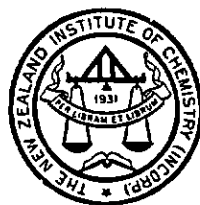
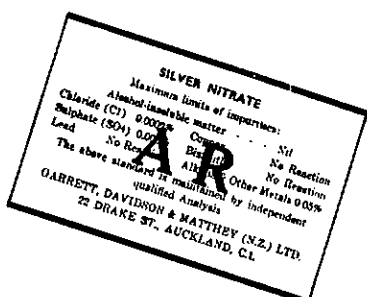
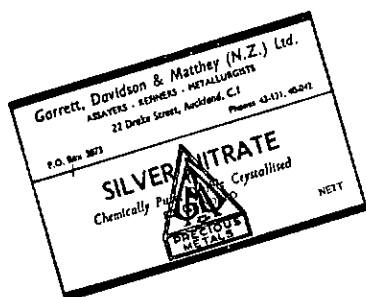


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INSTITUTE OF CHEMISTRY

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Vol. 26, No. 5

October, 1962

CONTENTS

	<i>Page</i>
Policy and Politics	157
The Future Role of the Institute	<i>F. B. Shorland</i> 158
Chemistry of Hot Water Solutions	<i>A. J. Ellis</i> 165
New Developments in the Field of Fats and other Lipids	<i>F. B. Shorland</i> 170
Honorary Doctorate: Professor Packer	178
Council Minutes	179
Thirty-second Annual Report	181
General Meeting	183
Enquiry into Organization of Science	185
Conference, 1962	186
Institute Prizes	187
The Registry	188
Graduates in Chemistry in 1961	188
Branch News and Notes	190
Obituary: Dr Rosa Stern; R. L. Andrew; and F. T. Seelye	191
Book Review	193

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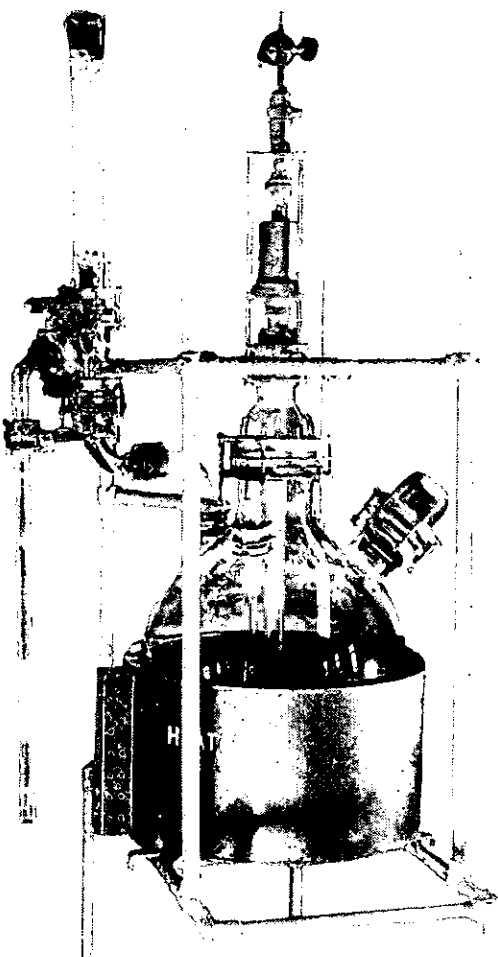
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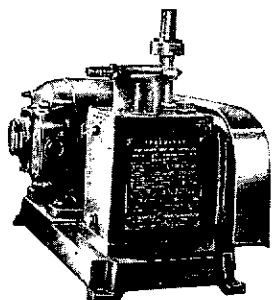
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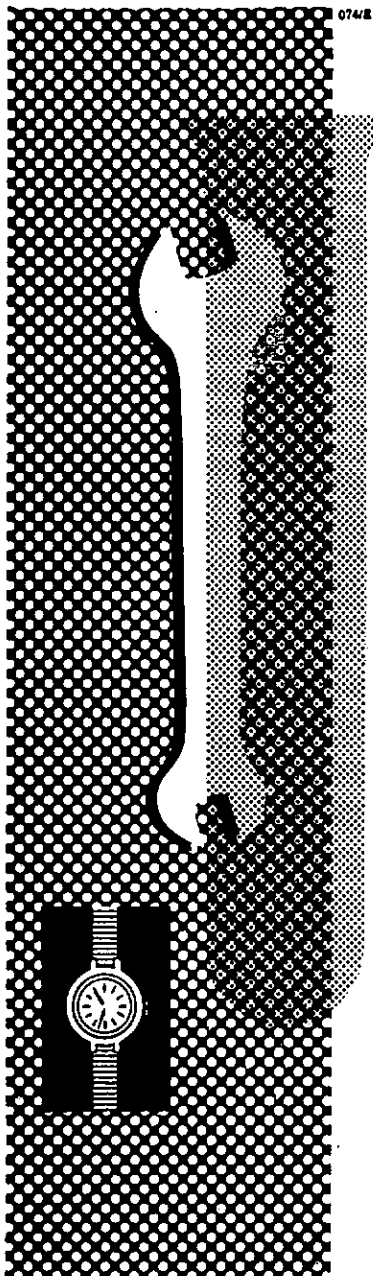
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POLICY AND POLITICS

Our biographical notes on the 1961-62 President in the February *Journal* referred to Dr Shorland's "debunking" approach to problems. In the prefatory remarks to his Presidential Address, published in this issue, Dr Shorland has neatly taken up the challenge by applying this treatment to the Institute itself. His comments should urge us to consider our past attainments, our future aims, and the approach to the achievement of these.

Dr Shorland's remarks are appropriate in a year that has seen much discussion (in which he has played a leading part) on the desirability of integrating the attitude of New Zealand's scientific bodies towards matters of national importance. Perhaps it is his interest in the necessarily slow deliberations on this subject which prompted him to point out that the Institute system, whereby a president holds this office for only one year, allows little time for the president to carry through any policy which he may introduce as his contribution to progress of the Institute. It must be remembered, however, that any member chosen for this office has normally played a leading role in Institute affairs in the past, and furthermore that he has a full year as vice-president to become familiar with the work of Council and to formulate his policy.

To add point to Dr Shorland's plea for the Institute to consider wider issues in the application of chemistry to the welfare of the community, the Annual General Meeting decided to express to the Prime Minister its opinion on the need for an enquiry into the organization of science. Let it be noted, however, that this is no new departure since it springs from similar action 18 months earlier. If such an enquiry is set in train the extent to which members have heeded the President's exhortations may be judged by the role which the Institute plays in making submissions to the enquiry authority.

THE FUTURE ROLE OF THE INSTITUTE

F. B. SHORLAND

(Prefatory comments made by the President of the Institute in his Presidential Address to the Conference in Christchurch.)

The experiences of a president in preparing a presidential address, attending to meetings and functions and at the same time exercising himself in the rather pleasant study of informal discussion have been earlier described to you by Professor S. N. Slater during his term of office in 1955 and they now become for me a reality.

Your presidents have been chosen from a variety of occupations relating to chemistry and it is perhaps natural that each should beat his own sort of drum. Each has his own concepts of what is the right sort of thing to do. Some talk about abstract chemical theories, others about their own researches. Some like to be practical and concern themselves with chemical fields akin to the economy of New Zealand. Others have dealt with educational, philosophical and historical aspects.

I know I shall run the risk of being challenged if I suggest that no president has ever laid before you what he thinks of the Institute and how it should function in the future. So far as I am personally concerned, however, I cannot recall a message of this sort at an annual conference.

I feel that the Institute cannot survive as an exclusive organization with an ostrich-like head-in-the-sand interest in chemists and chemistry. If I may misquote the title of an address by Professor Parton⁽¹⁾, "Chemistry is not a Sacred Cow". If we are to survive and prosper let us listen to outside voices. In 1948, the Hon. T. H. McCombs⁽²⁾, then Minister of Education and Minister of Scientific and Industrial Research told the Institute, "Not only have the public to obtain a greater appreciation of the needs of the scientist but the scientist himself also, in many cases, does not appreciate that he himself is a part of the community and has a responsibility to that community."

I shall return to this theme again as my subject develops. In the meanwhile I want to reflect without apology on a statement made by Professor Parton when the Institute was only seven years old and himself not all that much older. He said, "Apart from providing the opportunity for chemists to meet and hear each other's views on technical and general topics, admittedly a useful function and one which the Institute performs excellently, I have been unable to persuade

myself that the Institute is performing any function at all'. In his Presidential Address last year, Professor Parton⁽³⁾ modestly disclaimed his early forceful utterance as being rather brash and now no longer justified. I would like, however, to suggest that perhaps Professor Parton was not so far out and that his statement serves a very useful purpose in stimulating us to think.

We are very apt to fall into the trap recognized by Roger Bacon⁽⁴⁾ in the 13th Century and which perhaps at the moment prevents our seeing the Institute in its right perspective. Dealing with the causes of error he states, "There are in fact four very significant stumbling blocks in the way of grasping the truth, which hinder every man however learned from obtaining a clear title to wisdom, namely, the example of weak and unworthy authority, long standing custom, the feeling of the ignorant crowd and the hiding of one's own ignorance while making a display of apparent knowledge".

We are coasting along as a sort of receiving body dealing with only those things that come to us. We are not generally a motivating body forming public opinion, shaping education and influencing Cabinet decisions. We have a competent and knowledgeable secretary who knows all about the Institute, a most worthy treasurer, an earnest council and a fine set of sub-committees all doing their job. A wonderful piece of machinery. Why not let us do something with it?

It is relevant here to touch upon important events in our history to see how far we fall into the error of long standing custom mentioned by Roger Bacon.

As you know, the N.Z.I.C. was formed in 1930 with the late Emeritus Professor W. P. Evans as President and Mr W. A. Joiner as Honorary General Secretary-Treasurer. To both of these gentlemen and their committee we owe a great deal, including, of course, the original draft rules and the seal designed by Mr Joiner. Then followed the Denham Code of Ethics and the first annual conference in Hamilton (1935).

In 1936 appeared the first N.Z.I.C. *Journal* with Mr O. H. Keys as Editor, a stout effort with a mixture of original or semi-original papers and reviews. We have been well served by our editors including Parton, Brooker, Wallace, McGillivray and Clare. Committees dealing with membership, employment and examinations have been with us for a long time. Dr Dixon and Mr Mandeno started salary surveys in 1944 and continued in that work at intervals for many years before it was taken over by other members of the Institute. Dr J. K. Dixon has certainly given of his competent best to the Institute. We are not lacking in prizes and awards, including the Chemical Essay Prize (instituted in 1943), the I.C.I. Prize (1949)

and the Morcom Green, Edwards Prize (1951), while the Easterfield Award of the New Zealand Section of the Royal Institute of Chemistry is also open to our members.

The Institute of Chemistry was functioning smoothly and well by 1948 with a membership of 300. What more does it do now with its membership of 650? There are a few new ideas but in the main we are coasting along on the administrative organization of fifteen or so years ago. We are asleep on the job and self-satisfied with being called chemists. We care little for others and they care not for us.

