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Chemistry in new zealand

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Analytical laboratories are routinely using ARL ICP systems for the analysis of ores, rocks, minerals, metals, alloys, petroleum products, soil, water, waste, plants, foodstuffs, clinical and pharmaceutical products, semi-conductor materials, forensic samples, cements, glasses and ceramics. Applications are limited only by the analyst's imagination.

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Chemistry in new zealand

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EDITORIAL

Is the downhill slope towards old age already? Conference has come and gone and the overiding impression is the rigours of staying in Weir House for a week! Perhaps that's not quite true. There were also the pleasures of meeting up with old (that word again) friends, the intellectual stimulation of some of the papers, and of course the splendour of the two lectures from Sir George Porter (of which we enjoyed every femtosecond!)

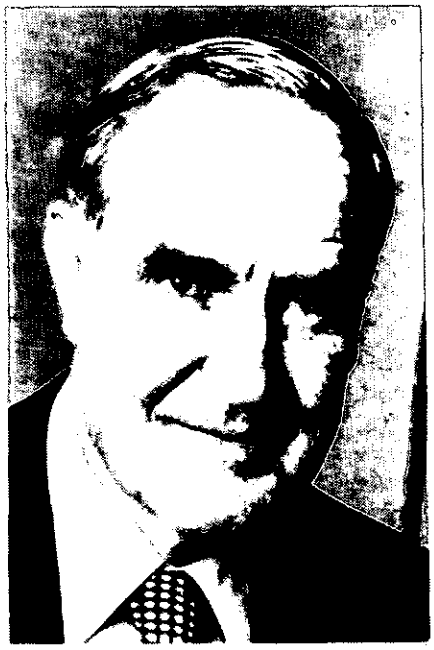
During Conference and in the Council meeting that preceeded it, there was considerable discussion of aspects of Institute membership — in particular professional standards and grades of membership, and the question of what should the Institute be doing for its members? I would like to suggest that this last matter be redirected — rather, what should the members be doing for the Institute?

The point I wish to raise is this. The activities of this organisation are essentially the outcome of efforts by individual members. At the administrative level we almost take for granted the dedication and hard work of Denis Hogan, Betty Wignall and John Rogers. We select a President each year and expect him to perform around the Branches, keep matters generally under control, but not speak out in public unless he knows that all fifteen hundred and sixty one of us agree with him. The efficient running of Conference each year is virtually in the hands of one person — the secretary, upon whom all wrath shall descend. (Not too many grumbles this year Graeme, you did a great job!) Come down to the Branch level and you find the same thing. Meetings, functions, visits, etc., are organised by individuals for the benefit of the rest of us.

There are a lot of members out there doing a lot of good work for this organisation. There are many more though who are not. If you happen to be one of those, standing back and wondering when the Institute is going to do something that you particularly want, your chance has come. The annual elections of Branch Committees will soon be upon us. There is a vacant position waiting just for you!

Bruce Graham

PEOPLE



A.W. MACKNEY — NZIC President 1984/85

Alan Mackney, OBE, is an Australian by birth but has left his mark firmly on New Zealand industry since coming here forty years ago. A graduate of the University of Sydney he worked initially for CSIR, and then Australian Newsprint Mills in Tasmania. He came to New Zealand to take up the position of Chief Chemist with NZ Forest Products Ltd, rising through the ranks until he became Managing Director in 1973, a position he held until his retirement five years later.

Alan has had extensive involvement in public and scientific affairs. He was a member of the Atomic Energy Committee (1960-62), National Research Advisory Council (1964-68), and the Advisory Committee on Pulp and Paper for the Food and Agriculture Organisation of the U.N. (1970-82). In a busy retirement he is currently a member of the Liquid Fuels Trust Board (1978-), Chairman of NRAC (1979-), and a Director of two companies.

All of this activity has obviously had its rewards, among the more tangible of which are the OBE in 1982, the APPITA L. R. Benjamin Award (1972), Hon. Fellow NZIC (1978), and Hon. Life Fellow APPITA (1984).

Alan is already working enthusiastically to see some positive developments in the Institute during his year of office. He supports the move to simplify the membership structure without sacrificing professional standards and is keen to see a membership drive directed at students in the universities and technical institutes.

INSTITUTE AND OTHER AWARDS

NZIC ANNUAL AWARDS

The following awards were announced at the AGM.

ICI Prize: *Dr W. R. Roper* (University of Auckland).

Shell Industrial Chemistry Prize: Dr J. S. Ayers (Massey University).

Chemical Essay Prize: Mr U. Roxburgh (University of Auckland).

CONFERENCE AWARDS (1984)

The Student Paper Competition was won by *J. D. McCombs* of University of Canterbury for his presentation entitled Dimeric butenolides from the New Zealand red alga *Delisea elegans.*

The conference committee also organised a poster competition for the first time this year, and this resulted in a significantly increased number of this type of presentation. The standard of entries was extremely high, with many people using the services of professional artists available within their organisations. The winning entry was entitled Depolymerisation of condensed tannins for industrial applications by *L. Y. Foo* (Chem. Divn, Wellington) and *R. W. Hemmingway* (USDA, Pineville, U.S.A.). The poster was prepared with the assistance of *P. M. Grant-Taylor* of Chemistry Division, D.S.I.R.

RSNZ PRINCE AND PRINCESS OF WALES AWARDS

The RSNZ recently announced the second group of six awards in this scheme. Two of these went to members of the NZIC.

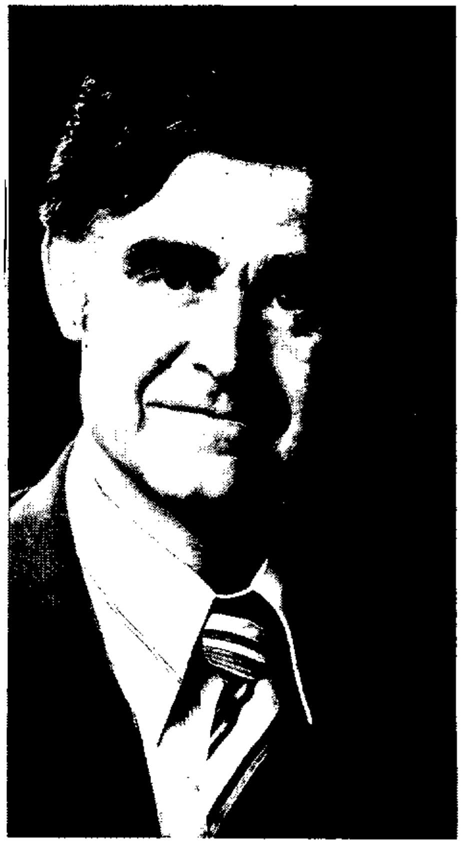
Mr Clay Cardile, a junior lecturer in Chemistry at Victoria University of Wellington has been awarded the New Zealand Bankers Association Award from the Prince and Princess of Wales Science Award Scheme.

Mr Cardile commenced his tertiary education with an NZCS from Auckland Technical Institute, followed by studies at Victoria University of Wellington for BSc (Hons). He registered for PhD studies with *Dr J. H. Johnson* in 1982 to study clay minerals. The award will enable Mr Cardile to visit the Universities at Liverpool and Aberdeen during October and November to study low temperature Mossbauer spectra of clay minerals and iron oxides.

Dr Roy Daniel, a senior lecturer in biochemistry at Waikato University has been awarded the Unilever New Zealand Award under the Scheme.

Dr Daniel is a graduate of the University of Leicester and held post-doctoral fellowships at the Agriculture Research Unit for Nitrogen Fixation, University of Sussex, and the Division of Plant Industry, CSIRO, Canberra. He was appointed to a lectureship in the Department of Cell Biology, University of Glasgow in 1971, and took up his present position in 1975. The award will be used for a visit to the United Kingdom to promote the thermophilic enzyme work being done at Waikato.

NZ INSTITUTE OF FOOD SCIENCE & TECHNOLOGY



Dr Peter Robertson, Director NZ Dairy Research Institute, is the recipient of the New Zealand Institute of Food Science & Technology's J. C. Andrews Award, for eminence in food science and technology, for 1984. This award was made in recognition of Dr Robertson's contribution to, and role in, studies on the biochemistry and microbiology of cheese and its manufacture; pioneering the preparation and use of deep frozen concentrates of cheese starters; the mechanisation of the cheese manufacturing process and his involvement with many organisations within the scientific community and the national and international dairy industry.

AMERICAN DAIRY SCIENCE ASSOCIATION

Dr Lawrie Creamer, Head of the Protein Chemistry Section, NZ Dairy Research Institute, has been selected by the American Dairy Science Association as the recipient of the Miles-Marschall International Dairy Science Award for 1984 for outstanding contributions to dairy research, especially in the field of chemistry of the milk proteins. This is the fourth occasion on which the Award has been presented, last year's recipient being Dr R. C. Lawrence, Assistant Director at the Institute.

INDUCTIVELY-COUPLED PLASMA EMISSION SPECTROMETRY

ICP EMISSION SPECTROMETRY FOR DETERMINATION OF ELEMENT CONCENTRATIONS

J. Lee and M. M. Sutton

Applied Biochemistry Division, DSIR, Palmerston North and Ruakura Soil and Plant Research Station, MAF, Hamilton

Introduction

Inductively-coupled plasma emission spectrometry (i.c.p.e.s.) is a technique for the determination of both metals and nonmetals in solutions and, occasionally, in solids. The technique is applicable, in theory, to any element that exhibits suitable excitation properties in the plasma (most of the periodic table). The development of the plasma as an excitation source in atomic emission spectrometry in the 1960's [1,2,3] and gradual improvements in performance since then, have lead to a dramatic revival of emission spectrometry in elemental analysis [4,5]. Special performance characteristics of i.c.p.e.s. are its extended linear dynamic range, simultaneous and/or sequential analysis, favourable signal-to-background ratio and fewer interference effects compared to other sources. The nature of this short article precludes any detailed discussion covering the full scope of i.c.p.e.s. However the basic principles will be briefly covered and only the argon plasma will be discussed. The reader is directed to several reviews [4,5,6,7] for further information.

The Plasma Condition

The i.c.p. differs from classical spark and arc discharges and flames in the means by which free atoms are excited. Emission spectra from atoms and ions are observed when sample aerosol is introduced into the plasma source. There is a quantitative relationship between the intensity of emitted radiation at a particular wavelength and the amount of the corresponding element in the sample: this relationship is empirical.

The plasma 'torch' consists of three concentric quartz tubes surrounded at the upper end by a water-cooled gold or silver plated inducation coil (Figure 1). A radio-frequency (r.f.) electric current is applied to the coil, usually from a crystal-controlled 27.12 MHz r.f. generator with automatic power control (typically up to 2 kw). An intense magnetic field of the same frequency is induced around the coil. An argon gas stream flowing through the torch is 'seeded' with free electrons from a Tesla discharge. This causes the argon to become conductive, with argon ions and electrons flowing in a circular path. Charged particles, ions and electrons, are quickly accelerated in the oscillating magnetic field and collisional heating occurs. Afer initiation, a flame-shaped plasma which is annular in cross-section spontaneously forms near the top of the torch. The plasma is self-sustaining as long as r.f. power is supplied. The temperature in the plasma is typically between 6,000° and 10,000°K, which is much hotter than arcs or flames. The argon gas flows in the three quartz tubes which are carefully regulated to give a stable plasma. The main flow (10-12 l min^{-1}) is introduced tangentially into the outer tube, and is used to cool, stabilise and shape the plasma. A lesser flow (about 1 l min^{-1}) called the plasma support or auxiliary gas, is available via the intermediate tube to provide extra control of plasma stability when required. Another argon flow (about 1 l min^{-1}) through the inner quartz tube, transports sample solution, in the form of an aerosol produced in a nebulizer, into the central axial channel of the plasma. Almost all the sample introduced into the plasma is vaporised and excited and little if any is subject to chemical interactions; for instance the well known Ca/PO_4^{3-} interference in flame spectroscopy is non-existent in the plasma.

The spatial structure of the plasma is such that atomic emission is observed above the high background emission of the plasma itself. This enables large signal-to-background ratios to be obtained. The unique toroidal geometry of the plasma, which provides a relatively long residence time in the high temperature environment, is an important factor leading to the high sensitivity of i.c.p. The spectrometer normally views the plasma 14 to 18 mm above the r.f. coil. In this zone, commonly referred to as the 'normal analytical zone', the best compromise between optimum limits of detection and freedom from potential interferences is achieved. Outside this zone, which may vary in different plasmas depending on the operating parameters, sensitivity for some elements may be improved, but potentially severe interferences may arise. Atomic emission from the analytical zone appears as an optically thin source through the transparent surrounding argon.

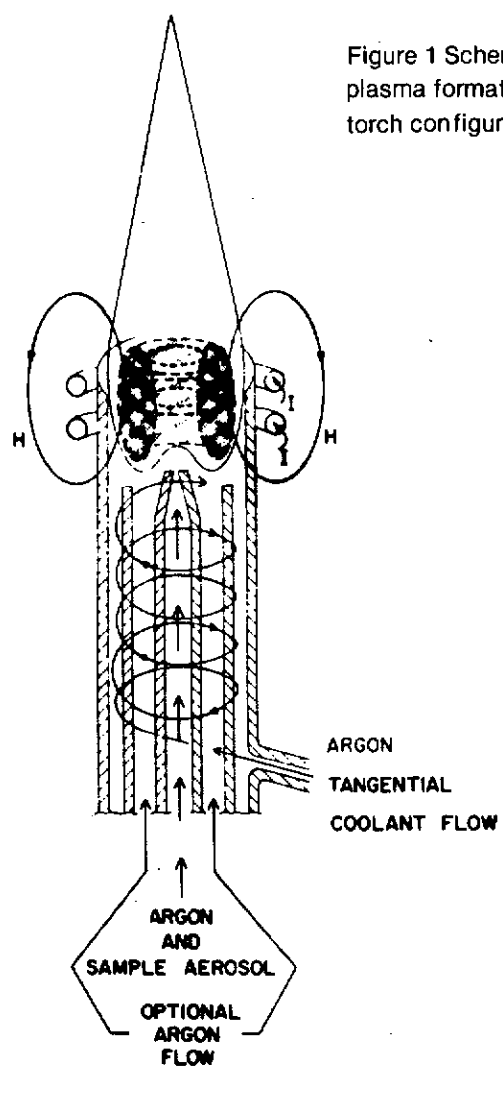


Figure 1 Schematic showing plasma formation and torch configuration.

