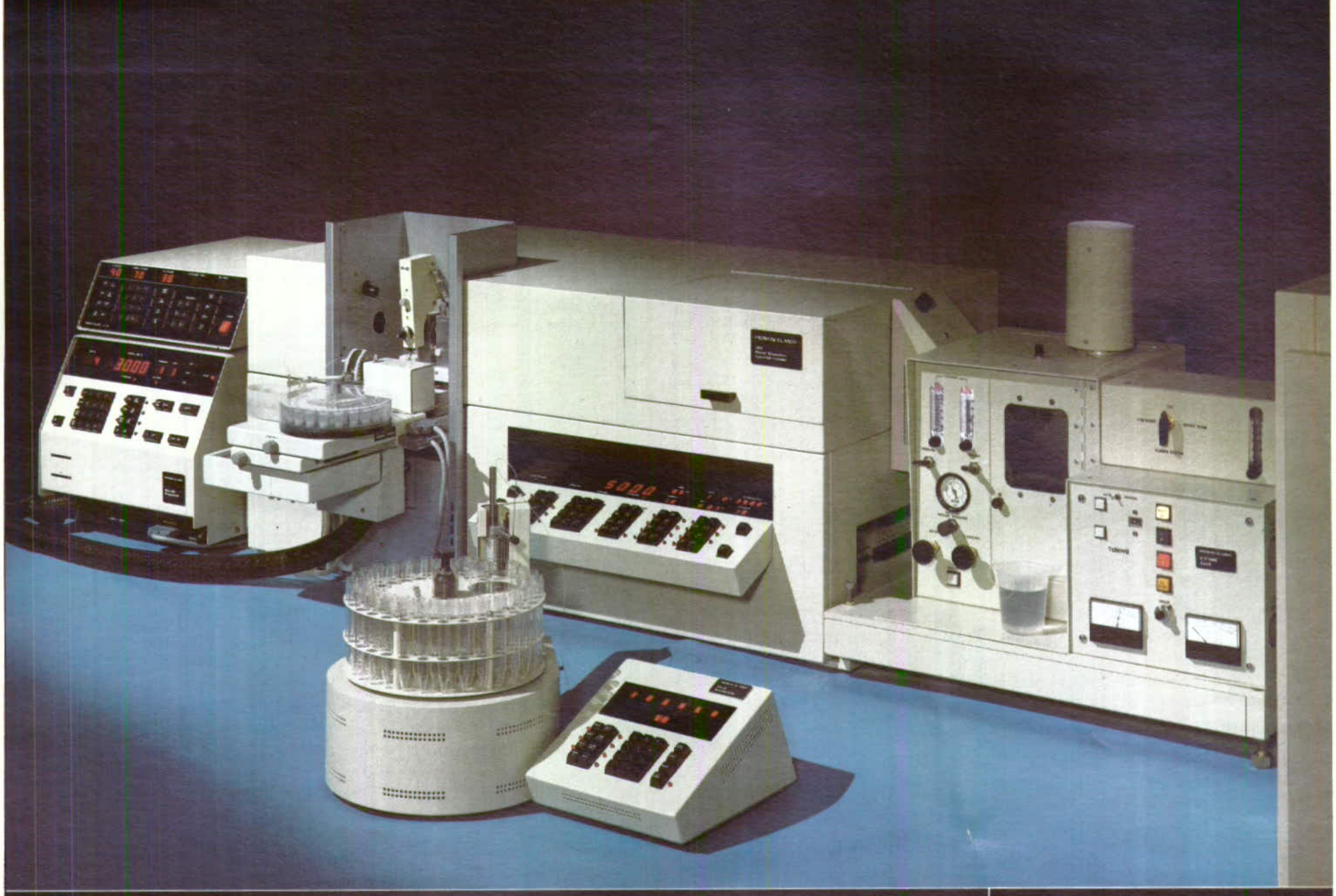
December 1980 Vol. 44 No. 6

Chemistry in new zealand

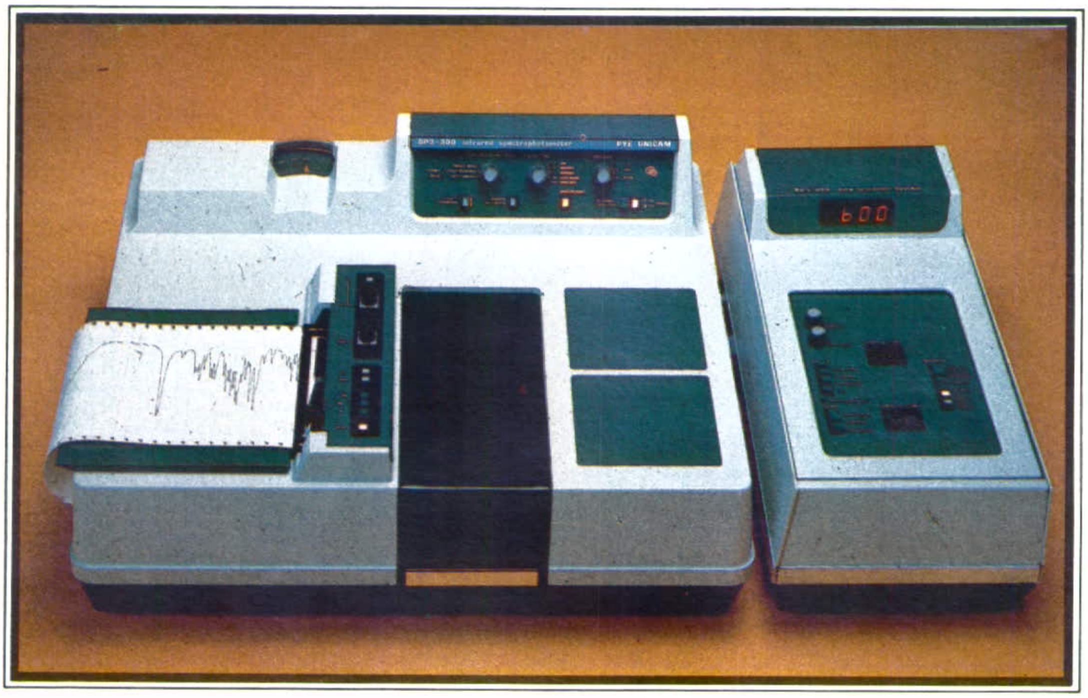
Official Journal of the New Zealand Institute of Chemistry

Atomic Spectroscopy

INSIDE: Chemistry — Fact or Fiction?: Jobs For The Boys: The Technical Institutes: Chemical Education: Analytical Chemistry: Renaissance of Polarography.



SP3 Series Ratio Recording IR Spectrophotometers



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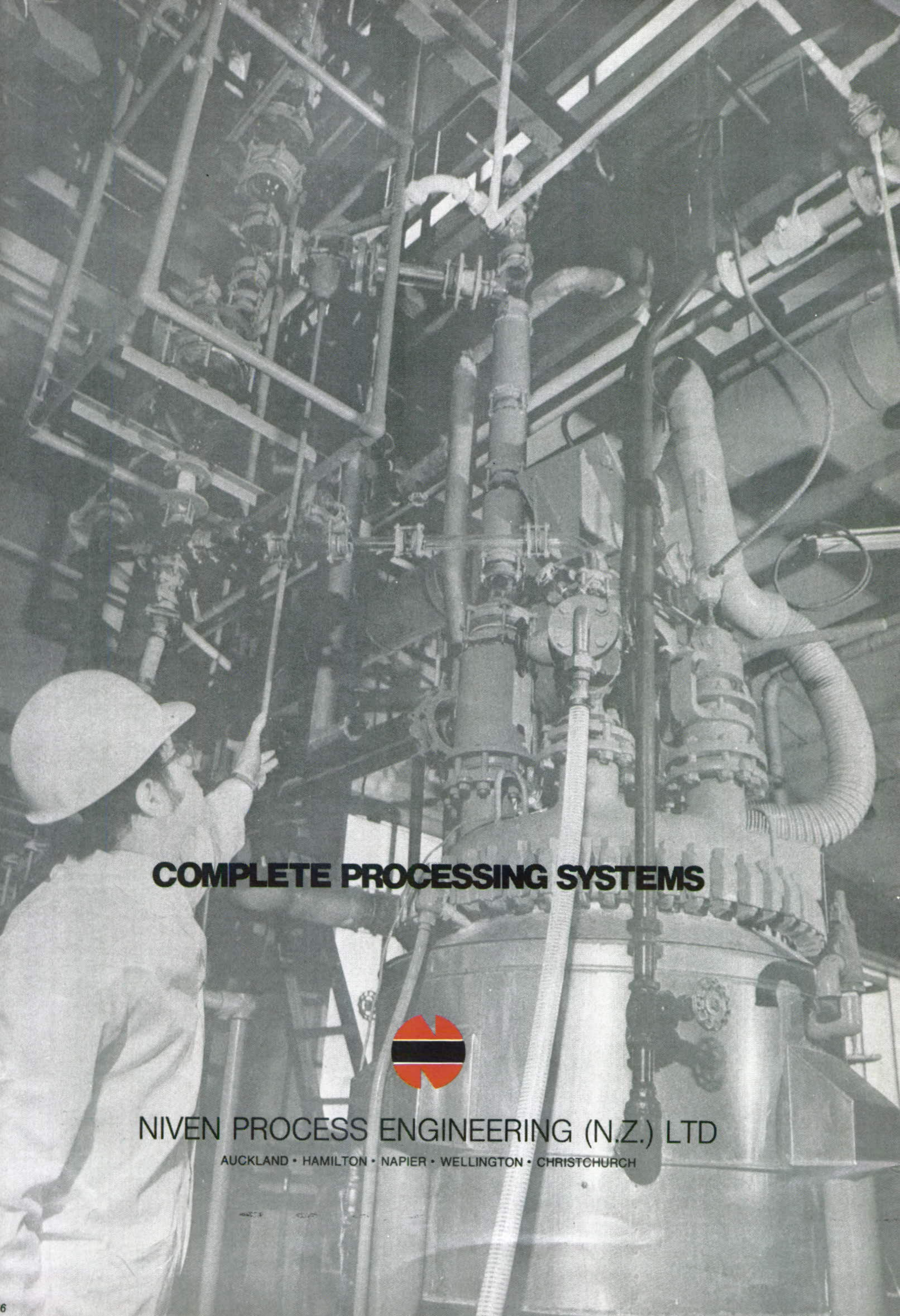
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December 1980
Vol. 44 No. 6
ISSN 0110-5566

Published on behalf of the New Zealand Institute of Chemistry (Inc.), P.O. Box 1926, Christchurch.

Publishers: Tricom Publications Ltd., P.O. Box 8669, Auckland.

Cover:
Top photo: Perkin-Elmer HGA 500 furnace programmer, AS 40 furnace autosampler, HGA 500 graphite furnace, AA 5000 spectrophotometer, ICP 5000 autosampler. Below: Data 10 System. (See page 235 this issue.)

Chemistry in new zealand
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CONTENTS

STOP PRESS

Guest Editorial

Education In Chemistry

Chemical education is at present a major concern of many professional educators and professional chemists, as indeed is much of the overall teaching of science at both the secondary and tertiary levels.

As Chairman of the Universities Entrance Board, I am particularly conscious of the difficulties being encountered in arriving at syllabuses in chemistry which are balanced and relevent to the future needs of the present-day student. The NZ Institute of Chemistry is to be commended for its contribution, in this issue of the Journal, to the continuing debate on this relevant problem in education.

The first function of the Universities Entrance Board is to establish and maintain a common educational standard as a pre-requisite for entrance to NZ universities. In carrying out this function, the Board determines prescriptions and administers examinations at Forms 6 and 7. However, the status of the University Entrance qualification is such that its attainment has been the primary objective of most students at secondary school, whether they intend proceeding to university or not.

The University Entrance syllabuses for chemistry have been largely academic in content and designed as a basis for those proceeding at least to Stage III at university. However we now have the situation in chemistry where no more than a small proportion of secondary school students will continue the subject after leaving school. Only 20% of those entering for University Entrance will study the subject at Stage I at university and about 5% will continue to a more advanced level.

We thus have several groups of students taking Form 6 chemistry —

- those who have no further contact with the formal teaching of chemistry
- those proceeding to tertiary level institutions such as universities and technical institutes where chemistry is only taken as a pre-requisite for professional courses such as medicine, engineering, veterinary science, pharmacy, nursing etc. or for a degree in biological sciences
- the small minority making chemistry their career.

How can we cope with the teaching of chemistry relevant to all pupils under the one University Entrance syllabus? There is little doubt that the present academic emphasis in both the University Entrance and University Bursaries prescriptions is of little relevance to the majority of students. In NZ proposals are being studied to change the basis of university entrance from the Sixth Form to the University Bursaries Examination taken in the Seventh Form. Additional entry methods would be the accrediting of the most able, mature sixth-formers and students with a successful year of tertiary study in a teachers college or technical institute.

The University Entrance Examination as such would disappear and there would be a single sixth form award — Sixth Form Certificate — which would not be tied so closely to the University Entrance academic prescriptions, but to prescriptions which are more relevant to the 80% of students who do not continue chemistry at university. This move would go some way to alleviating the present problems, but there will need to be a continuation — and indeed an intensification — of the very good work that a number of dedicated school chemistry teachers and university staff have been doing to determine the most appropriate syllabuses for Forms 5, 6 and 7 as well as for the first-year courses at university.

Focus on the issues involved in the teaching of chemistry in this December number of the Journal will, I hope, help in stimulating informed discussion on the problems of teaching science and in particular chemistry, relevant to the 1980's.

A.T. Johns

Dr Alan T Johns M.Sc., Ph.D. (Cantab), FRSNZ, is currently chairman of the University Grants Committee, the Universities Entrance Board and the University Curriculum Committee. He is a past Director-General of the Department of Agriculture. Our report in the Journal for December 1965, recognising him as President of the NZIC, notes that at that time, he was also President of the Grasslands Association and the Animal Production Society as well as being Pro-Chancellor of Massey University. (It does not indicate what he did in his spare time!)

Comment

Polemics From The Pulpit

Our message for the December issue is one of peace and goodwill and we extend our Christmas benediction to one and all. We hope they spare a thought for the Great Chemist, and do not get too much involved with hazardous chemicals such as ethanol.

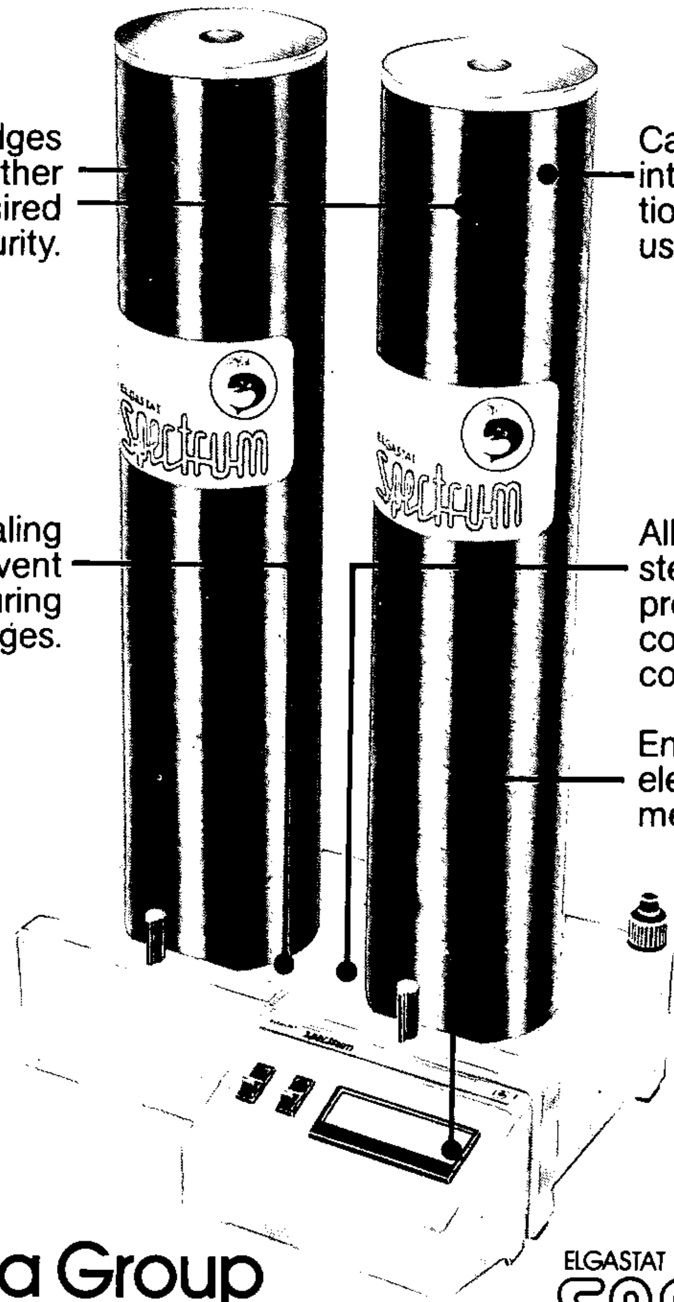
However this message is not one of unalloyed joy. In between times of earnest study of the Bible and Beilstein, we consult 'Nature' and other scientific periodicals, and were shocked to read of 'selfish' DNA; even the writer in 'Nature' said the 'notion was midly (sic) shocking'. The 'midly' puzzled us, and could be a misprint for 'middy' which in Australian means half a pint of beer, plunging us deeper into disconsolation over sinful science. The article (Nature, 26.6.80 p.604) tells us this selfish DNA is really 'junk' DNA; it gets into the cells and does nothing. This suggests real laziness, with overtones of the drug scene.

We experienced more depressing despair when we read in the same journal (29.6.80 p.311) of 'divalent spectator oxo bonds'. This surely indicates again laziness on the part of these bonds — why can't they get into the act and do something? We might have been able to bear this better had they been trivalent bonds, indicating some attempt to take action, but to be divalent indicates a reprehensible change of colour and shiftiness into different parts of the visible spectrum.

We feel that we have some support for our views on selfish DNA; the name apparently stems from a book entitled 'The Selfish Gene' which 'Nature' says '... may be a joke, but whole-organism biologists find it offensive.' We are glad to range ourselves (as far as our by-pass heart surgery permits) alongside these 'whole-organism' biologists; such scientists cannot be one-eyed. But moral turpitude goes even further: We read that selfish DNA has 'Lamarckian tendencies' and it would seem to us that the sooner it is put into an institution of some kind the better.

The Selfish Gene suggests another sector of sin since it smacks of male chauvinism. We cannot believe that there are not selfish Johns also. Here may we express our approval of the decision to award a woman chemist $100,000 damages, because she claimed that she had been discriminated against with regard to an appointment at the University of Minnesota. A certain Judge Lord, who was involved in the case said somewhat equivocally, 'The argument that academic excellence and equal opportunity principles (are) in conflict is so much hogwash.' We looked up the word 'hogwash' to extend our legal expertise and found that it does not mean what it says — it relates to the pig's alimentation rather than its ablution. Which prompts us to add to our message of good cheer the hope that all our readers enjoy their Christmas 'wash'.

S.G. Brooker



What's Happening

Serendipitous solution chemistry - Part 1. A keen reader of the prestigious US journal 'Science' has found that it doesn't pay to spill peanut butter on that journal, since it dissolves printing ink. Since printing inks are oil-based, this phenomenon may be expected to be due to the oil in the p.n.b. A similar experiment with 'Chemistry in NZ' failed, and we had the p.n.b. on a bun afterwards.

The US Government recently set up a task force to review data incriminating **nitrite in food.** Plans to phase it out were based on work by Paul Newberne of MIT. After examining 50,000 of his slides the task force decided that "... there is no basis at this time to initiate any action to remove nitrites in food."

Recent work at the University of California at Berkeley has linked the rather **sudden end of the dinosaurs 65 million years ago** with unusually high concentrations in the strata of iridium taken from 3 different locations — one in Denmark, one in Italy, and one at Woodside Creek, NZ. Woodside Creek? The NZ Atlas has 2 Woodsides, one in Wellington and one in Otago; which can it be?

Chemistry Catalyses Goodwill. A rather unique crossing of barriers has been achieved by the International Union of Pure and Applied Chemistry which recently signed agreements by which the Chinese Chemical Society in Beijing, People's Republic of China, and the Chinese Chemical Society in Taiwan both became member organisations of IUPAC.

110 hectares of **peppermint** are now being grown in New Zealand under contract to Mint Oil Industries, a joint venture between Mauri Bros and Thompson and an overseas user of peppermint oil. Most of the oil is used in chewing gum, followed by toothpaste and mouth washes, with a minor amount in confectionery.

Lead pollution: Snow from Greenland and Antarctica has shown a dramatic increase from .07 parts per billion to .22 since 1950, according to results presented at the 26th Congress of Pure and Applied Chemistry. On the other hand, though **carbon monoxide concentrations** in areas of congested automobile traffic can be enough to cause headache and dizziness (500ppm), amounts in the atmosphere of the Arctic and Antarctic are not increasing showing that the gas does not build up.

The two giants of the wood pulp industry in NZ are reported to have signed contracts with Japanese manufacturers for **electrolytic plants to manufacture chlorine and caustic soda,** with hypochlorite and hydrochloric acid as by-products. The cells do not use mercury, as is the case with NZFP's present plant, and will be more efficient than the present diaphragm cells at present being used bv Tasman P. & P. The special technology involved appears to lie in the nature of the membrane material and the use of high quality brine. The new plants will replace units now over 20 years old.

Serendipitous solution chemistry — Part 2. Further work on the effect of peanut butter on 'Science', conducted in a proper scientific manner, has shown that p.n.b. removed the ink in 17.9 seconds, but de-oiled p.n.b. took only 9.1 secs, and in fact the most active solvent of the peanut butter ingredients was a solution of the salt used to flavour it.

Plans are well in hand for our next issue, which will be a major feature of the **Institute's Golden Jubilee** celebrations. February 1981 has been chosen because, although the Institute was constituted at a meeting in November 1930, the first President, the late **Prof Emeritus W.P. Evans,** of Victoria College, was not elected until the following February. The issue will form part of the normal sequence of the Journal and its numbering, thus being in contrast to the Silver Jubilee issue which was completely separate and does not figure in many bound sets, so that it has become comparatively rare.

According to **Prof Jim Lovelock,** writing in 'Nature' and (with **Michael Allaby**) in the 'New Scientist' the risk to the **ozone layer** due to chlorofluorohydrocarbons from spray cans has been greatly exaggerated, and legislation banning these compounds should at least be deferred. The authors suggest that those who are concerned about the effect of a nuclear war on the ozone layer have got their priorities wrong, and probably their facts too.

Truth in Advertising has suffered another blow with the TV commercial about investing in gold Kruger rands, which are shown to be melting at 1400°. But gold melts at 1063°C (1945°F) and gold coins are usually 92 parts of gold and 8 parts of copper giving a melting point of 949°C (1740°F), so what are Kruger rands made of? (Many iron alloys and steel melt at about 1400°).