Amongst the very few recent developments I see, I would like to mention the *Chemistry in Action* project, now in its fifth year. This is to the credit of the Canterbury Branch. Each year there are three lectures by three prominent members of the Institute given to selected sixth form chemistry students in Christchurch on chemical matters which are relevant to New Zealand research problems. This confers on the pupils a sense of the reality of a chemical career and gives point to their academic studies at high school and at the university. Other branches including those of Manawatu, Wellington and Auckland have also participated to some extent in similar schemes.

The Professional Status Committee⁽³⁾ is keeping an occasional tag on the activities of graduates in chemistry and following their survey they reported to the Prime Minister on the loss of graduates. At least half of the 33 M.Sc. candidates who graduated with 1st class honours in chemistry in New Zealand during the period 1955-58 departed for overseas.

I have made a survey myself of the graduates in chemistry in 1961 and although in general I do not see a wholesale departure of the top graduates there are some disturbing features that ought to be examined by the Institute. We should know, for example, whether the New Zealand Ph.D. leads, as it did in Auckland, to a wholesale departure of the Ph.D. graduates overseas or if, as we would hope, the New Zealand Ph.D. is a really good thing because the graduates are here long enough to appreciate the opportunities in New Zealand and want to settle here.

The Institute should be concerned not only with facts but also with reasons and remedies. The link between ourselves and young students should be strengthened but in addition we must turn our attention to the older student to ascertain what he thinks and if possible encourage and enliven him to local possibilities.

I personally deplore the departure from New Zealand of the bright young graduate before he has had the opportunity to see

what is going on here. In other words, I would suggest that all scholarships for overseas should require as a prerequisite some experience in New Zealand.

The Institute in recent years has been more active in its endeavours to attract leading overseas chemists to give lectures at the annual conferences and to branches but while credit is here due to the enthusiasm of some of the members it is to some extent a growing custom of the world we live in.

Returning more specifically to the future role of the N.Z.I.C., I can see in chemistry a great change since the Rules and Code of Ethics were first formulated. The Rules were drawn up at a time when analytical chemistry and testing of samples provided one of the main outlets for chemists. Chemists were, in fact, mainly servants to other needs. But for all that I think the Code of Ethics should remain. It still gives to the chemical consultant the considered opinion of the Institute as to how he should uphold the dignity of his profession.

Chemistry leans heavily on physics for its advancement. Chemistry in practice thrives when it is injected into other sciences. Biology cannot advance without the aid of chemistry and medicine without chemistry becomes witchcraft. Chemistry, in other words, depends on the other sciences and they on it; and all in turn depend on the community.

Most of us who practise chemistry have to apply the fundamentals of chemistry to other sciences. The pattern set by our elders is no longer applicable. We must integrate ourselves into the community on the one hand and into the other sciences on the other, possibly I think, by closer union with the Royal Society of New Zealand.

We are the largest scientific organization covering a single discipline (so called) but the important question is not how large it is but how mature is our thinking. We are still isolationists terrified of being involved with other organizations in case we should be taken over.

When I examined the objects of the Institute I was rather appalled at several items. I thought for the moment I had turned up a translation of the Japanese Chemical Society when I read item 3.4: "To promote honourable practice, to repress malpractice, to settle disputed points of practice and to decide all questions of professional usage and etiquette". This matter is perhaps only incidental. What impressed me was the deeply introspective and parochial nature of the objectives. It is wrapped up in item 3.2 which reads, "To raise the status and advance the interests of the profession of chemistry and those engaged therein". There was no item requiring co-operation with other sciences

and no item requiring us to use chemistry to promote the welfare of the community. The Association of Scientists in this regard have grasped their duties and obligations better than we have.

Although we find no place for service to the community in our objectives we nevertheless want from the community a sort of halo in the form of honourable status. This halo has not come and it may be that chemists and other scientists feel that great blame is to be placed on factors outside of science. At this point I want to forget about chemistry in particular and to consider science in general. Here I am not sure of my grounds because our Code of Ethics refers to the science and art of chemistry.

We wonder why the community takes so little interest in us and on the other hand the community may well wonder why we take so little interest in it. However, it is perhaps usual for people who have a doctrine to preach not to be concerned with the beliefs of their prospective pupils, a point noted by Parmelee⁽⁶⁾ in his book dealing with Eastern and Western cultures. The Institute must study the community in which it lives to see how it can ensure better relationships and wield a wider influence in bringing to fruition the application of science for the improvement of the welfare of the people. In this regard I particularly deplore the attitude, "Science is fun; to hell with the community".

I do not believe that enough chemists are interested in the Institute, other sciences or the community. Criticism of the Institute, the Royal Society and the community serves no useful purpose unless those concerned are prepared to participate in those areas wherein they see faults.

A few of our presidents have foreseen the future. In 1945, Dr J. C. Andrews⁽⁷⁾ said in his Presidential Address (which incidentally was unique in carrying on again after a supper break), "I hope the day is not far distant when a Chair of Food Technology will be established in New Zealand". As you know this dream has come true but I doubt whether it was because the Institute pushed the idea. Again Dr Andrews⁽⁸⁾ in 1946 had something to say about atomic energy and its possible use in New Zealand. The Institute has no informed opinion about the subject. The Auckland Branch in 1952 had a symposium on the training of chemists and many points emerged which included the submission by Professor Worley. Industry must have its share of the very best students university can turn out. What does the Institute think and recommend? Absolutely nothing.

Mr W. A. Joiner⁽⁹⁾ chose "Science in Industry" as the subject for his Presidential Address in 1957 and touched upon the relative amount of aid given to industrial research as compared with agri-

cultural research. Does the Institute care if industry suffers because it has not been scientifically developed? It has not expressed any opinion on a subject which should be a lively issue, affecting as it does the future prosperity of New Zealand.

Chemists have had to take on a variety of jobs in industry and it could be that their training has not been suited to their needs. The Institute should study job content in relation to training and ascertain whether the courses in the university and elsewhere fit into the pattern required for the development of New Zealand. I have little doubt that a competent analysis of the problem would lead to better training and thereby raise the prestige of chemists, the Institute, industry and the university.

Professor Parton⁽¹⁰⁾, even in his younger days in Christchurch, in 1938, had a few thoughts about the Institute that are worth recording. In his Chairman's Address he said, "An institution which is functionless should die. Some have a lingering death, living on to plague the vigorous in the community." Dr Parton proceeded to advocate increased association of the Institute with other professional bodies and proposed a series of contacts with men of all types. He considered that the Institute had not as yet given a lead in chemical education.

What has the Institute done about Dr Parton's suggestions? Very little. We have been far too concerned with Royal Charters, pharmacists and red herrings.

Your president should, I consider, give an idea for the Institute to work on but the practical difficulty is that the short space of one year of office is not long enough to sift an idea let alone action it. The next president is hardly likely to follow exactly the footsteps of his predecessor nor do I blame him. The term is restricted to one year because the late Dr Robin Page, when president, made the generous gesture of foregoing the extra year so that more members would attain the honour of becoming president.

My recommendation is that the Institute should appoint a strong committee, that can be relied upon to give informed opinion, to advise on policy and action. The committee could take the shape of the present Chemical Committee of the N.Z. Royal Society but instead of merely reporting to that body it should be an Institute of Chemistry outfit.

I would hope also that before long the Institute will try to play a role in science as a whole by co-operation with the Royal Society which with its revised rules should become a truly professional body. Those who imagine this course to affect the sovereignty of the Institute or our *Journal* have not read the rules. We would remain exactly as

at present in regard to the autonomous running of our Institute but we would, in addition, have the power to speak on the wider issues of science to some effect without being side-stepped as at present. As the largest scientific body dealing with one discipline we have a duty to play a leading part in the organization of science in New Zealand. Let us stop asking what will we get out of it, and ask instead why are we not putting something into it.

The advisory committee should make a list of the problems confronting chemistry in New Zealand and after determining priorities make a systematic attempt towards their solution.

As far as the Institute at present is concerned I feel that the machinery for dealing with routine matters is well organized. What is lacking is an active advisory council to formulate policy and recommend action on education, utilization of resources including manpower and materials, organization of science, public relationships, co-operation with other sciences and so on. Such an advisory committee would turn the Institute into an activating body instead of a functionless ostrich-like organization in danger of dying through keeping its head in the sand.

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CHEMISTRY OF HOT WATER SOLUTIONS

A. J. ELLIS

Dominion Laboratory, Petone

INTRODUCTION

In the last ten years there has been an increasing interest in the chemistry of water solutions above 100°C, as a result of the investigation of problems concerning high-temperature boilers, atomic reactors, desalting of sea water, synthetic minerals, hydro-metallurgy, and geological processes.

Hydrothermal research in Dominion Laboratory commenced in 1950 with D.S.I.R. participation in the geothermal power project at Wairakei. In this area drillholes at 1000 to 3000 ft tapped water at 250 to 260°C, containing in solution sodium and potassium chlorides, silica, boric acid, fluoride, the gases carbon dioxide, hydrogen sulphide and ammonia, and minor constituents. It was soon found that even the simplest information on water solutions at these moderate temperatures was not available in the chemical literature (*e.g.*, the density of NaCl solutions; the solubility of gases), and it became necessary to build up a background of information that would be of use in interpreting the chemical processes in the natural hydrothermal systems.

The specific requirements included the solubility of carbon dioxide and hydrogen sulphide in high-temperature water and sodium chloride solutions; the solubility of scale-forming substances such as silica and calcium carbonate; the ionization of the weak electrolytes CO₂-H₂O, H₂S, H₃BO₃ and silicic acid; volatility of sodium chloride, boric acid, etc. in steam; and chemical interchange between hot water and rhyolite pumice and ignimbrite rocks. Knowledge of the pH of the hot underground waters was required, as many equilibria involve this variable, such as those determining the precipitation of metal carbonates, sulphides and fluorides, the volatility of H₃BO₃, NH₃, HF, H₂S, CO₂, the tendency for silica to precipitate from the water as quartz, and hydrous mineral interconversions. Experimental work in the last five years has been largely directed towards gathering this type of information.

SOME PROPERTIES OF HOT WATER AS A SOLVENT

Water is an exceptional solvent, having high melting, boiling, and critical temperatures compared to other low molecular weight hydrides. Its dielectric constant at room temperature is higher than all other hydrides except hydrogen fluoride. With its high specific

heat and latent heat of evaporation it is a highly efficient medium for transporting heat.

In a two-phase liquid/vapour system, as temperature increases the density and dielectric constant of the liquid fall, and the steam pressure increases. At the critical temperature of water (374.15°C) the steam pressure is 225.65 kg cm^{-2} , the specific volume is $3.1\text{ cm}^3\text{ g}^{-1}$ (1), and the dielectric constant is about 5 (2).

Solution of Solids

With the decrease in dielectric constant at high temperatures, liquid water loses much of its power as an ionizing solvent. Two types of solubility behaviour occur. The solubility of many salts such as NaF, Li_2SO_4 , K_2SO_4 , Na_2CO_3 , CaCO_3 decreases with increasing temperature, almost to zero at the critical temperature. For other salts such as KCl, NaCl, Cs_2SO_4 , K_2CO_3 , the solubility remains high and usually increases. With increasing temperature, a point is apparently reached where either the ion-water interactions are sufficient to hold the water together as a dense and ionizing solvent, or the dissolved ions have insufficient action to prevent further lowering of density, dielectric constant and solvent power.

