct to the training of students. It is necessary if we are to carry out that work that there should be avenues available for pure research work in our universities and I have indicated to you that in the past some encouragement has been given. Nevertheless, there are opportunities for research work in our Universities which are not being seized to the full. Some of our University staff are carrying out brilliant research work, while other members of the staff are claiming that they are unable to carry out research work because they are overburdened with teaching duties. It would not be unreasonable to say that the average University staff member could spend up to eight weeks a year full time on research in addition to generous holidays.

What are the fundamental needs of research? It is like most other problems—it is a human problem. It is the gathering together in one place of sufficient people to be able to have intelligent conversation on the one subject. If we have sporadic bursts of research here and there, not related, we cannot provide workers with the facilities that they need to do their very best. The research worker must have other people working in the same line so that he can discuss his work with them. We can do that only if we develop schools of research work along limited lines so that we have the main essential which is the development of a mental climate in which the research worker can do his best work. One of the means of achieving this has been effected by associating research work with Universities by placing Government financed research work in close association with the Colleges. That has been done for instance, with the Dairy Research Institute at Massey College, and it was the original idea when the Wheat Research Institute was established at Lincoln College.

There has been a good deal of discussion going on as to whether or not we should have a separate Council of Scientific and Industrial Research administering Scientific Research as a co-ordinating authority. . First of all, it might be desirable to let you know just who the present Council are and what is the function of the Council. The members are:—

Sir Theodore Rigg, Chairman-Head of the Cawthron Institute.
Dr. J. C. Andrews, Vice-Chairman-Manager, Challenge Phosphate Limited.
Dr. R. O. Page, Manager, Woolston Tanneries.
Dr. N. L. Edson, Medical School, Otago.

Professor W. Riddett, Dairy Research Institute, Massey College.
Mr. J. Ranstead, a farmer from Waikato.
Mr. Sandys Wunsch, Dairy Products Limited, Edendale.
Mr. E. J. Fawcett, Director-General of Agriculture.

These men represent a wide body of knowledge available for advice to the Government on what research projects are to be undertaken. The statutory duties of the Council are set out in the Act—

(a) To consider and report to the Minister upon the scientific aspects of all proposals made to the Department for the encouragement and organisation of scientific and industrial research.

(b) To submit annually to the Minister, a programme of the work, with estimates of the cost thereof, for each of the scientific institutions and services under the control of the Department.

(c) To make recommendations as to the expenditure of money by the Department in grants for purposes of scientific research.

(d) To advise the Government on the scientific aspects of any proposals made by any other Department of State and referred to the Council for its consideration and recommendations.

Associated with the Council are some 22 Committees. The important thing is that these committees are deputed by the Council to supervise on its behalf the work of a part of the Scientific and Industrial Research Department. In many cases they are people recruited from outside. The Committee members are people with particular knowledge of the branch of science upon which they are called to advise and they are an essential part of the Council of Scientific and Industrial Research. Members of the Council have said to me that as the Council is now constituted it is not able to exercise over the Department the close supervision which the Act prescribes. I do not agree. Any successful large organisation is an organisation that delegates authority, and the Council delegates authority to these various Committees. In their turn these advisory committees are essentially part of the Council as a whole and assist it to perform the duties laid upon it by the Act.

(Please turn to Page 125)

DR. F. B. SHORLAND.

The New Chairman of the Wellington Branch

After four years at Wellington College, Dr. F. B. Shorland started work in the Accounts Section of the Department of Agriculture in 1927, but was transferred nine months later as a cadet to the Agricultural Chemical Laboratory. With the exception of six months' leave to complete the M.Sc. degree, which he took with first-class honours in Chemistry in 1932, he studied as a part-time student.

In 1931 he was awarded the Sir George Grey Scholarship, and in 1932 the Jacob Joseph Scholarship. In 1935, he was awarded a Scientific and Industrial Research Scholarship, and with the help of a University Free Passage, he proceeded to study under Professor T. P. Hilditch, D.Sc., F.R.I.C., F.R.S., in the Department of Industrial Chemistry at the University of Liverpool. The subject of investigation was "The Composition of New Zealand Fats with Special Reference to Fish Liver Oils." For this purpose he took with him samples of fish oils and animal liver lipids prepared in New Zealand.

While in England he also gained experience in the British Drug Houses, Ltd., London, and in the Department of Spectroscopy at the Liverpool University.

Returning to the Agricultural Chemical Laboratory in 1937, he continued to work there under the Chief Agricultural Chemist, Mr. R. E. R. Grimmett, until 1944, when that laboratory was incorporated into the Animal Research Station at Ruakura. For the greater part of the period, 1937-1944, Dr. Shorland was virtually responsible to the Chief Agricultural Chemist for the organisation and control of the Agricultural Chemical Laboratory.

In 1945, Dr. Shorland was transferred to the Department of Scientific and Industrial Research, to investigate the composition of New Zealand butterfat. In 1946, the Fats Laboratory was established as a separate unit with Dr. Shorland as officer in charge.

He has published 38 papers, covering a variety of researches, in overseas and local scientific journals, the later papers being mostly concerned with the chemistry of the fats. In his first publication with J. A. Bruce in 1932, he advocated the use of thermal heat for power and agricultural purposes, and in 1934 with F. A. Denz, he recorded for the first time the possibilities of development of a local fish liver oil industry. Much of his work on fats has been reviewed from time to time by overseas workers, and the well-known text-book on "The Constitution of Natural Fats" by T. P. Hilditch, has many references dealing with Dr. Shorland's investigations.

◆

WELLINGTON BRANCH

At the Annual Meeting on 6th October, the following officers were elected:—

Chairman: Dr. F. B. Shorland.

Secretary-Treasurer: J. L. Mandeno.

Committee: Messrs. C. G. W. Mason, R. C. Bell, B. E. Swedlund and S. E. Wright.

Delegate to Council: J. L. Mandeno.

Sub-Editor and Publicity Officer: Miss M. E. Malcolm.

Hon. Auditor: G. A. Lawrence.

This year a new procedure was followed at the Annual General Meeting: After the general business, the remainder of the evening was spent in discussing Institute and Branch affairs. Members had plenty to say with the result that only two of the suggested items were covered. Therefore, it was decided to begin Branch meetings 15 minutes earlier during the coming year, so that such topics could be discussed at the beginning of each meeting.

R. M. Sinclair, formerly Chief Chemist to International Paints (N.Z.) Ltd., is now Paint Chemist at the Dominion Laboratory, Wellington.

Dr. R. A. Robinson, Professor of Chemistry at Raffles College, Singapore, writes that he sees quite a bit of A. I. Biggs, who is stationed there and who is working in the laboratory of the Government's chemistry department.

D. J. Ross, of the Dominion Laboratory, Wellington, has been successful in gaining a Defence Science Bursary. Before proceeding to England where he will study microbiology, he will go to Trentham and Burnham and will be working under Brigadier Bull on medical prophylaxis.

RESEARCHES ON FATS AND RELATED CONSTITUENTS BY NEW ZEALAND WORKERS

A REVIEW—PART III.

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Fat Content of Hides

Greasy leather, because of discolouration, lack of firmness and difficulty in filling in with other materials, is objectionable to industry. White and Caughley[85] have shown that greasy leather in New Zealand commonly contains 12 to 15% fat, while non-greasy leather to which no oil has been added, generally contains less than 1%. Using rough tanned chrome leather they found an average fat content of 0.64%. The grain layer which comprised 21% of the hide contained 55% of the total fat, the centre layer 15%, and the flesh layer 30% of the total fat. The fat in non-greasy leather was shown to exist chiefly around the hair follicles and especially near the sebaceous glands. They concluded that the fat from greasy hides (iodine value 51.8 to 62.7) was different from the natural fat of hide (iodine value 41 to 48) and resembled more the nature of a tallow oil. The iodine value of the oil squeezed out from the fatty tissue associated with the hides ranged from 59.9 to 64.8.