Efforts to enter the containment dome of the damaged nuclear reactor at **Three Mile Island** had to be abandoned because the inner door of an airlock could not be opened. The only theory of the cause of the trouble is believed to be corrosion, and further attempts to open it have been postponed indefinitely.

A new laboratory hazard: C Cameron and J Bolland, of the University of Strathclyde, Glasgow, have found that 68% of the workers in their laboratory hold their breath all the time they are shaking separating funnels, thus denying the brain vital oxygen during a period of vigorous physical activity, leading to early senility. We have in our time frequently used these bits of glassware, which explains any weaknesses in Chemistry in NZ.

A 2-clause bill introduced into the House on October 24, gives the Government sweeping control over **genetic engineering** in NZ. Under questioning from the Opposition as to why more detailed legislation was not brought forward, the Minister said he saw the Bill as a holding action until this could be done.

In our June issue we referred to the action takin by **Morrison** and **Boyd,** authors of a **text book on organic chemistry,** and their publishers, against **Solomons** and his publisher for a similar book on the basis of plagiarism. This claim did not succeed, but a case in which Solomons alleges disparagement of his book by the statements of the other authors had still to be heard at the time of writing.

Blood alcohol prosecution fails because of inadmissibility of computer readout. We have referred before in Chemistry in NZ to the DSIR's automated system for blood alcohol testing. Head space chromatography releases the alcohol, the content of which is registered on a chromatograph; the areas under the peaks are integrated and the result fed into a computer, which prints out the final report for the Transport Department. The analyst involved was required to give evidence, and while it was agreed that she was a competent analyst, she was not an expert in computer technology, and her testimony constituted what the legal wallahs call 'hearsay'. An appeal against an original conviction therefore succeeded. However we understand that legislation eliminating this legal loophole is being considered.

ENERGY EXTRACTS

Biomass is now big enough business in Britain for an association to be formed — the British Anaerobic and Biomass Association — BABA. It is headquartered at The White House, Little Bedwyn, Marlborough, Wilts.

The Union of Concerned Scientists in USA has published a book, 'Energy Strategies: Towards a Solar Future' (Ballinger Pub. Co., Cambridge, Mass., 1980 320pp $7.50 US) in which it argues that solar power is the only answer to US energy needs. The book has been reviewed in Chemical & Engineering News for July 14.

Anaerobic bacteria can convert biomass to methane. This approach, being pursued in North America, requires considerably less energy than conventional industrial waste treatments.

Energy research was the main topic at the 7th International Meeting of Chemical Society Presidents held in Switzerland last year. **Prof Fernand Gallais,** of France, said that his country's only hope was to develop nuclear power on a very large scale. At the same time, his country leads in solar power generation, having had a 1000kw. solar furnace operating for some years, and it is planned to have a much larger unit of 2MW operative in the Pyrenees next year. The mirrors will cover an area of 5 hectares. Under optimum conditions, the radiation power received is 13KW, so the overall rate of conversion is about 16%. Canada has large reserves of fossil fuels, but much of it is locked up in tar sands, development of which is being considered at an estimated cost of $7,000 million. In addition much of Canada's mineral wealth is in areas which are so inhospitable that turnover of personnel presents an almost impossible obstacle, according to **Dr Louis Renzoni,** president of the Chemical Institute of Canada. The country is therefore looking to nuclear power based on fission of uranium, of which it appears to have promising reserves. Japan is looking at gasification of coal very seriously, using coal from Australia. At the same time Japan converves fuel and energy; per capita

People

Prof R.C. Cambie, Auckland, is the NZ representative for 'Chemistry in Asia', the newsletter of the Southeast Asian Network for the Chemistry of Natural Products, which has its headquarters at Chulalongkorn University, Bangkok, where Prof Cambie attended the 4th Asia Symposium on Medicinal Plants and Spices in September. Copies of 'Chemistry in Asia' are held by Prof Cambie.

Mr John Beck has been promoted from Associate Director to be Director of Lion Breweries, replacing Sir Bernard O'Connell, who has resigned. Those of our members who knew the late **Mr 'Tas' McKee,** a very colourful member of the NZIC who died in 1973, were interested in a photo which appeared in the newspapers for October 15, showing members of his family drinking a bottle of special wine. 'Tas', who devoted his life to the exploration for and development of minerals in NZ, was a Director of L.&M. Oil, the company that first explored for petroleum in Taranaki 10 years ago, when he was presented with the bottle of wine, which he declared should not be opened until oil was found in this country. His daughter, Mrs Helen Fisher, decided that the conditions had been fulfilled with the finding at the McKee No 2 well.

Dr E.P. White, who gained a considerable reputation as an organic chemist for his work on facial eczema, among other projects at Ruakura, has retired. His new address is Woodlands Rd., R.D.1, Hamilton. **Mr D.M. Budhia** is now with NZ Aluminium Smelters, Bluff. **Mr B.W. Rountree** has left Borthwicks, Feilding for Waitaki-NZR, Imlay, Wanganui. **Mr P. Lever-Naylor** has resigned from the Australian Dairy Corporation, Becroft, NSW, to become Executive officer of ANZAAS, located in Sydney. **Dr Leslie Swindale** of the Crops Research Institute, Begumpet Andhra Pradesh, India, has been promoted from Director to Director-General. **Mr A.T. Morcom** has gained his Ph.D. from the University of Auckland, and joined the R & D staff at UEB Industries Ltd., Auckland. **Dr R.H. Furneaux** is now with Chemistry Division, Gracefield. **Mr M.K. Jogia** of the University of the South Pacific, Suva, is studying for his Ph.D. at Otago.

The perpetrators of our Crossword Puzzles, **Lawrie Kennedy** and **Mike Boland** of the Applied Biochemistry Division of the DSIR Palmerston North, are both going overseas, and there will be no further puzzles — unless someone else can step into the breach.

Our erstwhile Associate, **Dr Bill Denny** of Cancer Research, who has been in USA for the past year, is completing his stay overseas with a Professorship at the University of California at San Diego charged with the task of setting up a laboratory to synthesise DNA sequences of known structure. He says it is becoming clear with the present plasmid cloning techniques, that it is very tedious to obtain reasonable quantities (100's of mg) of short DNA, and at San Diego they are hoping to develop a method of total synthesis. He hopes in the allotted 4 months that he will learn enough to set up the capability in Auckland.

Dr Peter Steel ex Canterbury, who has been doing post-doctoral research at Montpellier, France, has been appointed assistant lecturer there. Before going to France, he was at the University of Sydney.

We recently met **Frans Setiabudi** from Indonesia, who has completed a Doctorate in organic chemistry at the University of Braunschweig, Germany, and has an appointment there until next May. He is of Chinese extraction, and although his family has been in Indonesia for several generations, this prevents him from obtaining a position in that country, and the openings for graduates in Germany are not very good either. He is looking for a position in NZ, where he has relatives, and his fluent German could be an asset. Anyone interested in Frans should get in touch with the Editor or **Dr John Spedding** at the University of Auckland.

We have removed the stamps showing **Lord Rutherford** from our collection, since we read recently in the 'New Scientist' that he said on one occasion that Physics is the only true science — all the rest is just stamp collecting.

Our **Bill Denny** has sent us a cutting from the 'Los Angeles Times' saying that the Florida Power and Light Co. and the US Customs Service are hoping to fuel a power plant with marijuana and hashish seized from drug smugglers. **Mary Ann Linden,** a company spokesman (sic) is reported to have said, 'We plan to run some tests before we go into a full-scale Burn.'

What's Happening (Cont)

consumption is only one third of that in USA, because of highly developed transportation systems and small living quarters. **Dr Y. Yukawa,** President of the Chemical Society of Japan, also listed a wide variety of chemicals which are being used in fundamental studies in the conversion of photochemical energy to chemical energy. (Chemistry International, 1980, No 2.)

The Seveso Incident: The Italian Parliamentary Commission of Enquiry has not produced anything definite in its report on this matter. The direct cause of the accident was a rise in temperature to 230°C. plus, when an exothermic reaction could start, but the plant is heated with steam and there seems to be no reason why this temperature should be reached under the conditions obtaining when the accident occurred. The Givaudin Company which owns the plant has still to make its own investigations public.

New Specialist Group

At a meeting convened at the Institute Conference in Palmerston North, it was decided to form a specialist group with the title 'Inorganic and Organometallic Group'. The functions of the Group will be as follows:

1. To provide a member(s) to co-ordinate the Inorganic and Organometallic Chemistry Programmes at Institute Conferences.
2. To provide a mechanism whereby information about overseas visitors could be readily distributed throughout the Branches. Itineraries for visitors could be coordinated and information about travel by members within NZ (e.g. to attend Ph.D. oral examinations) could be disseminated.
3. To investigate and promote the holding of 'mini-symposia' on topics of particular specialist interest within the Group.

Notices regarding the formation of the Group have been sent to all Branch Secretaries for distribution among members with interests in the fields of Inorganic and Organometallic Chemistry. Further information about the Group can be obtained from the secretary: **Dr Jim Simpson,** Department of Chemistry, University of Otago, Box 56, Dunedin.

LIPIDS IN CEREAL TECHNOLOGY

A 2-day symposium is to be held at 14 Belgrave Square, London, on January 29-30, organised by the SCI Oils and Fats Group in association with the Food Chemistry Group of the Royal Society of Chemistry. The meeting is intended to present recent developments and an up-to-date appraisal of the composition, properties and role of lipids and lipid-degrading enzymes in cereals and cereal products. Further information and registration forms will be available from the SCI Conference Secratariat, 14/15 Belgrave Square, London, SW1X 8PS, UK.

COMO 10

The 10th Conference of the Coordination and Metal Organic Division of the Royal Australian Chemical Institute will be held in Queenstown May 10-14, 1981. The Conference will be sponsored jointly by NZIC and RACI. Particular fields to be emphasised at the Conference will include theoretical and structural studies, catalysis in relation to energy resources and the application of coordination compounds to biological chemistry. Plenary lectures will be given by **Prof Larry Dahl** (University of Wisconsin), **Prof Peter Vollhardt** and **Prof Ken Raymond** (University of California, Berkeley).

Further Conference information is available from **Dr Jim Simpson,** Department of Chemistry, University of Otago, Box 56, Dunedin. Intending participants who have already indicated their interest in the Conference should have received a second circular by now.

Central Institute of Technology

Seminars recently held include: "Pharmaceutical Research in New Drug Development" by **C.J. Budgen,** and "What is the Pharmaceutical Industry in NZ?" by **R.W. Martin,** Executive Director, Pharmaceutical Manufacturers' Association.

Wallaceville Animal Research Centre

Seminars recently held include: "Intravaginal Devices for the Sustained (Controlled) Release of Chemicals/Polymer Release Systems" by **R.A.S. Welch,** Ruakura Animal Research Centre, and "Plasma Pepsinogen" by **J.C. Turner,** Membrane Biology, Wallaceville.

BRANCH NEWS

Manawatu

At the Branch AGM on October 13, **Dr Cecil B. Johnson** was elected Chairman for the coming year. **Mr Mark W. Pritchard** (Secretary), **Dr John Shaw** (Treasurer), **Mr E.C. (Ted) Fletcher** (Hawke's Bay Representative) and **Dr O. Keith Sewell** (Taranaki Representative) were re-elected for another term. Other members of the new Committee include **Mr Stan W. White** (Ex-officio, Past Chairman), **Dr E.N. (Ted) Baker, Dr Vaughan Crow, Mr Tony Gerritsen, Dr Ken Whittle** and **Dr John Kirkman.**

The Chairman's Address was given by **Mr Stan W. White** (Works Chemist at Borthwicks-CWS, Fielding) on "A Chemist in the Freezing Industry". Mr White discussed the processing of sheep from slaughter to freezing for export, with particular reference to recently introduced hygiene regulations. He also described effluent treatment, sausage casing production and a deboning machine for removing the last traces of meat from bones.

Prof Frederick Kaufman (Department of Chemistry, Pittsburgh University), the present Erskine Fellow at Canterbury University, recently addressed a combined meeting of the Branch and the Chemistry Department at Massey University on "Stratospheric Ozone Chemistry: Present Status and the Chlorofluorocarbon Problem". Prof Kaufman provided the meeting with a brief background of stratospheric chemistry, before describing some laboratory and upper atmospheric research. He described difficulties in verification of the halocarbon problem, particularly to point out political, economic and human components of the problem.

A group of members, ex-members and potential members in the Napier - Hastings area held a successful informal meeting on 21 October. Those present at the meeting represented a wide range of occupations and interests. Another meeting is planned for mid-February to be held, by invitation of **Peter Krafft** and **Anne Coles,** at the Leopard Brewery. Further information can be obtained from **Peter Dawson** (Napier 446-323) or **Ted Fletcher** (Napier 777-769) in the evenings or weekends or **Godfrey Husheer** or **Barry Streeter** (Napier 439-218) during business hours.

Science Fair

The 6th Manawatu Science Fair was held at the Queen Elizabeth College Hall, Palmerston North, during September. There were 264 exhibits displayed by pupils from intermediate and secondary schools in this area, with the two best exhibits being entered in the Philips NZ Science Fair in Wellington. Exhibits were classified under Biological, Social, Physical and Earth Sciences in Intermediate, Secondary and Senior Open Classes. The local branch of the NZIC donated two prizes for the best entries in the Chemistry Section.

Within this section, topics displayed included various crystals and batteries, anodised aluminium and studies of rust and the action of acids on metals. Prizes were won by **Mark McGee** of Ross Intermediate School, Palmerston North ("A Chemical Garden") and **Mary MacDonald** of Awatapu College, Palmerston North ("Water and Green and Bleach = ?")

Wellington

In October the annual "Mellor Lecture" was delivered by **Dr Cyril Childs** (Soil Bureau, DSIR) on "The Ruddy Earth; Iron Oxides in Soils and Streams". His address covered, in particular, the mineralogy of the chemically "active" iron oxides which have small particle sizes and large surface areas. Dr Childs also described recent work on determining the structure of some of these oxides, previously thought to be amorphous but which have short range structural order.

Otago

In September **Dr David Forss** gave a very interesting talk entitled "Odours and Flavours from Lipids". It covered the development of odour and flavour research over the last 20 years and was well appreciated by the large audience present.

In October a special meeting was held with the Otago Science Teachers' Association to discuss educational changes required in the secondary school chemistry syllabus.

Later in the same month, former NZIC President, **Prof Arthur Campbell** gave a talk on Analytical Chemistry. As well as covering recent advances in analytical chemistry, this talk covered the place of analytical chemistry in the University undergraduate course and analytical chemistry as a profession.

News From Govt. Departments

DSIR

Applied Biochemistry Division

Dr Laurie D. Kennedy of the Biochemistry and Microbiology Group of Applied Biochemistry Division left in October for 14 months' study leave. Dr Kennedy will be working with **Dr W.J. Whelan,** University of Miami, Florida on glycogen biosynthesis.

Dr Frank R. Visser recently resigned from the Food Technology Research Centre, Massey University, to take up a position at ABD. Dr Visser is to develop research on chemical aspects of food composition in relation to the processing industry. He will initiate analyses of selected foods for NZ food compositional data.

Mrs Jane E. Lancaster (ABD, Lincoln) returned at the end of September from 4 months' study leave, in a centre for work on the metabolism of the flavour precursors in onions, at Liverpool University.

Mr Rod Asmundson also recently returned to ABD after 3 years at the Chemistry, Biochemistry and Biophysics Department, Massey University, where he has been studying for a Ph.D. on the aerobic and anaerobic electron transport pathways of propriono-bacteria.

Dr R.L. Bieleski, Director, Division of Horticulture and Processing, Auckland, gave the local Divisions "A Cooks Tour of Horticultural Processing in NZ" in September. Dr Bieleski briefly described aspects of processing of many food items. Increasing pressures for the processing of new foods will result in the development of further research facilities in the near future. Many processing problems arise from variations in the supply and demand for raw materials leading to the requirement for innovative research rather than the adapting of overseas products. Many other Divisions and Research Associations are also involved in various aspects of this work.

Dr Ray W. Brougham, Director, Grasslands Division, recently presented to the local Divisions a very interesting and informative seminar on his visit to China. He described the landscape and various agricultural possibilities and problems in the areas that he visited. These areas included the Shansi and Kwangsi Provinces and the Huang Ho (Yellow) River Delta.

Chemistry Division

Dr R.H. Furneaux, a graduate of Victoria University, who has been in USA, on Post-Doctoral Fellowships, has joined the Applied Chemistry Section. **Dr K.R. Markham** has returned to the Division following 15 months at Reading University, UK. He has been promoted to Group Leader with responsibility for the Food, Natural Products and Organic sections.

Dr Margaret Bailey has transferred to the Commission for the Environment. **Mr R.J. Norris** has transferred from the Toxicology section to the Auckland Branch Laboratory of the Division. **Mrs C.A. Brown** has left the Forensic Section to take up one year's maternity leave. Mrs Brown gave birth to a daughter on October 23, 1980. **Dr R.H. Newman** recently gave a seminar at the Division on "Nuclear magnetic resonance in soil science."

Dairy Research Institute:

Dr Kevin R. Marshall recently visited Melbourne to present a paper at the Australian Academy of Technological Sciences Workshop on "Food Wastes for Profit". His subject was the uses of ultrafiltration and reverse osmosis in treating food washes generally and whey in particular.

Mr V.T. Vickers recently attended the IDF Annual Sessions in Bristol and, after fact-finding visits to Research Institutes in UK and Scandinavian Dairy Architectural Groups, he travelled to Spain to attend an International Symposium on Energy in the Food Industry.

University News

Auckland

On February 1, 1981, **Prof P.B.D. de la Mare** will step down from his post of Head of the Chemistry Department. He will continue to serve as Professor of Chemistry and hopes to devote much of his time to his research interests as well as taking on extended teaching duties in Physical and Physical-Organic Chemistry.

Prof D. Hall has been appointed as the new Head of Department and will take up his duties on the same date. Prof Hall is a graduate of Auckland University, receiving B.Sc. (1949), M.Sc. (1950), Ph.D. (1955) and D.Sc. (1969). He has been on the staff of the Chemistry Department since 1950, as a Professor since 1965, except for a 2-year period in 1966-68 when he joined the Chemistry Department at the University of Alberta. At various times he has spent leave periods at the Atomic Energy Research Establishment at Harwell, at the Crystallography Laboratory of the University of Pittsburgh, and at the Medical Research Council Laboratory for Molecular Biology at Cambridge. His longstanding research interest has been X-ray crystallography, his studies centring for many years on co-ordination compounds (mainly in conjunction with **Prof Neil Waters**) and organometallics. In recent years his emphasis has moved to computational analyses of the packing of molecules in crystals, and of the conformations of flexible molecules, with particular interest in polypeptides. He is the author or co-author of 115 scientific papers.

Dr Peter Boyd has been promoted to Senior Lecturer.

Dr John Packer has been promoted to be Associate-Professor. He recently attended the biennial AINSE Conference on radiation chemistry at Lucas Heights, Sydney. Dr Packer is Editor of the Auckland Branch's very successful publication, 'Chemical Processes in NZ', copies of which are still available.

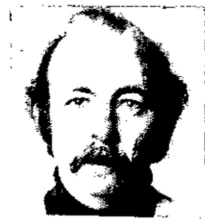
Associate-Prof D.J. McLennan has recently returned from a period of condensed leave. He attended the IUPAC Physical Organic Conference in Santa Cruz, California, and also visited the University of Arkansas, and Universities in UK, Israel, and Ireland. He will now settle down to his duties as Secretary for the 1981 Jubilee Conference.

Dr A.J. Easteal will be on study leave for the whole of 1981 which will be spent at the Diffusion Research Unit, Australian National University, Canberra.

Dr M.J. Taylor returned from study leave in September, most of his time being spent at Oxford and the University of Windsor, Ontario. Subsequently he has received a UGC grant to provide argon ion and dye laser excitation sources for Raman spectroscopy.

Prof Jack Garnett, of the University of NSW, visited Auckland in November and spoke at the University on 'Grafting to Natural and Synthetic Polymers', and he also addressed the Oil and Colour Chemists' Association. He has recently received the prestigious H.G. Smith Award of the RACI.

de la Mare



McLennan

Massey

Dr David A.D. Parry, Department of Chemistry, Biochemistry and Biophysics, is at the CSIRO Division of Protein Chemistry in Melbourne until Christmas. He is also visiting research establishments in Sydney.

A keen interest was shown in the recent Palmerston North City Council elections by many members of the Staff of the University. **Miss R.J. Leeming** (Sociology Department) was re-elected to the Council. Unsuccessful candidates were **Messrs V.J. Chettleburgh** (Registry) and **M. Gatenby** (Information Office), **Dr D.R. Husbands** (Department of Chemistry, Biochemistry and Biophysics) and a sitting member **Dr G.F. Serrallach** (Biotechnology Department). A similar enthusiasm should be again shown at the next elections.

Parts of the Science Towers at the University are being modified to provide storage areas, in particular for the Library until it is extended. Rooms within the Towers are to be changed to provide new lecture theatres and laboratory space.

Victoria

Mr Dennis Nelson has won the prize for the best student paper presented at the Australasian Foundation for Dental Research Conference in Adelaide. The prize provides partial funding for Mr Nelson to attend the international dental research conference in U.S.A.

Dr Robin Speedy has returned from the Gordon Conferences organised by the American Society and held in New Hampshire, USA. He visited a number of laboratories during his time away.

Prof Neil Curtis is spending his research leave until May 1981 at the research school of the Australian National University.

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Otago

Nutrition Dept.

Prof Marion Robinson as Chairman and **Dr Barbara Guthrie** as Secretary are planning a workshop on trace elements in NZ to be held in Dunedin on May 20-21, 1981. The workshop is being planned as an informal satellite meeting to follow the 4th International Conference on Trace Element Metabolism in Man and Animals in Perth, W. Australia. Anyone wanting more information can contact Dr Guthrie.

MEMBERSHIP OF THE NEW ZEALAND INSTITUTE OF CHEMISTRY

Membership of the Institute enables you to attend meetings of the Branches, receive the Journal, newsletters, salary surveys, attend the Annual Conference and to keep in touch generally with the activities of Chemists in New Zealand.

Several grades of membership are available to all employed in the field of Chemistry.

For further details write to:

The Registrar, N.Z.I.C P.O. Box 1926, CHRISTCHURCH.

The Technical Institutes: Faith, Hope And Mostly Stamina

Gail P. Irwin
Wellington Polytechnic, Private Bag, Wellington

SUMMARY

The course of structure and syllabuses for Chemistry 3, 4 and 5, and Biochemistry 1 and 2 are outlined. The discussion includes background material on the technical institute 'system' and possible future developments.