Confinement of the analyte to the axial channel minimises line reversal and self-absorption effects. Consequently the spectral response of i.c.p. excitation is often linear over four or five orders of magnitude. At low concentrations, however, the effect of sample excitation on measured spectral response may no longer be the only influence. Spectral interferences, secondary optics and grating scatter, line and diffraction broadening are some effects which may influence linearity at the low extreme of the analytical range.

The optimum temperature for maximum emission for a given spectal line depends on the sum of the ionisation and excitation potentials of the element. If the temperature is too high, neutral atoms will be depleted by ionisation, resulting in low emission from neutral states. Thus potassium has a poor detection limit in the plasma compared with that in the flame. For other elements e.g. calcium, ion line emission is of analytical benefit. In fact, many of the useful analytical emission lines are derived from excited states of ions. Detection limits in the range 0.1 to 10 ng ml^{-1} are obtained for many elements determined by i.c.p. emission spectroscopy. As well, plasma conditions favour the excitation and concentration measurement of non-metals such as boron, phosphorus and sulphur.

Basic Instrumentation

A complete i.c.p.e.s. instrument, schematically represented in Figure 2, consists of a radio-frequency generator, the plasma torch and associated gas flow controllers, a high impedance 'match-box', nebuliser and auto-sampler, imaging optics, a polychromator (multi-element) and/or scanning monochromator, electronic readout and signal collection system and a computer. As high temperature plasmas produce complicated spectra, with many closely spaced emission lines, high resolution, narrow bandwidth (0.02 nm) spectrometers with high quality optical gratings are necessary. Stray radiation must also be minimised using state-of-the-art designs. The i.c.p. spectrometer covers a wide wavelength range (170-800 nm) and in many cases is operated under vacuum (10^{-3}—10^{-4} Torr) so that optimum performance is obtained from emission lines such as S I 180.73 nm, Sn II 189.98 nm and As I 189.04 nm.

Two types of i.c.p. spectrometer are in common use: (i) simultaneous and (ii) sequential instruments. The simultaneous instrument or direct-reading spectrometer possesses a large number of slit and detector mirror assemblies and can determine simultaneously 40 or more elements in a single sample. The second type of spectrometer employs a scanning monochromator to isolate element emission lines in sequence. Exact control of the grating directs emission lines successively through the exit slit to the detector. Sequential instruments are versatile although sample through-put may be limited. Both spectrometers are generally computer controlled. Computer functions are many: it controls the spectrometer scan, sets wavelength, runs the autosampler and other instrument functions. Data handling software collates raw measurements, makes spectral interference corrections, recalls stored calibration data and outputs data in a desired format.

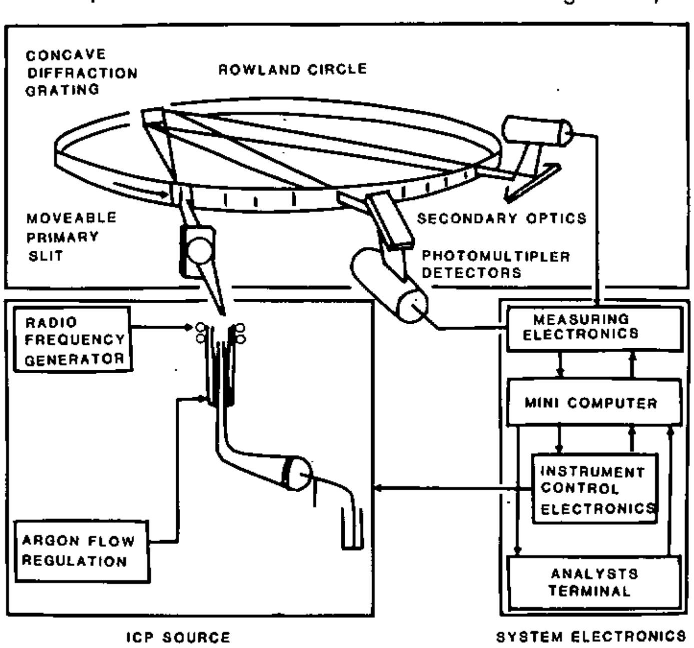


Figure 2 Block diagram showing typical instrument layout.

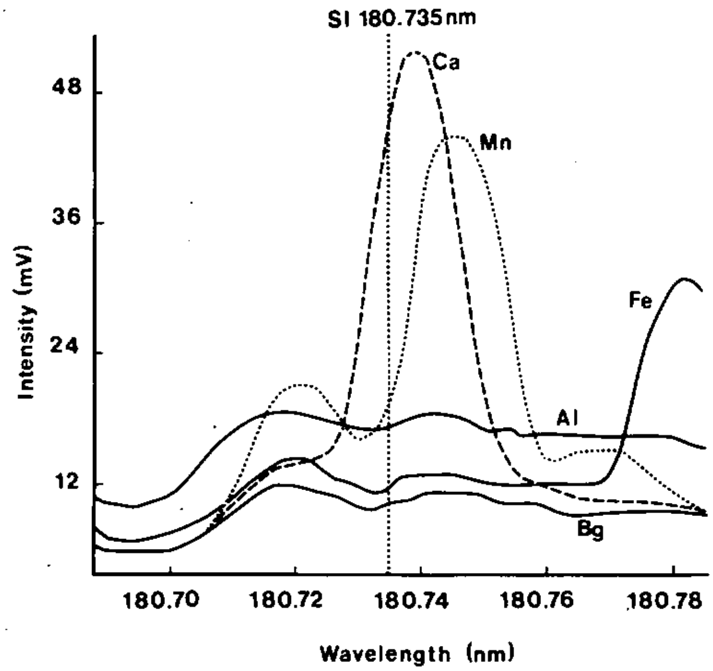


Figure 3 Wavelength profile of Al (4,000 ug ml^{-1}), Ca (500 ug ml^{-1}), Mn (500 ug ml^{-1}) and Fe (5,000 ug ml^{-1}), about the SI 180.73 nm emission line. The centre profile position of SI 180.73 nm is shown as a vertical dotted line.

Interference Effects

It is easy to extol the virtues of i.c.p.e.s. and ignore some of the problems that arise when real samples are encountered. Like any other form of emission spectrometry, it is subject to spectral interferences such as direct spectral overlap of emission lines and molecular band spectra, overlap of 'wings' from broadened lines, stray-light and radiative recombination continua. Some of these phenomena are shown in a spectral scan around the SI 180.73 nm emission line (Figure 3). Proper selection of lines and operating conditions and the use of appropriate background correction may overcome such interferences. Other interferences which may be potentially serious and more difficult to correct, are matrix effects due to viscosity and other solution properties of the sample, and transport effects in the plasma itself. Aerosol production, line intensities and background structure may be modified by changes in the concentration of major constituent elements and residual organic material[8,9]. Thus full advantage of the excellent detection characteristics of i.c.p.e.s. is often limited in practice by restrictions imposed by matrix effects.

Applications

In New Zealand there are now six i.c.p.e.s. systems in operation, while overseas the sales of these systems have increased substantially in the last four years. Some examples of analytical applications using i.c.p.e.s. will be given in the papers following this article.

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APPLICATIONS OF I.C.P.E.S.:

ANALYSIS OF BIOLOGICAL AND BIOGEOCHEMICAL MATERIAL

J. LEE

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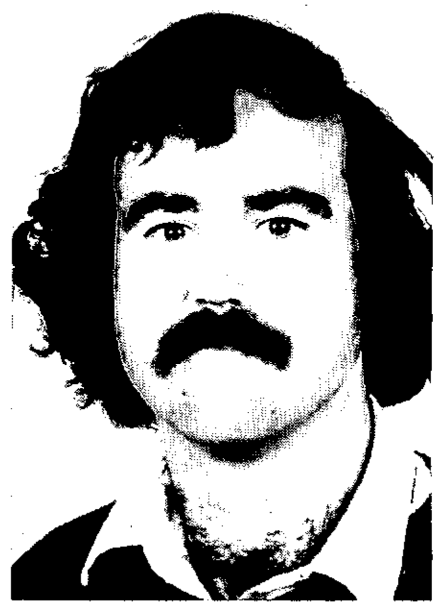
DSIR, Palmerston North



Julian Lee completed his PhD in Chemistry in 1977 at Massey University and then took up a 2 year post-doctoral position at the Geological Survey Canada in Ottawa studying aspects of trace metal speciation in waters. In 1980, he joined Applied Biochemistry Division, D.S.I.R. Current research include metal transport in plants, bioinorganic speciation of metal ions and analytical chemistry.

Inductively-coupled plasma argon emission spectrometry (i.c.p.e.s.) is proving to be a rapid and accurate method in the analysis of biological and geochemical materials. In particular its applications in the fields of agricultural and environmental analysis are growing rapidly. In principle, any material that can be solublised can be analysed for a large number of elements by i.c.p.e.s.

The ARL 34000 emission spectrometer located at Applied Biochemistry Division, DSIR, has been in operation for four years and during that time has made well over 600,000 elemental determinations on a wide range of sample types. These have included plant material, soil extracts, foods and feeds, dairy products, animal tissues, digestive fluids, effluents, waters and plant nutrient solutions.

INSTRUMENTAL

The ARL 34000 polychromator is configured for 23 elements (Table 1) and is equipped with a movable primary slit operated under computer control. This enables the immediate vicinity of any line in the array to be scanned for possible spectral interferences. It also facilitates off-line background correction.

The spectrometer has a 1 m Paschen-Runge mount with a Bausch and Lomb grating (1080 lines/mm) used in conjunction with narrow bandpass (10-20 nm) filters for order sorting. It is operated under a partial vacuum pumped against an argon gas atmosphere. A standard ARL plasma torch consisting of three concentric quartz tubes is used in conjunction with a glass cross-flow nebulizer (GMK) and Gilson Minipuls II peristaltic pump. Plasma operating conditions are set to give optimum performance for simultaneous multi-element analysis. These are:

RF power	1.2 KW
Output frequency	27.12 MHz
Torch viewing height	15 mm above the load coil ($\pm$ 2 mm observation zone)
Sample uptake rate	2.0 ml min^{-1}
Argon flow rates:	
aerosol carrier	0.8 l min^{-1}
auxiliary	1.0 l min^{-1}
coolant	12 l min^{-1}

The instrument uses a PDP 11/03 mini-compluter with twin floppy disks for data acquisition, data treatment and instrument control.

Table 1. Wavelengths and 3 detection limits: (2M HCl matrix).

Element	Wavelength (nm)	Order	Detection limit (ug ml^{-1})
Al	308.22	2	0.03
As	189.04	3	0.06
B	249.68	3	0.005
Ca	317.93	2	0.02
Cd	226.50	2	0.007
Co	228.62	2	0.007
Cr	267.72	3	0.005
Cu	324.75	2	0.005
Fe	259.94	2	0.007
K	766.49	1	0.2
Mg	279.08	2	0.05
Mn	257.61	2	0.001
Mo	202.03	3	0.005
Na	589.59	1	0.01
Ni	231.60	3	0.005
P	214.91	3	0.1
Pb	220.35	2	0.03
S	180.73	3	0.02
Se	203.99	3	0.05
Si	251.61	2	0.04
Sn	189.98	3	0.005
Sr	407.77	1	0.0004
Zn	213.86	2	0.003

SAMPLE PREPARATION

In multi-element i.c.p.e.s. it is desirable to apply a single dissolution to a particular sample which is compatible with the complete recovery and determination of a wide range of elements. This often presents problems. Animal tissues, such as bone, blood and high lipid content samples, are especially difficult to analyse when trace elements are present at low concentrations. Dilution of the sample to reduce matrix effects only results in lowering trace analytes below their detection limit. As an example, matrix interferences give problems in the analysis of bone extracts where the combined effects of high

Ca, phosphate, Na and residual organic material causes suppression of analyte response[1].

A general nitric acid procedure[2,3] is used for the digestion of most biological material; appropriate dilutions are then made for the direct determination of major and minor elements.

Table 2. Freeze-dried animal blood (IAEA RM A-13)

Element	$\bar{x}$ (µg/g)	OE[1] %RSD	CE[2] %RSD
Ca	243	1.4	0.06
Cu	2.16	5.4	1.0
Fe	2193	1.4	0.07
K	2307	2.6	0.27
Mg	82	1.4	0.66
Na	11622	1.9	0.06
P	693	2.7	0.17
S	5992	1.6	0.2
Sr	0.17	27.8	5.0
Zn	11.9	2.0	0.8

[1] Overall error including digestion (N = 6)
[2] Counting error on one sample, 3 integrations.

ANALYTICAL

It is often necessary to employ one or more of a number of methods to overcome various matrix problems in the i.c.p.e.s. determination of trace elements. These include:

1. Standard additions method.
2. Matrix matching.
3. Internal standards.
4. Off-line background correction.
5. Separation of matrix elements using ion-exchange or solvent extraction.
6. Real sample calibrations.

Additional methods included are the well known dithiol and nitrosonaphthol extractions for Mo and Co, respectively, in an overall scheme using i.c.p.e.s. for the analysis of up to 15 elements in animal tissues such as liver, bone, muscle, and whole blood. Using these methods, good recoveries and precision for most elements including S and B are obtained. Various certified standard reference materials (NBS, IAEA) are used to verify accuracy.

More fundamental studies have been made using factorial designed experiments to elucidate interactions in the plasma between elements being analysed and the sample matrix. These results have been used to measure the magnitude of changes in analyte response in the presence of certain matrix components and to give information on the selection of appropriate internal standards.

Table 3. Analysis of IAEA H-5 bone reference material (ug/g dry weight).

Element	$\bar{x}$ (µg/g)	%RSD (N = 6)	IAEA[1]
Ca	247120	1.4	202980 - 220430
Cu	0.6	-[2]	0.47 - 0.82
Fe	82	4.9	76.7 - 84.8
K	680	3.3	563 - 706
Mg	3763	1.7	3430 - 3640
Mn	0.5	-	0.63 - 0.89
Mo	0.7	-	0.04 - 0.86
Na	5164	1.8	4400 - 5130
P	104340	1.8	73740 - 117816
S	2337	5.2	1670 - 3630
Zn	89	1.7	85 - 94

[1] Confidence limits for mean of population for probability level 0.95.
[2] N = 2.

In-house and External Quality Assessment Materials are routinely analysed as part of the Divisional group's analytical Quality Assurance Programme. This provides one of several checks on within and between batch variation.

Table 4. Bovine Liver NBS 1577.