Wool Grease

Raw wool contains up to about 30% of fatty and allied matter which must be removed with suitable detergents before the wool can be utilised in the textile industry. Wool grease is a complex mixture comprising chiefly esters of fatty acids (normal and branched chain) with cholesterol and lanosterol. In 1924, Finlay and Inglis[86] considered the problem of scouring wool in the Dominion with a view to recovering the products from the scouring liquors. They discounted the claims commonly made as to the high economic value of recovered wool grease and stressed the fact that the process in Great Britain was carried out in mills of larger capacity than in New Zealand, where, because of sewerage problems and the desirability of water conservation, it was necessary to treat effluents from the wool scouring process. In their paper they presented analyses of merino, half-bred and cross-bred wools showing percentage fat contents of 19.0, 9.5 and 6.5 respectively. They considered that a fair size mill putting through 650,000 lbs. of greasy wool a year, would recover 84,000 lbs. of wool fat, using careful sedimentation coupled with centrifugal separation. It should, however, be pointed out that practical experience in New Zealand shows that the wool fat recovery by centrifugal separation is much less than would be anticipated from the laboratory solvent extraction figures given by Findlay and Inglis. This is perhaps, to be expected, since compared with milk, wool scouring liquors are more complex, more variable in composition, and contain an immense amount of dirt incapable of being readily removed by prior sedimentation. Sutton[87] showed that yolk production of wool from New Zealand Romney Marsh sheep was not greatly affected by the use of light waterproof sheep covers. However, rain tended to leach the water soluble constituents of the yolk to a greater extent than the ether soluble constituents. A sudden increase in yolk production was observed at the beginning of winter. It was also found that finer wool contained a greater proportion of yolk than coarse wool. In another paper, Sutton[88] reviewed the present day knowledge of yolk in wool.

During the past fifty years, many unsuccessful attempts have been made to recover wool grease in New Zealand. At the present time the Lanoline Company of New Zealand have four plants in operation, situated respectively in Auckland, Feilding, Belfast and Winchester, and a further three are in the course of installation. A limited amount of semi-refined wool grease low in moisture and free fatty acid content is produced. While some of the plants may not be economic, they have been installed to meet stream pollution problems.

Beeswax

New Zealand beeswax was used by Rigg [89] in 1911 as a source of cerotic acid, while Cunningham[90] in 1929, made a detailed investigation of the component acids present in this wax. The characteristics of the waxes used were as follows:—

	Melting point	Acid value	Ester value	Sap. value	Iodine value	Meal mol wt. fatty acids
Rigg— Pure New Zealand beeswax	63°	18.62	72.34	91.50	—	—
Cunningham ditto	64°	17.61	76.07	93.68	8.02	419
European beeswax	62/64°	17-22	70-82	88-102	8-11	407

The acids were separated from the unsaponifiable matter by extraction with xylene of the boiling aqueous alcoholic saponification mixture. The recovered acids were resolved into their components by crystallization from alcohol, traces of contaminating higher alcohols being removed at various stages by extraction with boiling isopropyl alcohol after converting the acids to their barium salts. In the case of the least soluble acidic fractions it was found advantageous to use the lead salts for crystallization rather than the acids. From the most soluble fractions, which were liquid, an impure sample of oleic acid was isolated by crystallization of the lead salt from ether. By exhaustive fractional crystallization, there was produced a series of fractions, the melting point of which could not be changed by recrystallization. Taking into account the saponification equivalents which corresponded approximately with the pure acids and the known melting points for such acids, Cunningham deduced the component acids to be present in the following proportions:—

Percentage fatty acid composition of New Zealand beeswax calculated on the original wax.

		Saturated				**Oleic**
C16	C18	C26	C30	C32	C34	
21.5	7	9	1	4	0.5	2

The sum of the percentage of "higher" acids, and the mean molecular weight of the free acids were consistent with the view that the free acids comprise the "higher" molecular weight acids of the wax. In the light of subsequent work[9], it is now obvious that the higher saturated acids of naturally occurring waxes studied by many previous investigators, have not been isolated in pure form, the melting points of the acids being several degrees lower than those from the pure acids prepared by synthetic methods. The fact that the equivalents of the fractions had been determined, however, suggests that the estimated composition, shown above, of the component acids, would give a useful guide to the proportions of the acids present in beeswax.

The removal of the free acids from beeswax was shown to reduce to about two-thirds the load required to bend the wax. Thus it seems that the free acids render the wax more suited to its purpose in the beehive.

The alcohols were not investigated in detail, but their low solubility, 3 grams per litre in isopropyl alcohol at 14°C, together with the fact that no separation into portions of widely differing solubility could be effected, suggested a high molecular weight. The oxidation products obtained by heating with soda lime at 250°C for six hours indicated a molecular weight of more than 30 carbon-atoms. Chibnall and co-workers[91], in Great Britain, have since described beeswax as containing the normal even series of fatty acids from C24 to C34, primary n-aliphatic even alcohol series from C26 to C36, together with paraffins C25, C27, C29 and C31.

AQUATIC FATS

Early Researches

Perhaps the earliest investigations on New Zealand aquatic fats were those made by Malcolm[92], who showed in 1911 that the dorsal portion of the frostfish contained in the two samples examined, 4.55 and 7.36% fat as compared with 16.77 and 20.0% in the ventral portion. Malcolm also observed that the fat content of the flesh from two samples of oysters taken early in the season (May), were 3.66% and 3.47% as compared with 1.83% for a sample taken at the end of the season (October). Coincident with this drop in fat content the glycogen was also reduced to one-seventh, as compared with its value at the beginning of the season. It was noted that the ethereal extract contained a pigment which showed a distinct absorption band near the red end of the spectrum. Further studies by Robertson[93] showed that the pigment was characterised by a persistent band at about 600mη and by its great stability being unaffected by aqua regia, nitric acid, ammonium sulphide and hydrochloric acid. It was, however, broken down by alcoholic potash. Its properties and reactions appeared to be distinct from those of the known pigments.

Edson[94] found that the chief bands of the fat soluble green pigment of the oyster had their maximum absorption in the identical positions recorded by Robertson[93] and concluded from the chemical properties and absorption spectra that both hepato-chlorophyll and unaltered chlorophyll-B were present. He found that the toheroa also contained a large amount of dark green pigment. As in the case of the oyster, the pigment was concentrated in the hepato-paucreas. The chemical reactions and absorption spectra resembled those of the oyster pigment, with the exception of the main band, which extended further into the red than the corresponding band of vegetable chlorophyll and did not exhibit on dilution the same cleavage into two. As in the case of the pigment of oyster, the toheroa pigment was intimately associated with the liver fat and could not be isolated.

In 1920, Donovan[95] recorded the constants of stingray liver oil, while Malcolm initiated a series of investigations on the food values of New Zealand fish. In the first two papers of this series Johnson[96] recorded the fat, protein, moisture and ash content of the flesh of various varieties of fish as sold on the Dunedin market. The protein content deviated little from the mean value of 19.69%, and the variations in the composition of the flesh were due almost entirely to changes in the oil and moisture content. The fat content of the flesh varied from 10.3% in one sample of tarakihi **(Dactylopagrus macrop terus)** to as little as 0.11% in a sample of ling **(Genypterus blacodes).** The fat content within a given species was found to show individual and seasonal variations.

Studies on the fats of the red cod[97] **(Physiculus bachus)** in relation to its food, showed that during the scanty winter feeding there was a reduction in fat content. Vitamin A was found in tarakihi flesh[98], but none could be detected either in the ether extracts of the flesh or in the ether extracts from the flesh and liver of red cod (Physiculus bachus)[99].