In the two-phase water system between 0°C and 374°C the distribution of a solid in dilute solution in both vapour and liquid becomes increasingly in favour of the steam phase at higher temperatures, until at the critical temperature the concentrations become equivalent. For example in contact with quartz at 370° the saturated liquid phase contains 0.04% and the steam phase about 0.005% SiO_2 ; at the critical point about 374° the solubility is 0.02% SiO_2 (3).

For any solvent it is possible at sufficiently high pressure to pass with increasing temperature from the liquid into the super-critical region without a phase change. A liquid-like water state can exist at temperatures of 1000°C and above, and high temperature and pressure water under these conditions is as close to a universal solvent as any liquid. The properties of supercritical water as a solvent are largely dependent on its density, whether the solute be dissolved as molecules or ions.

The dielectric constant of supercritical water is a function of fluid density, falling with increasing temperature and rising with increased pressure. In low-pressure steam ionic solids are almost insoluble, although hydrolysis of many salts occurs, *e.g.*, in steam at 700° and 10 atmospheres pressure sodium chloride is less than 0.01% soluble (4) but appreciable hydrolysis into $\text{NaOH} + \text{HCl}$ occurs. At 700° and 1000 atmospheres the solution in contact with sodium chloride contains over 85% NaCl.

Solution of Gases

The solubility of gases in liquid water in the temperature range 0 to 374°C, as expressed by Henry's law or Bunsen type coefficients, shows a minimum, usually about 50 to 100°, followed by an increase which becomes more rapid as the critical temperature is approached. When weight distribution coefficients are used, *e.g.*, $D = \text{mole fract. gas in liquid} / \text{mole fract. gas in vapour}$, there is no minimum but the solubility increases continuously up to the critical point distribution of unity. A graph of $\log D$ versus $\log (d_s/d_l)$, where d is the density of the steam and liquid phases, is almost linear and allows simple interpolation and reasonable extrapolation of low temperature (0 to 100°C) results to the critical temperature (5). The liquid/vapour distribution of compounds such as H_3BO_3 , SiO_2 in dilute aqueous solution can also be treated similarly, the density being the factor controlling the solubility.

Weak Acid and Base Equilibria

In liquid water below 374° the ionization of weak electrolytes shows two competing effects. The dissociative effects of increasing temperature are opposed by the fall in the solvent's dielectric constant, with the result that the equilibrium constants for the ionization of weak acids (K_a) and bases (K_b), and including the self ionization of water itself (K_w), first increase with temperature, reach a maximum value, then steadily decrease. For simple carboxylic acids, above about 125°, a plot of $\log K_a$ versus $1/DT$ is approximately a straight line (6). As K_a , K_b , and K_w change considerably with temperature (powers of ten), a statement of the pH of a hot-water solution has little meaning unless a measurement was made at the temperature, or complete knowledge is held about changes in the relevant ionic equilibria from the measurement to the elevated temperature. The neutral pH of water decreases from pH 7.0 at 25° to 5.7 at 250°, but increases again to pass through pH 7.0 about the critical temperature. Increasing the pressure above the saturated steam pressure raises both the density and dielectric constant. At constant density, values of K_a , K_b , and K_w increase steadily with rising temperature.

EXPERIMENTAL METHODS

Pressure vessels of 5 ml to 1000 ml made from stainless steel are suitable for work with many aqueous solutions below about 400°. Strongly acid or basic solutions, or corrosive solutions, such as those containing sulphur compounds, require cylinder liners of platinum, gold, or Teflon. For temperatures up to 1000° and for higher pressures, vessels made from alloys such as the Stellite or Nimonic range

have proved successful. Pure zirconium or titanium vessels provide corrosion-free conditions for many halide-free aqueous systems at 200 to 300°. Sampling of the solutions in vessels is achieved through capillary high-pressure stainless steel or titanium tubing, and midjet high-pressure valves.

Most of the common room temperature solution techniques have been adapted to high-temperature experiments. Electrical conductance allows the simplest means of following ionic processes (5) although e.m.f. methods are now becoming established. The cell H_2 -Pt/HCl/AgCl-Ag has been successfully operated up to 250°C (7). Measurements of visible and u.v. spectra of many ions have been made in water at temperatures up to 250°. Radioactive tracers have been used to determine the steam/liquid distribution coefficients for compounds, and X-rays used to determine the densities of solutions of known composition in pressure vessels. With calibrated pressure vessels and high-pressure burettes titrations can be carried out, gas and solid solubilities measured by p.v.t. techniques, and solution densities determined.

HOT WATER—ROCK INTERACTION

In conclusion, a brief example can be given of a recent investigation in this laboratory. This work was aimed at reproducing processes which could give water solutions typical of natural hydrothermal areas. Some examples can be given from the interaction of various volcanic rocks with water at controlled pressures and temperatures. Table 1 compares the compositions of the solutions after the reaction of water at 260° for 2 weeks with four rock types, with that of a typical water at 2000 ft beneath Wairakei.

TABLE 1: Comparison of solutions resulting from reaction of 260° water and various rock types (rock/water ratio = 2) for 2 weeks, with natural 260° water at Wairakei (Concentrations in ppm).

<i>Constituent</i>	<i>Na</i> ⁺	<i>K</i> ⁺	<i>Li</i> ⁺	<i>Cl</i> ⁻	<i>F</i> ⁻	<i>HBO</i> ₂	<i>SO</i> ₄ ²⁻	<i>NH</i> ₃	<i>SiO</i> ₂
Rock Type									
Basalt	100	35	0.2	200	5	10	—	2	1000
Andesite	70	20	0.5	50	10	10	20	4	1200
Dacite	70	12	0.6	40	15	8	40	3	1300
Pumice Rhyolite	250	35	0.6	200	50	3	20	2	1300
Wairakei Water	900	150	9.5	1500	5.5	75	25	1	480

This type of experiment enables a distinction to be made between those elements in solution which are of superficial origin and derived during the migration of the hot waters through surface rocks, and

elements which could be of deeper origin and therefore of greater interest in trying to understand the processes which lead to the development of hydrothermal areas. For example, fluoride, ammonia, silica, and sulphate in thermal waters can be explained by simple leaching in the top few thousand feet of rocks. Both silica and fluoride are present in the interaction solutions in meta-stable high concentrations, caused by the solution of partly glassy rocks. The stable concentrations of these substances are limited by the solubility of fluorite in the presence of quartz (compare the solubility value of 500 ppm SiO_2 for quartz at 260° with the Wairakei value). Transport of large quantities of silica and fluoride in solution must occur at deep levels in the country.

The interaction experiments have shown that for each rock type and temperature an equilibrium Na/K ratio is attained in solution. At Wairakei, the waters rising from below 3000 ft into a series of rhyolite breccia rocks contain a slight excess of potassium for their temperature and environment. As they move away through the country from specific entry zones potassium is lost into the rock, and this fact has been utilized in showing the proximity of drillholes to hot water entry zones, from the Na/K ratios in their waters (8).

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NEW DEVELOPMENTS IN THE FIELD OF FATS AND OTHER LIPIDS

F. B. SHORLAND

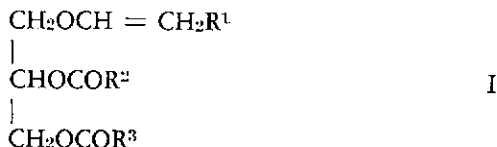
Director, Fats Research Laboratory, D.S.I.R., Wellington

Developments in the field of fats and other lipids have been remarkably rapid over the past five years. The structures of many types of lipid molecules which had resisted classical methods of investigation have now been placed on a firm basis because of the elucidation of the mechanism of their biosynthesis. This new knowledge has led to the concept that not only are fats and other lipids interrelated but also that complex lipids and fatty acids, including the mycolic acids with 88 carbon atoms, are in fact made up of smaller well-known lipid entities. I am doubtful whether the organic chemist could see, in mycolic acid, two units of hexacosanoic acid and two units of stearic acid or that he would suspect that sphingosine was formed by the condensation of palmitic aldehyde with L-serine. Nature starts with simple units wherewith to build intricate patterns and to know these units is to know the pattern. The seemingly chaotic pattern of the lipids is, in fact, quite orderly.

I do not wish to imply that all aspects of the lipids are now understood but I would like to indicate some fields in which our understanding has increased, including the prospect that lipids have a fundamental role in cell metabolism. The study of cell metabolism has perhaps for too long been the prerogative of the enzyme chemist.

In particular I would like to convey to you something of the fascination that the problem of biosynthesis of the lipids holds and then perhaps to touch on a few other recent developments.

I propose to restrict the term "lipid" to the naturally occurring substances that yield fatty acids on hydrolysis. You will all be familiar with fats or triglycerides which form the greater part of a sheep's carcass but will not suspect that with these well-known substances there are also traces of glyceride-like material (I) in which one of the glycerol hydroxyl groups has been condensed with a fatty aldehyde in place of a fatty acid.



Although fats are the best known lipids, in some tissues fats are less abundant than other lipids. In brain, cerebroside and

sphingolipids are important; in liver, phospholipids. In grass, fats are minor lipid components and their place is taken by galactolipids.

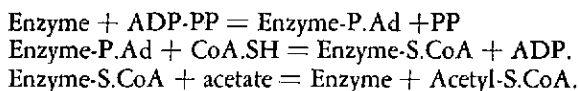
Biosynthesis of Fatty Acids

It is convenient when dealing with the biosynthesis of lipids to treat the fatty acids separately from the rest of the lipid molecule. In any case the synthesis of the fatty acids is by no means straightforward as different categories of fatty acids are formed by different biosynthetic routes.

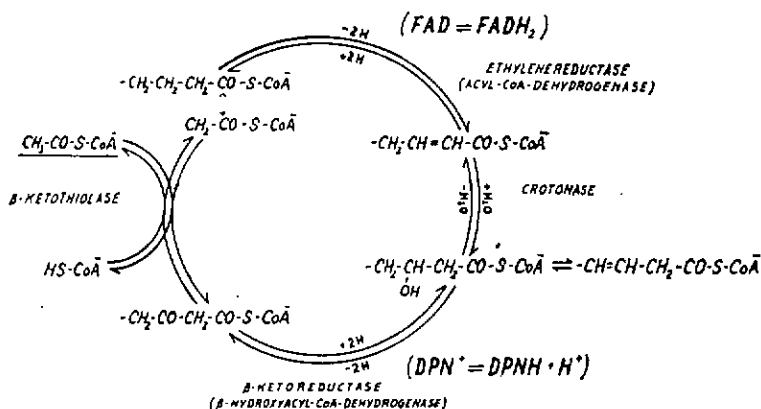
n-SATURATED FATTY ACIDS

In 1944 Rittenberg and Bloch established by use of isotopic labelling that acetate was the building stone of the higher molecular weight fatty acids such as palmitic, oleic and stearic acids. Acetate itself did not participate, but a unit known as "active" acetate. In 1951, Lynen and Reichert identified active acetate as the thioester of Coenzyme A and acetic acid.