Element	Assigned Value µg/g	Found µg/g
Ca	(123)	118
Co	(0.18)	0.2
Cr	(0.088)	LOQ
Cu	193 ± 10	195
Fe	270 ± 20	263
K	9700 ± 600	9785
Mg	(605)	578
Mn	10.3 ± 1	10
Mo	3.4	2.8
Na	2430 ± 130	2676
P	(11,000)	11830
S	-	7575
Sr	(0.14)	0.18
Zn	130 ± 10	138

CURRENT APPLICATIONS

Other specific areas of application of i.c.p.e.s. multi-element analysis in this laboratory have included studies on: the distribution of mineral elements in sheep, element anomalies in shales from the Cretaceous-Tertiary boundary, the distribution of assimilates in boysenberries, multi-element interactions in plants grown in hydroponic solution, aluminium toxicity and nutrient uptake and the analysis of solid and liquid phase animal digesta containing chromium marker solutions. As well, routine analyses are made on a wide range of biological and geochemical materials in a service capacity.

Particular emphasis has been made on the method development of elements important in agriculture that have hitherto been 'difficult' to analyse — aluminium, boron, cobalt, molybdenum, phosphorus and sulphur.

Typical performance data for selected reference materials are given in Tables 2,3,4.

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OBSERVATIONS ON ANALYSIS OF PLANT SAMPLES BY SEQUENTIAL ICP EMISSION SPECTROMETRY

M.M. Sutton

Spectrochemistry and Plant Analysis
Ruakura Soil and Plant Research Station
HAMILTON

Dr. Max Sutton graduated B.Sc.(Hons) Chemistry in 1961, M.Sc. Combustion Science in 1963 and PhD. Combustion Science in 1966 at the University of Leeds. He then went to the University of Canterbury in Christchurch, where he worked as a Post-doctoral Fellow with Professor Leon Phillips from 1966-68. His next appointment was as a Research Associate in the Centre for Research in Experimental Space Science at York University in Toronto. Dr. Sutton went back to Britain in 1969 to Shell Research Limited, Chester, where he worked in the Combustion Research Division. He returned to New Zealand in 1972 to work with the late Eric Allan at the Ruakura Agricultural Research Centre, Hamilton. Dr. Sutton is now responsible for the analytical, research and development work undertaken in the Spectrochemistry and Plant Analysis Section at Ruakura.

INTRODUCTION

Technical staff in the Spectrochemistry and Plant Analysis Section at Ruakura analyse between 25,000 and 30,000 plant samples per annum, on a routine basis, for up to 15 elements. Approximately 10,000 agricultural samples of various kinds are also analysed each year, on a non-routine basis, for a wide range of elements. These element concentration measurements are usually made by automated flame photometry, manual atomic absorption spectroscopy, or spectrophotometry using manual techniques and autoanalysers. The routine plant analysis system employed at Ruakura is summarised in Table 1. Up to four separate plant digests are used to determine the element concentrations.

It is apparent that it should be possible to speed up the plant sample throughput, if one analytical instrument could be used to analyse a single plant digest, for most of the elements of interest. At the present time it is not practicable to measure N concentrations using an inductively coupled plasma (ICP) emission spectrometer, but in theory it is possible to measure the concentrations of all the other elements. After careful consideration of our particular requirements, a sequential Labtest Plasmascan 710 emission spectrometer was purchased in September 1981. This instrument was acquired to complement rather than replace existing spectrochemical analysis equipment.

ELEMENT DETECTION LIMITS

One of the major advantages of ICP emission systems is that their element detection limits are relatively very low (by up to a factor of 1000) for elements such as B, Mo and Ti, which form refractory compounds in flames used to determine their concentrations by atomic absorption. These lower detection limits result from the fact that the argon plasma, used to decompose and excite the elements in the sample solutions, has a

TABLE 1
ROUTINE PLANT ANALYSIS SYSTEM AT RUAKURA

Digest Type	Elements Determined	Analytical Methods
(1) H_2SO_4/Se (Kjeldahl)	N, P	Spectrophotometry/ autoanalyser
(2) $HNO_3/HClO_4$	Cu, Zn, Fe, Mn	Manual flame atomic absorption.
	Co	Solvent extraction/graphite furnance atomic absorption
	S	Turbidimetry/autoanalyser (barium sulphate)
	B	Manual colorimetry (curcumin)
	K, Na, Ca, Mg	Automated flame photometry
(3) $HNO_3/HClO_4$	Mo	Manual spectrophotometry (zinc dithiol)
(4) $HNO_3/HClO_4$	Se	Hydride generation/flame atomic absorption

temperature at least twice that of analytical air-acetylene and nitrous oxide-acetylene flames. In addition, elements such as S and P, for which separate non-flame methods of concentration measurement are normally required, can also be determined directly in plant digests by ICP emission spectrometry. It can be seen that ICP systems are more versatile than atomic absorption analysis systems, in terms of the range of elements which can be determined directly.

DEVELOPMENT OF ANALYTICAL METHODS

Programs were developed for the determination of Cu, Zn, Fe, Mn, P, S and B routine 8% (v/v) perchloric acid plant digests, using our computer-controlled ICP emission spectrometer. This instrument has a pumped monochromator, so that emission lines for elements such as S and I can be detected in the vacuum ultra-violet region. No attempt was made to measure K, Na, Ca and Mg concentrations in the plant digests, because we have an automated four-channel flame photometer which is capable of a far greater throughput of samples than is the sequential ICP emission spectrometer. The flame photometer, which was developed at Ruakura by Mr Owen Clinton, can analyse about 200 samples per hour for the four major elements.

Initially, some deviations in Fe and Mn concentration values were observed, which apparently were the result of matrix interference effects, produced by one or more of the plant major elements K, Na, Ca, Mg. This effect was not investigated in detail. Instead, typical concentrations of these four major elements were included in the standard solutions used for the determination of the other elements. This matrix matching technique also largely compensated for a spectral interference effect of Ca on the S concentration measurements.

Highly satisfactory results were obtained when NBS 1571 orchard leaves were digested in triplicate and then analysed twice, using both the sequential ICP emission spectrometer and our routine plant analysis system. These results are summarised in Table 2.

TABLE 2
ANALYSIS OF NBS 1571 ORCHARD LEAVES

ELEMENT	NBS	Concentration (μg/g) ICP	ROUTINE
B	33 ± 3	29 ± 1	32*
Cu	12 ± 1	12 ± 1	11 ± 1
Fe	270 ± 20	266 ± 15	273 ± 8
Mn	91 ± 4	85 ± 5	89 ± 3
P	2100 ± 100	2060 ± 80	2200*
S	(1900)	2190 ± 120	2100*
Zn	25 ± 3	29 ± 1	29 ± 1

* = single determination ( ) = non certified

A certified S concentration value is not available for NBS 1571 orchard leaves. A set of 120 plant sample digests were analysed for S, therefore, using the ICP emission spectrometer, the routine barium sulphate turbidimetric method and an indirect lead sulphate flame atomic absorption method. Excellent agreement was obtained when the three sets of results were compared.

Similarly, P concentration measurements for a series of plant samples were made using the ICP emission spectrometer with routine nitric-perchloric acid plant digests, a vanadium molybdate spectrophotometric method with the same digests, and the routine autoanalyser method with Kjeldahl (sulphuric acid) plant digest solutions. Again, very good agreement between the three different methods of analysis was obtained.

It was apparent that the sequential ICP system should be particularly suitable for B, S and P determinations, for which separate methods of concentration measurement were required. As far as Cu, Zn, Fe and Mn are concerned, ICP and atomic absorption systems have similar detection limits.

The concentrations of Mo, Co and Se in plants are often in the sub-*μg/g* region, in which case direct plant digest measurements for these elements could not be made with the ICP emission spectrometer. An extraction/concentration step would be necessary for Mo and Co, and an hydride generation system would be required for Se. Appropriate methods of determination for these elements will be investigated in due course.

Measurements of the Ti concentration in plant digests can serve as a good indicator of soil contaminated plant samples. An ICP emission spectrometer program for the determination of Ti concentrations has therefore been developed. The ICP detection limit for Ti is about 50 times lower than that which can be achieved using flame atomic absorption spectroscopy. Consequently, ICP measurements of Ti concentration are much more reliable than atomic absorption values in the region of interest in plants below 10 *μg/g* Ti.

SAMPLE THROUGHPUT

The sample throughput rate for the sequential ICP emission spectrometer is relatively low. Approximately 30 seconds is required to produce a steady emission signal when the sample solution is pumped into the nebuliser by a peristaltic pump. Usually 10 or 15 seconds is then needed for each element emission intensity reading, plus a few seconds scanning time between the emission peaks, and approximately 40 seconds to transfer from one spectral order to the other. Ignoring initial standardisation time, it would take approximately 2½ minutes to analyse a sample for four elements and about 3½ minutes for seven elements. If the four elements were Cu, Zn, Fe and Mn, it would probably be much quicker to use atomic absorption spectrophotometry. If on the other hand B, S and P are included among the elements to be determined, it is very likely that the sequential ICP emission spectrometer system would be quicker overall. Analyses can be fully automated with the aid of an automatic sample changer, which may compensate to some extent for the sequential ICP's relatively low sample throughput rate. Advantage can sometimes be taken of the wide linear range of ICP systems, which can be up to four or five orders of magnitude. The likelihood of having to dilute samples before analysis is greatly reduced in this case, with a possible saving of time.

Sample throughput could be improved by using a simultaneous ICP system, but one then does not have the flexibility of the sequential ICP system in terms of the range of elements which can be determined, and being able to use the optimum atomic emission lines for different types of samples. Simultaneous ICP systems are also more expensive to buy.

PROBLEM WITH PERCHLORIC ACID PLANT DIGEST SOLUTIONS

An unexpected problem was encountered when an attempt was made to use the sequential ICP system to measure B concentrations on a regular basis in batches of 40 routine 8% (v/v) perchloric acid plant digest solutions. Digests of plant samples containing more than about 3% K (w/w) caused clogging problems in the "clog-free" Babington-type GMK

nebuliser. These digest solutions had a plant sample dilution factor of 50 i.e. 0.5 g of plant material in 25 ml of solution. The clogging effect was severe in the case of plant samples containing 6% K (w/w), and was apparently caused by the depositing of potassium perchlorate around the orifice of the argon jet in the nebuliser. The clogging could not be prevented by regular flushing with 8% (v/v) perchloric acid or water between samples. The deposit could only be completely removed by placing the nebuliser assembly in a sonic cleaning bath.

Possible ways of overcoming the clogging problem were investigated, and some success was achieved with a device which heated the sample solution just before it entered the nebuliser. However, heating the sample solution tended to produce instability in the ICP emission signals.

It appears that the clogging problem can best be overcome by diluting the routine plant digest solutions by a further factor of two with distilled water. This extra dilution step makes the ICP analysis system less compatible with the routine plant analysis system. It also reduces the reliability of Cu determinations in plants where the Cu concentrations can be as low as 1 or 2 $\mu g/g$. A Cu concentration of 0.02 $\mu g/ml$ in the plant digest solution would be at the lower limit of the analytical range for the ICP system.

CONCLUSION

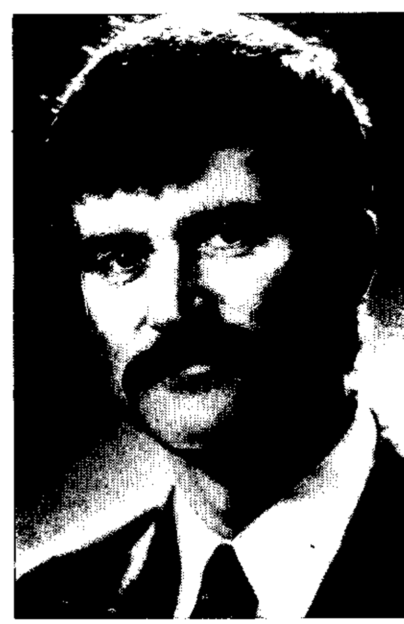
Our studies have shown that a computer-controlled sequential ICP emission spectrometer system can very effectively complement flame atomic absorption and emission facilities used for plant sample analyses, especially in terms of extending the range of elemental determinations which can be undertaken with a single plant digest solution.

ACKNOWLEDGEMENTS

The author is pleased to acknowledge the valuable contributions made by his colleagues Michael Lowe, Martin Kear and Mrs Gael Goodall during the course of the ICP studies.

THE ANALYSIS OF POTABLE WATER SAMPLES BY CHEMISTRY DIVISION USING THE INDUCTIVELY COUPLED PLASMA FACILITY AT APPLIED BIOCHEMISTRY DIVISION

F.R. Grasse & C.D. Stevenson



Richard Grasse: has a B.Sc in chemistry (1964-1967) and Ph.D in biochemistry (1967-1970) from Birmingham University, U.K. He held a Post doctoral fellowship at Victoria University of Wellington in the Biochemistry Department (1971) and then "dropped out" to travel around New Zealand, Australia, Papua New Guinea and with one year back in the UK. He rejoined the scientific community with a one year stint at Oceanographic Institute, Wellington, (1977), spent a year at Christchurch Secondary Teachers College, and joined the Water Section of Chemistry Division at Gracefield in 1979, principally to develop methods, work on AQC procedures and run the CHEMAQUA programme. Since 1983 he has been based in Christchurch.

Craig D. Stevenson holds B.Sc and M.Sc(Hons) degrees from Victoria University and a Ph.D from Cambridge. Since joining Chemistry Division, DSIR (Gracefield) in 1971 he has worked in many aspects of environmental and water chemistry, including analytical methodology and quality assurance, water and wastewater treatment, and natural water quality.

One of the major analytical tasks of the Chemistry Division Water Section is the determination of the chemical quality of potable water supplies throughout New Zealand. The constituents determined include a wide range of elements specified in Drinking Water Standards for New Zealand[1] and many of these have in the past been determined by atomic absorption.

For some time it has been obvious that simultaneous multi-element Inductively Coupled Plasma — Atomic Emission Spectroscopy (ICP-AES) could save staff-time and extend the range of constituents determined routinely for the potable water programme, provided an ICP instrument already in operation for other work could be used. The water analysis programme (about 2000 samples annually) is too small to justify purchase and maintenance of an ICP instrument, and would occupy only a tiny fraction of potentially available instrument time (perhaps 3%).