Mutton Bird Fat

In connection with the earlier researches on aquatic fats, a considerable amount of attention was focussed on the mutton bird **(Austrelata lessoni).** Carter[100] showed in 1921 that the constants of the stomach oil (prepared by draining from the crops of young mutton birds, the average yield from a single bird being about one fluid ounce), resembled those of the sperm whale oil. In a later paper Carter[101], gave further details regarding the composition of the stomach oil and of the abdominal fat, the latter, in the case of an average bird, amounting to one pound. The stomach oil was found to contain cetyl oleate 25%, with traces of cetyl stearate, together with the oleyl oleate as the chief constituent of the liquid esters and small amounts of free cholesterol.

The saponification mixture yielded 38.4% of "unsaponifiable matter" and 61.4% of mixed acids. The unsaponifiable portion contained cetyl alcohol 65%, oleyl alcohol 28%, and cholesterol 7%, with only a trace of glycerol. The mixed acids consisted chiefly of oleic, together with linoleic and more highly unsaturated acids, of which at least 12% was an acid to which the formula $C_{22}H_{36}O_2$ was assigned. The saturated acids amounted to only 5% of the total fatty acids. The body fat was found to consist of glycerides containing palmitic and stearic acids in nearly equal amounts, together with 25% of oleic acid. No unsaponifiable matter and no ether-insoluble bromides were detected in this fat. The simple fatty acid composition of the depot fats of the mutton bird contrasts with that of other sea birds[102], which have the complex marine type of fat. It is also dissimilar in composition to the depot fats of land birds, such as those of the light Sussex hen[103], which contain mainly (60%) unsaturated acids (ca. 40% oleic and 20% linoleic acids), together with ca. 25% palmitic acid.

Mutton bird (stomach) oil has long been thought to be a rich source of Vitamin A. Carter [101] found that the oil with sulphuric acid in anhydrous solvent gave the well-known colour test for Vitamin A. Carter and Malcolm[97] reported that the oil when tested biologically showed much the same proportions of Vitamin A as cod liver oil. Subsequently Carter and Malcolm[104] stated that 0.02 to 0.06 g. of the oil were required to produce rapid growth in ratsand to cure eye trouble. It was found that one sample gave little or no growth, but in this case it was suspected that the sample might have been subjected to some refining treatment. In 1939, Davies[105] re-examined mutton bird oil and found that the vitamin A content was of the very low order of 0.005%. Further investigation is needed to clarify the variable nature of these observations.

Carter and Malcolm[104] have discussed the purpose of the stomach oil in the mutton bird, which was commonly believed to be a nutrient fluid secreted by the parents and fed to the young. Although they showed that the stomach oil was capable of being digested, absorbed, and utilised by mammals, they did not hold the view that the purpose of the oil was to feed the young, because the oil was not accompanied by proteins, as is the case with a nutritive fluid like that secreted in a pigeon's crop. They considered that possibly the oil presents an indigestible residue of the fatty fish on which the mutton bird is said to feed, or more likely, the stomach oil is the tail gland secretion more or less accidentally swallowed.

Fatty Acid Composition of New Zealand Fish Oils

Investigations on fish inhabiting the Northern Hemisphere have led to the conception that the fats of fresh water life are distinct from those of marine life, except in the case of marine diatom fat. From the work of Lovern[106], the marine and fresh water types of fat may be defined as having the following typical fatty acid composition (weight %):

	Saturated	**Unsaturated**				
	C14 C16 C18	C14	C16	C18	C20	C22
"Average" marine type	15-20	tr.	10-15 (2.OH)	25-30 (2.5-3.OH)	25 (5-6H)	15 (6-8H)
"Average" fresh water type	15-20	tr.	20 (2.0H)	40-45 (2.5-3.0H)	15 (6H)	5 (8H)

It should perhaps be explained, that although the fresh water and marine fats remain in distinctive categories, nevertheless, there are within each of these types considerable variations. The work on the New Zealand fish oils, while preserving the general conception of a distinction between the marine and fresh water types, serves to illustrate and amplify the types of variations that may be encountered.

The highly abnormal fatty acid composition of the groper liver oils merits consideration. These oils are characterised by an exceptionally high content of palmitic, hexadecenoic and C18 unsaturated acids with a correspondingly low content of C20 and of C22 unsaturated acids, which in the case of the spring sample falls to 7%—the lowest value recorded for liver oil from a marine teleostian species. The liver oil thus appears to be more closely related to the fresh water type of fat than to the marine, but it may be clearly differentiated from the former by the presence of increased proportions of palmitic acid and diminished proportions of C20 unsaturated acids. The liver phosphatide fatty acids, on the other hand, while still retaining a high content of hexadecenoic acid, are present in proportions not unlike those of a typical marine fat. The higher content of C20 and C22 unsaturated acids in the liver phosphatide as compared with the corresponding glyceride, conforms to the observations made on other animal liver lipids[111], [112].

The available data for marine depot fats indicates that the composition of the fatty acids varies according to the place of deposition. Lovern[113] suggested that one of the mechanisms controlling selective deposition of fats depends on molecular size and possibly involves molecular filtration, whereby those depots which contain little fat might be regarded as relatively impermeable to acids of high molecular

TABLE I.—FATTY ACID COMPOSITION OF N.Z. FISH OILS

FATTY ACIDS (Weight %)

Species	Organ	Saturated C14	C16	C18	C20	Unsaturated C14	C16	C18	C20	C22	C24
English hake[107] **(Merluccius gayi)**	liver	2.1	18.4	1.2	—	—	9.3 (2.0H)	37.3 (2.6H)	21.0 (5.7H)	10.7 (8.0H)	—
Red cod **(Physiculus bachus)**	liver	1.6	14.4	3.1	—	—	7.7 (2.0H)	30.7 (3.0H)	28.2 (6.5H)	14.3 (10.3H)	—
Groper [107] **(Polyprion oxygeneios)** I. Spring	liver (gly.)	2.4	23.0	3.4	—	1.6 (2.0H)	23.3 (2.0H)	39.3 (2.5H)	7.0 (5.9H)	tr.	—
II. Early Winter	liver (gly.)	2.2	19.1	3.2	—	tr.	17.6 (2.0H)	44.7 (2.3H)	9.4 (6.3H)	3.8 (6.3H)	—
III. Late Winter	liver (gly.)	1.9	23.1	2.8	—	0.2 (2.0H)	18.6 (2.0H)	40.6 (2.4H)	8.8 (6.0H)	4.0 (6.0H)	—
Late Winter (Phosphatides only)	liver		18.5		—	—	16.9 (2.0H)	19.6 (2.4H)	31.1 (8.6H)	13.9 (?H)	—
Spring	head	3.0	16.0	3.1	—	1.1 (2.0H)	13.8 (2.0H)	30.8 (2.6H)	18.5 (6.2H)	13.7 (9.2H)	—
Ling[108] **(Genypterus blacodes)**	liver	1.8	16.4	2.5	—	—	7.2 (2.0H)	36.1 (2.1—) (2.6H)	24.3 (4.9—) (5.7H)	11.7 (6.9—) (9.7H)	—

Standard error φ ±	viscera (excl. liver)	0.17 0.9	0.30 18.9	0.31 2.9	— —	— —	0.47 6.7 (2.0H)	0.64 16.9 (2.9H)	0.50 36.6 (5.6)	0.85 17.1 (9.4H)	— — —
	roe (gly.)	—	20.4	2.0	—	—	7.0 (2.0H)	30.8 (3.1H)	28.7 (7.3H)	11.1 (7.3H)	—
	roe (phosph)	1.3	25.0	0.9	—		2.1 (2.0H)	20.2 (2.7H)	34.4 (7.1H)	16.1 (10.OH)	—
School shark[109] **(Galeorhinus australis)**	liver	2.3	16.1	4.7	0.9	0.9 (2.0H)	5.7 (2.0H)	27.6 (2.3—) (2.6H)	19.0 (4.5—) (5.8H)	22.3 (6.5—) (4.6H)	0.5 (4.0H)
Standard error*	± head & body (gly.)	0.55 0.2	0.45 7.8	0.75 19.0	0.4 5.2x	0.15 0.2 (2.0H)	0.20 5.2 (2.0H)	1.4 13.5 (2.2H)	1.1 22.8 (6.1H)	1.3 22.7 (12.OH)	0.55 —
	head & body (phos.)	0.3	9.9	13.3	0.3**	1.1 (2.0H)	4.3 (2.OH)	22.8 (2.3H)	16.1 (2.5H)	30.8 (10.0H)	— —
Fresh water eel[110] **(Anguilla dieffenbachii)**	body	2.4	15.9	0.8	—	—	21.2 (2.0H)	46.3 (2.6H)	12.9 (6.3H)	0.5 (?H)	

φ Mean of seven samples taken at different periods during the year.
* Mean of four samples.

x ± 3.4% C22 acids.
** ± 1.1% C22 acids.

weight. Lovern's theory is consistent with the presence of reduced proportions of C20 and C22 unsaturated acids in groper liver oil and in the liver oils of certain North Sea fish, including halibut, turbot and conger eel; here the liver is a subsidiary fat depot. In fish where the liver is the main fat depot, such as in ling and in school shark, the theory is rendered untenable by the presence of greater proportions of C20 and C22 unsaturated acids in the subsidiary depots (c.f. Table I) than in the liver fat.