Acetyl CoA has been shown to be produced through the action of enzyme-bound adenosine triphosphate (ATP or ADP-PP), CoA and acetate as follows:



The attachment of the sulphhydryl group of coenzyme A to the acetyl group confers on it the properties of an acid as well as labilizing the methyl hydrogen. With such head and tail labilization of the acetate molecule it is possible to visualize the chemical mechanism of the biological oxidation and synthesis in terms of Lynen's fatty acid cycle.



Fatty Acid Cycle (According to Lynen, 1954)

The steps are:

- (1) Two molecules of acetyl coenzyme A are condensed to give acetoacetyl coenzyme A.
- (2) Acetoacetyl coenzyme A is reduced to β -hydroxybutyryl coenzyme A.
- (3) β -Hydroxybutyryl coenzyme A is degraded to crotonyl coenzyme A.
- (4) Crotonyl coenzyme A is reduced to butyryl coenzyme A.

The repetition of the cycle eight times in a spiralwise manner will theoretically produce stearyl CoA. The acetyl CoA may condense with oxalacetate to enter the citric acid cycle, where it is broken down to carbon dioxide and water. Rate of oxidation depends on the availability of oxalacetate. For synthesis there is needed a supply of acetyl CoA and DPNH and low concentration of free CoA if the equilibria of β -ketothiolase and β -ketoreductase are to be shifted in the direction of synthesis. The various enzymes of the system and each of the reactions postulated have been established and it was thought by Lynen at the time that the synthesis of fatty acids was nothing more than the reversal of the β -oxidation process. In this area nature does not conform to a simple pattern; the equilibrium of the β -ketothiolase is far in the direction of oxidation and the oxidative and synthetic processes do, in fact, proceed independently.

In fact, it is now also clear that the processes of degradation and synthesis of carbohydrates and protein in living tissues are not alternate aspects of a reversible mechanism.

Whereas the enzymes which are concerned with the oxidative degradation of fatty acids are found in the mitochondria only, those concerned with synthesis occur in the particle-free extracts of liver and mammary gland (1). In addition, however, Wakil (2) has demonstrated that mitochondrial synthesis of fatty acids involving some of the enzymes of the β -oxidation system does occur.

In considering the mechanism of synthesis of fatty acids it is therefore convenient to subdivide the discussion under the headings of mitochondrial and non-mitochondrial.

Mitochondrial system of fatty acid synthesis. Stumpf and Barber in 1957 were the first to show the fatty acid synthesis by intact mitochondria derived from avocado mesocarp. Adenosine triphosphate, CoA, and Mn $^{++}$ were essential components for the conversion of C^{14} acetate into long chain fatty acids. More recently Wakil (2) has shown that intact mitochondria from pigeon, rat or beef livers can synthesize

long chain fatty acids from acetyl CoA anaerobically in the presence of CoA, ATP, DPNH and TPNH.

Mitochondrial synthesis for conversion of palmitic to stearic acid appears to proceed through four reactions. The first requires a condensing enzyme which probably contains pyridoxal phosphate, the second is brought about by β hydroxy acyl CoA dehydrogenase, the third by enoyl hydratase and the fourth by α , β unsaturated acyl CoA reductase. The role of pyridoxal phosphate in the fatty acid synthesis has not been established. Whereas thiolase of the Lynen fatty acid cycle favours the condensation of two acetyl-CoA molecules, the pyridoxal system appears to favour condensation of acetyl CoA with a higher acyl CoA.

Non mitochondrial or malonyl CoA system for fatty acid synthesis.

Investigation of the non-mitochondrial system by Wakil has brought to light perhaps the main route for fatty acid synthesis, involving the condensation of acetyl CoA with malonyl CoA units.

This system is widely distributed in living organisms, is located in the cytoplasm of the cell, and catalyses the conversion of CoA to palmitate in the presence of ATP, Mn^{++} , $\overline{HCO_3}$, and TPNH. Acetyl CoA is condensed with $\overline{HCO_3}$ to form malonyl CoA in a reaction catalysed by acetyl CoA carboxylase (a biotin-containing enzyme) in the presence of ATP and Mn^{++} . Malonyl CoA condenses with acetyl CoA or (propionyl CoA) and yields, on reduction by TPNH, saturated fatty acids, CO_2 and CoA. From the chemical standpoint it may be classified as an acylation of malonic ester.

The enzyme system involved in fatty acid synthesis from malonyl CoA behaves as a single enzyme which Lynen has named "*synthetase*".

Acetyl CoA acts as a primer in fatty acid synthesis. In contrast, the intermediate compounds which occur in the course of fatty acid degradation, such as α , β unsaturated, β -hydroxy and β -ketoacyl CoA derivatives, have been tested and found to be inactive as primers for the fatty acid synthesis from malonyl CoA. Consequently these compounds are not intermediates in the course of fatty acid synthesis.

The synthesis of fatty acids from acetyl CoA thus involves the condensation of the tail end of acetyl CoA to the methylenic group of malonyl CoA followed by the addition of malonyl CoA units via the union of carboxyl to methylenic groups with the ultimate elimination of carbon dioxide and reduction of the keto groups. The actual mechanism for this course presents a problem but the evidence produced by Lynen (1961) is in accord with a scheme in which fatty acid synthesis is achieved by a repetition of a cycle of six consecutive

reactions. According to Lynen (1961) the important principle is that the mechanism involves the attachment of the malonyl group to the SH groups of the enzyme itself. The enzyme remains attached during the reducing and dehydration reactions that follow until the chain has been lengthened by two carbon atoms. At this stage the enzyme interchanges with coenzyme A to begin the cycle again. The attachment of the enzyme during decarboxylation of the malonyl group ensures that the thermodynamic advantage gained by decarboxylation is not lost through thiolitic cleavage of acetoacetyl CoA catalysed by the enzyme thiolase.

Comparing biological fatty acid oxidation or degradation with synthesis it is found that whereas synthetase has a low affinity for acetoacetyl CoA, the corresponding enzyme in the oxidation sequence has a high affinity. Another point of difference is the specificity of the synthetase for TPNH and the D(—)- β -hydroxybutyryl derivative in contrast to DPNH and L(+)- β -hydroxybutyryl CoA. The same difference in stereospecificity is also found in the subsequent enzyme dehydration of the β -hydroxy derivative to the α , β unsaturated compound.

The purification data obtained during the concentration of synthetase led Lynen (1961) to the conclusion that the enzyme is a single unit formed by the combination of six different enzymes around a functional sulphhydryl group, which firmly binds the intermediate steps in fatty acid synthesis in close proximity to the active sites of the component enzymes. This would also explain the lack of free intermediates.

In summary, fatty acid synthesis with malonyl CoA differs from the reversal of the degradative cycle in that, although we have the same type of acidic intermediates, they are enzyme bound. The fundamental difference is in the condensation reaction itself. The condensing unit is a thiolester derivative of malonate, rather than of acetate. The driving force is supplied by the concomitant decarboxylation of the malonyl derivative. Other differences are mainly mechanistic and involve stereochemical considerations thereby keeping the biosynthetic and degradative pathways separate.

Whereas the end-product of the mitochondrial system is a mixture of fatty acids, including stearic, palmitic, oleic and C₂₀, that of the non-mitochondrial system is limited to palmitic (or heptadecanoic if propionic is the starting point). The first system, according to Wakil(2) can extend an existing long chain fatty acid by two carbons but the second system cannot.

n-MONOUNSATURATED FATTY ACIDS

The question of the synthesis of unsaturated fatty acids poses a number of problems. Earlier work using labelling techniques has shown the interconversion of stearic, palmitic and oleic acids, and perhaps there has been a tendency on this account to imagine that oleic acid or Δ^9 octadecenoic acid is produced directly by dehydrogenation of stearic acid. At all events the appearance of the double bond between the 9th and 10th carbon atoms is not easy to explain on this basis.

Generally speaking, it is believed that unsaturated acids are formed from saturated by an oxidative process the exact mechanism of which is not understood. Although monounsaturated and hydroxy-saturated acids are interchangeable as growth factors for yeast tracer experiments have failed to support the view that the hydroxy acids themselves are precursors of unsaturated acids.

In bacteria, however, there is now a clear picture of the anaerobic synthesis of unsaturated fatty acids (Bloch *et al.* (3)).

Labelled palmitate or stearate when added to bacteria such as *Lactobacillus plantarum*, *Clostridium butyricum* or *Escherichia coli* are not transformed to unsaturated fatty acids under either aerobic or anaerobic conditions. On the other hand when *C. butyricum* is grown with I-C¹⁴ octanoate or I-C¹⁴ decanoate both saturated and unsaturated long chain acids are labelled. Lauric and myristic acids on the other hand produce only higher molecular weight saturated acids. The mechanism for the synthesis of unsaturated acids from octanoic acid ($\text{CH}_3(\text{CH}_2)_5\text{CH}_2\text{COOH}$) involves addition of two C units, by means of two units of CH_3COSCoA , to form decanoic, followed by the formation of β -hydroxydecanoic and the removal of H and OH from this to produce the corresponding unsaturated acid. Subsequent extension of the chain with a series of 2-carbon units leads to *cis*-vaccenic acid, $\text{CH}_3(\text{CH}_2)_5\text{CH}=\text{CH}(\text{CH}_2)_9\text{COOH}$.

It may be relevant to the above mechanism that β -hydroxydecanoic acid occurs in bacteria and moreover commonly belongs to the D series which is the opposite configuration to β -hydroxy acids arising in fatty acid oxidation. β -hydroxylauric acid is also found in a *Pseudomonas* species.

SYNTHESIS OF POLYUNSATURATED ACIDS

The mechanism of formation of polyunsaturated acids in the mammalian body has been traced by means of labelling techniques

(c.f. Mead, 1961) and it is now recognized that there are four families of these acids each derived from a particular fatty acid and containing the terminal group of that acid, namely:

C_{22} with 6 double bonds, terminal group $CH_3CH_2CH = CH$, linolenic family.

C_{20} with 4 double bonds, terminal group $CH_3(CH_2)_4CH = CH$, linoleic family.

C_{20} with 3 double bonds, terminal group $CH_3(CH_2)_5CH = CH$, palmitoleic family.

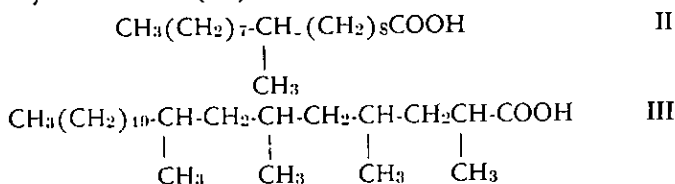
C_{20} with 3 double bonds, terminal group $CH_3(CH_2)_7CH = CH$, oleic family.

The enzyme systems involved have not been isolated but three types seem likely to operate. These are: a polydehydrogenase which dehydrogenates mono- or polyenoic acids in the 1 : 4 relationship (i.e. double bonds interrupted by single methylenic groups) from the existing double bonds towards the carboxyl group; the acyl transferase which adds 2 carbons when chain lengthening is necessary; and a system which disposes of unsaturated acids with double bonds.