Applied Biochemistry Division of DSIR (ABD) in Palmerston North operates, in conjunction with the other Palmerston North DSIR divisions and Massey University, an ARL 34000 ICP, which is used predominantly for analysis of digests of biological materials usually containing trace elements of interest at concentrations substantially above detection limits for the instrument. Many of the standards for drinking-water quality are near, or below the trace element detection limits for the ABD instrument as set up and normally operated. The ICP technique is capable of meeting detection limit requirements for most, but not all of the elements specified in Drinking Water Standards for N.Z.[1] when samples are aspirated directly, without preconcentration[2], but substantial changes in power and gas supplies, computer software and possibly computer hardware in the ABD instrument would be needed to achieve this. Since it was probable that, even with the best currently attainable ICP-AES detection limits, not all elements could be determined directly at the required levels, Chemisry Division chose to establish a preconcentration method for samples, rather than seek major improvements in instrument performance.

For the greatest staff savings to be realised, it was essential that the analytical data from the ICP be transferred to our "Water Atlas" laboratory data management and reporting computer programme without a manual data entry step. This was achieved through the DSIR National Computer Network.

Checks on recovery and potential contamination during preconcentration in a rotary evaporator showed that if nitric acid was used as the sample preservative, manganese was lost from the sample, possibly taking some other elements with it. Use of hydrochloric acid avoided this problem. During preconcentration, silica concentrations in many samples exceed the solubility of amorphous silica, and if the final stages of preconcentration are not watched very carefully to avoid any drying of dissolved solids, major silica losses do occur. However, careful control of the preconcentration avoids this problem and the supersaturated silica solutions are stabilised by the low pH (pH 1-2). Pre-concentrations by a factor of 10 have proved convenient for routine work, starting from samples of 250-300 mL, although this occasionally results in a few elements being over range.

DETECTION LIMITS

Early trials suggested that detection limits for many of the trace elements may vary from batch to batch and since our requirements are so close to the limits of current instrument performance, it was essential that detection limits be determined explicitly for each batch of samples. A combined trace element standard is made up in a typical potable water matrix, with each trace element present at a concentration slightly above its expected detection limit. Ten aliquots of this combined standard are taken through the preconcentration procedure and the concentrates are interspersed throughout the batch of samples. The standard deviation of results for the ten aliquots are computed and the detection limits for the batch are taken as 5 times this standard deviation, as suggested in the Water Research Centre publication TR66[3]. All results below this detection limit are then reported as "less than" the value of the detection limit.

Comparison of detection limits for different batches confirmed the suspected inter-batch variability and need for within-batch detection limit determinations. Detection limits determined in this way should be fairly conservative, but (except for selenium) meet the requirements for Drinking Water Standards for N.Z.[1] when a 10-fold preconcentration is used, as set out in Table 1.

In the latest two runs, baseline drift was a major contributor to variability between aliquots of the combined trace element standard in the same run. Correction for this drift is done manually at present and restores detection limits to about those obtained in runs where the blank results were more stable. In future, a drift correction sub-routine will be incorporated in our ICP data handling package. Table 2 sets out an example of the effects of drift, and its correction, on detection limits.

TABLE 1: ICP-DETECTABLE ELEMENTS INCLUDED IN NEW ZEALAND STANDARDS FOR DRINKING WATER; DETECTION LIMITS AS MEASURED BY CHEMISTRY DIVISION IN A TYPICAL RUN (all units : g/m³)

ELEMENT	NEW ZEALAND STANDARD	INSTRUMENT DETECTION LIMIT[1]	OVERALL DETECTION LIMIT[2]
Na	100*		
Ca	75		
Mg	30-150		
Al	0.05*	0.3	0.03
As	0.05	0.2	0.02
B	0.5	0.3	0.03
Cd	0.005	0.04	0.004
Cr	0.05	0.1	0.01
Cu	0.05*	0.2	0.02
Fe	0.1*	0.2	0.02
Mn	0.05*	0.02	0.002
Pb	0.05	0.2	0.02
Se	0.01	0.4	0.04
Zn	5.0*	0.03	0.003

* Highest desirable guideline values
[1] [5 x standard deviation (sd)] value
[2] (5 x sd) value ÷ Preconcentration Factor (10)

TABLE 2: ALUMINIUM RESULTS FOR THE COMBINED TRACE ELEMENT STANDARD (g/m³)

	TYPICAL RUN (Expected Value = 1.00)	RUN WITH BASELINE DRIFT (Expected Value = 0.30) Al RESULT	BLANK RESULT	Al MINUS BLANK
	1.08	0.29	−0.04	0.33
	0.98	0.42	+0.10	0.32
	0.94	0.33	−0.08	0.25
	0.94	0.27	−0.08	0.35
	0.91	0.25	−0.08	0.35
	0.94	0.18	−0.18	0.36
	0.96	0.21	−0.11	0.32
	0.94	0.19	−0.19	0.38
	0.91	0.19	−0.19	0.38
	0.91	0.11	−0.23	0.34
		0.21	−0.16	0.37
		0.23	−0.16	0.36
Standard Deviation (sd)	0.051	0.081		0.036
Detection Limit (5 x sd)	0.26	0.41		0.18

MAJOR ELEMENTS

The programme for detection limit calculation has been expanded in the latest two runs to include checks on the precision and accuracy of major element analyses and sample contamination due to carry-over between samples. The extended programme uses ten or more equivalent blocks of standards, the blocks being evenly dispersed throughout the batch. Each block consists of:

(i) An acidified tapwater sample to act as a check sample.
(ii) The combined trace elements standard for calculation of detection limits.
(iii) Two standards containing the major elements Ca, Na, K and Mg at different concentrations and a third standard containing Si.

Results so far have shown:

There is drift in the results of the major elements but the pattern is not uniform. It varies slightly from element to element, but it is similar for each element at both dilution levels (see Figure 1). The maximum drift is about 10%, and the maximum change between "consecutive" analyses (i.e. about ten places apart in the run) of the same standard is about 5%. The high and low major element standards show quite similar percentage changes between the same pairs of blocks, suggesting that a substantial proportion of the major element drift may be caused by factors such as changes in nebuliser efficiency. The use of another element as an internal standard in all samples and standards would allow partial correction of such drift and might improve precision to perhaps the 1-2% achieved in some systems[2].

The tapwater results show some variability. However, these samples were at the beginning of each block and so any carry-over contamination would show up here. In fact in one run some very "dirty" samples (groundwaters collected from near a rubbish tip) were analysed just before a tapwater sample and the results for the tapwater sample rose dramatically (Na and Mg results of 16 and 6 g/m³ instead of the expected 7 and 2 g/m³).

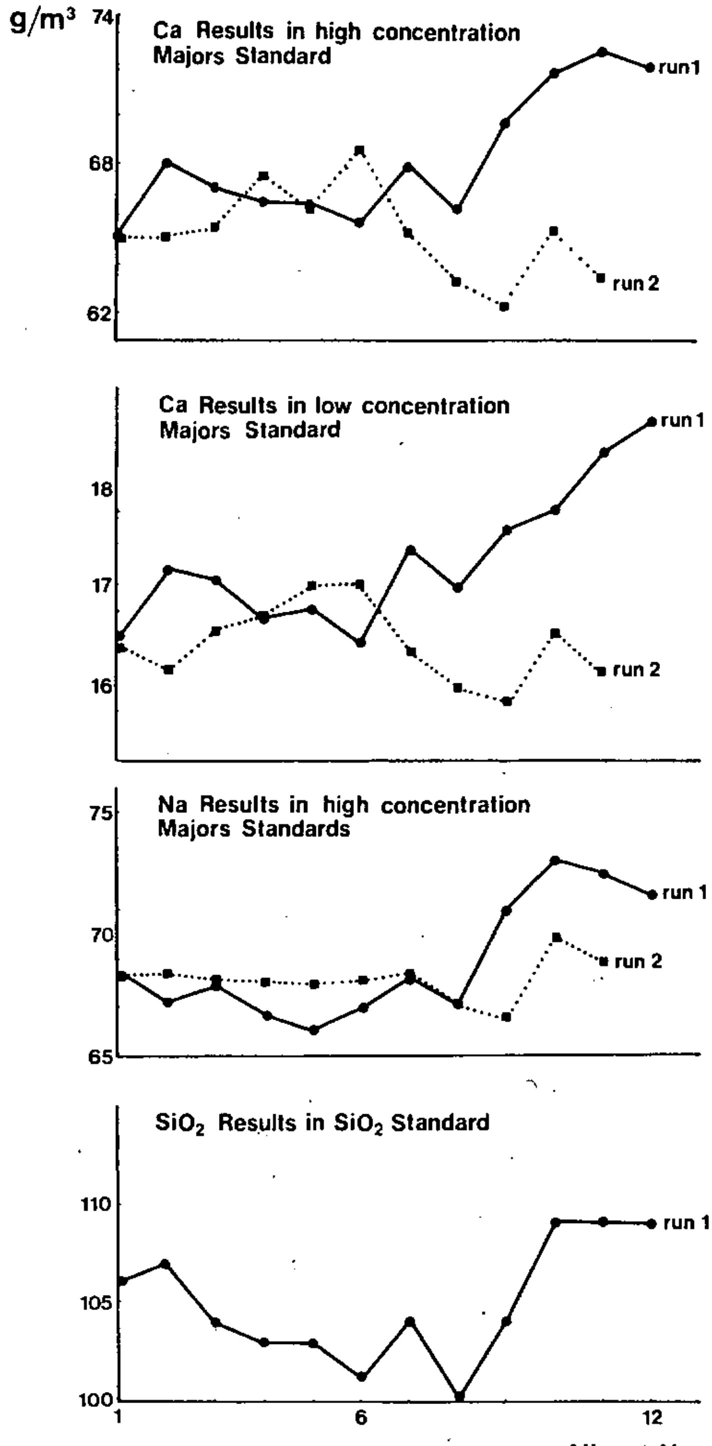


Figure 1: ICP Analysis Results of Aliquots of Standards Evenly Spaced within the Batch

FUTURE DEVELOPMENTS

The drift seen in the baseline and in the results of standards gives rise to less accurate results and higher detection limits. Apart from possible improvements to the instrument itself, there are a number of options available to minimise the adverse effects of these drifts by post-analysis data correction and for making these corrections less tedious. Computer routines will be developed for correction of baseline drifts, nebuliser efficiency drifts (via internal standard corrections) and, if appropriate, sensitivity change corrections for major elements, if the standards show consistent residual drifts after correction for the internal standard responses.

Carry-over contamination can only be rigorously detected (or proved absent) by running a blank or standard after every sample — clearly an impractical proposition. Results have shown, however, that carry-over does not occur with pure standard solutions or "clean" samples and so the few suspected "dirty" samples will be placed at the end of the run and separated by blanks.

CONCLUSION

There is no doubt that ICP is a useful technique for the analysis of potable waters. As with all automated analysis systems, instrument performance must be continuously monitored to ensure that results are meaningful. The fact that determination of several trace elements (notably selenium, but also arsenic, aluminium and cadmium) at or below levels specified in Standards for Drinking Water in New Zealand[1] is very close to the limits of performance of the system, even after 10-fold preconcentration, makes a very high level of quality assurance monitoring essential. The effort involved in this AQC work can be kept to acceptable levels by development of an appropriate suite of data handling programmes, and the very high analytical output achieved.

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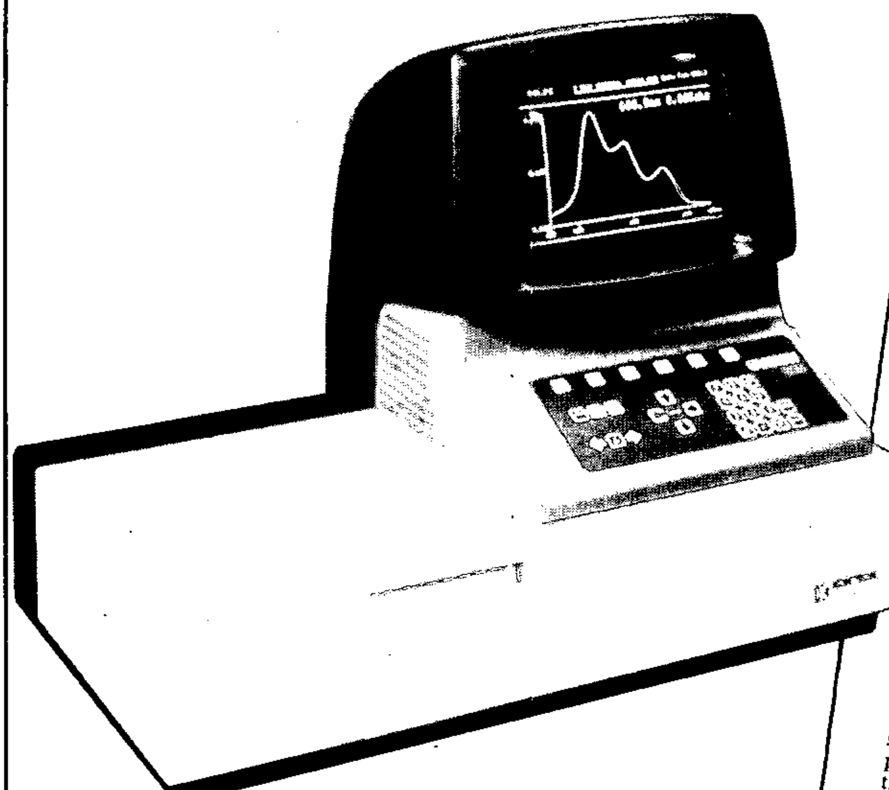

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CHEMISTRY IN 19TH CENTURY NEW ZEALAND

Joan T. Radford.

Department of History and Philosophy of Science, The University of Melbourne

The third and final part of this paper looks at Industrial chemistry: Part I on Government Chemistry, and Part II on Academia were in the April and June issues respectively.

Two factors which make the search for papers relevant to industrial chemistry in 19th Century New Zealand somewhat difficult are:

(i) N.Z. is not and was not a heavily industrialized country.

(ii) The sponsorship by Government of so many of the efforts of early industrial endeavours led to their being reported widely in the Journals to the Parliaments of the day. Hence, later historians have tended to use these reports as their primary sources of information and have neglected to 'chase up' the original papers and records of the companies and/or the laboratories of the earliest chemists — some of which have, by now, been relegated to either dust heaps or shredders.

Nevertheless, there are still some very valuable primary sources available, and may I make a plea to **all** writers of early chemistry history in N.Z. to quote their original sources? Although there have been several resumes of pre-20th century chemistry in the then Colony, none has quoted its original sources, hence confirmation has, in many case, been impossible.