The remaining fish oils described in Table I, conform mainly to the normal type, but ling liver oil and English hake liver oil show a tendency towards an increased content of C18 unsaturated acids at the expense of C22 unsaturated acids. The results for ling liver oil are based on seven samples taken throughout the year. As these showed remarkably little variation, there can be no doubt that the increased content of C18 unsaturated acids is a significant characteristic of ling liver oil.

Rapson, Schwartz and van Rensburg[114] put forward the view that the composition of a fish liver oil is profoundly influenced by the extent to which the liver is used as a site for fat storage. In fishes with fat storage localised in the liver, the composition of the liver fat corresponds approximately with that of the head and body fats, while in fishes with diffuse fat systems, the liver fats, due to an enhanced content of C16 + C18 saturated acids and a decreased content of C20 + C22 unsaturated acids, tend to be more saturated than those of the head and body. It was further stated[115] that in the case of fish with a diffuse system of fat storage, there is a direct relationship between the iodine values of the head and body oils and the content of oil in these organs. The relationship was thought to correspond with preferential deposition and utilization of C20 and C22 polyethenoid acids when the fish are in fat and thin condition respectively. Similar types of changes were thought to occur in the liver oils when the liver is the main site of fat storage. In direct contrast, in the liver oils of fish with diffuse fat storage[114], it was shown that the amount of C20 and C22 unsaturated acids decreased with increasing fat content. This may be shown in the case of New Zealand groper liver oil where the oil from fish in fat condition Spring) as compared with the oil from fish in lean condition (Winter) contains less C20 and C22 unsaturated acids.

As an illustration of the changes in liver fatty acid composition of fish with the fat storage localised in the liver, van Rensburg, Rapson and Schwartz[115] noted in connection with Merluccius species, that with decreasing oil content in the liver there was a decrease in the amount of C20 and C22 unsaturated acids. For example, the liver oils from the European hake **(M. vulgaris)** and New Zealand hake **(M. gayi)** differ in fatty acid composition, the former species containing 31.7% of C20 and C22 unsaturated acids as compared with 45.0% in the case of the latter species. Such differences are considered by Shorland and Hilditch[107] as possibly characteristic of fishes from North Sea and New Zealand waters respectively. Van Rensburg, Rapson and Schwartz[115], however, associate the observed differences to a variation in condition between the sample studied, the oil content of (about 50%) of the **M. vulgaris** livers being more than twice that (23%) of the **M. gayi** livers.

Change in oil content of the liver in fish with fat storage localised in the liver, does not in all cases afford a general explanation of the fatty acid composition of fish liver oils. For example, there was no correlation between the oil content of New Zealand school shark liver oils (c.f. Table I.), which varied from 23.1% to 55.9% and the fatty acid composition. Moreover, comparing the school shak liver oil with ling liver oil, it can be shown that in both species the oil contents of the liver are somewhat similar and that the liver comprises the main depot, while the fatty acid composition of the two liver oils is markedly different. The fish are caught from the same locality in Cook Strait, and it would appear not unlikely that the species factor, in some cases at least, is important in determining the fatty acid composition.

Eel oil[110] has a particular interest in illustrating a typical fresh water fat (c.f. Table I.), the example illustrated comprising an eel taken inland near Upper Hutt. In common with other oils of aquatic origin, it was found that linoleic and linolenic acids were absent from the C18 unsaturated acids, which comprised oleic acid, together with minor proportions of steаridonic acid. The effect of environment on fatty acid composition is illustrated in the case of fresh water eels taken from estuarine waters of the River Dee in Scotland, these eels yielding fats[116] containing more of the C20 and C22 unsaturated acids, and resembled more closely the marine type.

Distribution of Oil in the Tissues of Fresh Water Eels

Commencing with eels of ca. 50 cm. length, and proceeding to the fully adult migrant eels, Shorland and Russell[117] found that the oil content of immature eels tended to increase continuously with length, from 7% to 17% in **A. australis** and **frm** 7% to 23% in **A. dieffenbachii.**

The largest size of immature eel was found to approximate in oil content that of the migrant eel, the oil content of which was not found to vary appreciably with the length of the fish. In the immature eels it was found that the ratio $\frac{\%\text{ oil in tail}}{\%\text{ oil in trunk}}$ was 3.42 ± 0.27* and 3.29 ± 0.25 respectively for **A. australis** and **A. diffenbachii.** Corresponding values formigrant eels were 1.69 ± 0.08 and 1.47 ± 0.20. From a detailed study of the oil contents of the tissues of migrant and immature eels from Lake Ellesmere, as well as from other localities the hypothesis was put forward that just prior to migration, a more uniform distribution of oil is attained by a partial transference of oil from the tail into the trunk, and from thence into the head and ovary. The fact that the data arising from the above investigations have been subjected to statistical examination, serves to clarify much of the confusion in the literature in respect of the oil content of eels. For example, a relationship between length of eel and oil content postulated by Lovern[118] is contradicted by McCance[119]. It is now clear that there is a relationship between an oil content and length in the immature eel, but that the oil content of the migrant eel does not vary appreciably with the length of the eel.

Vitamin A and D Content of New Zealand Fish Liver Oils

Denz and Shorland[120] discovered in 1934 that the larger edible fish of Cook Strait, including ling **(Genypterus blacodes)** English hake **(Merluccius gayi)** and in particular, groper **(Polyprion oxygeneois)** and bass **(Polyprion americanus)** yielded liver oils of much higher Vitamin A potency than had generally been recorded elsewhere. Immediately following this work, Shorland[121] reported a detailed study of the characteristics and Vitamin A content of ling liver oils. In the following year, Cunningham[122] reported that groper and ling liver oils contained respectively 2,300 and 500 I.U/gm. of Vitamin D, as compared with 100 I.U/g. present in good medicinal cod liver

(*Standard error of the mean.)

oil. She also reported that eel **(Anguilla australis)** body oil contained 47 I.U/g., skate **(Raja nasuta)** liver oil 15 I.U/g., while whale **(Megaptera nodosa)** blubber oil contained less than 1 I.U./g. Later investigations by Cunningham and Scott[123] showed Vitamin D values of 2,000 to 4,000 I.U./g., 500 I.U./g., and less than 25 I.U./g., for the liver oils of groper, ling and shark respectively.

In 1945, Weeber[124] made further investigations on the Vitamin D content of New Zealand fish oils and recorded the following values:—

Groper liver oil (two samples)	5,300 and 19,000 I.U./g.
Ling liver oil	260 I.U./g.
Eel **(Anguilla australis)** body oil	25 I.U./g.

In assessing the Vitamin A and oil content of New Zealand fish liver oils, account must be taken of the fact that not only are there wide seasonal variations, but that the livers from the same species taken from a given catch may in some cases show enormous variations. In some cases wide locality variations have also been noted. For the purpose of indicating the main features and presenting an over-simplified picture, in Table 2 are collected together average values based on considerable numbers of samples from the author's published (120, 121, 125, 126) and unpublished data.