SYNTHESIS OF THE POLY BRANCHED LONG CHAIN ACIDS PRESENT IN MYCOBACTERIA

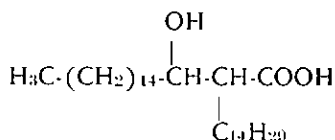
Another area of marked interest in the lipid field is to be found in studies in mycobacteria. Some of the lower forms of life, such as yeast, synthesize fats similar to those found in the higher forms of life. Superficially at least, the analyst presented with the fats from yeast and from pigs would find it difficult sometimes to tell from which source the fat had come. The lipids of mycobacteria on the other hand have features which are not found elsewhere.

Although the usual fatty acids including oleic, palmitic and stearic are found, branched chain fatty acids are also present in large proportion. These differ from those found elsewhere in that the branching occurs not near the methyl group but half way along the carbon chain as in tuberculostearic acid (II) or near the carboxyl end as in mycocerosic acid (III).



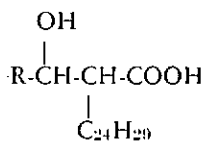
Two different mechanisms have been considered for the fatty acids with methyl side chains. One is the Birch mechanism consisting

of the fixation of a methyl group (from methionine) on to a polycyclic chain. It has been shown that the cyclopropane ring of lactobacillic acid is formed *in vivo* by the fixation of a one-carbon unit from formate on to *cis* vaccenic acid; the fixation of methyl groups on aliphatic chains by this mechanism does not seem to have been observed. The other is the propionic mechanism, consisting of the condensation of a normal fatty acid in the α position of one molecule of propionic acid. This mechanism has recently been proven in its simplest form for the biosynthesis of α methyl butyric acid in *Ascaris*. Fatty acids with more than 80 carbons and with long side chains occur in mycobacteria. The simpler forms of this type occur in *Corynebacterium diphtheriae* such as corynomycolic acid, with 32 carbon atoms.

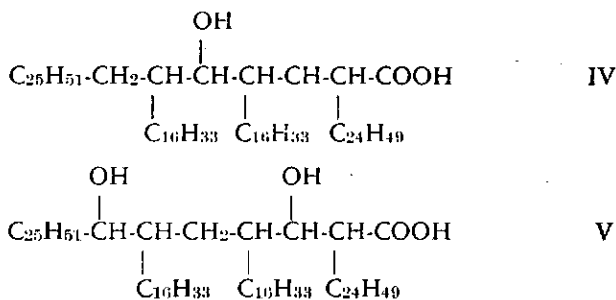


The presence of free palmitic acid and palmitone in these bacteria suggested that corynomycolic acid is formed *in vivo* by the condensation of two molecules of palmitic acid and the reduction of the intermediate keto ester. Experiments using $1\text{-}^{14}\text{C}$ palmitic acid support this mechanism.

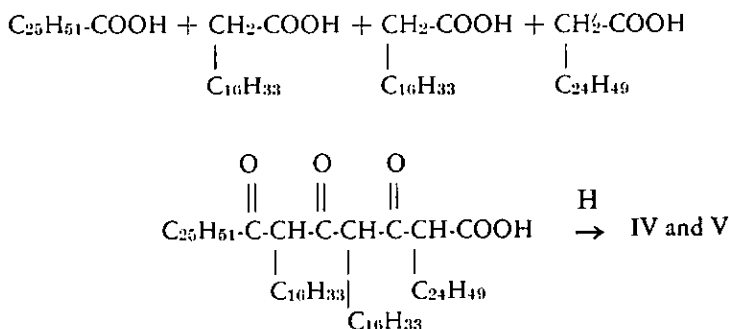
Mycolic acids are typical constituents of mycobacteria and were discovered by Lesuk and Anderson in 1938. The formula for mycolic acids of human and bovine strains of *M. tuberculosis* is approximately $\text{C}_{88}\text{H}_{176}\text{O}_4$ and the general structure



All the experimental evidence is in agreement with structures



Lederer envisages the formation of IV and V as resulting from the following condensation of long chain fatty acids by the mechanism proven for corynomycolic acid.



The avian saprophytic strains of mycobacteria are incapable of synthesising hexacosanoic acid, their longest chain free fatty acid is tetracosanoic and their mycolic acids are formed from this and in place of hexacosanoic acid.

The synthesis of n-saturated acids stops at C₂₆. Branched chain acids with several methyl groups have 21 to 34 carbon atoms, whereas mycolic acids have 32 to 88 carbon atoms.

The mycolic acids occur free as well as combined as esters with carbohydrates. The 6,6'-dimycolate of trehalose is known as the cord factor.

[REFERENCES: The numerals in the text refer to references which will be supplied in the concluding section.]

(To be concluded)

HONORARY DOCTORATE: PROFESSOR PACKER

Professor J. Packer was recently awarded the Honorary Degree of Doctor of Science by the University of Canterbury. Lecturer for over twenty years and Professor and Head of the Chemistry Department for almost as long, Professor Packer has been the architect of the present strong school of chemistry at Canterbury. He has been a stalwart supporter of the Institute since it was started, and was President in 1949.

COUNCIL MINUTES

ABRIDGED MINUTES OF A MEETING OF THE COUNCIL OF
THE NEW ZEALAND INSTITUTE OF CHEMISTRY (INC.),
TUESDAY, AUGUST 14, 1962.

PRESENT

Dr F. B. Shorland (President, in the chair), W. G. Hughson (Vice-President), R. W. Olliff (Auckland Proxy), R. J. Lancaster (Waikato), Dr A. T. Johns (Manawatu), Dr A. J. Ellis (Wellington), R. W. Cawley (Canterbury), Dr W. G. Hanger (Otago), D. J. Hogan (Registrar). Apologies were received from Professor D. R. Llewellyn and Dr W. E. Harvey.

CONFERENCE

Resolved that the Conference File be forwarded through the Hon. General Secretary. It was agreed to accept an invitation from Manawatu Branch for the 1963 Conference to be held in Palmerston North. A tentative schedule for future conferences was agreed to as follows:

1964: Waikato.

1965: Otago.

1966: Wellington.

EXAMINATIONS

A suggested draft for revision of Regulations 1 and 2 was received from the Examinations Committee.

Resolved that Council is not in favour of continuation of the Laboratory Assistants' Certificate. It was agreed to ask Mr Dasent to report to the next Council meeting on whether the termination of L.A.C. would cause hardship; branches are to report to Mr Dasent on the availability of courses for the N.Z. Certificate in Science and on the number of students in their areas wanting to take the Technical College courses.

Resolved that the Examinations Committee be requested to give further consideration to the Associateship Regulation particularly with regard to equivalence with the R.I.C. Regulations.

JOURNAL

The Editor presented a detailed analysis of the cost of the *Journal*.

Resolved that the Editor be empowered to discuss advertisements with Editorial Services Limited with a view to increasing both advertising rates and the number of advertisers and if agreement was reached that the Wellington Branch be asked to seek a Business Manager for the *Journal*.

PRIZES

Resolved that the Essay Prize Regulation be amended by replacing "6,000 to 10,000 words" by "not more than 5,000 words".

CHANGE OF RULES

Comments on branch comments were received from the Rules Revision Committee.

Resolved that these be re-circulated to branches and then referred to the Standing Committee for production of a final draft.

ANNUAL REPORT

It was agreed to ask branch secretaries to conduct a membership drive and to survey the number of graduates in their area who could be members.

Resolved that the Hon. General Secretary be asked to arrange for statistics to be kept concerning the fate of graduates with M.Sc., or above, in chemistry. It was suggested that the survey go back for five years and then be kept up to date and that a University staff member in each main centre be asked to be local liaison officer.

The President expressed Council's thanks to the Professional Status Committee, particularly Miss J. Mattingley, for the Salary Survey.

TRUST FUNDS

Many letters had been received in response to the Hon. General Secretary's circular letter about the purpose of and possible uses for the Trust Fund.

Resolved that these letters be referred to the Standing Committee.

ROYAL SOCIETY

The President reported on discussions with officers of the Royal Society.

Resolved that negotiations with the Royal Society be proceeded with and that a draft specification for entry be prepared by the Standing Committee for approval of Council and submission to the Royal Society.

COMMITTEE ON NEW ZEALAND SCIENCE

Resolved that the N.Z.I.C. is disturbed at the recommendation of the State Services Commission that any enquiry into N.Z. Science be postponed for five years.

W. E. HARVEY,
Hon. Gen. Secretary.

PROFESSIONAL STATUS COMMITTEE

The Professional Status Committee as part of its activities peruses the newspapers for advertisements for positions offered to chemists. In some instances these are badly or ambiguously worded, e.g., offer a chemist's position to a person without qualifications, or require a laboratory assistant with an M.Sc. When these advertisements are seen the committee sends a letter to the firm concerned, pointing out the discrepancies and suggesting that an advertisement correctly worded with no doubt as to status, is more likely to attract applicants.

As the committee is in Wellington, it can conveniently watch the newspapers only in its own area. Members can assist in this work by watching their own local newspapers, cutting out any advertisements which are doubtful in this way and posting them together with details of paper and publication date to The Professional Status Committee, N.Z.I.C., c/o P.O. Box 250, Wellington, C.1.

ADDITION TO SALARY SURVEY

The Committee has requested that the following addition be made to the Salary Survey, published in the April issue (*Journal*, 26, 46, 1962), under the section *Average Salaries*, 1st paragraph, line 3

"except for the Government and University groups for which actual scale figures were used".

THIRTY-SECOND ANNUAL REPORT

For the Year Ending July 31, 1962

OFFICERS

The list of officers for the year was published in the December, 1961 issue of the Journal.

MEMBERSHIP

Membership of the Institute has, during the period covered by this report, changed as follows:

New Associates, 39; new Fellows, 11; resignations, 9; deaths, 3; leave granted, 8; struck off, 3; deleted, 3.

Membership figures for the last three years are as follows:

	1960	1961	1962
Auckland	105	111	124
Waikato	29	32	33
Manawatu	51	58	58
Wellington	177	182	182
Canterbury	79	81	96
Otago	61	71	72
Overseas	52	66	62
	<hr/> 554	<hr/> 601	<hr/> 627

HONORARY FELLOWS

Messrs R. L. Andrew and A. D. Monro were elected Honorary Fellows in August, 1961. Both have given long and valuable service to the Institute and the profession. Details of their careers have appeared in the *Journal*.

DEATHS

It is with regret that we record the deaths of four of the Institute's members: R. L. Andrew, F. T. Seelye, W. O. R. Gilling, and Dr Rosa Stern.

SUB-COMMITTEES OF COUNCIL

JOURNAL: The Editorial Committee of the *Journal* under the Editor, Mr N. T. Clare, continues to be based in Hamilton. The cost of publication of the *Journal* continues to increase partly because of generally increased costs, partly because of additional pages.

EXAMINATIONS: This Committee, which was for many years based in Dunedin, is now composed of members of the Auckland Branch. The work of this Committee in connection with the Laboratory Assistants' Certificate Examination is lessening, but interest in the examination for the Associateship is increasing and the Committee is revising the Regulation covering this examination. It seems probable that in the future the Institute must become increasingly interested in the further qualification of those who complete the National Certificate in Science (Chemistry), a group which will soon be appearing and may present special problems.