Otago:

The South Island of New Zealand had never been more than sparsely inhabited by the Maori. Hence European settlers, mining and farming in Otago had a relatively unchallenged opportunity to develop industry, virtually unopposed except by their ignorance of the harsh terrain, and by the distance separating them from other European-style commercial centres.

And as may have been expected from the city widely considered the commercial centre of N.Z. in the 19th Century, Dunedin's industrial history (including that of the Province of Otago as a whole) has been fairly well documented, and many reports written upon it. Again, not unexpectedly, the N.Z.'ers based their chemically controlled industries upon their British and European counterparts. Hence, intensive search for chemistry of 19th Century industry in N.Z. has revealed very little indeed which is either strictly indigenous or highly original. As elsewhere, the "chemical" industries were those based on coal and metal mining (gold and iron, mainly), and working on building materials (cement, limestone, etc.) and on agriculture (fertilizer, food supply and processing including meat extracts, dairy supplies, refrigeration, boiling-down works and their by-products).

A burst of interest seems to have arisen in the 1940's and 1950's which produced a crop of theses from all the Universities and Colleges, dealing with the premier N.Z. industries. Of these, by far the most helpful to professional historians of chemistry is that by John Dennison[1] in which the domestic supply industries, soap, tallow and candles, the lime and cement industries, and the phosphorus-sulphur and nitrogen-based fertilizer and commercial acid industries, are all covered from their chemical interest, indicating as well their relationship with each other and with seemingly independent industries such as perfumeries and medicinal druggists. He covers too, the amalgamation of many of these industries into Kempthorne Prosser.

Other theses and articles cover[2] canning, wool, paper making, fertilizers, meat industry, flax, mining, flour-milling, building, wine making, rope making and baking powder.

Although not strongly dependent upon chemical control other Otago industries did make use of some form of chemical monitoring — these included[3] brewing, vinegar manufacture, dyeing, brass-working, galvanizing, tanning, health and sewage control. All of these warrant further research into their possible chemical interest in the 19th Century.

The city gas works engineer of 1875 (Henry Courtis) was using chemical applications in his industry. He reports[4] that he had, by then, cut out the use of distilling plant and experimental apparatus for producing water-gas, but was producing coal-gas for local use, rejecting the use of coal tar for anything other than asphalt paving, completely rejecting its distillation for further products because of the heavy expense of the commercial sulphuric acid necessary to produce the by-product sulphates.

Two chemists in the South Island, whose names I have met during this research, do not seem to appear again in 19th Century N.Z. chemistry. Perhaps someone can supply more data? They are[5] G.B. Smith, brought over from Australia by Kempthorne Prosser, and Dunlop, who was manager of the Orepuki works of the N.Z. Coal and Shale Oil Co., near Invercargill in 1899, and who is quoted[6] as having laboratories at the works.

Examination of the records available at Otago University of Professor Black's analyses as Provincial Analyst, show that most of them were of products or from businesses eventually amalgamated into Kempthorne Prosser. Hence Black's value as an adviser to the Company[7] is quite understandable.

The Prize Essays on the Industries of N.Z. of 1886[8] give no help upon chemical applications. The best source of data was the local newspaper — 'The Otago Witness', reporting on brewing, gas works, dyeing, pigments including tanning, brass works, and stoneware.[9]

Although there is so much of scenic value in N.Z., there was surprisingly little found of chemical interest relating to photography, except for the 1971 accounts by McIndoe[10] and

Hector's own list and comments on the photographic material taken on surveys[11] and photolithography reports to Government.

Wilkinson, the assayer at the Otago School of Mines[12] analysed for the Milton Pottery Works, and did regular assays for Co, Au, Sn, Cu, Sb, garnet, ruby, asbestos and limestone. But why was the School of Mines so badly treated by the Seddon Government, particularly when Larnach was Minister for Mines? I make one suggestion which may need further investigation. The detailed reports[13] made to the House of Representatives in 1891 and in The Otago Witness upon the explosive nature of coal dust, contained detailed chemistry culled from experience in Russia, France and UK from 1883. Did these originate from Professor Ulrich? And were they unwelcome to the mine-owner politician Larnach?

In terms of published material, Ulrich was undoubtedly a better chemist than Black, yet, it is the latter, whose opinion upon the already well-known effects of blasting powders upon coal distillation in mines was also sought, who has emerged to history as the brilliant man.

Although claimed by Dixon[14] that the chemistry of N.Z. natural products had long been active at Auckland and Otago, there is no evidence from 19th Century chemistry that much chemical attention was given it in Otago, nor even in N.Z. as a whole, except for the work by Skey on *Phormium Tenax* (referred back to British experts) and on the active principle of tutu[15] by Aston in 1899.

Canterbury:

As in Otago (and Auckland) the only 19th Century industries requiring chemistry to control their operation were the chemical works, fertilizers and drugs, coal and oil, gas and meat works. But as in the other centres there were businesses which did use analytical services to monitor purity etc. On this subject, the contribution of Dr. Llewellyn Powell, surgeon to Christchurch Hospital, lecturer in Chemistry at the High School, and public lecturer on chemical processes,[16] should be probed. Also, who was it who analysed the Canterbury building stone reported with such chemical detail by T.C. Doyne in 1867?[17] There must have been sufficient chemical interest in the area to warrant the reports by the Lyttleton Times of such matters as leakage of chemicals in vessels bearing freight to Los Angeles, new cheap ice-making machines, use of bisulphite of lime and common salt for food preservation, the alcohol content of common beverages, chemical formulae for lamp-chimney glass, and the use of grass fibres from Lyttleton for fabric manufacture. Perfumery, sugar-beet production, milk preservation[18] — these, too, were reported in the local Press well before the appointment of a Professor of Chemistry in 1873. So, a chemically interested public must have been present. Manufacturing chemists, George Bonnington, and Parkinson & Co., freezing works developments[19] by L.P. Syme, gas company and iron foundry chemistry[20] were all being established in the 1880s.

But there are several industries which could have applied a modicum of chemical control, though none is reported as such. These include cider, wine and spirit manufacture, aerated waters and cordials, confectionery, brewing, special soap production, galvanizing, tanning, paint production and vinegar production. Merely listing the "might have beens" is no direct help to chemistry's history. However, the records of the Colonial Lab. show dozens of analyses by Skey upon single samples submitted by small businesses, not all of which were reported in detail in the Annual Reports to Parliament. Close study of these could lead back to some positive conclusions upon the extent of real chemical interest in the populace.

When W.N. Blair delivered his address in Dunedin in 1884 to the N.Z. Manufacturer's Association, upon "The Industries of New Zealand" he referred to many flourishing ones but made no reference to scientific control either then or in the future. And the address was not confined to any one Province.

I do not wish this section of the paper to be largely a list of names and industries, but most of those I have listed really require more detailed historical study than they have yet had, by chemists.

In Canterbury there are three other names which warrant mention — F.B. Stansell, Metallurgist and Mineralogist of the 1880s; T.A. Mollett of 1881 and of course, W.P. Evans in the 1890s. And the influence on the fertilizer industry of the active Lincoln College chemists is a further chemical stimulus.

However, before moving to Auckland I want to bring up one big mystery I failed to solve when in N.Z. in 1978 — it is this — where did the refrigeration ships and the land-based Hercules machines obtain the ammonia they required for their operation? In what form was it supplied? Customs records of the period showed no import of cylinders of ammonia, New Zealand was not yet at the stage in iron and steel manufacture to produce the steel cylinders required for gas storage and transport. And ammonia gas distilleries were not common in the land. Christchurch had one in the South Belt,[21] but I could find no record of the form in which it was collected. Every account I read of the regrigerating works which used ammonia[22] referred to ammonia's passage through the coils, etc., but did not mention the source of the ammonia. Does anyone know with certainty? If it was as concentrated "880" ammonia, then there remains the question of where did the glass containers come from? Were they imported? Or was there a local glass works capable of producing the quality glass required for the storage?

Auckland:

Contrary to my expectation*, I found great interest in and use of scientific advice in technical industry in Auckland. As early as 1853, an advertisement had appeared,[23] announcing the arrival of an analyst and assayer with South Australian and Welsh experience. The advertiser was identified for me by the Auckland Public Librarians as Winchcombe. In 1848, Clark's Soap and Candle business was established at Stokes' Point, purchased in 1878 by Tunny and Pond for use for their sulphur works. Tunny was then the Provincial Analyst, concentrating on adulteration of food-stuffs and on the manganese and silver content of ores and clays. J.A. Pond who was successor to Tunny as Provincial Analyst was extremely active and successful with Auckland's businessmen, advising on pollutants in water supplies,[24] on Portland Cement production,[25], on sugar beet production[26] and on the chemistry of gold.[27] He was an active member of the Auckland Institute, making a strong plea[28] in 1889 for more persistent efforts by the colonists upon the development of their industries, berating them for their cessation of work on N.Z. fibres, and their one-year only attacks upon cereal, potato, flax, pumice and other industrial endeavours. Of his own initiative he developed a 'lacquered' butter box[29] which greatly increased the export of N.Z. butter in prime condition.

Another chemist whose name arises in association with analytical chemistry is D.R. Shireff Galbraith, in 1891, a consultant chemist and assayer[30] who had patented a gas shaft furnace in 1887 to separate Au and Ag, using water gas, and had also worked on attempts to solve the stubborn problem of separating iron from the North Island — 'ironsands' — a problem which was not satisfactorily solved until the 1970's.[31] There was some chemical work done, too, by James Napier, metallurgist to the Island and Cassell Company in 1885. Governor Grey kept an active interest in the Provincial industries, so much so that in 1869 he was receiving letters[32(1)] implying the potential of the land for industrial development, in 1875 being given advice on the suitability of the clays etc. for fine pottery [32(2)] (a potential again not developed until well into the 20th Century) and in 1878 was asked to host a Mr. Mulvaney, [32(3)] introduced to him by van Hochstetter, praising Mulvaney's 23 years of establishment of Collieries and ironworks in Germany.

In Auckland, the Auckland Institute and Museum seems to have exercised a much more obvious influence on the

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FOOTNOTE:
*The general histories of New Zealand, which I had read, had lead me to expect that in the 19th Century it was the South Island which pioneered industrial development.

chemical life of the city and province than in the other provinces and their capitals. The addresses were often chemically oriented, particularly those given by Professor Brown, whose assistance to the gas industry has been widely acknowledged, although the chemical details have never been published, to my knowledge. The library of the Auckland Institute holds several items of chemical interest, including the notebook[33] containing the chemical notes of Alfred Ginders for the analysis of the mineral waters of Rotorua in 1886 — the start of the spa-health industry.

The New Zealand Drug Company's branch in Auckland (a branch of Kempthorne Prosser, established in Dunedin in 1863) was chemically controlled, producing acids and manures at Westfield and supplying chemicals and medicines, dental and photographic supplies to the Colony.[34] So, too, were some of the aspects of Joseph Craig's Building, Coal and Carrying Trade, established 1866, particularly the hydraulic lime, brick and pottery works.[35] Hudson, Manufacturing Chemist of Auckland, was producing baking powder as early as 1874,[36] as was Edmonds in Christchurch. From 1874 the Auckland newspapers (Southern Cross, 26th October 1874) were arguing that it was more important to appoint an analyst to monitor food adulteration that it was to appoint a Medical Officer of Health.[37] It was probably this agitation which led to the appointment of Tunny as Provincial Analyst.

Although, as mentioned for Otago, there was surprisingly little chemical interest shown in native vegetation, there was *some*[38] and also some interest in the production of lacquers and the extraction of dyestuffs from native barks.[39]

Which brings me to another chemical puzzle I was forced to leave unanswered (or confirmed) from 19th Century N.Z. chemistry. It was this — what was the source of the sodium acetate used by Kempthorne Prosser in the production of acetic acid? Was it from the destructive distillation of wood, used so profitably in World War II to make producer gas? Distillation resulting in wood alcohol, thence acetone and methylacetate, with liquors strongly acidic with respect to acetic acid. Neutralization of this with lime gave crude calcium acetate, which when heated gave calcium carbonate and acetone. But if it had been neutralized with a sodium alkali, sodium acetate would result. One of the by-products of this distillation was fine grade carbon, extensively used in the past on the gold field. The tacky residue from distillation, Stockholm Tar, was extensively used for treating rope and cordage and for veterinary purposes, last century.[40]

Conclusion:

In conclusion I say that although few advances in fundamental chemistry were made in N.Z. in the 19th Century, not much could have been expected from a small population living in centres separated by rugged terrain and stormy seas. However, the stage was set so that when greater cooperation between centres of learning became more accepted, the Dominion set up its several research centres which have contributed to the fundamentals of the subject.

And I end with another plea to historians of science. Would you give serious and deep consideration to the consequences of the race by librarians and archivists to place so many records on microfilm, etc. I feel strongly about this — believing, as I do, that memory and brain storage of material by research workers results not solely from messages received from visual sense but from the input of the multitude of senses with which we are endowed, and which reinforce one another. The feel, the form, the colour, the smell, the texture and quality of the paper, and the sweep of vision by which one picks up names and incidents not necessarily relevant to one's current interest, are all contributions which will be completely lost to the future research worker who uses only VDU's and computer searches.

Footnotes:

1. Dennison, John, "History of Chemical Industry in Otago, up to 1914", thesis 1948 (liberally referenced).

2. (i) T.K. Cowan, "The N.Z. Canned Fruit Industry", 1939.
   (ii) Hilda Timms, "Development of Woollen Industry in Otago to 1900", 1947. G.H. Aitken, "Production of Wool in N.Z.", 1932. N.Z. Wool Industry Research Report of 1968. The Rosalyn Industry — "Saga of a Woollen Mill" — updated.
   (iii) N.Z. Jubilee and Exhibition Chronicle 1890, p.41, "Woodhaugh Paper Mills, Dunedin". G.B. McGhie, "Pulp and Paper Industry of N.Z.", 1965. John H. Angus, "Paper Making — 1876-1976", 1976.
   (iv) L.W. McCasgill, "Fertilizers in N.Z. 1867-1929", 1929.
   (v) A.McL. Wright, "Meat Extracts in N.Z.", 1907.
   (vi) Samuel J.D. McCay, "Phormium Tenax in N.Z. History", 1952.
   (vii) Marian M. Nimmo, "Coal Mining in Otago 1848-1908".
   (viii) E.N. Harraway, "Flour Milling in Otago", 1965.
   (ix) P. Pascoe, "Study of early buildings in Canterbury et. al., 1935. (The topic should cover studies of brick, cement and wood preparations).
   (x) J.M. Robertson, B.L. Kirk and Anne C. Crumm, "Chemical composition of some N.Z. Red and Rose Wines", Report No.C.D. 2247 of DSIR, N.Z., 1976.
   (xi) Jeanne H. Goulding, "The Rope Makers of N.Z.", 1968.
   (xii) (a) "Otago Witness", 1886 with advertisement of A.M. Loasby, manufacturing chemist of Dunedin, for Baking Powder production. Also,
   (b) "Industries of New Zealand", Published late 1890's by Arthur Cleave and Co., Auckland.