Consideration of the liver oils from New Zealand species with those from the same or similar species from other parts of the world shows wide differences in Vitamin A content. The New Zealand **Merluccius gayi,** for example, yields liver oils ca. fifteen times richer in Vitaman A than the same species caught off the Chilean coast or than the North Sea species **(M. merluccius)** [125]. Again the New Zealand ling **(Genypterus blacodes)** yields liver oils richer in Vitamin A than the same Chilean species[125] or the related South African **Genypterus capensis)**[127]. In the case of Vitamin D, there is less information, but it would appear that the liver oils of the South African stonebass **(Polyprion americanus)** is much poorer in Vitamin D (700-1300 I.U./g)[128] than are those of the related New Zealand **(Polyprion oxygeneios)** (2,000-19,000)[123, 124]. Similarly the Cape ling **(Genypterus capensis)** yields liver oils with Vitamin D content (85 to 130 I.U./g)[129] as compared with the New Zealand ling **(G. blacodes)** liver oil with 260-500 I.U./g [122, 123, 124].

Table 2. Vitamin and oil content of some New Zealand fish liver oils.

	Av. wt. of fish	% liver in fish	% Oil in liver	Vitamin A content of liver oil I.U/g.
Elasmobranchii				
School Shark .... (Galeorhinus australis)	44	9	55	30,000
Sharp finned whaler .. (Carcharinus brachyurus)	250	10	55	50,000
Blue Shark .... (Prionace glauca)	70	5	12	1,000
Dogfish .... (Mustelus antarcticus)	10	5	40	12,000
Teleostomi				
Ling .... (Genypterus blackodes)	30	5	35	15,000
Groper .... (Polyprion oxygeneios)	15	2.2	12.5	90,000
Swordfish .... (Makaira marlina)	250	1.5	12.5	320,000

Seasonal Variations in Vitamin A and D content of Fish Liver Oils

In contrast to the fish which had previously been examined in other parts of the world, Shorland[124 126] found that the seasonal variations in the Vitamin A content of ling liver oil were inconsiderable, varying from a maximum value of 0.7% during January-February to a minimum value of 0.5% in July-August. This may be compared with the South African kingklip **(G. capensis)**[127], a somewhat smaller fish in which the Vitamin A content of the liver oil falls to 0.1% in February and rises to about 0.3% in March, remaining approximately at that level till November.

Many fish, such as the North Sea cod and halibut, although their food is relatively deficient in Vitamin A, appear to store large amounts of this vitamin in their liver, and the liver oils from older fish usually contain higher concentrations of Vitamin A. In the case of the New Zealand ling, the food comprising chiefly whiptail, is relatively rich in Vitamin A, so that comparatively little storage is necessary to produce a high concentration in the liver. Consistent wtih this observation is the fact that the larger livers from the older fish have not been found to yield more potent oils than the smaller livers from the younger fish. Rapson, Schwartz and van Rensburg[129] later found that South African kingklip to be similar in this respect, and as previously suggested, they confirmed that because of the disproportionate increase in the size of liver with age, the Vitamin A content increased with the size of the fish.

The results of various investigations show that diet and changes in oil content are important factors in determining seasonal variations in the potency of fish liver oils. Changes in oil content are frequently connected with spawning. The North Sea cod, for example, ceases to feed at such times, and a considerable proportion of oil is transferred to the gonads leaving the vitamin reserves unimpaired. The residual liver oil, therefore, contains a higher concentration of Vitamin A than when the fish in feeding normally[130]. In the New Zealand ling 98.9% of the total oil and 97.9% of the total Vitamin A content is concentrated in the liver, the yield of the liver oil remaining practically constant throughout the season[126]. To judge from the time of appearance of mature roes, it is probable that spawning takes place towards the end of August. However, consideration of the fact that the oil content of the gonads amounts to less than 2% of the total present in the fish, suggests that spawning imposes an insignificant claim on the oil reserves of the liver. If, therefore, the ling eats little or no food while spawning, the slightly reduced potency of the liver oil observed at this period would be expected to occur.

In the case of the North Sea halibut, the spawning effect is completely masked by pronounced seasonal variations, which follow closely the normal rhythm of the diatom cycle, and as the abundance of diatoms is the only measure of the carotene content of the sea, it is suggested that the great abundance of these organisms in the spring may be responsible for the increased Vitamin A potency of the liver oil at that period[131]. The New Zealand groper liver oil from Cook Strait also shows a greatly increased Vitamin A content in the spring (September-October), but a detailed study to be published shortly, suggests that any connection between the diatom rhythm and potency of the liver oil is fortuitous[132].

The reduction in oil content associated with spawning alone would be sufficient to account for most of the observed increase in Vitamin A potency. The curves showing respectively the variations in average size of liver and changes in oil content throughout the year tend to follow the same general course, especially during the period associated with the marked increase in Vitamin A content. The particularly marked reduction in weight of liver at this period seems to indicate that spawning imposes a severe strain, other constituents besides oil being removed from the liver. Assuming that there is no transfer of Vitamin A from the liver during spawning, the observed reduction in size of the groper liver from the mean monthly value of 155 g. to a highly significant lower value of 98 g. and a similar highly significant reduction in the oil content from 12.5% to 6.0% is calculated to cause an increase from a monthly average Vitamin A value of 3.53% (90,000 I.U./g.) to a value of 11.6% (297,000 I.U./g.) as compared with the observed value of 7.83% (200,000 I.U./g). This suggests that the Vitamin A has also been depleted to some extent during this period[132]. The Vitamin D assay of 19,000 I.U./g. recorded by Weeber[123] was made on bulked liver oil samples of high Vitamin A potency (9.46%) from fish caught during the months of September and October, while the lower value of 5,300 I.U./g. was obtained from liver oil of average Vitamin A potency (3.98%) prepared from fish taken in May. These results are not inconsistent with the view that the Vitamin D content may also be at a maximum just after spawning.

The South African stonebass **(Polyprion americanus)** is closely related to the New Zealand groper and tends to be an even richer source of Vitamin A and to contain greater proportions (up to 25%) of oil in the liver[128]. The seasonal variations in Vitamin A content, however, are somewhat different, and the maximum occurring over the months, September to December, is less pronounced than in the groper. It may further be distinguished from groper liver oil by its lower Vitamin D content, ranging from 700-1300 I.U./g.

It was generally found in the case of the groper that the smaller livers yield a more potent oil, but a lower percentage of oil than the larger livers, while within a given sample the livers of male fish were found to be smaller than those of the female. In a study of the distribution of oil, it was found that the head and body contained over 75% of the total oil reserves, the liver 2.4-2.8%, pyloric caeca, 0.8-0.9%. The milt was relatively unimportant as a fat storage organ containing 1.92% oil, but the roe comprising 9.27% of the fish contained 14.0% of the total oil reserves of the fish. About 90% of the total Vitamin A was concentrated in the liver, and the bulk of the remainder in the pyloric caeca; traces were also found in the intestines and body[132].

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THE NEW PRESIDENT

Professor J. Packer, M.Sc. (Melb.), D.I.C., F.R.I.C., F.N.Z.IC.

The President of the Institute for 1949 has achieved well - deserved popularity among the chemists of the Dominion. A foundation member of the Institute and one of its first fellows, he has served it in many capacities including that of Chairman of the Canterbury Branch in 1936.

Professor Packer is a graduate of Melbourne University, receiving his early chemical training under Professor D. O. (later Sir David) Masson. As an undergraduate he was awarded Dixon Scholarships in Chemistry III. and Honours Chemistry and a non-residential scholarship at Ormond College. His research for the M.Sc. was in organic chemistry on cupritartrates, but as a post-graduate research scholar he carried out physicochemical investigations under Professor A. C. (now Sir David) Rivett. In 1921 and 1922, he was tutor-lecturer in chemistry at Queen's College, and in the latter year was engaged in control work on an industrial scale investigation of a low temperature coal-carbonisation process. This was followed by a brief period as research chemist in the Munitions Supply Branch of the Commonwealth Defence Department, from which position he resigned to come to Canterbury College as lecturer in 1923.