The 5-year chemistry and biochemistry courses in technical institutes lead to the award of a NZ Certificate in Science (NZCS). The Authority for Advanced Vocational Awards (AAVA) prescribes the courses (Tables 1 and 2) and syllabuses, conducts examinations and awards the certificates. Chemistry 1 and 2 are equated to school certificate and university entrance respectively. On entering technical institutes, most NZCS students have studied sufficient science at school to gain exemptions for all subjects of the first two years except Communications English for which no exemptions are given. Consequently, most successful students require 3 years part-time study. Most students enter laboratory based employment direct from school, although in recent years there has been a trend towards full-time enrolments at year 3. The students must be suitably employed before beginning year 4 of the course. With the maximum possible exemptions from the first two years, a minimum of 1200-1300 hours of formal tuition plus three years of suitable employment are required before the NZCS is awarded.

The NZCS Syllabuses

The syllabus for Chemistry 3 (Table 3), quite correctly as evidenced by student abilities, assumes very little previous knowledge of chemical principles. Year 4 (Table 4) supposedly teaches the remainder of pure chemistry needed by technicians and year 5 (Table 5) is applied chemistry. Biochemistry 1 (Table 6) has a prerequisite of Chemistry 3 and is an introductory course in biochemistry with emphasis on analytical aspects. Biochemistry 2 (Table 7) contains more advanced subjects.

Gail Irwin (nee Wilkins) was educated at Otago Girls' High School, Heretaunga College, Victoria University of Wellington and Waikato University. She was awarded the Wellington NZIC Chemistry 1 prize in 1965, graduated M.Sc. with first class honours in 1968 and D. Phil. in 1971. From 1966 to 1971, she was associated with the biochemistry section at Wallaceville Research Centre (MAF). At various times during her university courses, she was employed as demonstrator and tutor in Chemistry by both Victoria and Waikato Universities. In June 1971, she was appointed to her present position at Wellington Polytechnic where she is now a Senior Tutor. She is actively involved with AAVA as a member of the Science Course Committee and a deputy for the Authority itself, and with the NZ Association of Teachers in Technical Institutes, as Chairman of the local branch and a member of the Executive. She joined NZIC in 1968, was a branch committee member for one year during which every committee meeting clashed with her classes (!) and is at present a Councillor of the NZ Association of Scientists.

One of the important aims of NZCS courses is to teach laboratory skills. Thus most syllabuses include suggested and, often, compulsory laboratory experiments. The apparatus provided is similar to that in their own laboratories. These mandatory experiments are considered to be an integral part of the course and are examinable. Most tutors agree in principle, but wish to see the number of such experiments reduced to give the students sufficient time to attempt each experiment. With nationwide external examinations at the completion of years 3 and 5, student performance may be determined by how much of the practical syllabus was actually covered in each institute.

Over the years, the syllabus revision has tended to involve the addition of material without concomitant deletions, resulting in continual expansion. The actual number of hours (Table 8) per annum (including revision and assessment times) usually exceeds the suggested time allocations given in the syllabuses because of the amount of material which must be covered. Most employers will give the trainees 8 hours per week on day-release. With the addition of two evenings per week in the student's own time, this gives a practical limit of 12-16 hours per week tuition for all subjects.

Interviews with NZC holders showed an almost unanimous disapproval of late night classes. '... After a day's work you don't take much in ... listening to a lecture is a dead loss after 7pm.'[3] Much formal homework is necessary. With most students spending 2 evenings per week in classes, over and above normal working hours, and tutors doing 24-27 class contact hours per week, this homework and its evaluation become an onerous burden. Little time, and few facilities, are available for remedial work with students.

Career Prospects

The NZCS holder is preferred by most employers and is on a higher salary than the recent B.Sc. graduate. Nevertheless, many NZCS students feel 'under-used' once they have gained their qualification.[4] Employers should attempt to give the NZCS holders more responsibility and recognition if they wish to retain them. Laboratory based employment gives little prospects of future promotion. Only limited opportunities are available for transferring to the professional classification necessary for advancement in the Government service. There is a gradual movement of NZCS (Chemistry) personnel towards private industry [5] where many find managerial positions.

Allied with this change in the nature of the employment is study continuation. It has been shown that 52% of those gaining an NZCS prior to 1970 embarked on further study.[6] Those shifting towards management may study allied subjects in the technical institutes, while those desiring a laboratory career often begin university studies.

The cross-credits given for NZCS (Chemistry) vary between the universities, but they usually equal 1/3 of the B.Sc. course. Increased cross-credits would diminish the cost to the taxpayer and relieve the frustrations felt by these mature students who are forced to repeat much material.

TABLE 1

Course Structure : NZCS (Chemistry) [1]

Subjects of the first two years (seven required) :

Compulsory:	Chemistry 1	Mathematics 1
	Chemistry 2	Mathematics 2
	Communication English	
Balance from:	Biology 1	Mechanics 2
	Biology 2	Physics 1
		Physics 2

Subjects

Year 3 Chemistry 3
AND TWO OF:
EITHER Biology 3 OR Medical Biology

Mathematics 3	Laboratory Technology
Physics 3A	Geology 1
Elements of Statistics	Food Science 1

Subjects

Year 4	Chemistry 4A	Year 5	EITHER:
	Chemistry 4B		Chemistry 5A
	Chemistry 4C		Chemistry 5B
	AND ONE OF:		Chemistry 5C
	Biochemistry 1		AND ONE OF:
	Microbiology 1		Chemistry 5D (i)
	Instrumentation		Chemistry 5D (ii)
			OR
	Applied Statistics 1		Biochemistry 2
	Mathematics 4		AND ANY TWO STAGE 5
	Numerical Methods		Chemistry papers

TABLE 2

Course Structure: NZCS (Biology) [1]

Subjects of the first two years (seven required):

Compulsory:	Chemistry 1	Biology 1	
	Chemistry 2	Biology 2	
	Mathematics 1	Communication	English
one from:	Mathematics 2	Mechanics 2	
	Physics 1	Drawing	

Subjects

Year 3 Biology 3 OR Medical Biology

AND TWO OF:	Laboratory Technology
Elements of Statistics	Geology 1
Chemistry 3	Food Science 1

Year 4	TWO OF:	Year 5	TWO OF:
	Biology 4		Biology 5A
	Microbiology 1		Biology 5B
	Biochemistry 1		Biochemistry 2
	Applied Statistics 1		Microbiology 2

TABLE 3

Outlines of Chemistry 3 Theory Syllabuses[2]

1. Physical and Inorganic Chemistry:
   - 1.1 Gas Laws
   - 1.2 Thermochemistry
   - 1.3 Expressions of Concentration
   - 1.4 Equilibria in Aqueous Solution
   - 1.5 Electroanalytical Methods
2. Analytical Chemistry:
   - 2.1 Gravimetric
   - 2.2 Titrimetric
   - 2.3 Precipitation Titrations
   - 2.4 Complexlmetric Titrations
   - 2.5 Visible Spectrophotometry
   - 2.6 Qualitative Inorganic Analysis
3. Organic Chemistry

TABLE 4

Outline of Chemistry 4 Theory Syllabus [2]

Physical Chemistry (4A)

1. Equilibria in Solution
2. Colligative Properties
3. Phase Rule and Relationships
4. Kinetics
5. Electrochemistry

Organic Chemistry (4B)

1. Stereochemistry
2. Mechanisms of Organic Reactions
3. Revision and Extension of Functional Group Chemistry
4. Heterocyclic Chemistry
5. Difunctional Compounds
6. Analytical Organic Chemistry

Inorganic Chemistry (4C)

1. Chemical Bonds
2. Descriptive and Analytical Chemistry

TABLE 5

Outlines of Chemistry 5 Theory Syllabuses[2]

General and Physical Chemistry (5A)

1. Coordination Chemistry
2. Applied Radiochemistry
3. Applied Equilibrium & Process Rates
4. Absorption of Light by Molecules
5. Colloids
6. Electrolytes and Electrochemistry

Applied Organic Chemistry (5B)

1. Spectrometry
2. Carbohydrates
3. Amino Acids, Peptides & Proteins
4. Lipids
5. Surfactants
6. Polymers
7. Vitamins
8. Terpenes
9. Synthetic Dyestuffs OR
10. Pesticides and Herbicides

Applied Inorganic Chemistry (5C)

1. Air
2. Water
3. Silicates
4. Metals

Analytical Chemistry (5Di)

1. General Considerations
2. Atomic Emission and Absorption
3. Electrochemistry
4. Chromatography
5. Thermal Methods of Analysis
6. Infrared Spectroscopy
7. Autoanalyser Systems
8. Micromethods (Classical)

Industrial Technology (5Dii)

1. Principles of Chemical Engineering
2. Unit Processes
3. Corrosion of Metals and Alloys
4. Process Measurements and
5. Quality Control
6. Legal and Safety Requirements

TABLE 6

Outline of Biochemistry 1 Theory Syllabus [2]

1. **The Cell**
2. **Biochemical Techniques**
3. **Buffers and Their Biological Role**
4. **Chemistry of Amino Acids and Proteins**
5. **Enzymes**
6. **Amino Acid Metabolism**
7. **Chemistry of Carbohydrates**
8. **Metabolism of Carbohydrates**
9. **Chemistry of Lipids**
10. **Metabolism of Lipids**
11. **Digestion and Absorption**
12. **Nucleic Acids**
13. **Integration and Control of Metabolism**

TABLE 7

Outline of Biochemistry 2 Theory Syllabus [2]

1. **Proteins and Enzymes**
2. **Biochemical Organisation of Cells**
3. **Intermediary Metabolism**
4. **Nitrogen Economy**
5. **Nucleic Acids and Protein Synthesis**
6. **Additional Topics: Blood, Muscle, Photosynthesis, Plant Hormones, Microbial Fermentations, Plant Phenolics, Terpenoids.**
7. **Experimental Methods and Techniques: Biochemical Reagents, Isotopes, Chromatography, Techniques in Protein Isolation, Oxygen and Carbon Dioxide Measurements, Centrifugation, Electrophoresis.**

Technical Institutes (Cont)

Another avenue for higher qualifications is the provision of advanced courses by the technical institutes. In chemistry and biochemistry the recently approved AAVA Diploma in Science, which requires two or more years' part-time research on a work-related topic, is filling a need, as shown by increasing enrolments. It is to be hoped that this qualification will be recognised by employers and used as the basis for improved technician career opportunities.

Funding of Technical Institutes

Accurate attendance registers are an essential part of the technical institute funding system. These figures are the basis on which the entire technical institute system is financed and on which staff is provided for the following year. With widely fluctuating student numbers from year to year, technical institutes can find themselves 'overstaffed' by the formula based on the previous year, yet with a much higher teaching load.

The incidentals grant, which covers consumables such as chemicals, is also based on a payment for each hour spent in class by each student. A funding system which effectively punishes the institutes if a student is absent is absurd. This payment has not kept pace with the rapidly escalating price of chemicals. Budgeting has become a nightmare and over-spending is often necessary merely to provide the specified practical tuition. Better methods of assessing the institutes' needs in terms of accommodation, staffing and finance must be found.

Financial restrictions are having adverse effects on the functioning of AAVA. One of their major cost items is the air travel of personnel involved in syllabus revision committees etc. Rapid price escalation is likely to overturn the traditional revision procedures and to limit their response to demands for change from industry.

AAVA has a new policy of reconsidering each syllabus every five years. Financial and staffing restraints have so far prevented the revision of chemistry 3 (dated 1974) to make it more teachable in the time available, as desired by the tutors. It is hoped that this syllabus will be given top priority under the new policy.

TABLE 8

Typical Actual Annual Hours

Subject	Annual Hours		
	Theory	Practical	Total
Chemistry 3	72	108	180
Chemistry 4A	45	45	90
Chemistry 4B	45	45	90
Chemistry 4C	45	45	90
Chemistry 4A, B & C			270
Chemistry 5A	40	70	110
Chemistry 5B	40	70	110
Chemistry 5C	40	70	110
Chemistry 5D (i)	40	70	110
Chemistry 5D (ii)	52	58	110
Chemistry 5 (4 papers)			440
Biochemistry 1	72	108	180
Biochemistry 2	72	144	216

Academic Staff

The tutors must have a thorough knowledge of their subject matter and be able to impart a genuine 'applied flavour' to the courses. To remain effective, they need an opportunity to keep up to date with the technological developments in the wide range of topics taught. Refresher leave of 12 weeks after the first 5 years and at 10 yearly intervals thereafter has been introduced. Such leave must be more frequent if it is to achieve its stated purpose.

Several suggestions have been made for facilitating greater job satisfaction and up-dating of techniques. One involves the setting up of applied research facilities [7,8] and another the establishment of centres for the testing and certification of industrial or agricultural products in technical institutes.[9] More consideration should be given to such possibilities, which would provide useful facilities for the country at the expense of some teaching relief. Such a system does exist for technical institute teachers in Britain.[11]

Technical institute libraries receive very limited funds as compared to university libraries. Most of this money is used to provide student texts; tutor texts or scientific journals are rarely provided. With the vast increase in costs for science texts (e.g. the latest edition of 'Enzymes' by Dixon and Webb is priced at $82.50), some librarians are becoming reluctant to provide even student texts. Thus the libraries are barely sufficient for students and are totally inadequate for tutors.

The teaching requirements for technical institute tutors disrupt their family and social lives. As administrative duties occupy most of the 'spare' duty time, class preparation and marking is usually done at home in the tutors' own time. Most tutors have at least one evening class, which frequently clashes with meetings of professional bodies (e.g. NZIC) or other leisure pursuits. Collaboration between tutors in the same discipline but in different technical institutes is restricted, as no suitable forum exists. Unlike most public sector employees, tutors rarely receive expenses for attendance at professional conferences. More money and greater opportunities are needed to improve communications between institutes and with colleagues in other employment.

Conclusion: Some Challenges

All members of NZIC should be aware of what subjects are taught in the technical institutes. As parents and teachers, you should try to improve the school chemistry courses by demanding better facilities, especially in the laboratories, and more suitable courses for those wishing to make their careers in chemistry. For your children, consider the year 3 NZCS course as a possible alternative to the school seventh form. Make your children or pupils aware of technical careers and the day-release system. As taxpayers, consider the advantages of more cross-credits

Analytical Chemistry

A.D. Campbell

Professor of Chemistry, University of Otago.
NZIC President 1979 - 1980

Szabadvary in his History of Analytical Chemistry points out that the earliest known chemistry was industrial chemistry followed closely by analytical chemistry. The fire assay method for gold is recorded as far back as 1380 BC. Other branches of chemistry by comparison are quite newcomers. After 100 years of independent existence the Society for Analytical Chemistry is, as a result of amalgamation, the Analytical Division of The Royal Society of Chemistry. It is the second largest Division, second only to Industrial Chemistry. The next nearest is the Division of Organic Chemistry. When the International Union of Pure and Applied Chemistry was established in 1949 one of the six Divisions set up was Analytical Chemistry. It would therefore seem that analytical chemistry is an important subject.

The early scientists performed their own analyses. Their theories rested on their results and the person with analytical skills was a prominent man of science. Analytical chemistry flourished about the 18th and early 19th centuries when scientists were interested in the quantitative aspects of matter and in developing, proving or disproving fundamental theories about matter. Boyle is probably best known for the work on gases that carries his name and he is therefore regarded as a physical chemist. However, it is not so well known that besides his contribution to gas analysis he was one of the first to suggest indicators, he used sulphide for separations of metals and he was interested in the concept of sensitivity of a chemical reaction — a good analytical chemist.

About 30-50 years ago there developed another type of analyst. He had a good theoretical background and a wealth of experience in analytical chemistry. Many developed new analytical methods but gained little reward other than the satisfaction of a job well done: a mineral with all the constituents (expressed as oxides) adding up very close to 100%. Unfortunately they were looked on as "back room boys" but they were usually the mainstay of many a scientist of international standing. Perhaps already the status of the analytical chemist had slipped.

Today another person has entered the field. He follows a procedure without comment or concern, he may even be meticulous in attention to detail, but he is interested in learning very little about the reactions involved in the tests he performs. He is interested in getting a number, and providing he follows a set ritual he believes his number will be correct and meaningful, no matter what the matrix. We have instruments with a red button for stop and a green button for go. They are virtually idiot-proof in that inexperienced persons can do little harm. They may be easy to operate but a good knowledge is required to master the reactions and technology involved. A good operator must know what the instrument is trying to do and he should not only be able to interpret the data but also evaluate it. Is the data adequate for the purpose? Is the device performing as it should?

Today there is a tremendous renaissance in analytical chemistry. Instrumentation has undergone a fantastic change in recent years, so much so that it is difficult to gain experience with all the methods which are now available. Analytical chemistry seems to be developing into a series of specialisations with few people with even the facilities, let alone the time, to conduct research in more than a small group of related fields.

If we as analytical chemists are to fulfil the requirements of being well qualified in analytical chemistry we are going to have to do a lot of study. Belcher recently pointed out that although there are still available a number of analytical chemists of wide interest, experience and knowledge capable of assessing which technique is the best for a particular purpose within a given set of conditions, they are from another generation and are unlikely to be replaced.

Specialisation is increasing but it would be disastrous for analytical chemistry if only specialists eventually remained. They would be unable to judge objectively whether or not their own technique was the best for a particular analysis. This danger can only be avoided if our Universities are able to produce post-graduates who have a sound training (a very wide training) in analytical chemistry.

The analytical chemist must be trained to think. He should question irregularities, he should know and understand the processes he controls. Many scientists, many of them chemists, speak about routine analysis. There was never a more misleading term — it suggests all samples are identical. This is seldom the case and it is the odd sample which is frequently the most important one of them all. All analytical work requires a good grounding in chemistry, meticulous attention to detail and a very attentive mind. How then should we train our analytical chemists? There will be various levels required, the

Technical Institutes (Cont)

between the universities and technical institute systems. Request the provision of a system similar to that based on bursary examinations for those technical institute students who wish to transfer to the universities after successfully completing year 3. As employers, you should be familiar with the relevant course structures; AAVA syllabuses and notes for teachers and examiners. Offer your services whenever possible; examiners are always needed. Learn to appreciate the knowledge gained by your technicians. Try to create a worthwhile technician career structure.

It has been said that ...

"Only the technical and vocational sectors of education can show a direct relationship between the relevance of courses and the efficiency of teaching, and the productivity of industry and commerce."[10] Help us to help you.

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Chemistry — Fact Or Fiction?

A proposal for a revolution in the teaching of introductory chemistry.

R.J. Gillespie

It is my opinion that the introductory chemistry course is at the present time in a very unsatisfactory state and that a major change, indeed a revolution, is needed.

By introductory course I mean the first serious course in chemistry that assumes little or no previous knowledge of the subject. In North America this course is generally a one-year senior high school course that is normally repeated at a somewhat higher level in first-year university and is known as the General Chemistry course. It attempts to give a general introduction to the main areas of chemistry and its present content is typically represented by books such as those by Sienko and Plane and by Masterton and Slowinski. In New Zealand, I believe, students at high school generally get at least two years of chemistry and the first-year university courses are therefore at a somewhat higher level than the typical North American university first-year course. Thus my remarks are directed here in New Zealand mainly to high school teachers although some of them may also be of some relevance to university teaching.

I think that it is clear that both here and in North America there has been a growing sense of dissatisfaction with the introductory course and many teachers of chemistry have had a feeling that something is seriously wrong with it. There has in fact been a considerable amount of discussion on the subject both in Australia and North America. A conference was held at McMaster University in the summer of 1978 entitled "New Directions in the Chemistry Curriculum" at which many participants criticised present courses and made proposals for changes and in particular for the introduction of a considerable amount of descriptive chemistry. In Australia also, proposals have recently been made for some rather significant changes. I am referring particularly to "Chemistry for Australian Secondary Schools" which outlines the proposals of a committee of the Australian Academy of Science for a revised high school chemistry course. Its introductory sections formulate many of the criticisms that I will be making and I find myself in rather general agreement with the proposed curriculum.

Prof R.J. Gillespie was educated and carried out his early scientific work under C.K. Ingold at University College London, where he became a member of the Chemistry Department staff in 1948. His studies of the ionization of organic and inorganic molecules in sulphuric acid extended and corrected the pioneer work of A. Hantzch, and are now part of classical chemistry. In 1958 he moved to McMaster University, Ontario, Canada, where he has been Professor of Chemistry since 1960. In his work there, he is best known for his use of a wide variety of physical techniques to study the formation and properties of ions and molecules in superacid solvents. His great experimental and theoretical contributions in this area led to his election to Fellowship of the Royal Society in 1977. He is equally well known for his contributions to the teaching of chemistry; and, jointly with R.S. Nyholm, he was responsible for developing and applying the valence-shell electron-pair repulsion theory towards rationalising and predicting molecular geometry. Among his many other distinctions, he became The Chemical Society's 1979 Nyholm Lecturer. During his short time in NZ in 1980 as a Visiting Professor at The University of Auckland, he gave lectures also in a number of other centres. This article is the basis of an address given by Prof Gillespie while in NZ.

Chemistry has come to be seen by many high school and first year university students as a difficult and rather uninteresting subject which is to be avoided if possible. I believe it is attracting fewer students and fewer really good students than it used to. Whereas chemistry used to be a much more popular subject at high school than biology the reverse is true today. Of course there have been many important developments in biology in recent years which have increased its interest to students and to the public in general. Widespread concern over the deterioration of our environment has made biology a more fashionable and popular field of study. In contrast chemistry is seen by most students as a subject of very little relevance to the world around them and of little importance in their everyday lives. Of course chemistry has not become any less interesting or any less important than it used to be and it is a tragedy that many students should have an erroneous view of a subject that we, as

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laboratory supervisors with a broad knowledge of analytical methods right down to technicians trained to perform one or two determinations under supervision. We in the Institute of Chemistry should be particularly concerned with the more senior of the staff, the qualified staff who will be the laboratory supervisors.

But let us have a look at our Universities. In Europe we find most countries with good schools of analytical chemistry. Sweden with a population of 8.5m has 10 chairs in analytical chemistry. Even Bulgaria established a chair in analytical chemistry when it founded the new University at Sofia in 1907. In the British Isles chairs in Analytical Chemistry did not exist until 1958. In a survey of British Universities a few years back, of 106 chairs in Chemistry only four were described as analytical. Two of these no longer exist but two new chairs have recently been established. It is obvious that very few analytical chemists, no matter how talented, can ever hope to attain professorial status. Of 59 Departments of Chemistry surveyed, 38 had no specialist staff in analytical chemistry whatever.

And how about New Zealand? When chemists are asked to record their interest the largest number after University Teachers is the group professing to be Analytical Chemists. And our Universities? Unfortunately we derive our ideals not from continental Europe but from the British Isles where chemistry tends to be dominated by those with connections with a very small number of Universities with no tradition for analytical chemistry. Fortunately the position has brightened a little in New Zealand in recent years particularly with the introduction of options in advanced courses. At last it is possible in some of our Universities to take a course or courses of lectures and laboratory work on topics in analytical chemistry. How else can we train analytical chemists? But when will analytical chemistry be recognised as a division of chemistry teaching as an inorganic, organic and physical chemistry? Why teach analytical chemistry? It is almost like saying why teach chemistry, for if there were no analytical chemistry there would be no chemistry.

teachers, know to be of such profound significance and importance in the modern world. That they have this view must, I think, be blamed largely on the nature and content of the introductory chemistry course. It must also be admitted that students are to some extent reflecting current social attitudes towards science and to chemistry in particular, attitudes based largely on the obvious and unfortunate harmful environmental effects of the chemical and related industries.