3. For all the following topics, see the accounts in 2xii(b) above, and in W.N. Blair, "The Industries of New Zealand", address delivered to N.Z. Manufacturer's Association in 1884, and in "Resources of New Zealand" R.O.N.Z. for details of the situation at those dates.

3. (i) Brewing: Otago Witness, June 16, 1883, p.9, and N.Z. Farmer, Bee and Poultry Journal, April 1896 p.133.
   (ii) Vinegar: See David McIndoe, "N.Z. Grapevine Journal", for one method used.
   (iii) Dyeing: See Ref. 39.
   (iv) Brasswork: N.Z. Farmer Bee & Poultry Journal, Aug. 1895, p.251, and 1895, p.313.
   (v) Galvanizing: N.Z. Farmer Bee & Poultry Journal, Oct. 1894, p.370, 371 and May 1896.
   (vi) Tanning: Page — R.O. "Vegetable Tanning" thesis 1933 and R.O.N.Z. Vol. 1, No. 2, 1898, p.122 and any reports on fellmongering.
   (vii) Health and Sewage: For Council reports and reports of official analysts of the major cities and provinces as in Ref. 37 and hospital reports from major cities, also Christchurch Drainage Board Reports, 1886.

4. Henry Courtis (City Engineer), "Report to City Council on Gas Works".

5. J.K. Dixon, "Chemistry in New Zealand" 1957. (Copy of the original typescript held at Chemistry Department, Auckland University with Briggs' material.)

6. N.Z. Mines Record, Vol. III, No. 10, May 1900, "N.Z. Coal and Oil Company's Works at Orepuki".

7. Black was one of the earliest shareholders, and regularly took students to the Burnside Works to see industrial processes in action. From Ref. 1.

8. (a) Richard Winter, "N.Z. Industries, Past, Present and Future".
   (b) Wm. Haseldeen, "Present Condition and Future Prospects of Industrial Resources of N.Z.".
   In N.Z. Gazette, Jan. 2nd, 1885 and N.Z. Industrial Exhibition, Published, Wellington, 1886.

9. Otago Witness: (i) June 6, 1883; (ii) July 1883; (iii) July 1883; (iv) Jan. 6, 1884, p.28; (v) Oct. 20, 1883, p.2 and Dec. 8, 1883; (vi) April 10, 1886, p.22.

10. John McIndoe, "Photography in N.Z.", 1971.

11. Sir James Hector's Papers — list of photographic materials, Hocken Archives, Dunedin.

12. Professor Ulrich's report to University Council 1892, Hocken Archives, Dunedin.

13. (i) Appendices to Journals of House of Representatives N.Z. General Assembly, 1891, Vol.I, C3, pp.140-152; 1892, Vol. I, C4, pp.96-120.
   (ii) Report on "Explosions in Coal Mines" by John Hayes, Inspector of Mines, 1898, Dunedin. This reports the effects of the gas carbon monoxide at an explosion at Greymouth. The account of the above report, held at Alexander Turnbull Library gives Professor Black as reporting that ⅓ of the hydrocarbons and coal gas would have been distilled as CH_4 and CO.
   (iii) Otago Witness, March 31, 1883 in its Science Column, reports on British Professor Abel's accounts of Explosions in Collieries.

14. J.K. Dixon, "Chemistry in N.Z.", prepared for ANZAAS, 1957 and reported in "Science in N.Z.", ed. F.R. Callaghan, December 1957.

14a. See University of N.Z. Archives, 1891 10/26: Two parts of a

thesis from Cristchurch, submitted for the 1851 Exhibition Scholarship — one was entitled "The active principle of 'Axillaris' (The Colonial Pepper tree), but was soundly criticised by the examiner. The pseudonym of the student was 'Test' or 'Best'.

15. Tutu quite literally was poisonous enough to kill an elephant: *Lyttleton Times* May 4, 1868, reports that an elephant being brought overland from Dunedin to Christchurch died of tutu poisoning.
16. Lyttleton Times, 1-11-67.
17. Lyttleton Times, 4-7-67.
18. (i) Lyttleton Times, Nov. 8, 1867 (gas escape)
    (ii) Lyttleton Times, Nov. 19, 1867 (ice making)
    (iii) Lyttleton Times, Nov. 26, 1867 and Dec. 2, 1867 (meat preparation)
    (iv) Lyttleton Times, Nov. 26, 1867 (alcohol in beverages)
    (v) Lyttleton Times, May 18, 1868 (glass formulae)
    (vi) Lyttleton Times, April 14, 1868 (grass fibres)
    (vii) Lyttleton Times, May 14, 1869 (perfume atomizer)
    (viii) Lyttleton Times, May 31, 1869 and July 7, 1869 (sugar beet — abortive)
    (ix) Lyttleton Times, June 23, 1869 (milk preservation in Auckland)
19. G.R. Macdonald, "History of Canterbury Frozen Meat Co., 1882-1957" with Appendix 2 by L.P. Symes (h as technical details of chemistry) Christchurch, 1957.
20. (1) Report of Special Committee of Enquiry into Department of Chemistry and Physics, 25th February, 1895, Canterbury College, p.56: Mr Troupe of Crown Iron Works gives evidence.
    (ii) "Industries of N.Z." published late 1890s, Arthur Cleave & Co., Auckland.
21. As 20(i), p.57 — evidence for Dr Henry William Symes and as 20(ii).
22. (i) R.O.N.Z. 1898, Vol.1, No.2, p.86: Auckland Freezing Works has an Ammonia Refrigerator, but no detail on source of ammonia.
    As 20(i), p.57 — Ammonia reported as coming from gas liquor.
    (iii) As 19, Appendix 2 — Compressors send ammonia gas to freezing chamber.
    (iv) Article on Jas J. Niven & Co. (Napier) in "N.Z. Capital and Labour Review", Aug. 28, 1918, pp.41-44. They are described as the only manufacturers of ammonia compressors in the Dominion.
    (v) N.Z. Farmer Bee & Poultry Journal 1895, p.247 "Advances in Freezing Machinery" again gives no original source of the ammonia.
    (vi) Did they use the ammonia from K.P. from the 1890s produced from Ammonium sulphate, concentrated and stored in Woulff bottles. (see Dennison Ref.1).
23. Ad. in New Zealander, May 14, 1853.
24. Trans. Auckland Institute 1878-9, No.10, p.512; N.Z. Herald 4Ap. 1889, pp.6-18; and Trans. Auck. Inst. 1899-1900, p.241 Pond's work on water analyses for council.
25. Trans. Auckland Institue 1875, p.348 and North Shore Times Advertiser 15-7-75.
26. Trans. Auck. Institute 1881, pp.366-372.
27. J.C. MacLaurin was one of Pond's staff. Also Trans. Auck. Institute 1888 Vol.21 reports Pond's work as "Fe in Thames Lodes".
28. New Zealander, Aug. 6, 1889.
29. Description in N.Z. Jubilee and Exhibition Chronicle 1890 and Patent No.1717, 1886.
30. Cycl. of N.Z., p.470 from Auckland Institute Records.
31. D.R. Buist, R.H. Cooper and S.J. Griffiths, New Zealand Steel Ltd. Taharoa ironsands operation: Paper 24 of Eleventh Commonwealth Mining and Metallurgical Congress. Institute of Mining and Metallurgy 1978.
32. (i) James Wright to Sir George Grey, April 16, 1875. Grey Collection, Auckland Public Library (APL).
    (ii) von Hochstetter to G.G., 20th April, 1878, Grey Letters APL, H28/4.
    (iii) Sir David Monro to G.G., 1869, Grey Letters, APL, M39A/5.
33. Manuscript of Auckland Institute — book once belonged to John Kenderdine.
34. (i) The Resources of New Zealand, Vol.1, No.2, 1898, p.42, "New Zealand's Drug Company"
    (ii) E.C. Franklin "A century of Auckland Commerce 1856-1956", Auckland 1956, has a section on Kempthorne Prosser & Co. N.Z. Drug Co. Ltd. — 75 years of Life.
35. As 34(1), p.94, The Building, Coal and Carrying Trade.
36. (i) See "Industries of New Zealand", Hudson made Baking Powder in 1874 — all samples analysed by Pond and MacLaurin.
    (ii) Thos. Edmonds, 1879 — Baking Powder and Self Raising Powder Works "Have been subjected to exhaustive analyses".
37. G.W.A. Bush, "Decently and in Order — a centennial history of the Auckland City Council", Auckland 1970, p.150.
38. L.K. Gluckman "Tangiwai", A medical history of 19th Century New Zealand. Auckland 1976, refers to Taylor's "Leaf from the Natural History of N.Z." 1848.
39. Lacquers produced from Kauri Gum were urged from 1844 — Southern Cross, Oct. 5 and Nov. 16, 1844. Paints, Dyes urged from 1843 — Southern Cross, Aug. 12, 1843. "Resources of N.Z.", Part I, 1897, p.38, Part 2, 1898, p.66, Part 3, 1899, p.180 all refer to Kauri Gum Production. Blair in his address on "Industries of New Zealand", p.36, also refers to a fossil resin in lignite beds of the Middle Island which has similar properties to Kauri Gum.
    Firth, R.W., "The Kauri Gum Industry — "Economic", thesis 1922.
    Dyeing of Cloth reported in Otago Witness July 21, 1883.
    Vegetable Dyes reported in Otago Witness, Oct. 6, 1883.
    and Chemistry of Vegetable Pigments briefly outlined in Otago Witness, Jan. 6, 1884, p.28. By 1911 the Dominion Museum had issued Bulletin No.3 which on pp.74-76 refers to the preparation of native dyes.
40. I am indebted to Mr. Spackman of Auckland for the suggestion of possible source of sodium acetate, and the details of wood distillation in N.Z.

Bibliography: A full copy of the bibliography of sources consulted in the preparation of this paper is available from the Editor.

For further information circle 9 on Reader Reply Card

COUNCIL NEWS

Professor R. D. Batt presided over a meeting of Council at Weir House in Wellington on Sunday 19th August.

Election of Officers. From 1st September 1984 **Mr A. W. Mackney,** OBE, Hon. Fellow NZIC, FRACI, was elected President, **Professor G. B. Petersen** First Vice-President and **Dr B. Halton** Second Vice-President. **Dr J. Rogers** was re-elected Honorary General Secretary.

Honorary Fellowship. Emeritus **Professor C. J. Wilkins** was elected an Honorary Fellow.

Prizes. See elsewhere in this issue.

Fellowship — Royal Society of New Zealand. Nominations of NZIC members for Fellowship of the Royal Society of New Zealand should be forwarded before 15th November 1984. Twelve copies are required of the nominee's curriculum vitae and full biography. Further information is available from RSNZ, Private Bag, Wellington, the Executive Officer.

Membership. The following applications and changes of status were approved, resignations accepted and deaths noted with regret.

Fellowship:

BAKER, Edward Neill M.Sc. Ph.D.(Auck) Dept of Chem/Biochem/Biophysics, Massey University. (Reader)

HARLAND, Peter William, B.Sc.(Wales) Ph.D.(Edin) Chemistry Dept., Univ. of Canterbury. (Senior Lecturer)

MACKENZIE, Kenneth John Dallas, M.Sc. Ph.D.(Well) Chemistry Divn. DSIR., Gracefield. (Scientist)

MAISTER, Selwyn Gerald, M.Sc.(Cantuar) D.Phil.(Oxon) Christchurch Polytechnic. (Snr. Tutor in Chemistry)

MILLER, Ian James, B.Sc.(Hons) Ph.D(Cantuar) Chemistry Divn. DSIR., Gracefield. (Scientist)

ROPER, Warren Richard, M.Sc.(NZ) Ph.D. (Cantuar) Chemistry Dept. University of Auckland. (Associate Professor)

Membership:

LAL, Alick Ruyhit, M.Sc(Otago) Chemistry Dept., University of the South Pacific, Suva, Fiji. (Lecturer)

PERKINS, Francis William, B.Sc. Edmund Rice College, Rotorua. (H.O.D. Science)

TYLER, Peter Charles, B.Sc.(Hons) Ph.D.(Well) Chemistry Divn. DSIR, Gracefield. (Scientist)

VAN ENCKEVORT, Harry John, M.Sc.(Waikato) Chemistry Divn. DSIR, Gracefield (Scientist)

DEMORA, Stephen John, B.Sc.(Wales) Ph.D.(Br.Col.), Chemistry Dept, University of Auckland. (Lecturer)

FARR, Paul George, NZCS. Quik Stik International Ltd, Auckland. (Development Manager)

WILLIAMS, Archill, M.Sc.(Auck) Dept of Health, Auckland (District Air Pollution Control Officer)

Graduate Member to Member.

HARRINGTON, David Athol, B.Sc.(Hons)Cantuar). Ph.D.(Auck) 938 Elsett Drive, Ottawa, Canada. (Asst. Professor)

McKINLEY, Allan James, B.Sc.(Hons)(Cantuar) Chemistry Dept., University of Canterbury. (Ph.D. Student)

Graduate Membership

ADAMS, Christopher John, B.Sc. Chemistry Dept. University of Waikato. (Student)

BENNETT, Tony Edwin, B.Sc. 36 Stourbridge St. Christchurch. (Unemployed)

DIBBLE, Ken Peter, B.Sc.(Hons)(Otago) Chemical Cleaning Co. Ltd., Mt. Maunganui. (Industrial Chemist)

GOMMANS, Louie Herman Peter M.Sc.(Waikato) Chemistry Dept. University of Waikato. (D.Phil. Student)

HARNETT, Miss Michelle, B.Sc.(Hons)(Cantuar) Chemistry Dept. University of Canterbury. (M.Sc. Student)

* HAY, Michael Patrick, B.Sc.(Hons)(Cantuar) Chemistry Dept. University of Canterbury. (Ph.D. Student)

McLELLAN, Gavin David, B.Sc. Chemistry Dept. University of Auckland. (M.Sc. Student)

* O'DONOGHUE, Miss Erin Margaret, B.Sc.(Hons)(Massey) Levin Horticultural Centre. (Scientist)

* ROBINSON, Nicholas Peter, B.Sc. Chemistry Dept. University of Waikato. (M.Sc. Student)

* SCHOFIELD, Miss Linley Rose, B.Sc. Chemistry Dept. University of Waikato. (M.Sc. Student)

* TAY, Mrs Siew Hong, B.Sc.(Hons)(Cantuar) Chemistry Dept. University of Canterbury. (Student)

* LIN, Miss Min, B.Sc.(Hons)(Cantuar) Chemistry Dept. University of Canterbury. (Student)

* from Student Member

Technician Membership.