In his new position, Professor Packer took over the teaching of organic chemistry. In 1926 he was granted one year's leave, which he spent at Imperial College, London under Sir Jocelyn Thorpe, where he began the studies of the glutaconic acids which have been his main research interest since. This work has involved measurements of rates of racemisation as well as the study of proposed new methods of syntheses. For his work under Thorpe, he obtained the Diploma of Membership of Imperial College (D.I.C.). His appointment to the Chair of Chemistry in 1944 in succession to the late Dr. H. G. Denham was widely welcomed by New Zealand chemists.

Outstanding service has been rendered by Professor Packer on many Academic committees, notably the Academic Board of the University, on which he has served for five years and to which he has been re-elected for a further three years, the Standing Committee of the Academic Board (two years), the Entrance Board (three years), Lincoln College Professorial Board (five years). On these Committees he has worked consistently for greater autonomy for the University Colleges and for the right of teachers to determine for themselves the content of the subjects taught. Within his own department, Professor Packer has built up a team of enthusiastic teachers and researchers working harmoniously together and has been ever ready to encourage effort, develop individuality, and acknowledge merit. Students respect his scientific attainments and excellent teaching and find him always sympathetic to their problems.

Professor Packer has served other associations in a prominent capacity. He was President of the Canterbury Branch of the Royal Society of New Zealand in 1934, and is at present President of the Association of University Teachers of New Zealand, and also Chairman of the Canterbury Science Teachers' Association. His support has always been given to the furthering of other branches of science.

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PERSONAL NOTES

Dr. H. N. Parton, Associate-Professor of Chemistry at Canterbury University College and former Editor of the Journal, has arrived in Great Britain where he will spend about eight months' refresher leave. During November he will go to Beirut in Syria to represent New Zealand at a Unesco Conference. Dr. Parton will return to New Zealand via the United States of America as a guest of the Carnegie Corporation. Both in Great Britain and in America he plans to make contacts with physical chemists working in the same or allied fields and to study in the various universities he visits, methods of undergraduate instruction and of general education for science students.

Mr. M. D. Sutherland, late of Auckland, and now lecturer in Organic Chemistry at the University of Queensland, is conducting a refresher course in that subject under the auspices of the Australian Chemical Institute.

(Continued from Page 102)

Why should the Council of Scientific and Industrial Research become a separate and administrative body such as the one in Australia? Should we have a Council of Scientific and Industrial Research fixing pay for all scientific workers? —or for certain workers only? The Government has been asked at various times in recent years for tribunals to fix Railways wages, to fix Post Office pay, to fix Public Service pay, to fix teachers' pay and to have a Council of Scientific and Industrial Research to fix scientists' pay. A multiplicity of wage fixing authorities such as this could quite easily cause confusion. One body would be quoted against another. In the past this process has led to the application, for instance, to the whole of the Public Service of a £25 increase which was granted to the Railways staff by the Railways Tribunal. We can see that from an administrative point of view such an arrangement could lead to many anomalies. Were it just the establishment of a Council of Scientific and Industrial Research in order to fix scientists' wages and scientists' wages only and were the Government not in the least concerned with the problems of pay for other Public Servants, that difficulty might not be insuperable. I think, however, that there would be some administrative difficulties caused by this proposal. These administrative difficulties do occur in other countries—for instance, in Australia.

It is said that there ought to be a Council of Scientific and Industrial Research to co-ordinate research. There are only two things that a Council of that type can do. It can advise the Government on co-ordination of scientific work in various Departments or it can administer scientific research under one Department. It cannot do both. Sir Reginald Stradling suggested a set-up of a National Research Council of two or three people. Under it would be a Medical Research Council, an Agricultural Research Council, a University Research Council and a Sociology Research Council. He thought of that National Research Council as a body allocating research funds through the Scientific and Industrial Research Department. It could not administer University Research, for example—it could only advise. We should have an advisory body then, advising the Government as to what it was to do with these five branches. It would have to be composed of able people taken from scientific work in New Zealand and given an administrative job. They could not be actively associated with research work in any field because jealousies would then prevent them from co-ordinating work by allocation of funds and advice, and therefore their appointments would have to be full-time.

But there is a strong argument against making the appointments full time. It would mean taking out of New Zealand's research work three or four of its ablest men, because nobody less than our ablest should go on such a Council. If we took our ablest we would be crippling the work of the organisations for which they are now working.

We have had a considerable amount of friction and jealousies in the past between scientific workers and administrators, in various Government Departments. There is much less of it now than there was previously, but the time is not very far in the past when an Agriculture Department research worker and a Scientific and Industrial Research Department officer working on the same place and the same problem were instructed by their various Departments not to communicate wtih each other. We have to remember that that background is there.

When we come to the actual organisation of research work we can draw up pretty diagrams on paper, but these are not satisfactory in practice because we are going to ask men and women to work them. If we want the best possible work we must find our men and organise round them to make the best use of their abilities.

The present Council of Scientific and Industrial Research does carry out its duties and carry them out well. It does do what it can to co-ordinate the various branches of research work. It is as representative as any such body could be. It can bring to the service of the Government a body of knowledge which I think could not be improved. These people do exercise real supervision over the scientific worker in New Zealand and succeed very well in carrying out the functions which I described to you earlier.

I am very pleased indeed to note that 140 firms are employing 240 graduate scientists in New Zealand because 20 years ago the number employing scientists was negligible. I am a shade disappointed because there are so many potential vacancies for scientists which really do exist in industry and which it would pay industry to fill. I am sure industry could employ with advantage to itself and to the country as a whole, many of the graduates the University of New Zealand is turning out who are now going overseas. We depend to a large extent on the State for our scientific research work. That is so only because the public of New Zealand themselves are not prepared to employ scientists in any great number. When the people of New Zealand are prepared to employ scientists through their industries and in other ways, when they are prepared to endow our Universities to the extent that they have been endowed overseas, then I think the people of New Zealand can expect a higher level of research work. In the meantime, all of us must do our very best to ensure that the very well from which our scientists spring, the Universities, is preserved.

We have to find buildings in which to put our students. If we gave the Universities the buildings which they have indicated they would want, we should spend immediately between £5,000,000 and £7,000,000. If we approved the expenditure we should still have to put up the buildings. We have to place that building need against the building needs that we have in our schools and in other walks of life. We have to work with labour resources and limited material. We have to find some organisation, and to a large extent, I think we have it, which will give us the best possible out of the resources and the men at our disposal.

BOOKS RECEIVED

ORGANIC CHLORINE COMPOUNDS, by E. H. Huntress, Massachussets Institute of Technology, Pp. xxv, 1443, New York: John Wiley and Sons, London: Chapman and Hall, 1948. 27.50 dollars.

It is seven years since Prof. Huntress, in conjunction with the late S. P. Mulliken, published his "Tables of Data for the identification of selected Compounds of Order I", covering compounds of carbon with hydrogen or with hydrogen and oxygen. This book covers Order III—compounds containing carbon and chlorine alone and with hydrogen or oxygen or both. The nature of the work has been expanded, however, to include significant data on physical properties, chemical reactions, methods of preparation and uses, as well as lists of derivatives and methods of detection. The monographs on each compound are excellently done: all the information normally expected will be found there, and by means of a system of well-chosen and obvious abbreviations, a tremendous amount of information is packed into a short compass. The fortunate possessor of this volume thus has something far more extensive than any text-book on these compounds and replacing for many chemists the more extensive, but belated Beilstein. The references in this work are in some cases up to 1948. They are also most extensive, e.g., 626 for chloroacetic acid.