In order to try to answer the question why students appear to find such a vitally important, fascinating and fundamental science as chemistry rather dull, uninteresting and irrelevant, let us look at the nature and content of a typical course. Most of today's introductory courses are derived from an earlier revolution in the teaching of chemistry that took place more than twenty years ago in the United States. The early Russian successes in space exploration caused much soul searching among science educators in the U.S. and vast amounts of money were spent to improve and modernise science courses. The introductory courses of the time were criticised as being dull catalogues of unrelated and unexplained facts. Of course, fifty or so years ago chemistry was a much more descriptive subject than it is today and text books continued to reflect that fact. Obviously the most profound change that has occurred in chemistry during the last fifty years is that it has become much more theoretical, that is to say, chemists have during this time developed many basic principles and theories which enable us to correlate and explain, or at least rationalise, many of the facts of descriptive chemistry. And it was this change in the nature of chemistry that the new courses such as Chem Study and CBA attempted to reflect. These courses did not attempt to present facts in a systematic manner based on the Periodic Table for inorganic chemistry and on functional groups for organic chemistry, but instead attempted to show that chemistry is a logical and exact science based on a number of principles and theories, many of them well established and accepted — others, unfortunately, of somewhat more dubious and less lasting value. This type of course, exemplified by Chem Study and most modern General Chemistry text books, may be described as the Principles of Chemistry course. This approach quickly found favour with teachers who enjoyed being able to develop chemistry in what seemed to be a logical and satisfying manner and it seems that initially this approach was well received by students. We must ask therefore why the present dissatisfaction — what has gone wrong?

Let us first look at the content of such courses. The more important concepts and principles that are normally included and which seem to be accepted as necessary for an understanding of modern chemistry are:

- Atomic structure, valency, the chemical bond and molecular structure, including an introduction to quantum mechanical ideas.
- Gas laws and the kinetic theory of gases.
- The crystalline state and ionic solids.
- Chemical equilibrium (acid-base and redox).
- Thermodynamics (1st and 2nd laws).
- Electrochemistry, including electrolysis and electrode potentials.
- Reaction kinetics.

No one would deny that all these subjects are needed for a full understanding of modern chemistry and they should all be studied at some depth by a student who intends to major in chemistry. But should they be in an introductory course and, if so, to what depth should they be treated? These concepts and principles have been developed as the tools with which we attempt to understand chemistry but they do not by themselves constitute the subject of chemistry. Chemistry is the study of materials — their properties and their transformations, or, in other terms, the study of molecules — their structures, their properties and their reactions. In today's introductory course based on concepts and principles, molecules and their reactions often appear almost incidentally, simply as illustrations of these principles. In my view the cart has been put before the horse: theories have been put before facts. Theories are needed only insofar as we have a body of facts to explain. Modern chemical theory is a great intellectual development but it is sterile and meaningless if it is divorced from descriptive chemistry. If a student has already received a thorough grounding in descriptive inorganic and organic chemistry such a heavy emphasis on principles might possibly be justified, but students do not have this basic knowledge before they take the general chemistry course. Thus in the general course not only does a student meet for the first time a number of difficult and often abstract ideas, but he is also bewildered by the names and formulas of a vast number of different substances and by equations for reactions that he has never previously heard of, chosen primarily to illustrate the particular principle or theory under consideration. For example, to ask a student to balance the equation for the oxidation-reduction between the dichromate ion and the oxalate ion is ridiculous if he has never previously heard anything about the chemistry of chromium or of carboxylic acids; it becomes merely an exercise in algebra and adds nothing to his understanding of chemistry.

It was, I think, the original intention that having dealt with all the necessary principles and theory one would be in a position to discuss descriptive chemistry in a logical, interesting and satisfying manner. This seems reasonable enough but it is perhaps not surprising in retrospect that many students have been persuaded that chemistry is a difficult, uninteresting and irrelevant subject long before they get to the real subject, that is, the descriptive chemistry that the theory was supposed to explain. It is most unfortunate, however, that this descriptive chemistry has now more or less disappeared from the introductory course. This has happened, I think, because there has been a tendency among authors and teachers to treat the principles and theories in the introductory course to an increasingly greater depth. A growing number of conceptually difficult and abstract ideas have been introduced and it has been found that increasingly lengthy explanations have been needed to put these ideas over to students who, in many cases, have scarcely reached the necessary level of intellectual development. Frequently also, in order to bring the level of the discussion of abstract concepts down to the level at which the student might understand them, the discussions have been so grossly oversimplified that they are very superficial. Thus the student is likely to get the impression that he has an understanding of a topic of which he has really only scratched the suface. It is in the areas of chemical bonding and thermodynamics particularly that one finds the most examples of sophisticated treatments beyond the intellectual capabilities of the average student and also the worst examples of gross over-simplification. With the tendency to include increasing amounts of difficult theoretical material and the need for lengthy explanations, some introductory text books have grown to enormous lengths, even up to 1000 pages! In others which have been kept to a more reasonable length the amount of factual or descriptive material has been drastically reduced. Even when the descriptive material is included it is customarily placed towards the end of the book, and as the books are generally much too long neither teachers nor students ever get to this part of the book in a normal one-year course. Teachers feel obliged to cover the principles and theories, and little time remains for descriptive material. Some, I think, salve their consciences by asking students to read the descriptive chapters, but the overworked student never has time to do this and, as the material is rarely tested, he soon realises that it is the one part of the book that he does not need to read.

There has been a continual trend towards too much theory and particularly too much conceptually difficult theory in our introductory courses to the exclusion of real chemistry, i.e. basic descriptive inorganic and organic chemistry. This trend has been spreading downwards from the university through the senior years of high school and even down into the junior years. It is unfortunate that teachers tend to feel that the best way to prepare students for university is to give them an introduction to all the difficult ideas that they will meet there. Hence the unfortunate student often gets twice, or even three times, over the same principles and theories at only a slightly more sophisticated level each time. It is my view that a considerable amount of the physical chemistry presented in these elementary courses should be replaced by descriptive inorganic and organic chemistry.

Of course it is true that students are still passing the tests and examinations on all this material that I have claimed is too conceptually difficult for them. This is because most students simply resort to learning the material by heart without gaining any real understanding. For example, almost any beginning student in chemistry can draw a diagram of a *p* orbital or an sp^3 orbital and he will receive full marks provided he is not asked to explain exactly what the diagram that he has drawn actually means. He cannot give this explanation because he has almost no understanding of the concept of an orbital. He has to accept that there are three *p* orbitals mutually at right angles and that tetrahedrally oriented sp^3 orbitals can be obtained by the, to him, mysterious process of hybridisation. He does not have the necessary background in quantum mechanics to appreciate why there are three *p* orbitals mutually oriented at right angles or how hybrid orbitals are obtained. Since the conventional explanation of molecular geometry depends on the directional character of orbitals, the student can have no real understanding of the theoretical explanation of molecular geometry although he can readily learn the jargon for the purpose of passing a test. That is why I made a statement in a lecture a few years ago that has since been rather widely quoted, namely that "the much criticised uncomprehending learning of facts has simply been replaced by the uncomprehending learning of theories".[1] In my view none of this orbital theory is necessary for a good basic understanding of simple inorganic and organic chemistry. One might as well simply tell the student that the four bonds formed by carbon are tetrahedrally oriented because that is all that he actually learns from the orbital theory that he does not understand and, in any case, is all that he needs to know to understand a rather large amount of organic chemistry. About all that the orbital treatment of chemical bonding does at this level is to convince the student that there is perhaps a theory that can explain why the four bonds of carbon have a tetrahedral arrangement but it is a theory that he certainly does not understand and probably never will. He may even unfortunately conclude that he is not likely to understand other parts of chemistry — a subject that is much too difficult for him.

It is frequently maintained that the orbital treatment is necessary to give a satisfactory description of double and triple bonds. This is not so, since the two and three bent bond descriptions (conveniently represented by bent springs in a molecular model) are perfectly satisfactory and indeed are in every way equivalent to the $\sigma-\pi$ description.

Almost the whole of the material presently discussed under the heading of atomic structure, valency and the chemical bond could be removed from the course and replaced by a much simpler and shorter treatment. This need not go beyond electron shells, Lewis diagrams, simple ions and the covalent bond as a pair of shared electrons, followed by a simple VSEPR (Valence Shell Electron Pair Repulsion) treatment of two, three and four electron-pair valency shells.

Another subject of which beginning students gain a very poor understanding is thermodynamics. The concepts of free energy and entropy are difficult for the average beginning student in chemistry and an unjustifiable amount of time has to be spent in trying to explain them. Moreover, drastically oversimplified treatments of entropy in terms of molecular disorder are more likely to be misleading than useful. It is quite possible to give a satisfactory elementary treatment of chemical equilibrium without introducing the idea of free energy. The difficult concepts of free energy and entropy should be left for treatment in a full course on thermodynamics, just as the discussion of chemical bonding, in terms of orbital overlap, etc., should be left until after the student has had a course in quantum mechanics. If these topics were to be cut out, room could be made for the introduction of some descriptive chemistry. In fact, in order to add sufficient descriptive inorganic and organic chemistry to make a balanced course the discussion of some other physical topics would have to be omitted or at least considerably shortened. Opinions on what should be left out will vary but some of my own choices would be: the highly approximate and often somewhat dubious derivations of the ideal gas law from kinetic theory, deviations from the ideal gas law, crystal field theory and molecular orbital theory.

The principles of chemistry may be compared with the grammar of a language. We would never consider that a student had mastered a foreign language if he had learned only the rules of grammar and syntax. He also needs an extensive vocabulary and only after putting the grammar and vocabulary together can he use the language in a useful way. Similarly the chemistry student needs a vocabulary, which in this case is a knowledge of substances and their properties and reactions. If he can then integrate this knowledge of descriptive chemistry with the theory and principles, he may be said to have some understanding and appreciation of modern chemistry. Present day introductory courses are rather like old fashioned language courses which placed a heavy emphasis on grammar illustrated by a few model sentences — sentences which were utterly useless in everyday conversation.

There is a bewildering amount of material from which to choose the descriptive chemistry for the introductory course and the difficulty of making this choice has perhaps been a reason for the decline of descriptive chemistry in recent years; it was easier to ignore the problem than attempt to solve it. Obviously the choice of appropriate material will also be a subject for much discussion in the future but perhaps I might make a few suggestions. Surely it is important for students in an introductory chemistry course, the majority of whom may take no other course in chemistry, to know not only the important principles and generalisations on which the science of chemistry is based, but also something about what the practising chemist actually does in industry and research, and something about the place of chemistry in the modern world. With these objectives in mind the task of choosing descriptive material is made a little simpler. We might for example discuss those substances that are produced in the largest amounts by the world's industrialized nations. We might also choose the important constituents of the atmosphere, the oceans and the rocks, or substances that are of importance in fields of modern life, e.g. in agriculture, in biology, in computer technology. Thus the student should know something about the preparation of a few common metals such as iron, aluminium and copper and some of their important compounds; important non-metals such as oxygen, nitrogen, sulphur, silicon, phosphorous and chlorine; and the common acids and bases — how they are made and their important uses. He should know something of the mineral resources of the world and particularly of his own country. Among the mineral resources of great significance at the present time are hydrocarbons. Their chemistry not only illustrates structure but can also be used as a basis for the discussion of fuels and of the energy changes in reactions. Further discussion of organic chemistry should stress the importance of synthesis in industry and in the laboratory and also organic reactions in living organisms. In choosing the descriptive material the main aim should be to present chemistry as the science of materials — their structure and their transformations and to describe the applications of chemistry in the modern world and in everyday life.

I am not, of course, advocating a complete reversal of the present situation and suggesting that all the facts should be given first with no explanation, to be followed by the theories. What is needed is a careful integration of facts, generalisations, principles and theories. A student must have some knowledge of basic descriptive chemistry if he is to appreciate the need for principles and generalisations and for theories to explain observed facts. He would better appreciate that theories are only developed to provide explanations for observations and that they are continually undergoing modification and replacement. At the present time there is a tendency for students to accept laws and principles, and even theories that may still be controversial, as if they were the ten commandments — laws laid down by God that have to be obeyed. It is important to emphasise to students that there are areas of uncertainty where chemists may differ on questions of interpretation and that there must be compounds that have not yet been discovered because our present ideas concerning valency and molecular structure do not allow us to even visualize such compounds. No one would, for example, have set out in 1950 to make a compound with such a bizarre structure as that of ferrocene — such a structure simply could not have been visualized at that time. We need to emphasise that chemistry is a living and rapidly developing subject and that there are many unresolved problems to challenge those who go on to further studies in chemistry. Since fact comes before theories it is not necessary to provide an explanation for every fact mentioned in the introductory course. There is a tendency, for example, to imagine that the chemistry of the transition elements cannot be described even in an elementary way unless *d* orbitals and ligand field theory have first been discussed. This is why the chemistry of important metals such as iron and copper is always found almost at the end of most text books and why students are often ignorant of even the simplest chemistry of these elements. It should not be impossible to devise a course in which the type of descriptive chemistry that I have mentioned is integrated with the minimum of simple principles needed for its understanding in terms of the structures and transformations of molecules.

I believe that the type of introductory course that I have attempted to describe would be suitable for all students. There is no need for separate courses for students who plan to proceed to further chemistry courses at a higher level and for those that do not. All students need to have the same basic understanding of chemistry as a preparation for life and for studies in other disciplines as well as for further studies in chemistry. In my opinion a rigorous study of chemistry should not begin until after the introductory general chemistry course, which should not be regarded primarily as an introduction to further studies in chemistry. The aims should be to interest students in chemistry, to give them some basic ideas concerning its nature and the principles on which it is based, and in particular to show that chemistry is the science of materials — their preparation, properties and reactions.

Finally I should like to emphasise that a student can only gain a true appreciation of descriptive chemistry if his reading and classroom lectures are supplemented by a considerable amount of practical chemistry, including both experiments that he performs himself and demonstrations carried out by the teacher. Despite the cost of practical work and the time that it involves it must be retained in the general chemistry course and increased if at all possible. Practical chemistry is absolutely essential for any full appreciation of descriptive chemistry. A certain number of striking colour changes and spectacular explosions help to create and maintain interest, but in general the laboratory course should be closely integrated with, and should illustrate, the classroom material. Only in this way can the student be expected to absorb what at first seems a formidable amount of factual material. Although I would not advocate the full scale reintroduction of qualitative analysis, those of us who have done such a course know well that many of the observations that we made in the laboratory work are printed indelibly on our minds. The heavy emphasis on principles has contributed to the decline of experimental chemistry in the general chemistry course. The only experiments that are needed are those designed to illustrate the basic principles. Much of the theory, for example all the material on atomic structure and chemical bonding, had no accompanying experiments — there are very few, if any, experiments relevant to this part of the course that can be done in the first-year laboratory. This situation is itself criticism of the course, as it seems reasonable to maintain that there should not be large amounts of material that cannot be accompanied by relevant experiments.

I hope that I have been able to convince you that it is time for a revolution in introductory chemistry. A new course is needed which integrates much more relevant descriptive chemistry with considerably less theory, in other words more fact and less fiction. It is my belief that such a course will produce students with a better appreciation of the true nature of chemistry which will serve them well in whatever field or profession they later work and that it will also motivate more students to further studies in chemistry.

Reference:

R.J. Gillespie, *Chemistry in Canada* **28** (11), 23 (1976)

Chemical Education: How Do We Compare Internationally?

T. HITCHINGS

There are common threads of chemical education which are international and distinct trends which also appear to be world wide. These include the need to make more explicit what one is trying to do before attempting to write a detailed syllabus. Virtually all countries recognise the importance of teacher training and better methods of assessment but we see how in the United States and to a lesser extent in Canada assessment methods can become perverted and unduly influence the content of a curriculum. It is also obvious that politics cannot be ignored as a factor in determining the effectiveness of chemical education. Decisions about who is to have access to higher education affect profoundly the kind of programmes offered both at the secondary and tertiary level.

In this country we should regard ourselves as particularly fortunate. I would like to feel that this situation arises from inherent qualities of the inhabitants but I am left with the view that we enjoy our present situation in no small measure thanks to accidents of history and geography. The waves created by problems in North America and Europe tend to become ripples by the time they reach our shores. It is a great advantage to be equally exposed to both and to be small enough to be able to respond quickly to the best of these influences.

Our small size and relative compactness make it easy for us to communicate with one another. There are probably fewer than 800 chemistry teachers in the country — almost all of them university trained and, amongst the younger ones at least, a very high proportion have been through Teachers Colleges. The numbers involved at university level are far fewer. Although sometimes significant differences exist between schools, as far as the quality of chemistry teaching is concerned, it would be true to say that pupils of good ability can look forward to access to tertiary studies no matter what school they come from, and that their success there will depend more upon their own efforts than upon the quality of the teaching they have had at school. Similarly, while our universities do not all show the same strengths in the same specialised fields, the differences in quality of graduates produced are more likely to reflect the abilities and enthusiasms of individual teachers than major differences in quality of the institutions.

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It may be that we could produce some better chemists by concentrating our resources on fewer people, as is the pattern in so many other places, or by endowing selected institutions, be they schools or universities, much more generously, at the expense of the rest. At least we are in a position beforehand to examine the social and political consequences of moves in this direction. Before making decisions along these lines we should look at what we can learn from the Soviet Union, Italy, Germany, the United Kingdom and North America and ask ourselves whether it would be worth it.

I was impressed by how much the political system in various countries was reflected in education. In Italy, which has had 39 governments since 1945, anarchy reigns in the Universities, and the granting of degrees does not indicate true academic ability in many cases. On the other hand in the Soviet Union there is rigid specialisation, so that a child of 11 may be set on a course of chemistry which he or she has very little chance to alter at any subsequent stage.

In the matter of curriculum development I believe we have anticipated by several years, perhaps as many as ten, some of the problems with which those in the Northern Hemisphere are now attempting to grapple. The kind of concerns that were evident at the McMaster Conference are still regarded as highly novel in Europe. This may be because some countries see school chemistry in the kind of way that we did in the late 1950s. The steps made here in 1975/76 which we took to correct an over-emphasis on chemical theory are only beginning to be perceived as necessary in North America. In this sense our present look at sixth and seventh form revision is breaking new ground, ahead, I believe, of thinking in most parts of the world. We still have much to learn particularly in terms of assessment and the investigation of what is appropriately taught at what level in secondary schools. The Europeans have gone further in research than we can probably expect to match, with our much more limited resources. There is no need for this work to be duplicated here. It can be adapted to our situation and changes implemented so much more easily.

The most serious weakness in chemical education seems to me to be the low level of awareness of how to approach rationally matters of community concern, which have a chemical component. Consider the present debate beginning to gather momentum over the use of the herbicide 2,4,5,T. The poor level of information being supplied by the media is not being criticised for its inadequacy. The appeal to emotionalism and generation of so much heat with so little light will continue until levels of scientific literacy are raised significantly.

It is not possible to assess the value of chemical processes for national development without some conception of the trade-off required between environmental damage and economic advantage. Few, if any, of the decisions to establish chemical industries can be justified by finding the answers to a few simple questions. For example the expansion of Comalco activities has to be considered not only in the light of the economics involved but also the environmental impact. These can only be appreciated with some chemical knowledge.

Even clear cut issues like smoking still get comparatively little community understanding when one out of three of our third formers is a regular smoker. The relatively complex issues such as the eutrophication of lakes, chemotherapeutic treatment of mental illness and contraception all require clear thinking to separate main effects from side effects and to make some assessment of the relative consequences of each of these.

I agree that much of an understanding of the chemistry involved, particularly when interaction with biological systems is concerned, will always be beyond most of us. What I am concerned about is the almost complete

JOBS FOR THE BOYS

C.H. Hendy

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ABSTRACT

Despite massive unemployment in the workforce as a whole and rumours of science graduate unemployment the impression at Waikato was of an unfilled demand for chemistry graduates. We, therefore, surveyed the changes in the availability of employment for chemistry graduates and the availability of graduates for employment. This survey has shown several trends which must be of concern to the Institute of Chemistry and the public as a whole. Firstly, during the period 1973-1980 the number of advertised vacancies for chemists with professional qualification has doubled, whereas the output of graduates from New Zealand Universitites has remained constant. Secondly, during the same period demand for a new class of desirable qualification, that of B.Sc./NZCS has developed rapidly. Thirdly vacancies for chemists with technical qualifications (NZCS or less) have also risen three-to-four fold during the same period of time.

The overall effect has been a steady increase in the vacancy rate for chemists of all qualifications, by a factor of four since 1973. In only one of the years surveyed (1975) was there a decrease over previous years. The static production rate of chemistry graduates by NZ Universities [and of NZCS in Chemistry (?)], therefore must be of grave concern to the profession as a whole in the light of the forecasted development of new massive technically advanced industries.

Introduction

Faced with growing concern over our inability to find suitable graduates for employers enquiring directly of the University of Waikato Chemistry Department, and the forecast by government that the total number of graduates will decrease during the present quinquennium, we have undertaken a survey of the rate at which vacancies have been advertised in order to assess how the employment prospects for chemists have changed during the 1970's.

Several sources of information have been tapped. Firstly, advertisements appearing in the country's largest daily newspaper, the *NZ Herald*, have been scrutinised during the months of February, July and October between 1972 and 1980. Care was taken to avoid counting the same vacancy twice. Secondly, vacancies notified to NZ Universities are collated and circulated in a weekly publication "current vacancies". Vacancies applicable to chemists appearing in the 1979 issues have been counted and used to calibrate the fraction of national vacancies which appear in the *NZ Herald*. Thirdly, the NZ Vice Chancellors Committee conducts a survey of all graduates which indicates how many are produced each year; how many are overseas students; how many enter the workforce etc. This survey has been used to estimate rate of supply of graduates to the workforce. Lastly, as a Department, we keep contact with many of our graduates including all of our post graduate students so that we are able to assess the employment record of all of these students. This record has been used to show that:

1. There has never been one unemployed M.Sc. or D.Phil (Ph.D.) graduate in chemistry from the University of Waikato, and
2. The proportion of these graduates who find employment in fields not normally associated with degrees in chemistry is 7 out of 50. Because we know the full details of the employment of all these students we know that all but one of these students are using their qualifications in chemistry in a professional capacity.

The national employment figures show that about 25% of chemistry graduates take up employment in fields which would not normally be associated with chemistry; however it is likely that the employment of these students follows a similar pattern to Waikato graduates.

Results

The analysis of advertisements appearing in the *NZ Herald* (Fig. 1.) has shown that the number of discrete vacancies for graduate chemists has increased steadily during the period 1972 to 1980 from an average of 6 per month to an average of 12 per month. During the same period, however, an entirely new desired qualification has appeared in vacancy advertisements, that of a B.Sc/NZCS option. This category has increased from none in 1972 to 13 per month in 1980. The combined total of these two categories of vacancies has risen steadily from around 70 per annum in 1972 to 300 per annum in 1980.