SPENCER, Miss Raewyn Jane, NZCS NZ Fertilizer Manufacturers' Research Assn. Auckland. (Technician) (was Local Member)

Deaths: S.H.J. Wilson (Wgtn, Hon. Fellow) J.F. Barnes (Otago), D. J. Spedding (Auck)

Resignations accepted: J. W. Dryden, Mrs M. L. Mullins, G. D. Edwards, M. S. Greig, Mrs A. A. Ridley, R. J. Sims, V. L. Grow, Mrs T. H. McTague, R. Chittenden, J. F. Lewin, B. R. Seymour, L. A. Williams, Mrs D. O. Chen

Remission of subscription granted

A. G. Hale, J. T. Hughes, R. S. Malthus.

After discussion of the existing non corporate grades of membership and comments on proposals for change received from Branches, past and present members of the Membership Committee, past Presidents and other members, Mr Mackney and Dr Rogers were asked to prepare a memorandum for Council, Branch Committees and the Membership Committee on three options. These are:

1. The status quo i.e. Student, Technician, Graduate, Associate. Council established the Student grade in 1982, Technician and Associate in 1975 and Graduate in 1973.
2. Student, Graduate, Associate.
3. Student, Graduate.

Council's Standing Committee will consider responses to this memo in November.

Action will be taken by Council at its meeting 7/8 February 1985 on a revised version of the Rules to be circulated to Branches before Christmas as required by the Rules.

A recent survey by Branch secretaries shows there are 110 NZCS and 340 B.Sc final year students of Chemistry and Biochemistry eligible for Student membership. The 1983/84 Annual Report shows NZIC has 34 Student members. Estimates of the cost of a recruiting drive have been circulated to Branches as an appendix to the memo on non corporate grades of membership. A graph shows that since 1956 the rate of increase in NZIC membership has on average remained constant at 37 to 38 per annum. The administrative changes required and the cost of say trebling or more this rate of increase are under consideration.

Finance. The decision of the February meeting of Council not to increase subscriptions by $5 for 1984/85 reduced budgeted income by about $5000 so that a deficit of over $8000 was reported as probable by the Registrar. To reduce this deficit to $2000 Council resolved to cut expenditure and adopted an alternative budget tabled by Mr Hogan.

Production of a careers publication budgeted to cost $2000 was deferred. The decision not to make a contribution of $2000 to the Royal Society of New Zealand Prince and Princess of Wales Fund this year was reported to the Annual General Meeting. The travel budget was reduced by $2000 and general expenses and the Overseas Visitors' Fund trimmed by $500 each. The Journal is the biggest item in the budget, being a third of total expenditure at $21,000. Possible savings are to be explored with the Editor and publisher.

A motion was passed at the Annual General Meeting recommending Council to increase subscriptions.

Annual General Meeting. Resolution on Promotion of Research and Development. On the motion of Professor R. D. Batt seconded by Dr J. Rogers the following motion was adopted by the Annual General Meeting on 21st August. "This Annual General Meeting of the New Zealand Institute of Chemistry notes with concern that Government expenditure on research and development has remained static in real terms for the last five years and the expenditure on research and development in the private sector is very low in comparison with that of other developed countries. The incentives designed to promote research and development in Australia are much superior to those available in New Zealand with the result that both professional scientists and sectors of industry may transfer to Australia.

Members agree that the Minister of Science and Technology should be informed of this serious situation and recommend that he should examine and adopt recommendations for assistance in respect of research and development in the private sector as put forward by National Research Advisory Council and the Manufacturers' Federation."

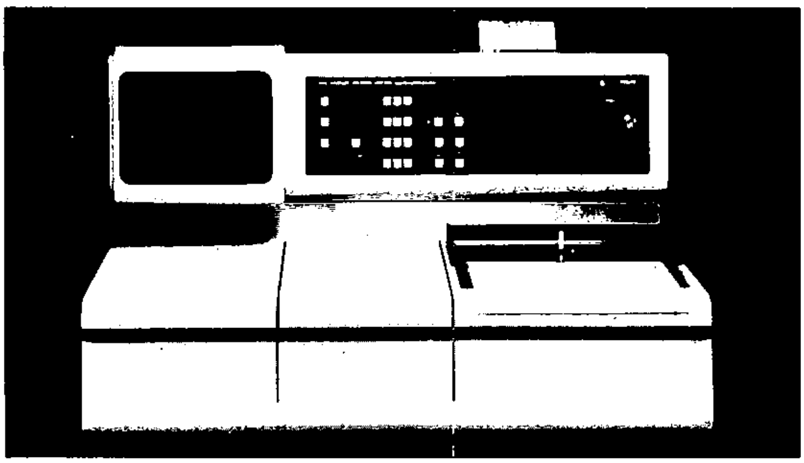
Annual Conference. Council expresses its appreciation of the arrangements made by the Conference Committee (Chairman, **Gordon Leary** and Secretary, **Graeme Gainsford)** for 1984's joint Conference of the NZIC and NZ Biochemical Society held in Wellington 20-24 August. Reciprocal arrangements with the NZ Science Teachers' Conference were made on this occasion to allow delegates to attend Conference sessions and field trips.

A Quality Assurance Symposium, organised by Telarc, seminars on liquid fuels and forensic science, the Pharmacia Award Lecture of the Biochemical Society and plenary addresses by Sir George Porter, Director of the Royal Institution, were features of this Conference.

Council congratulated the Christchurch Conference Committee on the early distribution of an attractive brochure giving preliminary details of the programme planned for August 26-30 1985. The theme of the Conference is to be "Chemistry becomes Computerised". **Dr W. H. Swallow** is Chairman and **Dr P. W. Harland,** Secretary.

PAC CHEM. 84. Mr Mackney is to lead the NZIC delegation to the 1984 International Chemical Congress of Pacific Basin Societies at Honolulu December 16-21 1984. Members wishing to participate in this Congress are asked to contact Air New Zealand or the Honorary General Secretary for details of the revised price of the package tours offered by Air New Zealand in the February issue of "Chemistry in New Zealand".

J. Rogers
Honorary General Secretary.
14 September 1984.



GOVT DEPTS AND RESEARCH INSTITUTES

DSIR, CHEMISTRY DIVISION, WELLINGTON

Mr L. M. Smith, head of the instruments section, has transferred to the Ministry of Works and Development Laboratory. *Dr W. C. Tennant* has agreed to supervise the Electronic and Instrument Services section of the laboratory, and *Dr R. H. Newman* has been appointed head of the Spectroscopy section in place of Dr Tennant.

Dr Gary Strange has been working at Chemistry Division for three months, on a Liquid Fuels Trust Board Contract to examine the use of tallow esters as diesel extenders. Dr Strange completed his PhD at Auckland University, and will be continuing studies at Imperial College in London on a Post Doctoral Fellowship.

CHEMISTRY DIVISION, CHRISTCHURCH

TELARC inspectors from Australia visited the food laboratory in late August and the results of their visit are awaited (with or without bated breath? — Ed.)

INS, WELLINGTON

Dr C. J. Adams returned recently to the Institute after 20 months study leave in West Germany as an Alexander von Humboldt Fellow. His research program there was based partly at the Geological Institute of the University of Munster and partly at the Federal Geological survey in Hannover, and concentrated on technical aspects of geological dating of rocks by isotopic methods, with particular application to the early geological history of Antarctica.

APPLIED BIOCHEMISTRY DIVISION

Dr Richard Biggs recently presented a Departmental Seminar titled "Factors in Resistance of Legume Roots to Grass Grubs". This seminar was based on group work between this Division and Entomology Division in Auckland. Several mechanisms for plant resistance have now been defined, including feeding deterrance and toxicity. Bean was described as unusual in that it is not toxic but it appears to depend on feeding deterrence for resistance to attack. This deterrence is based principally on the isoflavonoid phytoalexin, Phaseollin.

Dr Dave Greenwood attended the 33rd Annual Conference of the New Zealand Entomological Society in Dunedin from 15 to 18 May. He presented a paper on "The Fate of Aliphatic Nitro Compounds on Injestion by Grass Grub and Black Field Cricket". *Drs Oliver Sutherland and Dave Gaynor* of Entomology Division, D.S.I.R., also addressed the Conference on other aspects of combined Applied Biochemistry Division/Entomology Division projects on plant resistance to grass grub.

Mr Denis Body recently received histological materials from two male Stephens Island Tuatara (Sphenodon punctatus) for analysis of their lipid contents. Few analyses of such materials from rare New Zealand species have been undertaken and special authorisation is required from the Wildlife Service of the Department of Internal Affairs for this work. Mr Body has recently analysed eggs of Kiwi (Apteryx australis mantelli), Takahe (Notornis mantelli) and the Dwarf Cassowary (Casuarius bennetti).

Dr Terry Thomas, Head of the Biochemistry Section, is currently on a 12 months Staff Development Bursary at the Department of Food Science and Nutrition, University of Minnesota. He gained a Fulbright Award (travel) to facilitate this study.

Mr Howard Heap, Starter Technology Section, is on a Short-Term Staff Development Bursary at the University of Utah to study recent developments in bulk starter handling.

Dr Steve Haylock, of the Casein Section, recently attended a Milk Proteins Conference in Luxembourg, and *Mr T. O. R. Haggett,* Analytical Chemistry Section, participated in a Seminar entitled "Challenges to Contemporary Analytical Techniques", held at the University of Reading in the United Kingdom.

Mr Russell Wilson recently left the Division to take up a position as Research Officer with the N.Z. Dairy Research Institute. Mr Wilson will be studying aspects of the flavour chemistry of dairy products.

On 11 July *Dr Mark Ulyatt* addressed a Divisional Seminar on "Animal Nutrition at ABD". Dr Ulyatt gave a brief history of the Division, with emphasis on the development of the Nutrition Group (which he is Head of), and then he described the structure of the Group and aspects of its research program. He then described the ABD Nutritional Data Base, its purpose and its operation. Aspects of the nutrition of ruminants, in particular the loss of nitrogen under some feed situations and methods for limiting this loss, were also discussed by Dr Ulyatt.

In a Divisional Seminar on 24 July, *Dr Mike Boland,* Officer-in-Charge of the Biochemical Processing Centre, described recent developments in the Centre and the industrial uses of enzymes, both in New Zealand and overseas. Dr Boland discussed recent developments in enzymic processing, in particular the use of immobilised enzymes, modification of the active sites in enzymes and the use of enzymes in non-aqueous solvents. He described various aspects of down-stream processing in the biotechnology industry and the problems that may arise in adapting a laboratory process to those used on a pilot plant or an industrial scale. The old dairy factory near ABD was recently upgraded to give a 100 sq. metre processing hall, a small office, workshop, storage area and laboratory for the Centre. Dr Boland completed his presentation with a discussion of aspects of the role of this pilot plant in the development of industrial processes.

HEALTH DEPT., AUCKLAND

Dr R. V. Winchester of the Department's Northern Regional Occupational Health Unit will shortly be leaving to take up a position with the Food Section of Chemistry Division, DSIR, Auckland.

WOOL RESEARCH ORGANIZATION OF NEW ZEALAND

Dr Peter Ingham left on September 2 for a seven week trip to Europe and Japan. The main purpose of his trip is to attend I.S.O. flammability meetings in London. He will also visit other establishments associated with fire research and textile research, and will attend a Bruker FT-Infrared users workshop run by the company in Karlsruhe, West Germany.

On 22 August, WRONZ held a visitors day for more than 100 guests drawn from industrial members, farming organizations, politics, DSIR, university and other technical organizations. About 20 displays, several involving industrial partners, were mounted emphasizing the general theme of introduction of new technology in all aspects of the wool industry.

Mary Trounson who has just completed her Ph.D. studies at Otago University joined WRONZ in July as an assistant scientist in the textile chemistry group.

WHEAT RESEARCH INSTITUTE

Director *Tom Mitchell* left in mid August for a visit to kindred organizations in USA and Europe. He will be presenting a paper on the Mitchell mixers at a cereal conference in Manhattan, Kansas towards the end of September. He returns at the end of October.

BRANCH NEWS

AUCKLAND

FATS AND OILS SPECIALIST GROUP

When the Fats and Oils specialist group of the NZIC convene, participants can be assured of an interesting and entertaining event, with topical discussion of relevance to chemists, bio-chemists, nutritionists, medics and the public.

Twenty four people (including visitors from DSIR Wellington, MIRINZ Hamilton and DRI Palmerston North), attended the Oils and Fats Group's 1st AGM held as an informal dinner function at the Waipuna Lodge on the 8th August.

Apparently the 1983 elected Chairman, Treasurer and Secretary of the group performed their duties so well that all have been re-elected for the 1984-1985 year — namely *Laurence Eyres, Gordon Winward* and *Sharon Hannon.*

Themes proposed for future meetings include work on Yeast Oil by the DSIR: Emulsifiers (to coincide with a visit by *Mr J. Hughes* of Unilever U.K.) and a Teach-In day conference on Oils & Fats for all interested persons. Watch for details as they come to hand.

The evening's discussion topic was chaired by *Professor R. C. Cambie.* Speaker for the night was that indefatigable character, *Stanley G. Brooker,* who related anecdotes from his recent overseas trip during which he included visits to the Kaufman Institute Federal Centre for Lipid Research at Munster, Germany, PORIM in Malaysia and also attended the Nutrition Conference at Reading U.K.

WAIKATO

Dr Murray McEwan, Reader in Chemistry, University of Canterbury, presented a very interesting address on "Extra-terrestrial chemistry" at the July branch meeting. The large audience included local High School teachers and members of the Astronomical Society. The talk was extremely well illustrated with the aid of movie films and slides. Dr McEwan discussed some of the problems associated with planetary exploration, and clearly showed that enormous steps have

BRANCH NEWS

been made in space research in the last 15 years. He gave a concise summary of present knowledge concerning the chemistry of planetary atmospheres, and briefly reviewed future plans for further studies of the planets and their moons.