An unusual feature which will be appreciated by many is the negative information given where a derivative has not been prepared, such as the methyl ester of trichloro benzoic acid (2, 3, 5). Less advisable is the monographing of about twenty compounds for which physical data are non-existent, and in some cases definite evidence of their ever having been prepared is lacking On the other hand out of a list of 195 compounds coming within Order III offered for sale by a leading manufacturer of organic chemicals, 10 are not in Huntress's volume. There is no article on gammexane, possibly because its configuration is unknown. The α and β isomers are included. However, no system of selection of compounds is infallible and most users will find all the compounds they are interested in amongst the 1300 covered by the work. The book has 5 indexes, so that location of any compound is easy. It would have been a help if all the commercial and trivial names had been included in the general index.

The reviewer found only one error: an extra H in the formula of compound 3:5540.

SYNTHETIC METHODS OF ORGANIC CHEMISTRY. Vol. 1, 1942-4. Translated from the German of W. Theilheimer by Hans Wynberg. Pp. 254, 1948. New York and London: Interscience Publishers, 30/-.

Two years after the original, this is a translation of Repertorium I of "Synthetische Methoden der Organischen Chemie," reviewed in our last issue (p.83). The translation is a free one and the names of a number of compounds have been altered to conform to Chemical Abstracts usage, and each reference to the literature is followed by the corresponding reference to "C.A." instead of to the "Zentralblatt." However, some of the errors in the original appeared to have been carried over, e.g., pentavalent carbon in reaction 534. The printing and binding are good. An author index to these volumes would be most valuable.

ISOMERISM AND ISOMERISATION. By Ernst David Bergmann, Daniel Sieff Research Institute, Palestine. Pp. 138. 1948. New York and London: Interscience Publishers, 21/-.

This book contains six lectures delivered in New York in the winter of 1945-6. The titles are (1) Resonance Phenomena in Organic Molecules, (ii) Cis-Trans Isomerism and Inter-conversion (iii) Isomerisation of Olefinic Structures (iv) Mechanism of Substitution Reactions; Racemisation and Walden Inversion (v) Isomerisation of Paraffins and related Phenomena (vi) Mechanism of Intramolecular Rearrangements. The author in his preface says, "It should be emphasised that these lectures did not aim to cover the field fully; they were expected to invite discussion and to furnish food for thought. I should feel most happy if they have the same effect on the readers of this little booklet. . ." The reviewer feels confident that the author should have no doubts on this score.

There are a few misprints, the most glaring being two errors in the calculations on p.6, though the right answer is obtained.

FORTSCHRITTE DER BIOCHEMIE, 1938-1947

F. Haurowitz, 1948, S. Karger Ltd., Basle, Switzerland (364 pages, in German). Price 40 Swiss francs.

In this age of specialisation a publication which will give the worker a resume of progress in fields allied to his own is always welcome. In his Fortschritte der Biochemie, Prof. Haurowitz has collected the biochemical work published during the years 1938 to 1947 into a very abbreviated form. Although detail has been sacrificed for brevity, adequate references to the literature are given (over 2,2000 have been collected) and the book is well indexed, so that it forms an excellent introduction to the biochemical work published during the last ten years. The book contains 24 chapters among which there are chapters dealing with carbohydrates, carotinoids, steroids, proteins, haemoglobin and its derivatives, enzymes, immuno-chemistry and the use of isotopes.

The reviewer has found an immediate use for this book.

AUCKLAND BRANCH NOTES

The Annual Meeting of the Branch was held on October 12th. The following officers were elected for the coming year.

Chairman: Mr. S. G. Brooker.
Secretary: Mr. G. Stace.
Treasurer: Mr. W. E. Russell.
Committee: Professor F. J. Llewellyn, Messrs. G. S. Lambert, M. B. Rands, J. B. Brown.
Delegate to Council: S. G. Brooker.
Branch Editor: J. B. Brown.
Publications: J. Ricketts.

Dr. M. M. Burns, F.N.Z.I.C., has been appointed Director of Research for the New Zealand Fertilizer Manufacturers' Research Association. Dr. Burns is at present lecturer in Soil Chemistry at Canterbury Agricultural College, and acts as tutor for students proceeding to Agricultural degrees. He has served for many years on the committee of the Canterbury Branch of the Institute, was Chairman in 1943, and has served several times on the Council. In his new position, he will be working on all aspects of fertilizer manufacture and utilisation, and of the reactions of fertilisers with soils. Dr. Burns will be stationed in Auckland.

THE COUNCIL

Items of interest from the meeting of the Council-in-Person held at Dunedin, 26th August, 1948.

Advertising Rates for small advertisements in the Journal have been changed as follows:—Members 1d per word, Non-Members 2d per word.

Employment Committee: The following motion was carried:—That Council recommend to the Employment Committee that it should in all cases require the identity of a firm advertising through a Box number or through an agency before an advertisement is distributed.

The accrediting of subjects towards the laboratory assistants' examination has been raised a number of times both by individual members and by branches.

When the first draft of the regulations was formed the Council, because of the number of Government technical assistants and the desirability of getting the training started under good sponsorship, approached the Public Service Commissioner of the day for some recognition of the passing of the examination. Mr. W. G. Hughson and Dr. J. K. Dixon went as a deputation to the Public Service Commissioner and general agreement was reached with his representative. He offered a double increment in salary for passing the full examination, but was against any accrediting since he felt that—

1. This was a backdoor method of passing the examination and therefore suspect in a new examination.

2. That the technical assistants who would enter for the examination would not be strong academically, otherwise they would be going for a degree. and therefore they should be encouraged to keep in touch with their theoretical subjects during the course of their studies.

Finally, it was agreed that accrediting would be acceptable where the candidate was passing University Entrance during the period of registration, but if he had already passed the subject at University Entrance Standard before registration, then he would be required to continue his theoretical work and to sit the Institute Examination of somewhat wider scope during his study period.

The Examinations Committee has adopted the attitude that when a candidate has passed the University Entrance a number of years prior to registration it is in the candidate's own interests that he should sit the theoretical subjects. Where a candidate has recently passed the Entrance Examination, in the majority of cases he has been accredited with a pass, but the Committee has no means of ascertaining the standard attained by the candidate in the subject in which he desires to be accredited.

Members have pointed out that the Institute should not be under the domination of the Public Service Commission. The Institute is not under the domination of the Public Service Commission, and it would be free to-day to amend its regulations in any way it chooses.

The Council would point out, however that the Public Service Commission has given a lead both to Industry and the University in the treatment of laboratory assistants, not only in recognising by a double increment the passing of the Institute's Examination, but also by providing a good scale up to £635 for these workers. It is appreciated by those who have dealt with the Commission that the granting of a double increment is regarded as a reward for special merit and any action which might cause the withdrawal of the Public Service Commission's support at this stage would seriously damage a successful scheme for the betterment of technical assistants and, through good, well trained technical assistants, ease chemists' burdens in the laboratory. It is hoped, therefore, that members will accept the present regulations and get the scheme thoroughly under way before serious amendments are proposed.

Membership Committee: Prof. Packer to act during the absence of Prof. Briggs.

Conference: Council congratulated the Otago Conference Committee on the excellence of their arrangements, and accepted Auckland's invitation to hold the Conference in Auckland City in 1949.

IMPERIAL CHEMICAL INDUSTRIES PRIZE: After receiving a report from Professor Packer, the following regulations were adopted:—

The prize of twenty-five guineas has been donated by Imperial Chemical Industries (N.Z.) Ltd., and will be known as the I.C.I. Prize.

The conditions of the award are as follows:—

1. The prize shall be awarded to the member of the Institute who, in the opinion of the Council, has contributed most to the development of some branch of chemical science, this contribution to be judged by research work published or accepted for publication during the five years immediately preceding the date fixed for the closing of nominations, 30th April, 1949.

2. Branch Committees shall be invited to submit nominations to the Council to be accompanied by copies of the papers presented in support of the nomination. The Council itself may also nominate candidates. Branch Committees shall invite nominations from individual members of their Branch of the Institute.