Although the rate at which vacancies have been advertised has increased four-fold, the output of graduates in chemistry potentially available to take up employment has fluctuated around 150 per annum, showing no real growth during the review period.*

It should be emphasised, however, that the rate of advertisement of vacancies does not tell the whole story. Many employers do not advertise their vacancies in newspapers, this being especially true of the education

* *(The total output of B.Sc. and B.Sc. Hons. less overseas students, NZ students intending to take up employment overseas and students otherwise indicating that they are not available for employment.)*

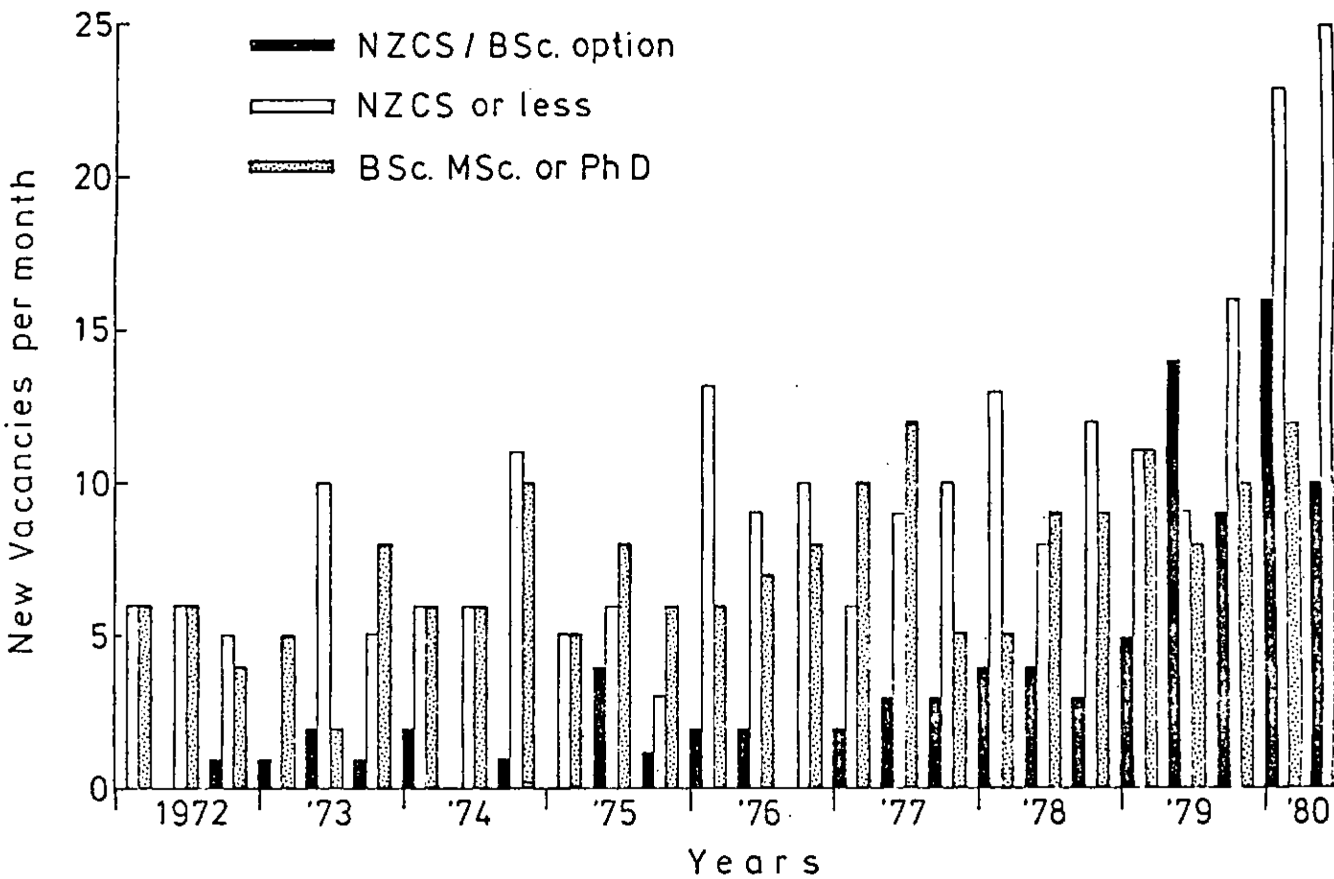
Chemical Education (Cont)

absence of any carry over from the laboratory of "a critical attitude supported by theoretical speculation based on experimental facts ..." to these highly important value judgements. If any general value can be attached to chemical education it must surely be here.

Talking with teachers from both schools and universities helped me to clarify in my own mind what I see as our greatest strength. It is the close triangular relationship between the three vital components of our discipline: teachers in schools, teachers in universities and professional chemists represented by the Institute of Chemistry. From the inside it is difficult to appreciate the great advantages deriving from the strength of these bonds, the high level of understanding of the others' problems and the degree of mutual support. Of course there do exist groups elsewhere which work closely to mutual advantage but I am left with a conviction that we are indeed fortunate for whatever reason, to be part of such a responsive, unified system."

* Part of an address to the Canterbury Branch NZIC, April 1980.

Fig.1.

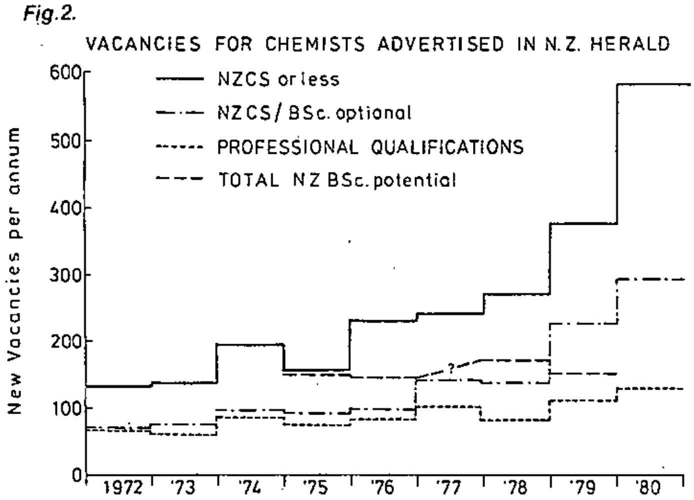


profession, and major companies which conduct their own staffing campaigns by touring the Universities. Evaluation of the total number of vacancies is further complicated by the advertisement of multiple vacancies by large organisations.

Vacancies advertised through the University of Waikato Student Services were largely for positions in central and local government. Those in the *NZ Herald* were mainly for jobs with small and medium-sized companies and there was thus little duplication between the two sources.

In 1979, there were 118 vacancies for chemists with B.Sc. or higher qualifications in the Student Services list. In the same period vacancies in the *NZ Herald* were appearing at a rate of 228 per annum. Making allowance for the vacancies not accounted for in either survey, the total number of positions available for graduates or other qualified chemists in 1979 could have been in the range of 450-500. (Fig 2) **

Fig.2.



How did this compare with the output of chemistry graduates? The NZ Vice Chancellors Committee on Graduate Employment conducts a survey of all NZ graduates at the time of their graduation. This survey shows that about 190 NZ students graduate each year with a B.Sc., B.Sc. (Hons) or B.E. in Chemistry. In 1979, there were also about 40 graduates with higher degrees. Of all these NZ graduates, about 100 go on to higher degrees or into teaching. Some emigrate, leaving 121 entering, or seeking to enter, the workforce (103 in 1978). Furthermore, of the approximately 110 chemistry graduates who enter the workforce each year only about 85 take up vacancies which would have been recognised in our survey as available for chemistry. Whereas this number of vacancies appearing in the 1972-73 period, it has now dropped to between one-fifth and one-sixth of the number of vacancies.

The number of first degree graduates has remained fairly constant over the last few years and is unlikely to rise significantly in absence of direct action to encourage students into Chemistry. The number of higher degree graduates will probably rise for a few years (compare 80-90 entrants and 40 graduates in 1979) while the number entering may drop. Thus the total number of qualified chemists may rise over the next few years until higher degree graduates reach steady state, but the number will be much lower.

Such a situation must be of grave concern given the long lead time taken to train graduates, the growing shortage of chemistry graduates reported in Australia and the United Kingdom and the foreseeable growth of major high technology industrial developments in NZ.

** *(i.e. estimating about 120 direct recruiting, by proportion to Waikato graduates.)*

B.Sc. (Tech.) Degree In Chemistry At Waikato University

In our April issue, Prof A.G. Williamson, University of Canterbury, discussed the value of contributions made by Chemical Engineering students during periods of employment in industry as part of the requirements for their degrees. He suggested that the opportunity for Chemistry graduates, too, to work in industry during their undergraduate days would have a number of advantages. Such opportunities already exist for students enrolling in the B.Sc (Tech.) degree in Chemistry at the University of Waikato ....

The B.Sc. (Tech.) degree, which originated in the Physics Department at the University of Waikato 6 years ago, is now offered also in Chemistry, including Biochemistry. The 4-year degree was set up to meet the needs of students who have an interest in employment in industrial or other applied Chemistry and to meet the demand of employers for graduates with some working experience in such areas.

The degree comprises 28 courses as opposed to 22 for the 3-year B.Sc. The 24-course core of the degree is made up of most of the courses taken for a normal B.Sc. [it is possible to do the M.Sc. degree subsequently to the B.Sc. (Tech.)] but includes at least 2 courses in Management Studies to allow an introduction to areas such as administration, law, accounting and marketing. The major difference from the bachelors' degree, however, is that 1 year's paid employment is undertaken, normally in two 6-month segments, the first commencing at the end of the student's second year (November-May) and the second running from August of the third year to February of the fourth. The employment periods give the student valuable experience in at least two applied areas. The work, mostly of project type, but normally giving insight into the routine operations of the employing firm or institute, is written up into reports for assessment, and counts as 4 courses towards the degree.

The employment is of mutual value to student and employer, the student benefitting from the varied employment experience, the employer finding value in the results of the work.

The longer term value to employers lies in the availability of a pool of B.Sc. (Tech.) graduates, better prepared for employment in industrial or applied Chemistry than the normal B.Sc. graduate.

Many firms and research institutions have shown their support for the degree with their readiness to take on students during the 6-month employment periods. Others wishing to do so should contact the Chemistry Department at the University of Waikato.

Books Reviewed

THE MAKING OF A TECHNICIAN

H. Offenberger
(NZ Council for Educational Research No. 61 (1979))
336 pages, 130 tables, paperback.

Mr Offenberger reports the results of an investigation into the training and performance of technicians in NZ since 1954 (when the Controlling Authority for NZ Certificates in Engineering was established), through 1960 when the Technicians Certification Authority supplanted the older authority, and up to the end of 1969.

His principal method of investigation was via a questionnaire addressed to all holders of NZ Certificates who had completed the certificate by 1969, some 2000 technicians being studied.

Part I of the book describes, in 3 chapters, the history and structure of the Technicians Certification Authority and also its function in providing syllabuses and examinations for technician courses in Engineering, Science, Building and Commerce. The author takes care to point out the differences between the NZ pattern of courses and those developed in Australia and UK where courses for technicians have become very similar to, and sometimes competed with, those in universities. In NZ the courses for technicians have been deliberately given a much less academic and more applied flavour than the university courses and the applied nature of the courses has been further emphasised by requiring every candidate to be "suitably employed" for at least 2 years of the 5-year course.

Along with the development of the administrative structure of the Technicians Certification Authority has come a growth and reorganisation of the Technical Colleges as Technical Institutes charged with providing tertiary level education for apprentices and technicians, these latter being described as occupying a middle position between tradesman and professional.

Part one concludes with a description of the methodology of Mr Offenberger's survey of facts, and opinions obtained from certified technicians.

Part II of the book describes the "Training of the Technician" and details histories of students beginning with recruitment and proceeding through course structures, and success/failure levels. Many interesting details emerge in this section. e.g. Only 53% of the sample of technicians tested had taken NZ Certificate as their first choice, some 26% being apprentices seeking up-grading of their qualifications and 19% being unsuccessful university students.

In this Part, in Chapters 4-9, the author presents, inter alia, facts concerning socio-economic factors influencing career choice and success rate, the role of careers teachers and their influence on technician recruitment, the effect of Technical Institute training and its difference from university and teacher training programmes.

The efficacy of part time study (in which the employer subscribes some 4 hours per week and the student a similar time) is compared with that of full time study. All these, and many factors, are studied not merely by casual observation, but by results from the questionnaire after treatment by statistical procedures to indicate the reliability of each conclusion.

Chapter 10 discusses the careers of NZC holders and seeks to assess both the suitability of the training for employment, and also the suitability of the employment for a trained technician. While it appears that the training is in most cases very suitable and at about the right level, it is not always clear that the work environment has been suitably shaped to fit the needs and aspirations of the newly certificated technician. In some cases there is evidence of feeling "under utilised" which leads to frustration. For this chapter alone, this book should interest employers. In Chapter 10 I found two statements close together which seemed strangely at variance.

"There is no question that over-training is expensive both in time and cost to the employer and the consequent under-use (of the technician) makes for a disgruntled employee."

This appears to contradict the reported views of an employer who did not care whether his NZCE man was "electrical, mechanical, or even civil. Our sophisti-

Jobs For The Boys (Cont)

This concern has been heightened by recent recruiting drives by four major Australian companies who were reported as each looking for approximately 150 science graduates.

The above figures may appear alarming but it must be emphasised that the data gathered in this paper have come from different sources which are not necessarily completely compatible. To provide a more definite assessment of the situation there appears to be a need for:

1. A similar survey of N.Z.C.S. output.
2. A survey of employers for
   (a) vacancies
   (b) projected vacancies
   (c) reasons for vacancies, i.e. are they the result of growth in positions, more movement of chemists between positions within NZ, or migration of chemists out of NZ?
   (d) difficulties in making suitable appointments.
3. Annual updates of these surveys to show trends.
4. Action as necessary to attempt to match the supply of qualified chemists to the demand.

Acknowledgments

I thank Miss R.M.D. Singh for helping to collect the data presented in this paper.

cation lies in techniques of management and we require people who have the necessary education to the level of NZCE to assume responsibilities — ultimately of middle management. We use graduates for top management in the same way."

It seems to me that the results of the survey support the sentiments expressed in the latter quotation rather than those in the former.

Part III. The Technician and his Job comprises chapters 11-16 and discusses such topics as changing jobs, job contrast, job satisfaction, titles given to technicians, post-certificate studies and open questions.

The whole work is an impressive compilation of factual data, carefully summarised and presented in a thoroughly readable manner.

The tables presented with each chapter enable the reader quickly to apprehend the essence of the data without wading through too many detailed results, but the raw experimental data is clearly presented in appendices so that the process of arriving at each conclusion may be followed in detail.

"The Making of a Technician" has faithfully recorded the beginning of tertiary technical education in NZ in all its many aspects — one can only hope that the work will be up-dated as the years pass. Already 11 years have gone since the technicians studied have passed their certificates and no doubt there have been changes in the pattern in this period. These changes should be recorded with the same thoroughness and care which Mr Offenberger's book shows.

A.L. Odell

A.L. Odell is Professor of Chemistry at the University of Auckland. He is also the representative of the Vice-Chancellors' Committee on the Authority for Advanced Vocational Awards (formerly the Technicians' Certification Authority).

First Year Chemistry

By J.M. Coxon, J.E. Ferguson and L.F. Phillips. (University of Canterbury) Pp 370

(Edward Arnold Ltd., London, 1980)

Price $27.50.

The choice of first year university chemistry textbooks has not been easy to make and therefore the publication of this book has been awaited with interest as it represents the first attempt by NZ authors to write a single text suitable for the whole NZ Stage I course. The authors state (i) "we have included rather more material than would reasonably be covered in such a course in order to allow selection of topics by teacher and student", and (ii) "one of our main aims was to produce a text in which approximately equal weight would be given to physical, inorganic and organic chemistry, and in which the divisions between the three branches of chemistry would as far as possible be minimised".

The first seven chapters cover physical chemistry and in my view give a scholarly presentation of the subject at this level, the choice of material and depth of treatment being excellent. Elementary wave mechanics and theory of bonding, topics which can be difficult to understand at this level are particularly clearly presented. If a student had time to do fully the sections on thermodynamics and equilibria presented here his second year physical chemistry would seem much less of a transition. Activities and activity co-efficients are introduced and a feeling for their chemical meaning and magnitude clearly developed. Principles of chromatography are nicely built in to the discussion on physical equilibria, and entropy introduced in a clear manner.

My criticisms of this section are only minor: the equations for orbital energy levels of the hydrogen atom and the Rydberg constant are not in SI units and a student attempting to use the constants in the appendix might wonder why he could not get the expected numerical values (pp 17-18); PV, not its square, is proportional to a gas's stored energy (p 13) and if nitrogen can have all oxidation states from -3 to +5 why is carbon limited to -4, 0, +4 (figure 2.11)?

Chapters 8-12 cover inorganic chemistry under the headings: Extraction of the Elements; the Chemistry of Hydrogen; the s-block Elements; the p-block Elements; the d-block Elements. Very good use is made of tables and figures to present a large range of factual material which is discussed in the text. The general theme is to identify trends in behaviour and give a rational explanation of them in terms of a number of concepts. Considerable use is made of Born-Haber cycles to break down a process into simple steps and the appropriate steps selected to account for certain phenomena. The approach is definitely academic, but brief references to practical uses of specific compounds and to the methods of production are made throughout.

My main criticism of this section is the introduction of "standard oxidation potentials" with opposite sign to the "standard electrode potentials", or as they are called in chapter 6 "standard reduction potentials". This unnecessary concept, devoid of physical meaning, is in my view completely unnecessary and is almost certain to lead to confusion. Also the placing of arrows in the direction of reduction only on the many reduction potential diagrams could give the impression that only reductions occur. Fig. 10.8 giving the solubilities of the alkali metal halides shows unbroken curved lines implying, for example, that fluorides intermediate between Li and Na exist! NH_4OH suddenly appears in the equations for the Solvay process, and the reason for using this sequence of reactions is not given.

The final seven chapters cover organic chemistry under the headings: Compounds of Carbon and Hydrogen; Alkenes and Alkynes; Aromatic Compounds; Haloalkanes; Alcohols; Amines and Ethers; Aldehydes, Ketones, Carboxylic Acids, Acid Anhydrides and Esters; Di and Multi-Functional Molecules; the Chemistry of Living Things. Again the approach is fairly academic with considerable emphasis on mechanism. The tables are clearly set out (although with much blank space in some because of the wide-page-two column format of the book) giving useful summaries of the main reactions and reagents. However the author of this section has been much less successful than his inorganic colleague in integrating text and tables. Wheras the language of the physical and inorganic chapters is concise and clear I found this section terse with abrupt change from one topic to another. In chapter 10 I felt that sections had been written before the order had been decided, and then put together without effort to integrate them. The overall impression is not helped by the much larger size of the structural formulae used within the text compared with that in the tables, giving a very uneven and distracting appearance and leading to considerable waste space in places.

I also find most to criticise in this section over choice of material. With the great impact of modern physical methods I felt the splitting patterns of proton nmr deserves more than just one high resolution spectrum without comment in the text, mass spectrometry worthy of a mention and infra-red spectroscopy deserving of a little more discussion in addition to the three (unnecessarily large) spectra. I also felt that five pages devoted to electrocyclic reactions and orbital symmetry considerations out of place in a first year book especially when the only free radical reaction discussed is the chlorination of methane and reactions with molecular oxygen such as combustion and autoxidation are not even mentioned.

As the authors state they have included more material than could be covered in a single course, and to achieve this in only 390 pages they have had to curtail any detailed discussion of "chemistry in action". Thus I feel this book more suitable for those intending to advance further in the subject than for the majority who terminate formal chemistry at this stage. The aim of minimising the divisions between the three branches of chemistry has not been achieved in my view; not surprisingly considering it is obvious that the book has been written by three different authors with individual responsibility for each section.

To summarise, I could happily use this book as the text for the physical and inorganic sections of a first year course but I found the organic section disappointing and I would prefer my students to have a more attractive account of this branch of chemistry for their basic text.

J.E. Packer

Dr Packer is Associate Professor of chemistry at the University of Auckland, is the present chairman of the Institute's Chemical Education Group, and editor of "Chemical Processes in New Zealand".

Technical Employment — What Future?

Most sectors of the economy, with a few striking exceptions, are in a somewhat depressed state. This has had a dramatic effect on the balance of employment opportunities generally available, although there are particular market sectors which are very buoyant.

Mr Bill Davies, technical recruitment manager, Lampen Associates Ltd., management consultants, feels the impact of the overall situation is not fully appreciated. "People will be aware of, for example, the difficulties being faced by graduates in arts, law, social sciences, chemistry and other sciences, to say nothing of the inexperienced youngsters leaving the technical institutes. The immediate future is not rosy for these people. Prospects for graduates in the sciences who wish to pursue a purely technical career are very limited as most companies are also seeking managerial qualities and potential in these areas."

Graduates with good degrees in commerce, marketing and chemical and mechanical engineering are more fortunate. The unprecedented industrial growth of the 1970s, particularly in the processing sectors, has led to proportionately greater employment opportunities for chemical, mechanical, instrument and industrial engineers, not to mention the finance and marketing areas. To date there have been too few graduates to satisfy the demand in these fields.

"Employers placing increasing emphasis on management potential —"

Davies

The development of agricultural processing, forestry and heavy manufacturing/process organisations has created immediate demands for highly skilled people in both technical and managerial areas. This demand has also been supplemented by the growth of numerous servicing, supply and engineering organisations all of which demand similarly qualified individuals.

In certain key areas, such as the dairy, energy, steel, aluminium, and timber industries, there are major development programmes which will call for additional skilled staff. At the same time, internationally, huge projects are currently underway which will require staffing both in the construction and operational phases. In Australia, some enormous construction programmes are planned, mainly in the mineral processing, refining and petrochemical fields. For many companies this will mean the establishment of project teams of several thousand engineers, technicians and draughtsmen at the peak. These developments tend to require engineering rather than science qualifications and it is of interest to note that one university is advising science graduates to consider gaining chemical engineering qualifications rather than to pursue an advanced science degree.

"The effect of these projects will very quickly filter through to the NZ market place," says Mr Davies. "Australian organisations are already very much in evidence on NZ university campuses. One organisation recently paid the expenses of an entire graduating class of chemical engineers to attend interviews in Australia. Out of a total class of 22 job offers have been accepted by 11 students. Experienced people are also strongly sought after and the combination of slightly higher salary, lower taxes and wider experience is often very appealing."

"Consequently we have a paradox — a critical shortage of specialist skills within a generally stagnant economy. Generally the demand for people in these areas has far outstripped the capacity of universities, technical institutes and NZ employers to meet the current requirements.