SALARY SURVEY: During the year under review a further salary survey was carried out and the results have been published in the *Journal*.

RULES REVISION: This Committee, based in Auckland, has brought down recommended changes in the Rules which it is expected will be adopted in August, 1962. Some of these suggested changes are relatively minor, but others, such as those relating to qualifications for membership, are of considerable importance and have been subjected to close scrutiny by both the Committee itself and branch committees.

EMPLOYMENT OFFICER: Mr E. S. Borthwick took over during the year from Mr J. L. Mandeno, to whom our thanks are due for his several years' work in this capacity. The Employment Officer handles enquiries regarding employment of chemists and technicians. Almost all of these enquiries come from overseas and although the majority are rather general, a number do display genuine interest in opportunities in New Zealand.

OTHER SUB-COMMITTEES: The members of the Membership Committee, the *List of Members* Committee, the Honorary Librarian, and the Institute's representatives on the Standards Council and the Technicians Certification Authority continue to carry out an increasing amount of work requiring a considerable amount of time and much specialized knowledge. The Institute is extremely well served by these members, and it is easy to overlook the important contribution they make to the smooth running of the Institute and the advancement of the profession.

INSTITUTE PRIZES

Prizes for 1961 were awarded as follows:

I.C.I. Prize	Dr W. A. McGillivray.
Morcom Green, Edwards Prize	Dr J. R. L. Walker.
Chemical Essay Prize	Dr P. Meredith.

CONFERENCE 1961

The 1961 Conference was held in Auckland during August. Professor R. C. L. Bosworth of the University of New South Wales was the guest lecturer.

OVERSEAS VISITORS

Dr W. A. Waters, F.R.S. of Oxford University, paid a brief visit to New Zealand at the conclusion of a tour of Australia. Dr Waters, who was accompanied by his wife, visited all the branches, and his visit, which was arranged with the co-operation and assistance of the Royal Australian Chemical Institute, was much appreciated.

ROYAL SOCIETY OF NEW ZEALAND

The year under review has witnessed extensive discussions, both on the part of Council and between the Standing Committee of Council and officers of the Royal Society, with a view to increasing the ties between the two bodies. The Act under which the R.S.N.Z. operates is being modified and it seems, at this stage, probable that closer ties between the Institute and the R.S.N.Z. would be beneficial to both organizations and, ultimately, to science as a

whole in New Zealand. In the past there has been considerable opposition from Institute members to the Institute's becoming too closely associated with the R.S.N.Z., but it is hoped that the revisions planned to the R.S.N.Z. Regulations will largely remove the source of earlier objections.

FINANCIAL

The balance sheet for the year ended April 30, 1962, reveals an excess of expenditure over income for the financial year of £109. Although the overall financial position remains sound it is apparent that steps must be taken either to increase income or to trim expenditure. Council has considered this matter and has taken steps to improve the position. The number of Council meetings will be decreased, with increasing power being delegated to the Standing Committee. In this way it should be possible to effect considerable savings in travelling expenses. The cost of overseas visitors can be considerable and a determined effort will be made to recover as much as possible of these costs. This course of action seems preferable to the obvious alternative of inviting fewer chemists from overseas to visit this country. These steps should be adequate to prevent any significant drain on the Institute's resources in the near future, but it seems inevitable that either subscriptions must be raised or the Institute activities may be severely curtailed in the next year or two. The increasing cost of the *Journal* could possibly be partly offset by an increase in advertising rates.

F. B. SHORLAND, *President*.

W. E. HARVEY, *Hon. General Secretary*.

GENERAL MEETING MINUTES

MINUTES OF A GENERAL MEETING OF THE NEW ZEALAND
INSTITUTE OF CHEMISTRY (INC.) HELD AT LINCOLN
COLLEGE, ON WEDNESDAY, AUGUST 15, 1962.

PRESENT

Dr F. B. Shorland (President, in the chair) and about 120 members. Apologies were received from Dr W. E. Harvey, Dr C. R. Barnicoat, Messrs S. G. Brooker, O. H. Keys and L. Wilkinson.

DEATHS

The Chairman reported the deaths of Messrs R. L. Andrew, W. O. R. Gilling and F. T. Seelye and Dr Rosa Stern. Members stood in silence as a mark of respect.

ELECTION OF OFFICERS

The Chairman announced the election of officers as follows:

President: Mr W. G. Hughson—unopposed.

Vice-President: Mr S. G. Brooker—unopposed.

Hon. Gen. Sec./Treas.: Dr W. E. Harvey—unopposed.

PRIZES

The Chairman announced that the prizes had been awarded as follows:

I.C.I. Dr A. J. Ellis.

Morcom, Green, Edwards Dr G. Butler.

Chemical Essay W. Freitag.

ANNUAL REPORT

Resolved that the annual report be adopted.

Reports were presented by the Editor, the Employment Officer and Mr Lambert (for the Rules Revision Committee). The Chairman outlined discussions that had been held with officers of the Royal Society.

BALANCE SHEET

Resolved that the balance sheet be adopted. The Registrar briefly outlined the salient features and said that a rise in subscription seemed inevitable if Institute activities were to be maintained at their present level. The Editor outlined *Journal* finances and indicated steps that Council was taking to increase advertising revenue.

TRUST FUND

The Registrar outlined replies that had been received to the Hon. General Secretary's circular letter about uses for the Trust Fund. There was a strong feeling that the fund should not be touched in the meantime and several industrial members considered that a reserve for possible legal expenses was still required. Professor Fastier commented on a scheme in operation at the Medical School where a Trust Fund was used to assist deserving students with loans to help them complete courses.

THANKS

The President expressed his thanks to members of the various sub-committees.

MR T. A. GLENDINNING

Dr Panckhurst brought to members' attention reports of Mr T. A. Glendinning's 50 years' association with the profession of chemistry. It was decided to send Mr Glendinning a telegram of good wishes from the Conference.

ENQUIRY INTO NEW ZEALAND SCIENCE

It was moved That the N.Z.I.C. is disturbed at the recommendation of the State Services Commission that an enquiry into the state of science in New Zealand should be postponed.

Resolved that the meeting agree to the principle of the motion outlined by Dr Johns and that Dr Johns, the President and the Registrar be empowered to draft a suitable resolution.

Resolved that this resolution be conveyed by telegram to the Prime Minister.

(Note: The text of the telegram sent to the Prime Minister and repeated to the Minister of Agriculture and the Minister of D.S.I.R. is given elsewhere in this issue.)

W. E. HARVEY,
Hon. General Secretary.

ENQUIRY INTO ORGANIZATION OF SCIENCE

At the Annual General Meeting held at Lincoln on August 15, the following resolutions were passed :

That the N.Z.I.C. is disturbed at the recommendations of the State Services Commission that an enquiry into the state of science in New Zealand should be postponed.

Following a thorough discussion of this subject a telegram was sent to the Prime Minister and copies were sent also to the Minister of Agriculture and the Minister of the Department of Scientific and Industrial Research. The text of this telegram is as follows:

The Annual General Meeting of the New Zealand Institute of Chemistry has re-affirmed its previous recommendation that an enquiry be held into the organisation and financing of science in New Zealand. It is disturbed at the suggestion of the Royal Commission of Enquiry into State Services that such an enquiry be postponed in favour of an interim advisory council. It is of the opinion that an enquiry into New Zealand science should be held forthwith and that the committee should consist of a majority of eminent overseas scientists.

During the discussion it was pointed out that proposals for an enquiry had been made early in 1961, and that Professor Parton, President of the Institute at that time, had made specific recommendations on the matter. The issue had in effect been shelved by reference to the Royal Commission of Enquiry into State Services. If the recommendations of the Commission were followed by the Government—and members indicated that such action was imminent—any enquiry would be indefinitely postponed. In the meantime scientific work in State Departments would be controlled by a National Research Council consisting of "not fewer than five members appointed by the Government, among whom should be the chairman and deputy chairman; and four official members representing D.S.I.R., the Department of Agriculture, the Department of Industries and Commerce, and the Treasury." (*Report of the Royal Commission*). Members expressed the opinion that a Council constituted in this way could prove unsatisfactory for the direction and control of scientific research.

"THE CHEMIST CUSTOMER"

A paper entitled "The Chemist Customer", presented by Mr A. H. Horn to the final session of the Conference at Lincoln, led to lively discussion. On a motion by Mr Horn, seconded by Dr Metcalf, it was resolved

"that this meeting (appointed for the reading of papers in August, 1962, at Lincoln College) recommends that Council set up a committee to take steps to assist chemists in the choice of apparatus and instruments and to inform manufacturers as to the requirements of chemists as outlined in the summary of Mr Horn's paper, *Journal of the N.Z. Institute of Chemistry*, August, 1962, page 144."

CONFERENCE 1962

The organization of an Institute Conference in conjunction with a Royal Society Congress presents many difficulties, and neither of the two previous attempts were very successful. This year members of the Canterbury Branch are to be congratulated on organizing Section B of the Science Congress and dovetailing parts of the Conference into the Congress without losing the identity of the Institute and without creating confusion. The use of Lincoln College, with a high proportion of the delegates in residence there, no doubt contributed to this achievement (with perhaps some attendant worries for the transport organizers). The Lincoln setting with its gardens and recreation rooms was excellent for those "informal discussions outside the formal sessions" which, it is now commonplace to claim, are the most valuable features of such conferences. Typical of such activities was the interruption of a snooker game and the arrangement of the balls to demonstrate a heterocyclic formula—the "billiard ball atom" still has its uses. The two social occasions made their contribution to that atmosphere which can convert strangers into collaborators in an evening.

Knowing that it cannot please everyone, the Conference Committee has requested suggestions for improvement to be sent to the Secretary. On matters that are primarily the responsibility of the Committee it is more helpful to do this than to criticize in public. The more serious faults of this Conference, however, lay in the nature of some of the papers and the way they were delivered, and on these misdeeds of members public comment is pertinent.

There has been a remarkable increase, in the last 10 years, in the influence of the universities on the Conference. Once, the university played its part mainly by providing a venue. By 1958, university participation had greatly increased and in that year the universities contributed 21% of the 38 papers, with government laboratories supplying 55% and industry 24%. With Section B included, the corresponding figures this year were: University 66; government 20; industry 14. Of those registered for the 1962 Conference the proportions were: University 43%; government 30%; industry 25%; teachers 2%; but half of the university members were from Canterbury and probably included a number of students. This reflection of the post-Parry development of the universities is welcome evidence of the increased research in our chemistry departments; yet it is very doubtful whether some of these papers justified the time devoted to them. One wonders whether conference expenses for university staff depend on giving a paper. Many of these papers were confidently delivered by most competent young men (although one of the most striking lecture performances was given by a young lady); but comments indicate that often the audience would have preferred less detailed treatment of specialized subjects. The Conference is a good forum for young chemists, but one hopes it will not become an advertising hoarding or a platform for priority publication.