3. If in the opinion of the Council there is no candidate among those nominated who has sufficient merit, the Council may refrain from making the award.

4. The prize shall be presented at a meeting of the Branch to which the prize-winner belongs."

Election of Fellow.—S. G. Brooker (Auckland).

Election of Associates.—A record number of 18 were elected.

Union Membership.—The Hon. Gen. Secretary should be informed where attempts are being made to make members join industrial Unions.

POSTAL BALLOT

The Postal Ballot on the motion of Mr. K. M. Griffin, F.N.Z.I.C., providing for frequent moving of the headquarters of the Institute, resulted as follows:—

For the motion	23
Against the motion	119
Received too late	6

The total number of votes cast included 3 from Australia, and shows a keen interest in the affairs of the Institute by the general membership, suggesting that more frequent appeals should be made to the rank and file of the Institute in this way.

SALARY SURVEY

The recent survey revealed the following average salaries for chemists in industry:—

Age	21	22	23	24	25	26	27	28	29
Average Salary	£480	490	500	515	530	550	565	580	605

Age	30	31	32	33	34	35	36	37	38	39	40	41	42
Average Salary	£630	660	685	710	740	770	800	825	850	880	905	925	950

Age	43	44	45
Average Salary	£960	975	985

We publish below salary scales for University staff and Public Servants; also a statement on teachers' scales.

UNIVERSITY SCALE

	£	£	£
Professors	1225		
Associate Professors	825	875	900
Senior Lecturers	775	825	850
Lecturers	625	675	725
Junior Lecturers	425	475	525

These rates include the recent general rise of £25 which, although it was made retrospective, was not known at the time of the questionnaire.

PUBLIC SERVICE SCALE

	£	£	£	£	£	£
P.VI.	350	375	400	425		
P.V.	460	485				
P.IV.	510	535				
P.III.	560	585				
P.II.	610	635				
P.I	685	735				
P.Sp.	785	825	875	925	975	1025

Starting salaries for recently qualified graduates is as follows:—B.Sc., £350; M.Sc., £375; M.Sc., 1st Cl. Hons., £400.

Where appointee enters the service some time after graduating, it is usual to fix this starting salary at a higher level than the minimum and to allow one increment for each year of useful experience since graduating and for war service.

The normal officer can rise to £585 by automatic annual increments; thereafter the degree of responsibility his position carries is taken into account. Outstanding officers may have their value recognised by the granting of one or more double increments at any point on the salary scale. Until recently, females were paid £25 less than males. From December, 1947, however, these starting rates for males and females were made the same. This alteration would not have been known at the time of the questionnaire.

POST PRIMARY SCALE FOR TEACHERS

Estimated Average Salary for Unmarried Male Assistant Teacher (M.Sc., with Hons.):

	Grade I	Grade 2	Grade 3	Grade 4
1st Year Age 21	£385	445	£535	600
	395	465	545	615
	405	485	555	630
	415	510	570	645
	425	525	585	655

For Special Posts, £60 per annum is paid in addition to the salary of £655 p.a., the maximum salary of Grade IV. Progress better than average is necessary to obtain Grade V. the normal preliminary requirement for a Special post position.

Holders of Special Posts may also receive the £60 allowance as First Assistant or Head of Department. If he should hold a Special Post and be First Assistant, a teacher may under special circumstances be appointed to a Head of Department position, but would receive only £20 p.a. as Head of Department.

Thus, the maximum salary for an unmarried male assistant teacher who holds a special post and is a Head of Department is £775 p.a., or £795 if he holds a Special Post, is First Assistant and Head of Department.

All Post Primary School Inspectors are on the Public Service Salary scale:

Senior Inspectors (Two Grades)	£975—£1025
Staff Inspectors	£825—£925
Chief Inspector	£1125

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SEVENTH PACIFIC SCIENCE CONGRESS

Early registration is urged for this gathering, which will be held in Auckland from 2nd to 9th and Christchurch from 15th to 22nd February, 1949, in order that accommodation may be reserved. The necessary form may be obtained from any Branch of the Royal Society, or any office of the D.S.I.R. The subscription is £1.

Among the subjects of interest to chemists to be discussed are the following:—Chemistry of the Sea; Antu, a new rat poison; Control of Livestock Insects by the new organic insecticides; Chemical control of wireworms in Canada; The 2-3 butanediol fermentations; Minor or trace elements; Synopsis of the trace element problem and catalo (bison x domestic crosses) breeding; and Toxicity of vegetable oils. Apart from the first, it is probable that all these papers will be delivered at Christchurch.

CONFERENCE, 1949

N.Z.I.C. R.I.C.

will be held in Auckland from Monday to Thursday inclusive, August 22nd-25th, 1949.

The Combined Committee of the N.Z.I.C. and R.I.C. (N.Z. Section) is anxious to receive as soon as possible opinions concerning the organisation of the meeting.

The conference secretary is Mr. G. L. Calnan and all correspondence should be addressed to him C/o Government Analyist, Durham Street West, Auckland, C.1.

The attention of members is drawn to the enclosed card requesting an indication of your intention to attend conference. and of an expression of opinion regarding subjects or themes for discussion.

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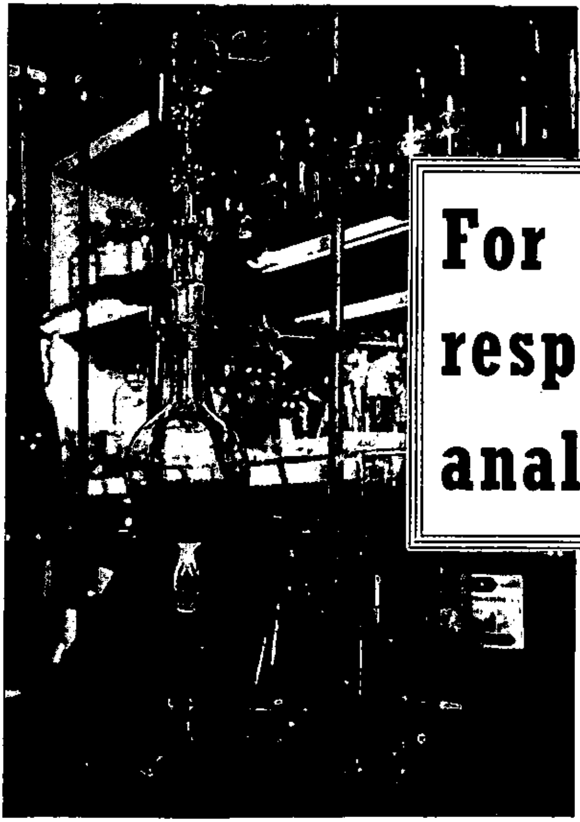

Roger Bacon

showed the world, for the first time, the importance of scientific observation and experiment. This remarkable man was born at Ilchester in Somerset in 1214. After studying at the University of Oxford and in Paris and Italy, he eventually returned to Oxford, and became a Franciscan monk in 1251. In an age when "science" was largely synonymous with the alchemists' search for the philosopher's stone and attempts to transmute base metals into gold, Bacon displayed a scientific vision far in advance of his era. He foresaw the possibility of mechanical flight, the use of explosives, the improvement of sight by lenses and the propulsion of ships by engines.

In all his teaching he insisted on the importance of experiment rather than discussion, and on the necessity for first-hand practical experience, particularly of such chemical operations as distillation and calcination. He saw clearly that, without this practical foundation, natural science was little more than a collection of words. One result of his insistence on experiment was to enable him to show that air is necessary to sustain combustion. He has also been credited, but without adequate evidence, with the discovery of gunpowder. Some explosive mixture was undoubtedly known in Western Europe in his time for Bacon complained of the annoyance caused by boys letting off fireworks outside his study. He died on the 11th June, 1292, leaving as his contribution to science a way of thought which still persists all over the world. Roger Bacon, Englishman, may justly be described as the first modern scientist.

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