"One major factor which has emerged over the last 2-3 years is the increasing emphasis that employers are placing on management potential. Companies are generally being far more precise regarding their requirements and are also taking longer to decide on the potential suitability of applicants. One client company has, as a matter of policy, decided that all future production or engineering management appointments will require graduate qualifications in chemical or mechanical engineering. Even for technical positions, they stress the importance of a high level of management skills."

With the increasing trend towards more sophisticated technology in many industrial sectors, companies are stressing greater technical competence in their managers. Chemical engineers and, to a lesser extent, chemists are now able to develop careers in more commercially oriented areas such as sales, marketing and manufacturing and company management.

Mr Davies says that "in considering people for broader managerial roles, rather than purely technical ones, a manager will place greater weight on an applicant's personal ability. Obviously for positions involving direct contact with potential customers, or company managers, a high standard of personal presentation is required. This is an aspect which is well within the control of the individual applicant and which is an essential part of a professional image."

"From the individual's viewpoint, much is determined by the original choice of discipline. There is little doubt that the situation is quite tight for science graduates while the reverse situation applies for chemical engineers. In Australia this group is the highest paid of all engineering disciplines."

Regardless of current circumstances, Mr Davies says that "individuals are able to influence their own situation. Attitude, interest and flexibility are particularly important and frequently will be a major influencing factor in an employer's decision."

NEW FUNNELS

The latest additions to the Whatman range of 3-piece funnels are the 2.5 and 4.7cm sizes. The funnels and reservoirs are manufactured from borosilicate glass with arcylic filter support plates, which are intended for use primarily with aqueous solution, say distributors Selby-Wilton Scientific Ltd.

Polypropylene and PTFE filter support plates are available for use with more aggressive solvents.

As with the existing 7 and 9cm sizes, the new Whatman funnels are designed primarily for use with glass microfibre filters. The design and method of construction ensure that precipitates can be easily collected, efficiently washed and recovered for subsequent analysis.

The 2.5 and 4.7cm funnels are suitable for a wide range of applications involving the vacuum filtration of small volumes, in analytical and biochemistry laboratories.

PTFE filter support plates are recommended for use in techniques involving radiochemistry labelled compounds.

CO63 For further details, use Reader Service Card.

Cover Story:

A New Era In Atomic Spectroscopy

As a leader in atomic absorption spectroscopy (AAS), Perkin-Elmer has maintained its position by constantly developing and introducing the most advanced and sophisticated atomic absorption spectrophotometers available. The ICP/5000 System is yet another "first" in analytical instrumentation. It is said to be the first complete instrument for atomic spectroscopy. Flame or furnace AA or inductively coupled plasma (ICP) atomic emission can all be used with the ICP/5000 System. The system consists of the Model 5000, ICP assembly, the Data System 10, the PR-80 Line Printer, and if desired, the HGA-500 Graphite Furnace. A complete system would also include the AS-50 Autosampler for flame and ICP analyses and the AS-40 for automated furnace analyses. This remarkable system is designed for optimal performance with each of the techniques.

The following features distinguish the system:

- It is said to be the only commercially available instrument that can be used for AA and ICP.
- It is a sequential ICP spectrometer which can automatically determine up to 20 elements in 50 samples without operator interaction.
- It has a dedicated computer for operational control.
- The software is designed to be used by even the most inexperienced operators as it continuously guides them through the sample and analysis.
- The ICP torch is permanently mounted on a Model 5000 spectrophotometer.
- The system can be changed from ICP to AA simply by turning a knob.
- The Model 5000 has a high-dispersion monochromator to provide the resolution required for ICP emission.
- It has a blazed holographic UV grating to reduce stray light, a potential problem in ICP emission.
- It provides the user with the flexibility to choose background correction for emission on one or both sides of the analyte peak at variable intervals.
- It enables the user to choose the best wavelength for each element in each matrix.
- The optical path can be purged with an optically transparent gas so that elements can be determined at wavelengths down to 175nm.

Data System 10

To control operation in the ICP mode, a powerful microcomputer is used. Called Data System 10, it includes a standard ASCII keyboard, CRT display, dual floppy disk drive, and 64K-byte central processing unit, as well as all software for the operation of the ICP/5000 System in either a single or multi-element mode. Programmes for automatic operation in conjunction with the AS-50 Autosampler are also in the software package.

The power of the ICP/5000 as an ICP spectrometer lies in the flexibility provided by the software for the Data System 10. The operator is free to choose the analyte line best suited to the particular analysis being performed. If one wavelength has spectral interferences it is a simple matter to go to another wavelength. This is possible only with a sequential ICP. Background correction can be done by measuring the background emission on one or both sides of the analyte peak. In addition, the wavelength intervals for background correction are variable. The operator selects intervals which will best define the background at the analyte peak. For quantitative analyses, the operator can use up to 5 standards, although only one is normally used. For high-precision work, longer integration times or multiple determinations can be used. With multiple readings, a mean, standard deviation, and coefficient of variation are calculated and displayed. All of these parameters are operator-selectable, depending on the samples to be analyzed. Once the parameters for a particular determination have been established, they are stored on a disk for future use. If a multi-element programme is to be used, the parameters for each element are stored. These programmes can be recalled at any time. Further details of the system can be obtained from the Perkin-Elmer agents. Contact Josina Stynman, Warburton Franki Ltd, Ph. Auckland 770-924.

The 9th Australasian Conference on Chemical Engineering is to be held at the University of Canterbury, August 30—September 4, 1981. The Conference is being organised by the Chemical Engineering Group of the NZ Institution of Engineers, in conjunction with the Institution of Engineers, Australia, and in association with the Institution of Chemical Engineers, London. Further details are available from: Conference Secretary, Chemeca 81, c/- Chemical Engineering Department, University of Canterbury, Christchurch.

Chemical Education Conference

The 6th International Conference on Chemical Education will be held at the University of Maryland, USA, August 9-14, 1981. With the theme "Teaching Chemistry in a Diverse World", it will be co-sponsored by IUPAC and the American Chemical Society in collaboration with UNESCO. Details are available from Prof. Marjorie Gardner, University of Maryland, College Park, Md. 20742 USA.

The Renaissance Of Polarography

A.C. Herd, Auckland Technical Institute

The analytical technique of polarography was developed by the Czechoslovakian chemist Heyrovsky between 1918 and 1922 and he was awarded the Nobel Prize for his work in 1927. These dates certainly do not conjure up the picture of a modern dynamic instrumental technique and the rather gloomy illustrations in many analytical textbooks tend to confirm the widely-held view that polarography is an obsolete technique long displaced by atomic absorption spectroscopy. This view is prevelant in NZ and few people are using polarography for analytical purposes. The method, although taught in NZ Technical Institutes, is generally ignored by University undergraduate courses, and a self-perpetuating situation has arisen in which the technique is not taught because it is not used, and it is not used because of the lack of awareness of modern improvements. This article will revise the basic principles of polarography, briefly outline recent advances in instrumentation and specifications, then attempt to summarise the many and varied applications.

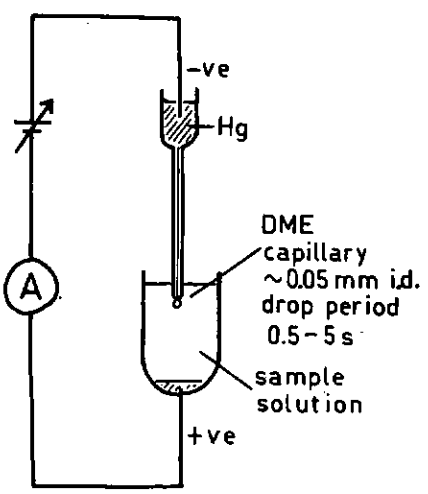


Fig.1. Simplified diagram of the apparatus for dc polarography.

Basic Principles

The basic principles of polarography can best be explained with the help of an oversimplified diagram such as Fig. 1. Consider a sample solution of Pb^{2+} and Cd^{2+} ions in a supporting electrolyte solution of O.IM KCl, in a cell consisting of a dropping mercury electrode (DME) and a mercury pool electrode (or saturated calomel electrode, SCE).

A linearly increasing negative potential is applied to the DME and the current in the circuit measured as a function of potential. The current remains low until the potential of the DME is sufficiently negative for the reaction

$$Pb^{2+} + 2e \rightarrow Pb \text{ (amalgam)}$$

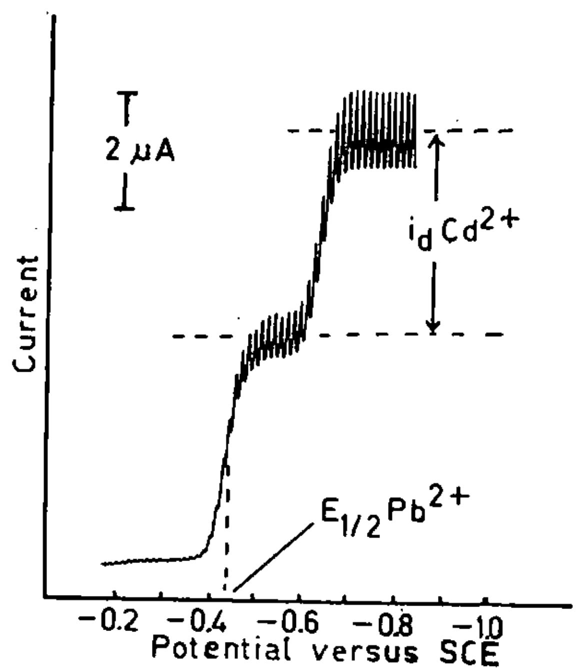
to occur. With further decrease in potential, all of the Pb^{2+} ions reaching the DME are reduced, and the current becomes limited by the rate at which lead ions reach the mercury drop. In an unstirred solution containing an excess of supporting electrolyte, this process is diffusion controlled, and the current becomes constant and dependent on the concentration of Pb^{2+} in solution. A further increase in current will occur when the DME becomes sufficiently negative to reduce Cd^{2+}.

The polarogram therefore takes the form of a series of current waves (see Fig 2) and gives two pieces of information;

1) the half-wave potential, which will be characteristic of the reducible species and the supporting electrolyte
2) the diffusion current which will be proportional to the concentration of reducible species in solution.

The value of the diffusion current depends on drop rate, drop size, temperature etc., but provided these are kept constant, it may be related to concentration by either a calibration curve or the method of standard addition.

Fig.2. A dc polarogram of a solution 0.001 M in Pb^{2+} and Cd^{2+} in 0.1 M KCl containing 0.005% gelatin.



However, Fig 2 illustrates that the situation is not quite as clear as perhaps implied. Although the DME has its advantages in that it provides a fresh unpoisoned surface on which the hydrogen overvoltage is high (and therefore can be made quite negative in acidic solutions without the interference of hydrogen evolution), its behaviour is complicated by the increase in the size of the drop during its lifetime and the movement of its surface through the solution. The drop charges during its growth, and the observed current is a combination of capacitive and faradic components.

Another result of the growing drop is distortion of the polargraphic wave by the appearance of a maximum. Although the cause is not well understood, it is a surface effect and can be suppressed by the addition of a surfactant such as gelatin at the 0.005% level.

*The Auckland Branch Symposium on **Modern Laboratory Practice**, held October 21-22 was quite successful, and attracted chemists from as far away as Invercargill. Our photo shows Dr Donald Nelson, Government Analyst at Auckland, addressing the meeting. He spoke on the microscope and its use in the modern laboratory. We hope to publish further papers given at the Conference in future issues.*

The third complication is evident in Table 1, a very abbreviated list of half-wave potentials for a number of species, including oxygen which has two waves,

$$O_2 + 2H^+ + 2e \rightarrow H_2O_2$$

$$H_2O_2 + 2H^+ + 2e \rightarrow 2H_2O$$

These waves, particularly the broad wave at -0.9V versus the saturated calomel electrode, will interfere, and dissolved O_2 must be removed from the sample solution by bubbling an inert gas such as nitrogen through the solution before analysis.

Conventional dc polarography as described above will readily provide detection limits as low as 1 ppm for metals such as copper, cadmium, lead and zinc; however the noisy output is obviously susceptible to improvement by electronic means.

Recent Development

There are several techniques for distinguishing between capacitive and faradic current, such as ac polarography, Kalousec polarography, pulse polarography and differential pulse polarography. The last of these is the most

widely used and is the only one that will be described. Differential pulse polarography combines a linear voltage ramp with pulses of fixed magnitude (5-100mV) applied during the last 60ms of a drop's life (Fig 3). During the pulse, the capacitive current decreases rapidly to zero but the faradic current decays more slowly. The current is sampled twice, immediately before applying the pulse, and again during the last 17 ms of the pulse, and the current difference is plotted against potential, resulting in current peaks rather than waves (see Fig 4).

Detection limits which are of the order of 1 ppm for conventional dc polarography are reduced to about 0.02ppm with differential pulse polarography i.e. of the same order as atomic absorption spectroscopy.

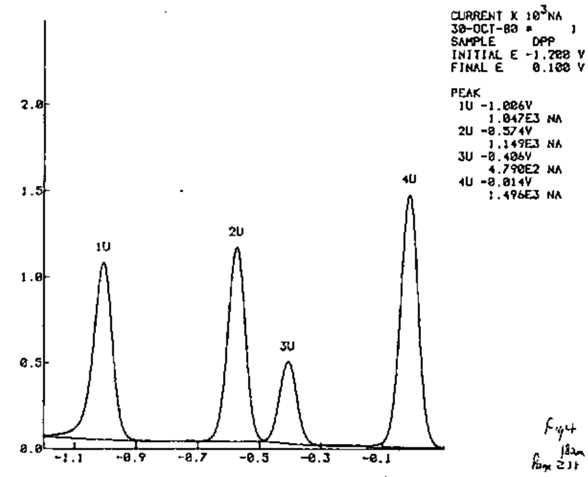
Other refinements in modern instruments include the three-electrode potentiostat which permits compensation for the resistance of the solution. Some polarographic systems have what is known as a static mercury drop in which the drops are controlled by an electromechanical valve. The drops are allowed to grow very rapidly, then are held at constant size during the current sampling.

Some Applications

The applications to the analysis of metal ions are obvious but polarography is not restricted to inorganic cations, or indeed to inorganic species. Any species will be polarographically active provided it is able to be oxidised or reduced between the approximate limits +0.4V and -2.0V versus SCE. (These limits are set by the oxidation of mercury and the reduction of hydrogen ions respectively). This includes a large number of organic functional groups such as carbonyl, azo, nitrile and disulphide groups. The actual potential at which these groups will be reduced depends on their chemical environment, allowing different compounds within the same class to be differentiated. Non-active organic functional groups can be converted into reducible groups eg conversion of a primary amine into an azomethine using piperonal.

The range of sample types that are amenable to polarographic analysis is therefore very extensive, potential applications being indicated by manufacturers' literature [1] and recent review articles [2,3]. Sample types include drugs, vitamins, food products, biological samples, herbage and water samples, and alloys. Applications in the analysis of inorganic species that are not readily performed by AAS include the determination of ions such as phosphate, chloride and ammonium. Also, speciation is possible with polarography, the differentation between As (III) and As (V) for example.[4]

Fig.4. Differential pulse polarogram of a solution containing Cu^{2+}, Pb^{2+}, Cd^{2+} and Zn^{2+}. Current on the y-axis, potential versus Ag/AgCl on the x-axis. The figure is the actual output from a Princeton Applied Research 384-1 system, including blank subtraction and the drawing of baselines. (Courtesy ANAC Ltd)



Species	Supporting electrolyte	E½(v. SCE)
Cd^{2+}	0.1 M KCl	-0.64
Cu^{2+}	ammonium citrate	-0.06
O_2	0.1 M KNO_3 (1st)	-0.05
	(2nd)	-0.90
Pb^{2+}	0.1 M KCl	-0.40
Zn^{2+}	acetate pH 4.5	-1.10

Table 1. Half wave potentials for some polarographically active species.

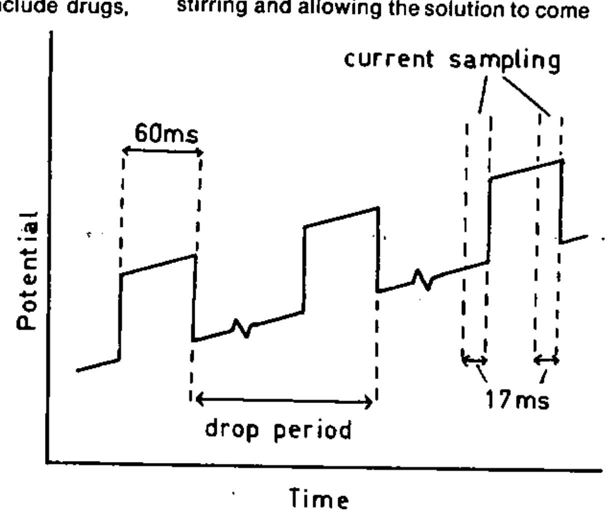
Polarography, therefore, is applicable to a diverse range of sample and analyte types, with detection limits for trace metals of the same order as AAS, but usually with more complicated and time consuming sample preparation.

Stripping Analysis

The same apparatus, however, permits the use of a preconcentration step in a technique known as stripping analysis. For anodic stripping, the working electrode may be a hanging mercury drop or a thin mercury film on a carbon electrode. The ions in solution are first reduced at a negative potential under constant stirring, and preconcentration occurs as the metal atoms amalgamate into the microelectrode. After stopping stirring and allowing the solution to come to rest, the potential of the mercury drop is scanned in a positive direction. As the half-wave potentials are passed, the amalgamated metals are successively stripped out of the amalgam, giving current peaks, the heights of which are proportional to the original concentrations of the ions. It is neither practical nor desirable to amalgamate all of the ions from the solution, as long as the proportion is constant for the sample and standards, though the detection limit can be lowered by increasing the plating time.

As an example of the application of anodic stripping, 0.2 ml of whole blood was digested with perchloric acid, made up to 5 ml with sodium acetate solution, 30 minutes plating at -1.0V then swept at 60mV/s gave peaks corresponding to 61 ng of Cu, 61 ng of Pb and 1 ng of Cd (0.3, 0.3 and 0.005 ppm respectively).[5] Lower levels still of metal ions have been reported in water samples (eg 0.3 + 0.1 ppb Cd)[6] but contamination problems start to become limiting.

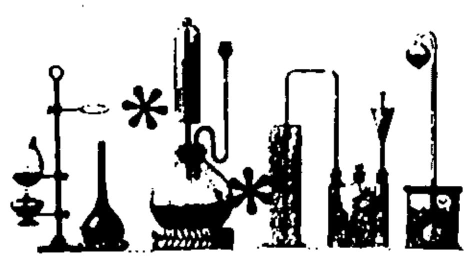
Fig.3. The form of the applied potential for differential pulse polarography.



Conclusions

The current state of polarography in NZ appears as a combination of very optimistic claims by the manufacturers of polarographic equipment on the one hand, and the rather sceptical lack of awareness of most chemists on the other. The future is bound to see a compromise reached between these two extremes, as practicing chemists, working with real samples, sort out those areas in which polarography is more useful than other methods. The applications are likely to be where low detection limits for multicomponent analyses are required with low capital outlay (approximately half the cost of AAS).

Polarography is not going to displace any current methods, but the renaissance of the 60-year-old technique has arrived and it is now up to analytical chemists to restore it to their repertoire of analytical skills.



New Products, Services

DISPOSABLE GAS, DUST, ODOUR MASKS AND RESPIRATORS

Now available for NZ laboratories is a range of 3M masks and respirators that will enable laboratory personnel to work with many hazardous materials/samples or in difficult environments. Distributors are Labsupply Pierce (NZ) Ltd.

8500 Non-Toxic Particle Mask: For personnel exposed to nuisance dust and powders. These masks will last for about 8hrs, are disposable, low cost, while enabling users to enjoy lightweight comfort, unrestricted visibility and ease of breathing.

8713 Nuisance Odour Mask: Designed especially for filtering out most annoying odours. It negates the need for a toxic vapour respirator by providing the user with a lightweight mask that offers minimal interference with normal breathing, vision or speech.

8706 Hydrogen Fluoride Gas Respirator: A simple effective way to provide workers' comfort in low concentration atmospheres of HF. The respirators are disposable (after one normal work shift), efficient, economical and allow for clear communications and clear vision.

8707 Mercury Vapour Respirator: Designed for protection against elemental mercury vapour concentrations up to 0.25 mg/m³ for a full 8 hour shift. They are disposable and thus economical as well as being comfortable to wear and allowing clear communication when worn.

8710 Dust Respirator: Designed to offer maximum protection against dusts while providing lightweight, disposable comfort at an affordable price. Approved for protection against pneumoconiosis and fibrosis-producing dusts, including asbestos, coal and carbon black, silica and cotton dust.

8712 Organic Vapour Respirator: Assures excellent respiratory protection from most organic vapours in concentrations up to 1000 ppm. Disposable, economical and colour coded, its half-mask design enables glasses and goggles to be worn easily.

8714 Acid Gas Respirator: Designed specifically for efficient protection against chlorine gas (up to 10 ppm), hydrogen chloride gas (up to 50 ppm) and sulphur dioxide gas (up to 50 ppm). It is disposable, economical, colour coded and has all the features of model 8712.

C070 For further details, use Reader Service Card

ISI AGENTS

ANAC Ltd, Auckland, announces its appointment as exclusive NZ agents for ISI Inc., a leading manufacturer of scanning electron microscopes with what is claimed to be the widest product range.

The instruments start with the Alpha-9, which can be used for teaching or quality control applications. Top of the range is the DS-130, which has a microprocessor controlled lens system. Dual top and bottom stage with 30 angstrom resolution on the top stage. The instrument can also be operated in the STEM mode and channelling pattern mode. With the unique charge-free anticontamination system, non-conducting specimens can be examined without sample preparation. Between the Alpha-9 and the DS-130 are four other SEM's with varying degrees of sophistication.

C072 For further details, use Reader Service Card.

LAB-LABELLING SYSTEM

Following its successful introduction recently in USA, the 3M lab-labelling system is now available in NZ through Labsupply Pierce (NZ) Ltd. This system offers labels that resist most solvents while adhering well to glass, metal and polyethylene. They are not affected in extreme environments, e.g. in liquid nitrogen (-196°C), in dry heat (+200°C), in boiling water (+100°C) and in steam autoclaves (+121°C).

The system includes labels, a dispenser and a special tape that protects the labels under adverse conditions. The labels remain legible and in place.

A special introductory kit is available enabling NZ laboratories to evaluate the effectiveness of this evolutionary system for themselves.