Conversely, the government and industrial laboratories can correct any imbalance by submitting more papers. As it was, it seemed a pity that papers important to many attending the industrial section on fats were cramped for discussion time. There seems little value in giving a paper if it is not discussed, and something is lacking in paper, author or audience if discussion cannot be sustained for one third of the total time allotted to the subject. Future conference committees must consider carefully whether they can afford to

accept all papers or whether they should set out to plan a programme along specific lines. One suggestion, which might wed the academic and applied, is a series of lectures for the "over-forty" class with a kindergarten approach to some "recent" developments—say ligand field and orbital theories.

The main disadvantage of Lincoln was the lack of good lecture rooms, although the room chiefly in use could have been improved by better arrangement, better blackboards and better blacking out and screen. It is now 13 years since the writer first commented unfavourably in these pages on lantern slides at a conference. Most conference commentators since then have done the same and there have been several articles on the preparation of slides in this and other journals. This year's Conference Committee again reminded contributors of this matter—with what results? A few excellent slides, many mediocre or worse, and some utterly atrocious; and some of the bad ones shown by people who really must know better. The blackboard (the board at Lincoln was a poor one to start with) was badly used by some speakers who wasted valuable time scrawling illegible formulae and reactions at all angles, then swished them off to scribble more. It may have been good chemistry but it was poor exposition. For 1963, let us ask the Committee to provide first class equipment, and the speakers to consider how much their papers depend upon adequate illustration.

—N.T.C.

INSTITUTE PRIZES

At the meeting of Council on August 14 the Institute Prizes for 1962 were awarded as follows:

I.C.I. PRIZE: Dr A. J. Ellis, Dominion Laboratory, Petone.

MORCOM GREEN, EDWARDS PRIZE: Dr G. Butler, Plant Chemistry Laboratory, Palmerston North.

CHEMICAL ESSAY PRIZE: Mr W. Freitag, B.P. (N.Z.) Ltd. Laboratory, Wellington.

An article by Dr Ellis covering some of the work on which the award was based is included in this issue of the *Journal*. It is hoped to publish work of the other prize winners in subsequent issues.

As a result of comments by the assessors for the Chemical Essay Prize on the length of some of the submissions in recent years and the difficulty of publishing long contributions Council decided to amend the prize regulations to restrict the length of entries to not more than 5,000 words. It is hoped that this amendment will increase the number of entries for this prize. The Regulations governing the Institute prizes will be reprinted in full in the December issue.

THE REGISTRY**Fellows**

(Elected August 14, 1962)

- BAILEY, Raymond Wellesley, M.Sc., Ph.D.(Birm.), Plant Chemistry Division, Palmerston North (Principal Scientific Officer).
 NICHOLLS, Gordon Alfred, M.Sc., Ph.D., N.Z. Forest Products Ltd., Auckland (Chief Research Chemist).

Associates

(Elected August 14, 1962)

- ANDERSON, Bryan, Frederick, M.Sc., Chemistry Department, Auckland University (Temporary Junior Lecturer).
 DUNCKLEY, Geoffrey Gordon, B.Sc., Nutrition Research Department, Medical School (Research Officer).
 GARDNER, Kenneth Hurst, N.Z. Standards Institute, Wellington (Technical Officer, Chemical).
 GUMBLEY, Janice Marjorie, M.Sc., Ruakura Animal Research Station (Scientific Officer).
 HODGE, Robert Alexander Paul, B.Sc., Auckland Gas Co. Ltd. (Assistant Chemist).
 HODGES, Richard, M.Sc., Ph.D.(Manc.), Ruakura Animal Research Station (Scientific Officer).

GRADUATES IN CHEMISTRY IN 1961

In an address published in this issue the President of the Institute, Dr F. B. Shorland, refers to an analysis of the activities of students graduating in 1961 which he had made from data supplied by the university chemistry departments. A condensed table compiled from Dr Shorland's analysis is published below.

Degree	<i>Advancing M.Sc or Ph.D.</i>		<i>Proc. to other degree</i>	<i>University Lecturer</i>	
	<i>In N.Z.</i>	<i>O'seas</i>		<i>Temp.</i>	<i>P.-time Ph.D.</i>
Ph.D.	—	3	—	1	—
M.Sc. (1)	6	4	—	—	1
M.Sc. (2) *	7	2	—	—	—
M.Sc.	—	—	—	1	—
B.Sc. (Hons.)	12	—	—	—	—
B.Sc.	53	—	10	—	—
Totals	78	9	10	2	1

* 1 overseas.

JOBNEY, Desmond Ernest, B.A., B.Sc., Selwyn College, Auckland (First Assistant and Head, Science Department).

JOHNSON, Cecil Barry, M.Sc., Chemistry Department, Victoria University (Research Student).

LE QUESNE, Phillip William, M.Sc., Chemistry Department, Auckland University (Ph.D. Student).

MAYNE, Alan John, M.Sc., Lever Bros. (N.Z.) Ltd. (Chief Chemist).

NAISH, Geoffrey, B.Sc. (Birm.), Palmerston North B.H.S. (Teacher).

SOUTHWARD, Charles Ramsay, M.Sc., N.Z. Fertiliser Research Association (Research Chemist).

TUCKER, David Harry, B.E.(Chem.), B.Sc., Dominion Laboratory, Gracefield (Scientific Officer).

YOUNG, Jason Carmel, B.Sc., Dip.Ind.Chem., Kempthorne Prosser Ltd., Christchurch (Works Chemist).

Resignation

P. J. GRAHAM.

Leave of Absence

E. WONG, J. T. FRANCE.

Deaths

R. L. ANDREW, W. O. R. GILLING, F. T. SEELYE, ROSA STERN.

The Council hopes to arrange the collection of this information in future years. A summary of similar material covering chemistry graduates for the years 1955-58 was published in the *Journal* for October, 1960. Unfortunately other figures to complete the picture of the movement of New Zealand trained chemists, that is, records of their return to New Zealand, are much more difficult to obtain.

Over-seas leave	Sec. teaching	D.S.I.R.	Industry	Other	Total
1	—	—	1	—	6
—	—	1	—	—	12
—	4*	2*	1	2	18
—	7	—	7	3	18
—	—	—	—	—	12
—	7	2	12	1	85
1	18	5	21	6	151

BRANCH NEWS AND NOTES

AUCKLAND BRANCH

Mr C. C. Roberts has returned after nine months study of science teaching in the United States and England.

Mr R. A. Scott, Acting-Principal of Takapuna Grammar School has left for London to take up an Imperial Relations Fellowship. On his return, Mr Scott will be an inspector of post-primary schools with the Education Department in Auckland.

Professor L. H. Briggs has returned after a year's research at Edinburgh University.

Associate Professor A. L. Odell has departed for nine months' study at Stanford and Yale Universities.

CANTERBURY BRANCH

Mr L. Wilkinson, Dominion Laboratory, Christchurch, has commenced a three-month tour of air and water pollution research establishments in France, Germany, U.K., Canada and the U.S.A. While in England he will deliver a paper to the International Conference on Water Pollution Research and will attend the International Conference on Alcohol and Road Traffic.

Mr J. Vaughan, Reader in Chemistry, University of Canterbury, left in September to spend six months refresher leave in the U.S.A. Most of this time will be spent on a teaching and research programme at Reed College, Portland, Oregon.

Professor J. Packer was President of Section B of the recent ANZAAS Conference at Sydney and delivered the Presidential Address of that Section. Other members of the Branch at ANZAAS were Mr J. Vaughan, Dr R. D. Topson, and Dr C. J. Wilkins, all of whom presented papers, and Dr T. Haggard.

MANAWATU BRANCH

Dr F. H. McDowall has recently returned from Europe where he visited Dairy Research Centres and attended the International Dairy Congress in Copenhagen.

Dr B. H. Howard has returned to the Rowett Institute, Aberdeen. He has been working at the D.S.I.R., Palmerston North, for the past twelve months.

Mr P. Chapman, formerly of Alliance Textiles Ltd., Oamaru, has joined the staff of the Dairy Research Institute.

WELLINGTON BRANCH

Dr D. S. Adcock, formerly of Standard-Vacuum Oil Co. (N.Z.) Ltd., has now joined Shell Refining (Aust.) Pty. Ltd., at Geelong, Australia, and will work with the N.Z. Refining Co. at Whangarei on his return to New Zealand.

Mr W. Vose has left Winstone Ltd. to join the Huntly Brick and Tile Co. Ltd., Huntly, as Managing Director.

Recently the Branch organized two special lectures for upper-sixth form chemistry pupils from secondary schools in the Wellington district. The lectures, on the pattern of those which the Canterbury Branch has successfully held for a number of years in its *Chemistry in Action* series, were delivered by Dr W. S. Simpson, of the Dominion Laboratory, on "The Structure of Molecules", and by Dr A. T. Wilson, of Victoria University, on "Radio-chemistry". It is hoped to make similar lectures an annual event.

OTAGO BRANCH

Dr J. E. Prue, Reader in Chemistry at Reading University, will be visiting Dunedin from September 17 to 21, and will address the Branch.

OBITUARY

Dr Rosa Stern

Rosa Stern was born in Vienna in 1891, and was awarded her Ph.D. by the University of Vienna in 1914. From then till 1938 she was employed by the cereal processing firm of Hauser and Sobotka, Vienna, becoming Chief Chemist.

Forced by the Nazis to leave both her job and her country Rosa accepted a junior position at the Wheat Research Institute and proved a most loyal and valuable member of the staff. As well as participating in the day to day work at the Institute she carried out an important series of biochemical researches. She was fluent in English, German, French and Russian, and had an understanding of several other languages. She left the Institute with mutual regret in 1950 because she was approaching an age where retirement was mandatory, but continued to put her knowledge to good use as a consultant working for Edmonds and also for Kearns, the maltsters, till her death. She attended Institute meetings regularly and was Branch Chairman in 1952.

Both Rosa and her mother, who came to New Zealand with her and died some years ago, were most independent persons, and had a very youthful mental outlook. Though of quiet disposition, Rosa had a charming sense of humour, and endeared herself to her colleagues.

She was never heard to complain of her lot, and accepted her change of status with good grace. She undoubtedly carried out her promise, given in a letter to Dr Hilgendorf from Vienna in 1938, to "loyally do her duty" if she were permitted to come to New Zealand. She thought of herself as a New Zealander, and in 1946 she became a British subject.

She leaves a wide circle of friends.

—R.W.C.

Robert Leslie Andrew

The recent death of Robert Leslie Andrew has removed one of the last links with the early history of chemistry in the service of the Government in this country.

Mr Andrew belonged to a mining family in Thames where he was born in 1883. Although he did not follow the family tradition he maintained a keen interest in mining and had many stories to tell of the early days in the Thames Goldfields.

It was perhaps appropriate that after distinguishing himself at the Thames School of Mines and winning a School of Mines University Scholarship, he joined the Mines Department as an assistant at the Department's exhibit at the Christchurch Exhibition in 1906. This was no mere display of the mineral resources of the country, but provided the opportunity for much useful work, for here Mr Andrew with Mr W. Donovan, then first Assistant to the Colonial Analyst, carried out a comprehensive series of analyses of New Zealand coals. The results of these were published and for many years remained the

standard of reference. The next year, Andrew joined the Colonial Laboratory, later the Dominion Laboratory, as third assistant, and remained with the Laboratory until he retired in 1946, having been appointed its Director and Dominion Analyst in 1941.