C071 For further details, use Reader Service Card

Polarography (Cont)

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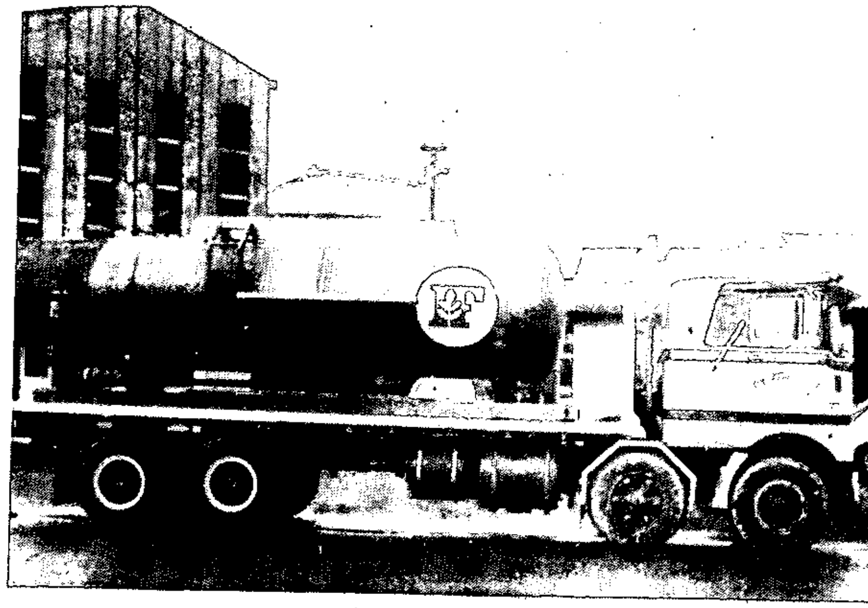
C276 For further details, use Reader Service Card

Road Tanker For Acid Transport



NZ Farmers' Fertilizer Co Limited has recently commissioned a road tanker unit, principally for transport of fluosilicic acid, used for fluoridation of public water supplies. The unit is constructed in fibreglass, lined with polypropylene, and has a capacity of 9.6m³ divided into two parts. The special liner makes it possible for the tanks to contain a wide variety of liquids such as hydrochloric acid, dilute sulphuric acid, caustic soda, sodium hypochlorite and others.

SAFETY CATALOGUE

For the first time in NZ a short form catalogue is available especially highlighting aids for safety in the laboratory.

This catalogue, from Labsupply Pierce (NZ) Ltd., offers a wide range of products each of which is designed to eliminate or cope with hazardous situations in laboratories. Among the products detailed in the catalogue are: Lab Spill and Mercury Spill Stations: Safety Charts: Alarm Thermometers: Temperature Indicators: Bench Coverings: Masks and Respirators: Winchester and Test Tube Carriers: Racks: Safety Pipettes and Pipette Fillers: Radiation Meters: Biohazard Bags: Radioactive Safety Products: Lab Timers: Spill Control Pillows etc.

C069 For further details, use Reader Service Card.

QUALITY CONTROL REPORT

Precise and rapid infrared determination and quantitative analysis of isomeric compounds in benzene solution used in the manufacture of pharmaceutical intermediates can be ensured despite the percentage of the solvent or presence of other interfering mixtures. Details of a solution to this analysis problem is the subject of a new Application Note recently published by the Wilks Infrared Centre of Foxboro Analytical.

The report points out how overuse of even a small percentage of raw material can result in a loss of thousands of dollars a year. It tells how the recently introduced MIRAN-980 computerised infrared spectrometer can make an accurate analysis of such compounds in less than one minute, complete with data reduction, thereby controlling such loss of costly chemicals and ensuring the quality of the benzene solution.

Descriptive text tells of an experiment using the MIRAN-980. It details the procedure which results in completing the analysis with a single keystroke on the keyboard. The report also includes a table which summarises the analysis of a set of knowns prepared via gravimetric means.

Copies are available from W. Arthur Fisher Ltd., Auckland.

C056 For further details, use Reader Service Card.

CHANGE COMING

BASF Aktiengesellschaft and Bayer AG have decided to separate their activities in NZ rather than continue trading under the name of their jointly owned subsidiary Henry H. York and Co Ltd. The change will take effect during the second half of next year.

CATALOGUE LISTS LABORATORY TESTS

A catalogue of internationally applied laboratory test methods has been compiled by the Dutch Standards Body (NNI) and is now available from the Standards Association of NZ.

The catalogue presents a systematic approach, enabling anyone to determine whether an ISO test method for a certain component or property exists. It aims to improve the accessibility of analytical methods as well as serving as a basis for future work in the field of standard test methods.

Four main areas are covered in the catalogue: sampling, chemical and physico-chemical methods, test methods for elements and inorganic compounds, and test methods for organic compounds.

The catalogue should prove a practical aid for industry, laboratories, and teaching institutions providing a quick reference source for ISO standard test methods required.

Copies of the "NNI Compendium of chemical and physico-chemical test methods" may be obtained from SANZ.

Long-established laboratory supply house, Selby-Wilton Scientific Ltd., Lower Hutt, will not lose its identity as a result of being merged with the Smith-Biolab group of companies.

The Auckland-based company, whose acquisition of Selby-Wilton was announced as this issue was going to press, stated that the Lower Hutt company, whose origins date back 117 years, would continue to trade under its own name. The association with its many principals would be continued.

Smith-Biolab believe the merger will afford significant advantages to its clients including:

- **More distribution outlets with greater stockholding ability**
- **Increased financial resources**
- **Greater purchasing power**
- **A national network of service centres**
- **More product specialists**

The Auckland company sees the merger as an important strategic move in its future growth, as between them the two companies service many of the NZ market requirements.

AFFINITY CHROMATOGRAPHY PRODUCTS

Affinity chromatography has become a most important method for the isolation and purification of biological macromolecules.

Pierce Chemical Co's dedication to affinity chromatography is the production of a immobilised ligand selection for use in a wide variety of purification protocols. A Bio Research Products technical bulletin has just been released containing a concise description of Pierce's affinity chromatography products with applications and literature references included.

In the design and preparation of these affinity matrices, special attention to the ligand, the choice of spacer, the method of attachment, matrix capacity and stability is given. Each lot Pierce produce of affinity matrix is application tested to ensure a consistent high performance product. Wherever possible Pierce's exclusive carbonyldiimidazole method of ligand attachment which yields high capacity, leak resistant and charge-free supports is used.

C068 For further details, use Reader Service Card.

Conference Impressions

Cecil B. Johnson
Applied Biochemistry Division, D.S.I.R.
Palmerston North.

In addition to the close involvement of the Biochemical Society, there were joint sessions of common interest with the NZ Society for Plant Physiology and the NZ branch of the Australian and NZ Society for Mass Spectrometry. Most of the main suppliers of chemicals and equipment were represented at the trade display. Some models of the latest equipment from the manufacturers, such as a gas chromatograph and an inductively coupled plasma spectrometer were demonstrated.

The Conference was opened by **Mr W.F. Birch,** Minister of Science and Technology. In his speech, Mr Birch mentioned many industries, such as those associated with horticulture, forestry and fishing, where scientists will play a vital role in their future expansion and in overcoming problems threatening the continued acceptance of our export products. Active collaboration between MAF and DSIR and the University will lead to major advances in many areas.

Plenary Lectures

Plenary lectures provided a focus for each day's activities in the major specialist sections. The Biochemical Lecture was presented by **Prof Eric Conn,** (Dept of Biochemistry and Biophysics, University of California, Davis) on "The Chemical Defences of Plants". Dr Conn spoke about plant and animal interactions produced by toxic or potentially toxic secondary plant metabolites, such as non-protein amino acids, alkaloids and cyanogenic glycosides. Many insects can tolerate specifically toxic substances in their diet, indicating plant/insect co-evolution. Other aspects he discussed included the activation of substances that are not inherently toxic, the storage of cyanogenic glucosides and their decomposing enzymes in plants and reactions of these glycosides under various dietary situations.

"Changes in Plant Secondary Chemistry. An Interpretation of the Feeding Preferences of Danaine and Ithomiine Butterflies" was the title of the Guest Lecture presented by **Dr John Edgar,** Divison of Animal Health, CSIRO, Melbourne. Dr Edgar discussed the ability of some insects to detect and utilize plants containing various secondary metabolites, primarily alkaloids. The plants are used as a food source, exclusively for given species of insects, and the toxic substances are stored for use as defence materials. Alternatively the toxic compounds may be converted to pheremones, compounds used in courtship rituals or territorial marking compounds. In an unusual bioassay, a spider is used. When a moth is trapped in the spider's web, it is usually quickly stung and eaten by the spider. However, if the moth contains toxic alkaloids the spider will snip the web around the moth allowing it eventually to fly away.

The Analytical Section guest speaker was **Prof Leo de Galan** (Technical University of Delft, The Netherlands) who spoke on "Emission Spectrometry with the Inductively Coupled Plasma". Prof de Galan described the instrumentation available for this type of spectrometer and some analytical applications together with advantages and disadvantages of the plasma. This method of elemental analysis has low limits of detection for 60 elements, gives good correlation with other methods of measurement, has a wide linear range and is substantially free from chemical interferences. However, the equipment is expensive to purchase and operate (e.g. argon consumption is 10-20 L/min) and some spectral interferences from concomitants may complicate background corrections. Modifications in the design of the torch to drastically reduce the argon requirement have generally resulted in increased detection limits of the elements.

Dr Keith Murray (Food Research Laboratory, CSIRO, Sydney) provided the Gas Chromatography-Mass Spectrometry Plenary Lecture on "Some Experiences in the Application of Mass Spectrometry to Food Research". Some of the topics discussed by Dr Murray included the chemical nature of characteristic and off-odours in various foods, toxins in food and the detection of intestinal disorders by the analysis of fecal products. He also described the analysis of root volatiles from a prickly wattle, which inhibit growth of a fungus that is responsible for extensive 'die-back' of Australian jarrah forrest. Applications of conventional ionisation and of field desorption mass spectrometry to these topics were discussed.

Specialist Sessions

The 135 papers presented at the Conference were divided into 8 specialist groups with each session consisting of up to 4 concurrent group presentations. Poster sessions were scheduled for the biochemistry and inorganic chemistry groups. Competitors for the student paper award, judged by **Prof Brian Davis, Dr Clem Hawke** and **Dr Bill Swallow,** were **S.J. Henderson** (Wellington, "A Berthelot-Bourdon Tube Method of Studying Water Under Tension") **B.D. Palmer** (Auckland, "The Synthesis of Some Odorants Related to Ambergris"), **B.E. Steenson** (Canterbury, "The Determination of Hammett σ_R Values by ^{13}C.M.R.)and **E.M. Goh** (Waikato, "Structural Investigation of Two New Groups of Triterpenoids from **Pseudocyphellarra** Lichens"). The award was won by **Mr Henderson.**

The Biochemistry Specialist Session was a very comprehensive one, comprising 27 oral presentations and 20 posters. Plant biochemistry was one of the themes of the Conference. A feature of the biochemistry programme was the specialist poster session. This was possibly the most ambitious poster session presented at a NZIC/NZBS conference and it appeared to be very successful. It is hoped that future conferences will see a continued trend towards poster presentations for specialist work, with oral presentations being reserved for longer review-type lectures.

Two review lectures were presented to the Organic Group, "Reactions of Alkynols with Lithium Aluminium Hydride" by **Prof M.P. Hartshorn** (Canterbury) and "The Study of Lipoprotein Function by Chemical Synthesis. A Role for Synthetic Organic Chemistry in Medical Research" by **Drs W.S. Hancock** and **D.R.K. Harding** (Massey). A diverse array of syntheses and reaction mechanisms were discussed during the first day's sessions. Following from Dr Edgar's paper, a series of NZ contributions in the field of chemical ecology were presented. Here, the effects of plant and animal metabolites on these and other forms of life were explored. The importance of an interdisciplinary approach to this type of research was emphasised by **Dr O.R.W. Sutherland** (Entomology Divison, DSIR Auckland) in his paper "The Chemist-Biologist Collaboration. Dynamics of a Relationship". The final day's sessions, devoted to the natural products field, was initiated by a most stimulating paper presented by **Prof R.J. Ferrier** (with **Drs R.H. Ferneaux** and **P. Prasit**,Victoria) on "New Approaches to Aminoglycoside Antibiotics and Prostaglandins".

The Inorganic Chemistry Review Lecture was presented by **Prof B. Kamenar** (visiting Professor at Auckland — The University, Zagreb, Yugoslavia) on "Characteristics of Crystal Chemistry and Stereochemistry of Mercury". The importance of catalysts for the production of synthetic gasoline from methanol was highlighted by three papers from the DSIR Chemistry Division, Petone, group of **Drs L.P. Aldridge, D.M. Bibby, N.B. Milestone** and **S.R. Beams** entitled, "The Synthesis of the Zeolites ZSM-5 and ZSM-11 and their Silica Analogues Silicalite-1 and Silicalite-2", "Coking and Stability of ZSM-5" and "Re-Examination of Classical Fischer-Tropsch Catalysts". Other papers presented to this Group described a variety of organometallic compounds and aspects of inorganic biochemistry and cement chemistry.

Following on from Prof de Galan's paper, two review lectures on ICP spectroscopy were presented to the Analytical Group, "New Techniques in Inductively-Coupled Plasma Atomic Emission Spectroscopy" by **Dr H. Eberhardt** (Labtest Equipment Ltd., Melbourne) and "A Low-Flow ICP Torch Utilizing a Flame — AAS Nebulizer, for Agricultural Analysis" by **Mr M.D. Lowe** and **Dr M.M. Sutton** (Ruakura). Other methods for the analysis of trace elements were also discussed. A popular paper, utilizing an analytical method based on stable isotopes, was "Detection of Tap Water in NZ Commercial Wines" by **Dr J. Dunbar** (Waikato) and **Prof A.T. Wilson** (Duval Corp., Arizona).

Methods for the analysis of lipids from a variety of sources were presented in the first session of the Chromatography Group. Volatile products in used frying fats were considered and applications of high pressure liquid chromatography described. Papers presented to the Physical Chemistry Group included aspects of ^{13}C NMR as well as Raman, X-ray, neutron and laser light scattering studies.

An insight into future teaching methods involving the use of microcomputers was illustrated in papers to the Education Group by **Prof B.R. Penfold** (Canterbury) and **Dr P.J. Pearce** (Victoria). **Dr I.D. Watson** ("Chemistry for the Eighties") and **Drs E.W. Ainscough** and **A.M. Brodie** ("Sixth and Seventh Form Chemistry and Everyday Life") discussed programmes for high school chemistry that would be relevant to current problems and also would present an adequate background of chemical principles. The introduction of a 1-year Diploma course, to be taken after completion of a BSc, involving business aspects of chemistry such as chemical marketing, research and development and patents would be of particular value to students going into industry. A re-emphasis is required of the value of chemistry and its beneficial influence on everyone's life.

Presidental Address

Prof Arthur Campbell (Otago) gave the Presidential Address on "The Analytical Chemistry of Selenium". He discussed a variety of analytical methods, including colorimetric determinations using either dithizone or 2,3-diaminonaphthalene (by molecular fluorescence), titration with thiosulphate using measurements of the heat of the reaction to detect the end point (from an enthalpogram) and atomic absorption spectrometry. Examples of the analysis of selenium in seawater using borohydride reduction and other techniques illustrated the latter method of analysis.

Symposium

The Conference concluded with a symposium on "Herbicides in Agriculture — Dioxin and Other Problems", chaired by **Prof Alistair Renwick** (Biochemistry, Auckland) and addressed by four invited speakers after which a general discussion was held.

Dr George Brooker (Ivon Watkins-Dow Ltd., New Plymouth) discussed the manufacture of the herbicide 2,4,5-T and of methods to limit the production of Dioxin during the process. He mentioned the necessary careful monitoring of all large scale chemical processes to prevent the possibility of destructive explosions, with the resulting release of toxic substances, that have occurred overseas. Environmental aspects of Dioxin releases were also discussed. **Dr Denis Hocking** (Massey graduate, now a local farmer) suggested that improvements are required in the spray application of chemicals to prevent drift onto people and plants. More information on the effects of agricultural chemicals on humans is required. A more mature approach to pest control is required where the spraying of chemicals is but one of an array of methods used. Many chemicals that are now widely used (e.g. those for preserving wood) could give disposal problems in the future.

Dr George Zabkiewicz (Forest Research Institute, Rotorua) claimed that spraying and burn-off of vegetation are necessary before forest trees are planted. Nutrient competition (other than for nitrogen) with gorse can seriously reduce tree growth and dense undergrowth can make pruning and thinning difficult and expensive. Research is currently being undertaken to discover the time for most effective spraying. **Prof E.G. McQueen** (Honorary Director, National Poisons Information Centre and MRC Toxicology Unit, Dunedin) provided a background to the 2,4,5-T controversy, with particular reference to the alleged production of birth defects in Vietnam and NZ by the spray, and also industrial accidents leading to the skin conditions known as chloracne. Toxicity effects of 2,4,5-T and dioxin were discussed.

The main concern of questioners during the final period of the symposium was the problem of trying to relate toxicity experiments on animals with the effects of chemicals on humans. Investigations of the long term exposure of animals to small amounts of chemicals may show up problems that are not produced by the high-dose-over-short-periods-of-time type of investigation.

Gas Chromatography — Mass Spectrometry Workshop

A specialist session, organised by **Dr John Shaw** (Applied Biochemistry Division, DSIR, Palmerston North) was held after Dr Murray's address. Topics discussed included the satellite mass spectral search system, advances in instrumentation in NZ and an insecticide metabolism study. Other Workshop activities (at ABD) included a demonstration of the OASIS link and of capillary gc/ms techniques and a general discussion of problems related to gas chromatography and mass spectrometry.

Dr Murray described further details of his work in a lecture to the Workshop. This lecture included techniques of trapping compounds for head-space analysis of volatiles and the transfer of these compounds onto a gas chromatographic column. The outlet of the column was connected to a mass spectrometer and a sniffing (or collection) port, which was used in a study of rabbit pheromones, where the animals' response to the eluting compounds was measured by changes in its heart beat. Applications of reaction gas chromatography were descrbed. Odour components of fresh purple passionfruit (**Passiflora edulis** (Sims)), the edulans (epimers of 2,4,5,8a-tetramethyl-3,5,6,8a-tetrahydro-2H-1-benzopyrans) and 6-(but-2'-enylidene)-1,5,5-trimethylcyclohex-1-ene isomers, were identified using this technique to effect oxidation, hydrogenation, hydrogenolysis and dehydration reactions under appropriate conditions. Trace quantities of substituted pyrazines have been found by Dr Murray's group in a number of fresh vegetables, first in peas, although their concentration in the pods is much greater. This may explain the tradition of cooking a few pods with peas to improve their flavour. Dr Murray also described the technique of field desorption mass spectrometry and his application of it to the analysis of leaf wax components and related compounds.

During a discussion at the end of the lecture, the effect of column bleed on background subtraction of mass spectra was considered. This can be important when an eluting compound increases the background, apparently by "pushing out" some liquid phase. In this instance a considerable variation in the mass spectral background peaks can be detected.

Readers' Letters

THE COMPUTER HITS BACK

The Editor,

Sir,

We are sorry that your faith in computers has been shattered (Chemistry in NZ, October 1980, p.172). In defence of the computer we would claim that the print-out accurately reflects the information supplied by members or branches (the well known GIGO principle). We hold that our customers are always right and change computer file entries according to member or branch instructions. However as with other scientific "black boxes" interpretation of the print-out is another matter! As always communication is everything and we will try to improve the amount of detail provided on the movement of members. Members can help by letting us know if address changes involve a change of occupation or position or are simply a change of domicile. As a postscript if you miss out on any Institute mail do **not** blame the computer — blame the information supplied, or perhaps occasionally the programmer or the Post Office. We would unblushingly claim that the computer file has the membership records in better shape than they have ever been — ask the volunteers who in the past manually prepared the lists of members. It remains true that the frequency with which our members change position and occupation leaves us running hard to stay in the same place.

May we take this opportunity of explaining to members who may have been irritated by apparent lack of action on address changes that there can be a big time-lag between receipt of the advice and a change being effected. The file is updated fortnightly. The publishers of the Journal require sets of labels 4 weeks prior to publication and branch secretaries require labels well in advance of their distribution of notices of meetings. For these reasons it is quite possible for a member's journal to go to an old address perhaps 6 weeks after the member has notified a change. We do attempt to keep the computer file as accurate as possible and believe that in general we are succeeding.

D.J. Hogan, Registrar

N.E. Wignall, Administrative Secretary

Mr Tom Whitfield has joined Revertex Industries (NZ) Ltd as manager, technical servies laboratory. He has had extensive experience in the paint and industrial coatings industry since studying chemistry and allied subjects to Royal Institute of Chemistry standard at Rutherford College of Advanced Technology, England. He was awarded a Licentiateship of the Royal Institute.

Control Of Industrial Cooling Systems — Part 2

J.M. Heng, Portals Water Treatment (NZ) Ltd and W. Pugh, Houseman (Burnham) Ltd.

Microbiological growth

Dirty and corroded surfaces decrease the efficiency of industrial heat exchanger systems and also add to costs in terms of labour and production down time. Inefficiency also means that the cooling system will need to work harder to maintain the required heat loss. This means that circulation rates and fan output must be increased and water loss by windage and drift will be higher with increasing water usage. Any considerable quantities of deposit whether they be scale, air-borne or water-borne detritus, corrosion products or microbiological growth, will therefore increase the water utilised to achieve the heat losses required. Control measures are therefore essential. Scale deposits and the corrosion processes have already been discussed. Growth from microbiological sources are equally significant not only in terms of blockages and fouling of heat exchanger surfaces but also from the indirect and direct corrosion processes that they produce. It is essential therefore that to run an open cooling system efficiently, careful and well-managed control measures against biological growths must be practiced.

The main agents involved in organic growths are the algae, the fungi and the bacteria. The algae concerned are of the green, blue-green and golden variety. The green algae found in cooling towers and cooling circuits may be large, fixed, frond-like structures or they may be filamentous. They also can be small, free swimming organisms in the cooling tower pond water. The blue-green algae and the golden diatoms are both small unicellular organisms which usually exist as the free swimming form. Algae need light to exist and are therefore only found in exposed areas of the cooling system. They may grow in profuse quantities on the cooling tower or in the pond water and will foul these areas to such an extent as to dramatically reduce the efficiency of the cooling tower and the flow characteristics of the system. More insidiously, they will however foul the heat exchanger surfaces, reduce the efficiency and may deposit and form sites for bacterial colonisation with ensuing corrosion.

Fungi can also create a number of problems. Primarily they will colonise the wood structures that may be incorporated into the cooling tower. The fungi produce enzymes which digest the cellulose within the wood and if unchecked will eventually lead to collapse. This may be the cooling tower pack, if this is wood, or in some cases it may be the supports, eliminators or fan housing. There are two types of fungal attack — soft or surface rot from one group of fungi and the more dangerous internal decay brought about by another group. The fungi will also provide copious organic matter which will support growth of other micro organisms. One group of fungi, the yeasts, which can exist as unicellular organisms, groups of cells or chains of cells, will quickly convert harmless organic detritus which drifts into the cooling tower water, to aggressive acidic materials.

The third group of organisms — certainly the most common and the most insidious — are the bacteria. There are very few organic materials that the bacteria will not utilise as a food source and dead algae in particular are eagerly colonised. The growth rate of the bacterium is prolific. It will divide to produce two daughter cells every 20 minutes if conditions are right. So from one cell it is theoretically possible that 280×10^{12} bacteria will develop in 24 hours. The bacterial cell is small, of the order of some 1-2 microns in length, and so this enormous number of organisms will only weigh 100 grams or so. In 2 days, however, if the maximum rate of growth were continuous, some 30×10^{12} tons of bacterial mass could ensue. Obviously conditions are never that perfect; the food source becomes exhausted or the bacteria produce conditions that are unfavourable for further proliferation. Alternatively, they may prey on each other, be preyed upon by other organisms, die off from viral infections and so on. The example does serve to illustrate, however, how quickly the bacteria can grow to problematic quantity.

Many of them produce slimes, which cause further fouling and blocking, but more dangerous to the cooling system is their corrosive action. This can be either due to the production of corrosive substances or by the creation of concentration or differential aeration cells. The sulphur cycle bacteria serve to illustrate the former effect. Under anaerobic (oxygen free) conditions such as will occur beneath deposits, particularly where dead algae are concerned, organisms proliferate which will reduce the sulphate naturally in the water to hydrogen sulphide. Hydrogen sulphide will attack metals such as iron to produce metallic sulphides of corrosion. But worse, other organisms will convert the hydrogen sulphide to sulphur and then back to the sulphate. Unfortunately, under a water environment this sulphate will not be sodium or calcium sulphate, but due to the excess of hydrogen ions, will be hydrogen sulphate or sulphuric acid. Sulphuric acid at the level of some 10-15% has been found beneath colonies of such organisms with correspondingly rapid corrosion of the metal surfaces upon which the colonies are situated.

The bacteria will also, by their metabolic processes, deplete or concentrate their immediate surroundings producing a concentration cell or a differential aeration cell as described under the section on electro-chemical corrosion. Any bacterial deposit will do this as well as the small algae and other organisms with a rapid rate of metabolism.

Microbiological control measures

Bacterial cells, fungal spores and embryonic algae are ubiquitous and being continuously drawn into the cooling tower and cooling tower pond. Control measures must therefore be part of the continuous programme to control microbes at a level which will not materially affect cooling system performance. Most cooling system corrosion and scale control programmes are run at pH's which are ideal for microbial growth and control measures must be compatible with these and with the cooling system operating conditions. The most obvious choice of control agent is chlorine, which is an excellent biocide against non-sporing forms and is also inexpensive. Unfortunately under cooling system conditions it is far more ideal since 0.5-1 ppm of chlorine must be maintained for a short period to achieve success. This is easily achieved in most of the system but free chlorine is soon lost with the scrubbing effect across the tower resulting in a pond area that is unprotected.

If chlorine is added at a sufficient level to protect this area then it will also be at a level that will attack and corrode metals elsewhere. Chlorine is also soon lost on any organic material and slimes and dead leaves, etc, will quickly deplete the necessary chlorine reserve. With recirculating water systems, chlorine usage is therefore limited and where it is employed requires careful monitoring. Other agents, the biocides, are therefore more commonly used. These fall basically into a number of groups:

1 Chlorinated and phenylated phenols.
2 Organo-metallic compounds.
3 Organo-sulphur compounds.
4 Quaternary amines.
5 Other amines.
6 Other compounds such as methylene bis-thiocyanate, iso-thiazolins, thiocarbamates, etc.

Products of each of these groups or mixtures of them are all effective and acceptable under various sets of circumstances. Factors such as the size of the system, the type and level of growths, the environmental considerations, the materials of construction of the system and so on have to be carefully considered before selecting the correct biocide programme. Further, due to the prolific nature of organisms and the possibility of resistant strains developing, biocides must be shot dosed and alternated. It is advisable to select two biocides, using one as the main agent and alternating with the other on each 4th or 5th dosing. The selection of the correct biocide, the level of usage and the frequency of dosing can only be determined after laboratory analysis, testing and also by site monitoring.

Fouling by air-borne deposits

The other major problem in open cooling systems is the management of the large quantites of air-borne deposits such as building debris, soil, etc, that will get carried into the tower and pond area. This detritus must be encouraged to deposit into the cooling tower pond where it will not impair the cooling and heat exchanger functions of the system. Once at the base of the pond, weirs can be used to trap the deposit and blowdown to remove it from the system.

Flocculating agents are utilised when these deposits are heavy. These materials, usually based on long-chain organic polymers, will coagulate the solids and cause them to sink to the base of the pond, to be subsequently removed by blowdown.

Summary

It is imperative that the industrial users of water take a close look at present water/effluent costs to their respective organisations and take advantage of the savings available.

The Fletcher Memorandum

Chemical Education is alive and well. A group in Christchurch is issuing an eagerly sought publication "CHEM NZ" now attracting 400 readers (mostly outside the Institute) in NZ, Australia, UK, India and the Pacific Is. NZIC Council decided to continue its full support of this activity. Editor **Jack Fergusson** is off for a short spell and **Dr Graeme Wright** (University of Canterbury) is to keep up the script. Thanks Jack for a successful enterprise.

The Authority for Advanced Vocational Awards (previously the Technicians Certification Authority of NZ) advises that a new NZCS in Water Technology is now offered and that the Chemistry syllabuses are again under review (NZIC representative - **W. Freitag**). Any comments on the latter to AAVA, Private Bag, Wellington. **Godfrey Husheer** (of HCE fame) asked Council to take up with **Mr W.F. Birch** the question of Government incentives (or lack of them) for companies for technician training (there are schemes and incentives for apprentices). President **Dr Jim Ellis** is about to do so!

Lester Stonyer (ICI Tasman) has drawn Council's attention to "Associate Company Grade of Membership" offered by the ACS. Idea is that companies become associated with the NZIC through an annual subscription. What do you think?

Branches, President **Jim**, Vice-Presidents **Stan** and **Doug**, Golden Jubilee Conference Committee and Journal Editor **Stan** are all getting steamed up for next year. The February issue is expected to be a boomer and will have details.

The NZ Branch of the Australasian Corrosion Association is compiling a Register of Corrosion Consultants in NZ. More details from the Technical Convenor, Box 5961, Wellesley St., Auckland.

Council is beginning to assess various ancillary professional services the Institute could offer members. Examples under current consideration are: Discounted life assurance scheme; a booklet on "How to write a resume and conduct an interview"; publication of a new version of "Careers in Chemistry". Others to be investigated include: Group superannuation; group medical insurance and general insurance (including discounted house, boat, car insurance); and travel. Any comments or suggestions are welcome.

You will have noticed that there have been a series of enquiries into various QANGOS (quasi non-Government organisations) of late — quite apart from the Industries Development Commission "restructuring reports" — one related to the Standards Association of NZ. I represent the NZIC (with **Dr Harry Percival**, PACRA) on SANZ Council and have been delving into the report and its recommendations. I would appreciate the opinions of members on the following three questions. How can Standards be prepared more efficiently? How can they be used more efficiently? What do you think of the Certification mark?

Inductively Coupled Plasma Atomic Emission Spectroscopy: Current Status

M.F. Hall, Managing Director, Advanced Electronics Ltd.

The development of the inductively coupled plasma source resulted in a rebirth of emission spectroscopy and a rapid growth in sales estimated to be over $40 million worldwide for the 1980/81 year.

A typical ICP system consists of several major components:

1) Source control system comprising RF generator, power supply and impedance matching network for the working coil;
2) Sample uptake system including nebulizer and gas control unit;
3) Optical dispersion system, usually monochromator or polychromator;
4) Readout system including strip chart recorders, computers and printers.

As users became more familiar with the early systems, a better understanding of the shortcomings of those instruments evolved.

Originally the ICP source was used with polychromators to take advantage of the true multi-element capabilities of the emission source. More recently, however, the source has been used with monochromators such as those designed for atomic absorption or other general purpose optical systems. In both cases it has been discovered that the performance requirements of the optical system for ICP are much more stringent than those needed for arc-spark and atomic absorption. It is now generally recognised that a reciprocal dispersion of 4 angstroms/mm in the second order is highly desirable and that the range of the second order be as broad as possible, from the vacuum ultraviolet to the near visible. The best ICP lines are usually found in this region. The use of further orders tends to diminish the signal strength of an already weak emission.

In addition, it is most necessary to keep stray light to an absolute minimum.

In another area, the RF generator itself was felt to be another source for error and presumably this was partly due to the fact that these RF generators were adapted and modified for a use for which they were never intended. These are now designed for ICP from the ground up, exhibiting precise performance which greatly enhances long term system repeatability.

Many papers have been written by a multitude of authors on nebulizers and torches. One used to need a range of nebulizers to handle different sample types and it is only recently that a "universal" nebulizer has found prominence because of its ability to cope with all sample matrices, whether they be aqueous or organic solvents. Current nebulizers can handle particulates up to 1mm diameter and have little memory effect; two factors which contribute much toward achieving a precision of better than 0.5% RSD on a routine basis.

Likewise, torches have been the subject of much discussion, with many authors making extravagent claims for good performance using very low argon flows, only to find that when one reached the bottom line, the most important requirement for precision was almost nonexistent.

Furthermore, existing data handling hardware through the use of limited analogue to digital converter interface to the computer did not provide the dynamic range required to take full advantage of the ICP emission. Data systems are now available which are specifically designed for ICP in the first instance — with powerful general purpose laboratory computer processing facilities as well.

There are a number of manufacturers of ICP systems and most have realised the constraints found in the first generation of instruments. Some still simply purchase generators from here, data systems from there, and optics from some other source, but the more dedicated are now building systems from the ground up.

The potential user should be made aware of some of the factors to consider when assessing the ability of ICP instrumentation to solve problems.

Some of these are:

1) 10-11 litres per minute of argon will be used whether operating single or multi-element systems.
2) Prices for a good single element system start from about $40,000, whereas a multi-element system will cost from $100,000.
3) Vacuum operation is highly desirable for almost all sample matrices, whether doing single or multi-element analysis.
4) Careful assessment of sample matrix is vital for, while there are few chemical interferences, there can be many spectral interferences.
5) Single element and sequential systems allow the user to optimise a system for each element of interest, whereas simultaneous systems must always compromise the working conditions for some elements, thus causing a down-grade in detection limits.
6) As with all sophisticated instrumentation, skilled operators are a "must" for getting the best performance.

Sequential ICP systems must be considered very strong competition for atomic absorption, because on routine basis the ICP is more flexible, more precise, with better detection limits and linearity for most elements than from AA.

Simultaneous ICP systems are less costly than XRF but in general are capable of a comparable performance at greater speed of analysis.

Overall, ICP appears an exciting, though hardly new, technique. The enthusiasm of its many users has resulted in a monthly publication "The ICP Information Newsletter", which is an excellent source of reference material for those involved in atomic spectroscopy.

The newsletter has now entered its 6th year of publication, its growth in content and distribution reflecting a parallel with the spread of ICP technology around the world. Today, for example, more than half of the newsletter's subscribers live outside the Western Hemisphere, whereas, only a few years ago, the majority were inside the USA. A recent article remarked that the substantive action by the US Environmental Protection Agency in developing ICP methods for waste water, and recently for lead in ambient particulate matter, emphasizes how the ICP technique is becoming an almost commonplace laboratory tool.

Many potential users who often agonize over the selection of the "best" ICP instrument, after surmounting the hurdles of gaining approval to purchase an ICP system, are now aided in their selection by very competitive manufacturers who, through their seminar and training programmes, newletters and application reports, and demonstration and applications laboratories, make possible practical "shopping" prior to purchase. As the newsletter points out, the ICP has changed from a novel research tool to a practical and serviceable laboratory workhorse.

Industrial Chemistry Prize

The Shell group of companies has assumed responsibility for sponsorship of this prize, formerly sponsored by ICI Tasman. Valued at $200, it is intended to encourage industrial chemists to submit applications based on their development of new processes for their companies, analytical techniques or quality control procedures. Scientists in research associations undertaking work for industry in these areas are also eligible.

The value of the ICI Prize for excellence in research has been increased to $500. The rules have been amended so that research work undertaken in the year preceding April 30, 1981, will be eligible for submission.

(Rules for the various NZIC Prizes will appear in the 1980 Chemistry Yearbook, now being compiled.)

New Membership Grade

Pursuant to a resolution of the 1980 AGM, the NZIC Council gives notice that it will create a new grade of membership, namely Student Membership, to be open to students at NZ tertiary institutions. This new grade is allowed for under Rule 5 and each application will require election by Council. A special application form will be available from the Registrar. Council will ratify the new grade of membership at its next meeting, set down for April 4, 1981. Any member wishing to comment on this Rule addition should write to the General Secretary before January 30, 1981.

November Council Meeting

The November Council meeting is the most important of the three meetings convened annually. It receives reports from all representatives, committees, specialist groups and officers. The meeting also sets the next financial year's subscriptions (in this case April 1, 1981-March 31, 1982), elects new representatives and considers a multitude of professional, financial and other matters including AGM remits.

This was **Dr Jim Ellis'** first meeting as chairman, following his election as President, and a long agenda was tackled with relish and many issues decided.

Council first elected **Dr John Rogers** (ex NZFMRA) as the new General Secretary.

Dr A.C. Herd has put forward a case for recognition by the Institute of the new Diploma in Science being offered by Technical Institutes. This was referred to the Membership Committee for a recommendation. The Shell group of companies has offered (and Council has accepted) to sponsor the Industrial Chemistry Prize for 1981. The prize is worth $200.

Unfortunately, inflation is eating at Council funds more than predicted and only by keeping our subscription rates comparable with a deflating dollar can we continue to offer the present services. Council deliberated for a long time on this issue, including financial priorities, cutting services and costs and assessing member reaction.

Relunctantly, the following subscriptions were set for the year April 1, 1981-March 31, 1982:

Fellow and Member: $36 (reducible to $32 if paid by August 31, 1981)
Associate Member: $26 (reducible to $22 if paid by August 31, 1981)
Graduate Member: $18 (reducible to $14 if paid by August 31, 1981)
Local Member: $20 (reducible to $16 if paid by August 31, 1981)
Overseas Members: 75% of above rates as applicable.

Council accepted all three AGM remits and set up appropriate machinery to deal with each. (These were reported in "Chemistry in NZ" October, 1980). It was also decided to take up with Government, **Godfrey Husheer's** question of company incentives for the training of technicians (see this issue's "Fletcher Memorandum").

The question of a new logo for the Institute is still under discussion. None of the suggestions so far received have been accepted. More please. Council has asked the Waikato Branch to follow up its suggestion of an enquiry into the employment of chemists and to report back.

Committee Reports

Hazardous Chemicals Committee (Messrs Kennett, Hopgood, Ogilvie): During the year the Committee met many times and considered several Bills before Parliament. The Committee has criticised the lack of use of simple, clear language and an inability to harmonise with international categorisation and labelling requirements. Mr Kennett (chairman) has represented the NZIC on SANZ committees considering standards on labelling, containment and transport of hazardous chemicals. Other topics considered and reported on by the Committee have been:

"Toxic Substances in the aquatic environment — Information retrieval" (July 1980, Water and Soil Division, MWD).

"Feasibility study of a Hazardous Substances Register" (May 1980 Health Dept. and SSC).

Overseas Access Service for Information Service (OASIS).

Environmental problems involving 2,4,5-T and PCB at Kawerau.

Incineration of chemicals, such as Dioxin (with Mr Gerrard).

Registration of Trade Names of Hazardous Chemicals.

Environmental Committee (Profs. Laverty, Campbell, Drs Temple, Laws, Larking): Two meetings have been held and discussed the EIR on the Waitara methanol plant. Other environmental matters are presently under discussion.

Energy and Chemical Resources Committee (Drs G.J. Wright, Metcalfe, Watson): Following its detailed study of the Ministry of Energy's "Goals and Guidelines" in 1978, the Committee early this year looked at the follow-up publication "Energy Strategy '79". This said little new and no public statement from the Institute was called for.

Public Affairs Committee (Drs Kingsford, Bibby, Featherstone, Wilson): A "Guide to Public Relations Planning" was sent to Branch Committees in 1979. Public comment has been made on fluoridation, fluoride from aluminium smelters and chlorine in the Ohau River. Several other issues were investigated during the year.

AAVA: Messrs L. Stonyer and **H.V. Brewerton** have been appointed, on the Institute's behalf, to the chemistry syllabii revisions now being conducted by AAVA (formerly TCA).

UNESCO: Dr G.R. Burns reported that the 4th Conference of Co-operating Bodies of the NZ National Commission for UNESCO will discuss the Commission's 1981-83 work plan and pertinent decisions arising from the 21st session of the General Conference held in Belgrade, September/October 1980.

He also reported on the 7th Regional Conference of National Commissions of Asia and Oceania. He noted that a UN development programme, sponsored by the Governments of Indonesia, Malaysia, Phillippines, Singapore and Thailand, began in September and would promote education, training and research at technological faculties, schools for engineers and technicians and research institutions in SE Asia and the Pacific. Total cost of the 5-year programme is $US6,850,000.

The Inorganic and Organometallic Specialist Group was formed at the 1980 Conference. It has now received Council's recognition. **Dr J. Simpson** (University of Otago) is secretary. (Further details are published elsewhere in this issue).

Chemical Education Group: This group is particularly active with the publication of "CHEM NZ" (see "Fletcher Memorandum" this issue) and at Conference time. It intends to investigate money allocated to schools for science and seeks publicity for the Chem Resource Centre in Dunedin.

Other matters discussed by Council included:

- Associate Company membership (referred to Standing Committee for comment)
- RSNZ matters
- Life insurance scheme similar to that being offered to NZIE (referred to Standing Committee and Branches)
- Meeting with Mr W.F. Birch.

WILLARD FRANK LIBBY, 1908-1980

The death of **Prof Willard F Libby** has occurred in California. Libby was educated at the University of California and graduated PhD in 1933. One of his earliest papers, published in 1933, describes a method of separating radiomanganese produced by the Szilard-Chalmers reaction. His interest in all aspects of nuclear chemistry was to continue throughout his life. In the late 1930's and the 1940's he published a series of papers on the efficiency and use of Geiger-Mueller counters. He paid particular attention to the techniques of preparation of samples for radio-counting especially those containing very small activities. He laid great stress on the importance of purity of samples and on the avoidance of "memory" effects in low level counting. This work prepared the scene for what was to be his greatest work — carbon dating.

In 1951 he published "Radiocarbon Dating" (Univ. of Chic. Press) and gave to the world this now well established technique for dating carbonaceous archaelogical material.

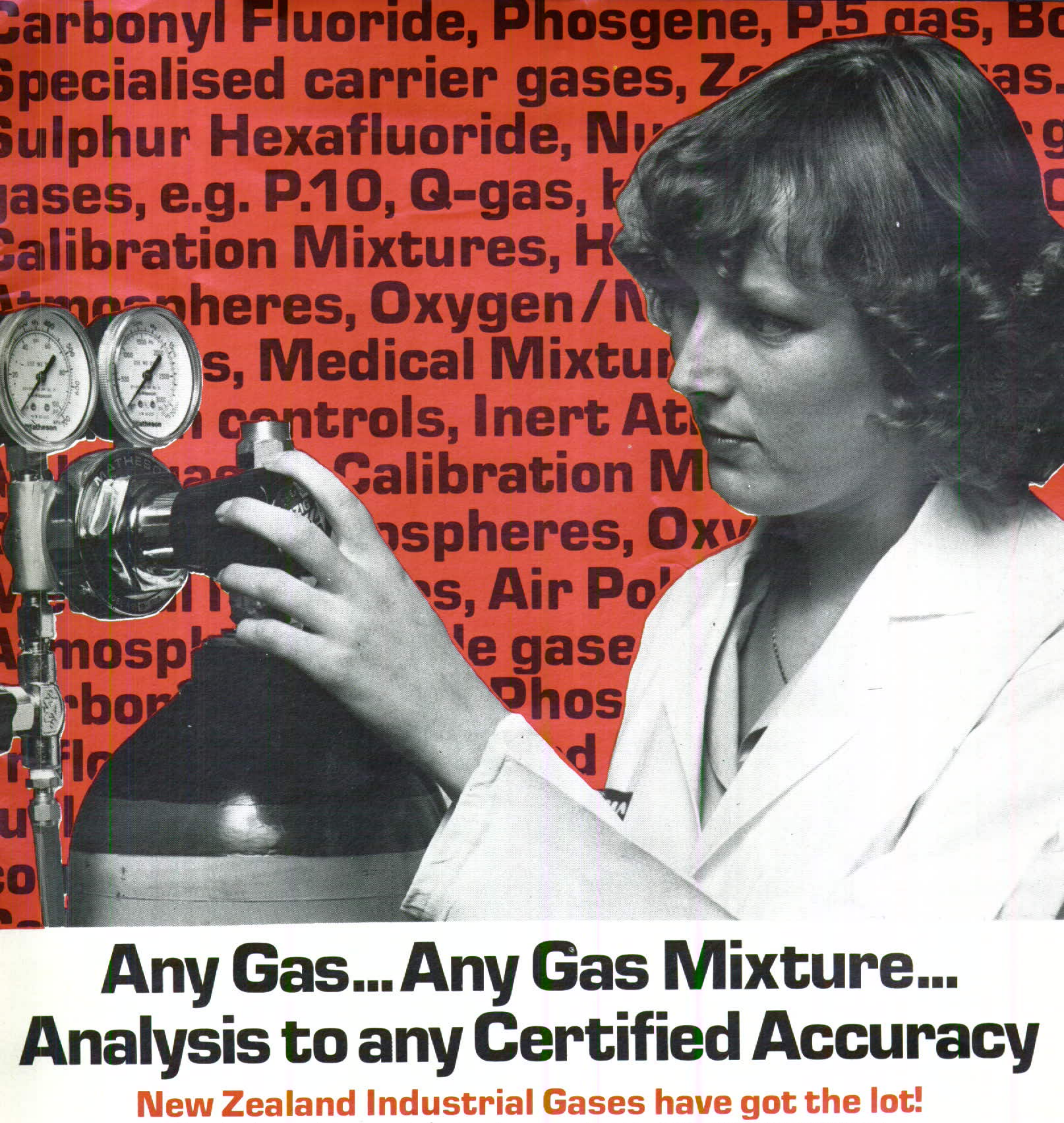
The early determinations of ages by counting ^{14}C activities were carried out using large proportional counters containing gaseous CO_2 and surrounded by a ring of protecting counters connected in anti-coincidence with the main counter to reduce cosmic background. Although these rather cumbersome counters have now been largely replaced by the more elegant liquid scintillation techniques, the pioneering work of Libby, stressing as it did the need for meticulous care in preparation of the counting sample, still stands as the foundation of the radiocarbon dating techniques.

Libby was also interested in many theoretical matters and two topics of this type in which he made important contributions immediately spring to mind, viz, theory of the Szilard-Charmers reaction (1947) and theory of electron transfer reactions in aqueous solutions (1952).

He was awarded the Nobel Prize for Chemistry in 1960.

During his life he held many academic and research appointments on both sides of the Atlantic and from 1959 up to his retirement was Professor of Chemistry in the University of California at Los Angeles and Director of the Institute of Geophysics and Planetary Physics.

A.L.O.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