Mr Andrew is best known for his work relating to public health, but he was far from being a narrow specialist and was interested in many aspects of his profession. He was made a Fellow of the Institute of Chemistry of Great Britain and Ireland in 1930 and took an active part as a foundation member of the New Zealand Institute of Chemistry. He served as Chairman of the New Zealand Section of the former and as chairman of the Wellington Branch of our own Institute.

R.L.A., as he was known at the Dominion Laboratory, earned the respect of his staff for his breadth of knowledge and ability to see clearly the issues involved in any problem and endeared himself by his ever-ready helpfulness, his personal interest in those with whom he worked and his sense of humour.

Mr Andrew had wide literary interests and found a great deal of pleasure in his extensive library. He was a man of strong spiritual convictions, and hated any form of pretentiousness or humbug. Fortunately, Mr Andrew suffered no long period of illness, and the end came rather unexpectedly. He lived a full life of service to his fellow men.

—W.A.J.

Frederick Thomas Seelye

Mr Seelye was born in Dunedin, in 1879, and was educated at the Otago University School of Mines where he gained the diploma of A.O.S.M. in both mining and geology, and also the certificate of Metallurgical Chemist and Assayer. He was a foundation member of the New Zealand Institute of Chemistry, and gained the Fellowship in 1943. In 1944 he was elected a Fellow of the Royal Society of New Zealand. He was the author, or co-author, of some sixteen scientific papers published in various periodicals or bulletins. His early published work consisted of an examination of New Zealand clays and glass sands. One of the most interesting discoveries by Mr Seelye was the high proportion of boron (up to 4.8 per cent of boric oxide) in the ash of Waikato coals.

During the war years at the Dominion Laboratory he was given the difficult problem of the estimation of the radioactive elements uranium and thorium and complex minerals extracted from the West Coast beach sands. It was through this work that we first came into contact with the then unknown uranium products being developed in America for nuclear weapons. When we received, through Dr (now Sir) Ernest Marsden, the then confidential information on uranium chemistry from America and England we found our methods of estimation and extraction were simpler, and patent rights were taken out in New Zealand and overseas for the extraction of uranium from the various minerals.

Mr Seelye was later asked to undertake the estimation of uranium and thorium for the World Standard for uranium proposed by the U.S. Bureau of Standards. This work led also to the development of an extremely simple

and effective method of decomposition of minerals by sodium peroxide fusion at such low temperatures that the otherwise corrosive nature of the peroxide flux could be avoided.

Mr Seelye was one of twenty rock analysts asked to undertake the analyses for scientists at the Massachusetts Institute of Technology in Boston who were attempting to evaluate the limits of accuracy of rock analysis. Results varied within such wide limits that the four analysts whose results came nearest to the mean were chosen to re-examine the specimen. Mr F. T. Seelye's results were on that mean.

It was a wonderful experience to work under such an analyst whose motto was "Train yourself to be as accurate as possible for it is easy to reduce one's accuracy if necessary when once attained". The name of F. T. Seelye will remain in the literature of the rock analysts and the petrologists and be as firmly established there for all time as the rocks and minerals he loved so much.

—T.A.R.

BOOK REVIEW

TRANSACTIONS OF THE SYMPOSIUM ON ELECTRODE PROCESSES, edited by Ernest Yeager, John Wiley & Sons, New York, 1961. 374 pages. Price £8.

Volumes such as this serve a purpose complementary to reviews, abstracts, monographs and the usual journals devoted to the subject. Sufficient detail is given for the reader to assess the value of the contributions with more certainty than from the first three sources of information and the inclusion of discussion sections after each contribution exposes the ideas there expressed to the criticism or confirmation of others working in the same or allied fields. To be valuable, therefore, the symposium must have been so organized as to draw contributions from leading workers in all major centres of the relevant research, critical discussion must have been adequately arranged and reference to the general literature must be adequate. The volume under review adequately satisfies these criteria and in addition is most opportune at this time when experimental methods in theoretical electrochemistry are being rapidly diversified with consequently increasingly detailed investigations into the double-layer and its role in electrode kinetics.

In a sense, the volume is a memorial to Grahame whose portrait is reproduced, whose ideas on double-layer constitution are implicit in nearly all the papers and who is posthumously co-author of one of them. It is peculiarly fitting that this particular paper should be criticized by Frumkin, another major architect of double layer theory, and by Bockris, an exponent of electrode kinetics.

Colleagues of the reviewer and research students were already using the volume before the arrival of the review copy and it can be confidently recommended to workers in electrochemistry and related fields.

A minor irritation is the invariable absence of a list of symbols after each paper, thus making reading unnecessarily difficult, since often the symbols were not defined in the text nor universally recognized. Since the volume is published as one of the Electrochemical Society series, it would be desirable for that body to concern itself with some degree of uniformity in the nomenclature of electrode kinetics or at least to follow chemical engineering publications in the provision of a nomenclature list with each paper.

—T.H.

**VACANCY 2905—PHYSIOLOGIST OR BIOCHEMIST,
NEW ZEALAND DEPARTMENT OF AGRICULTURE,
RUAKURA ANIMAL RESEARCH STATION,
RUMINANT METABOLISM**

A senior Physiologist or Biochemist is required to establish and lead a team to study metabolism in pasture fed ruminants. The work is expected to touch on considerations of practical importance such as the study of certain metabolic disturbances of grazing animals and the frequent failure of young animals, both sheep and cattle, to thrive on lush pastures during the autumn period; but it will also be possible to undertake more fundamental work.

Opportunities for field and stall feeding work are particularly good and there are the usual laboratory facilities. In addition a cow calorimeter is under construction and cold stores for large amounts of frozen herbage are to be provided. It is hoped that the appointee will participate in projected nutrition studies with these.

Salary up to £2,300 a year according to qualifications and experience. Housing will be available to a suitable appointee.

Applications close on 1st November 1962 with the Secretary, Public Service Commission, Box 8004, Wellington. Use Form PSC 17A obtainable at Post Offices; enclose copies only of testimonials and quote the vacancy number.

ANALYTICAL CHEMIST

Messrs H. W. Lawrence & Son Ltd., a Wellington firm of private Consultants and Analytical Chemists (established in 1907), have a vacancy on their graduate staff for an ANALYTICAL CHEMIST with some experience of industry. Particularly useful would be knowledge of Foods and Drugs.

Salary £1,500 per annum, and excellent opportunity for rapid advance to partnership for right person.

The Laboratory is well equipped, with modern instrumentation including U.V. spectrophotometer, gas chromatograph etc. Write to the Manager:

**H. W. Lawrence & Son Ltd.,
Chemical Service Laboratory,
46 Helston Road,
Johnsonville, Wellington.
Telephone 74-039.**

OPENING IN ANALYTICAL PRACTICE

There will shortly be an opening in the well-established practice of Dr R. Gardner and Partners, Dunedin. The present proprietor expects to be available for about half-time during 1963. Any of the following arrangements would be considered.

Assistantship (which could be part-time) with view to partnership; immediate partnership; sale of whole practice as a going concern; or any other reasonable arrangement.

Easy terms of purchase can be arranged for a suitable person. Enquiries (which will be treated as strictly confidential) should be marked "Personal" and addressed to

DR R. GARDNER, P.O. BOX 271, DUNEDIN.

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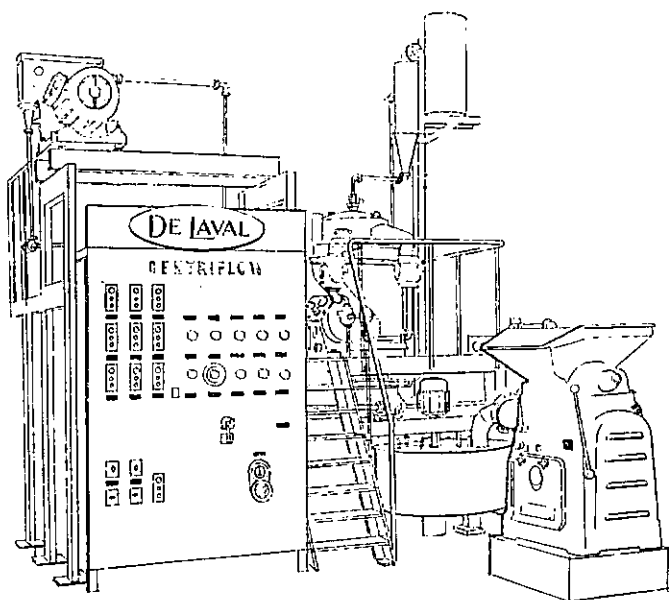
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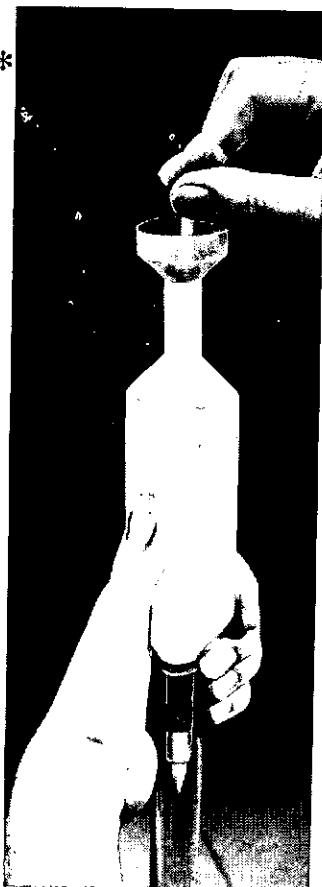
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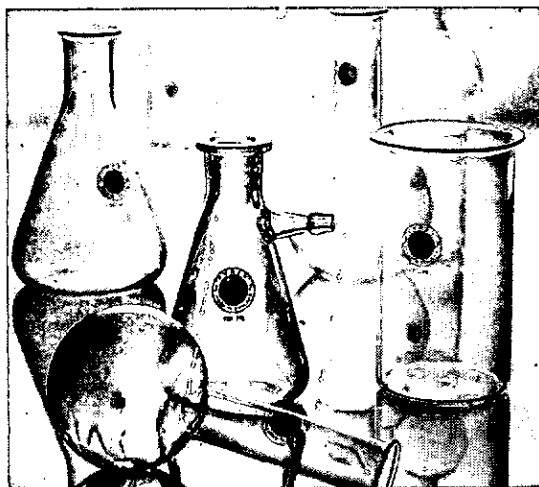
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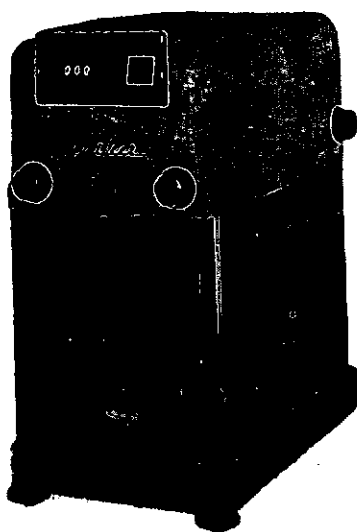
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2. Williams, T. R. and Harley, J. D., *Chemist-Analyst*, 1961, 50, 114.
3. Davies, M. T., *Analyst*, 1959, 84, 248.

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