MANAWATU

On 29 May *Professor R. D. Batt* gave his Taranaki Presidential Address to an enthusiastic group of members, from New Plymouth and the surrounding districts, at Ivon Watkins-Dow Ltd. Professor Batt's address was entitled "Alcohol and Politics".

Dr Colin W. Jones (Department of Biochemistry, University of Leicester, U.K.) who is well known for his work on biological energy conservation, particularly in relation to the growth of thermophillic bacteria, visited Massey University, the D.S.I.R. and Dairy Research Institute on May 9 - 10. In his lecture at the University, Dr Jones gave a very clear account of the energetics of bacterial growth, finishing with a brief but fascinating example of the industrial utilisation of bacteria as biomass. This presentation was appreciated by his audience of chemists, biochemists and microbiologists.

Mr Malcolm Reeves, a senior lecturer in food technology at Massey University, addressed the June meeting of the Branch on "The Maturing Wine Industry of New Zealand". He described the expansion of wine production in New Zealand since the 1960s and the new varieties of grapes now being grown. Other topics discussed by Mr Reeves included problems in viticulture, the quality range of New Zealand wines and changes in local marketing methods for wine. The meeting concluded with the audience sampling a variety of wines and cheeses.

The Branch's Annual Dinner, scheduled for 28 June at Massey University's Wharerata, was cancelled because of lack of support by the membership.

Dr Guy Dodson, Head of a Protein Structure Group in the Chemistry Department of the University of York, U.K., was in Palmerston North on 23 July as part of a visit to New Zealand sponsored by the Institute and the Biochemical Society. While here, Dr Dodson presented two lectures at Massey University, the first (a Departmental Seminar) being entitled, "Haemoglobin, and the Structural Effects of Ligand Binding". In this lecture Dr Dodson reviewed the nature of cooperativity in the action of haemoglobin, and went on to show how x-ray crystallographic studies have characterised not only the T (deoxy) state and R (liganded) state, but also an intermediate form with two subunits oxygenated and two not. This was a superb illustration of the importance of structure in biology.

In his second lecture (a Branch Meeting) entitled, "Insulin Structure, Behaviour and Function", Dr Dodson described how the insulin monomer readily underwent self-assembly to form dimers, and thence hexamers, in the presence of zinc ions. He also discussed the importance of aromatic interactions in the formation of hexamers, the physical properties of pro-insulin and he related the structures of various insulin molecules to their functions and activities in animals. Medical and scientific reasons for pursuing the study of insulin, to produce more active materials than that currently available, by modifying a vital (as yet undiscovered) part of the insulin molecule, were also discussed by Dr Dodson.

WELLINGTON

Dr N. B. Milestone gave the Wellington Branch Chairman's address at the July meeting, and this address was repeated at the Cawthron Institute in Nelson on September 18. Dr Milestone commenced his address with a brief description of the Development Finance Corporation, where he had been on secondment for seven months, attached to the Applied Technology Programme. The aim of this is to increase the economic return to New Zealand from technological innovation, principally by the commercialization of technology developed in New Zealand.

Dr Milestone's research interests are in the field of silicate chemistry, and during his address he described the various types of silicate, and how their structure dictated their chemical properties.

The August branch meeting was well attended by industrial chemists who heard *Dr Norman Clarke's* well illustrated and informative address entitled 'Progress towards an Integrated Steelworks'.

The address described the development of the unique iron and steel making process presently used at NZ Steel, leading on to the new process route being built as stage I of the expansion. The slabs from the casting machine of Stage I will feed the rolling mill complex, stage II of the expansion, which in turn will produce products suitable for the present finishing plants.

NZ Steel planned from its inception in 1965 to become a fully integrated steelworks. This aim is now in sight, with completion expected during 1986.

CANTERBURY

The Canterbury Branch sponsored two meetings in July. *Dr G. Dodson* (Chemistry Department, University of York) addressed the branch on his work on protein structures. The branch also sponsored a meeting on the place of chemistry in planning a career to which teachers and careers officers in secondary schools were invited. The programme covered such topics as job vacancies and opportunities in chemistry, salary scales for chemists and the chemistry background desirable for pursuing particular careers. Speakers included a school careers officer and representatives from tertiary teaching institutions, the Department of Labour and employers. The NZIC produced film "Chemistry for Agriculture" was shown as well as a slide presentation showing the types of chemical work done in the Christchurch area. A range of career publicity material was also made available for those attending.

In August *Dr K. U. Ingold* (Division of Chemistry, National Research Council of Canada) gave an address on oxidation and its prevention in biological systems.

OTAGO

Prof. R. D. Batt gave his address to the Branch as President of the Institute late in June. His subject was "Alcohol Metabolism", and it is perhaps as well that he concluded that alcohol could not be considered to be a poison for the meeting was followed by wine and cheese. Both lecture and refreshments were much enjoyed by those that attended. Shortly afterwards, the Branch and the University Chemistry Department held a joint meeting. This was the inaugural R. E. Corbett Lecture at which *Prof R. C. Cambie* (Auckland University) spoke on the utilisation of natural products. Then on 20 July the Branch and the Biochemistry Department of the University held a joint meeting at which *Dr Guy Dodson* from the University of York in England talked about "New Developments in Protein Structural Studies". Dr Dodson worked previously on the structure of insulin with *Prof. Dorothy Hodgkin* at the University of Oxford.

UNIVERSITIES AND TECHNICAL INSTITUTES

AUCKLAND

Dr Yasuhisa Hayashi of the Joetsu University of Education, Japan, has recently spent 2 months working with *Prof. John Aggett* on a rationalisation of the reported interference due to cobalt, copper and nickel in the generation of arsine for analysis by AA. They have also looked at a possible mechanism for the interference.

Dr Tom Mole from Materials Science Divn, CSIRO, Melbourne, visited Auckland on his way to the NZIC Conference. Dr Mole's interest is catalytic conversion of methanol to gasoline over the Mobil ZSM5 catalyst. He gave a talk on his latest views on the mechanism for this reaction which was of particular interest as it is also the subject of two programmes at present running at the University.

Prof. Pierre Laslo, of the University of Liege, Belgium, visited Auckland to attend the IUPAC conference. In addition he gave two lectures to the Department, one on 2-dimensional NMR, and the second on high resolution, solid state NMR.

ATI

Dr Roger Whiting is to spend two weeks in September in Christchurch, at the University and the Polytechnic. He is planning to study computer aided learning programmes, particularly with a view to teaching basic chemical arithmetic.

UNIVERSITY OF WAIKATO

Dr Kathryn Ivanetch, of the University of Cape Town Medical School, gave an interesting talk on the metabolism and carcinogenic potential of chloroethylenes to a joint seminar of the Chemistry and Biology departments at the end of June. A second joint visitor was *Dr Guy Dodson,* University of York, who gave lectures on protein structures and on evolutionary relationships of insulin. The cancer theme was continued in a review lecture by *Professor Parkanyi,* of the University of Texas at El Paso, who visited us on his way to the IUPAC Conference. That event also brought us *Professor Takeuchi* and *Dr Kakimoto,* of the University of Tokyo, who spent a day with us discussing germanium-73 n.m.r. work. It was interesting to see the methods and results of other members of the rather exclusive club of Ge-73 spectroscopists!

The coinciding meetings of IUPAC, NZIC, SCICON and the one-day heavy metals seminar emptied the department of all staff (Malcolm Carr even made both Auckland and Wellington). We were pleased that the Institute's scheme to assist student attendance was well patronised: six of our students attended NZIC and one went to IUPAC.

UNIVERSITIES AND TECHNICAL INSTITUTES

Continued

Malcolm Carr (Chemistry Subject Convenor) organised and chaired a four-day writing group on the 7th Form Chemistry prescription. He presented parts of the resulting draft prescription to some 80 chemistry teachers at SCICON in Wellington and received very helpful feedback.

MASSEY

Dr Ted Baker, Reader in the Department of Chemistry, Biochemistry and Biophysics, leaves in August to spend a period of study leave at the University of Oregon, Eugene. As a recipient of a Fulbright Fellowship, he will spend 10 months working with *Dr Brian Matthews* in crystallographic studies of protein structure, and will then visit laboratories in Britain and in Europe.

Dr David Parry of the same Department is now in England attending the Congress of the International Union of Pure and Applied Biophysics, held during July 31 to August 4 in Bristol. Dr Parry will also present two papers to a satellite meeting, "Structure and Dynamics of Connective Tissue", to be held in Oxford.

From December to late February Dr Parry will be studying aspects of the structure and function of intermediate filaments at the National Institutes of Health in Bethesda, Maryland, with *Drs Peter Steinert* and *Alasdair Steven.* Dr Parry has been awarded a Prestige Fellowship for this investigation at the National Institute of Arthritis, Diabetes and Digestive and Kidney Diseases. It is part of a three-way joint project involving *Dr Bruce Fraser* of the CSIRO Division of Protein Chemistry in Melbourne also.

Dr Malcolm Gerloch (University Chemical Laboratory, Cambridge, U.K.), visited the University on 17 April. In his address, "The Chemical Bond Probed by Ligand Field Analysis", Dr Gerloch discussed his work with the Angular Orbital Overlap Model that is used for describing bonding in metal complexes. He described how he developed this model to explain spectroscopic and magnetic properties of inorganic complexes. Recently Dr Gerloch wrote a book on this subject.

Professor S. Benkovic (Evan Pugh Professor of Chemistry, Pennsylvania State University), well known for his work on bioorganic mechanisms, visited the University on 23 May. In his address to the Department of Chemistry, Biochemistry and Biophysics, titled "Mechanisms of Enzyme-Catalysed Group Transfer Reactions", Professor Benkovic described a classic investigation of enzyme kinetics and then an example of the power of new techniques of site-specific mutation of protein structures. These techniques offer important new insights into protein structure and stability.

Dr John S. Ayers addressed a Chemistry, Biochemistry, Biophysics Colloquium (29 August) on the topic: "From Failure to Success — a Sixteen Year History of Cellulose Ion-Exchangers in New Zealand". Dr Ayers was recently promoted to the position of Reader.

VICTORIA UNIVERISTY OF WELLINGTON

Mr Alick Lal (Chemistry Department, University of the South Pacific, Fiji) has spent five weeks in the Department working with *Professor Ferrier. Professor James Scheirer* (Chemistry Department, Albright College, Reading, Pennsylvania, U.S.A.) has arrived to spend his sabbatical year working with *Dr Smedley.*

Recent visitors have included *Dr T. N. M. Waters* (Vice-Chancellor, Massey University) who gave a lecture entitled "Copper-Based Dioxygen Carriers. The Story of One Search for a Bioinorganic Model", and *Dr J. Tallon* (Physics and Engineering Laboratory, DSIR) who spoke on "The 3D Solid-Liquid Interface and its Relation to 2D Melting".

Dr Robin Speedy, Senior Lecturer in Phy¼sical Chemistry has recently spent four weeks in the U.S.A. attending a Gordon Conference and visiting several research centres.

Dr David Weatherburn has recently returned from sabbatical leave in Austin, Texas, while *Dr Gary Burns* and *Professor Robin Ferrier* have departed for the U.K. Dr Burns is spending a year in London at University College while Professor Ferrier is spending three months at Heriot-Watt University in Edinburgh. He is also attending the IUPAC synthesis meeting in Freiburg (F. R. Germany), and the Pan-Pacific Congress in Honolulu as an invited speaker, to present his recent results on the conversion of carbohydrates into functionalized molecules of medicinal interest.

Recent visitors to the Department have included *Professor Michael Hanack,* (Tubingen, F. R. Germany) and *Professor Peter J. Stang* (The University of Utah, U.S.A.) who provided complementary lectures on their research, namely 'Vinyl Cations' and 'Related Chemistry' respectively. Another visitor from the IUPAC Physical Organic Chemistry meeting was *Dr Lyn Williams* from Durham University.

CANTERBURY

Professor Bruce Penfold has been reappointed Head of the Chemistry Department for a term of three years.

Dr D. Smith from the University of Birmingham is visiting the Chemistry Department as an Erskine Fellow (September-October). His research involves gas-phase ion chemistry. He is accompanied by Dr N. Adams.

Drs Munro and Blunt have been awarded funds from the Golden Kiwi to continue supporting a Post-Doctoral Fellow.

Professor Hartshorn, Drs Coxon, Easton, Happer and Steel, and A. J. McKinley and J. White, attended the 7th IUPAC Conference on Physical Organic Chemistry, held in Auckland, August 20 - 24. Many conference delegates took the opportunity to visit Canterbury. These included Professors Hanack, Bunnett, Myhre, Stirling, and Stang and Drs Ingold, Morriss, Williams and Zoller.

CHRISTCHURCH POLYTECHNIC

Dr Roger Whiting (Auckland Technical Institute) visited the Department of Applied Sciences in September while completing his final section of tutor training at Christchurch Polytechnic.

OTAGO

Visitors to the Pharmacy Department have included *Mr Laurie Lichtenheim,* Technical Director of Glaxo Laboratories, N.Z., and *Mr John Ferguson,* Secretary and Registrar of the Pharmaceutical Society of New Zealand. *Wong Ooi* has now completed a Ph.D. with *Dr Rob McKeown,* and will proceed to postdoctoral research in pharmaceutical chemistry with *Prof. T. Higuchi* at the University of Kansas, U.S.A.

In the Textiles Department, *Dr Peter Barber* is assisting the Conservator of the National Museum in studies of the chemistry and physics of Phormium tenax (N.Z. flax) with the long-term aim of improving techniques for the preservation of Maori cultural artefacts. *Dr Ian Weatherall* will be attending a conference on "Computers in the World of Textiles", to be held in Hong Kong in September.

There have been several visitors to the Chemistry Department. *Ms Barbara du Benac,* Training and Development Manager for N.Z. Industrial Gases in Wellington, spoke about opportunities for graduates in her Company. *Dr Jarda Matousek* visited from the University of New South Wales and talked on "Selected Topics in Electrothermal Atomic Absorption". Then *Prof. M. P. Hartshorn,* from the University of Canterbury, gave a lecture entitled, "Ipso Substitution Reactions". *Professor Peter Stang* visited the University of Utah. He is an assistant editor of the Hournal of the American Chemical Society, and Secretary of the Organic Chemistry Division. Finally, *Prof. M. Hanack* from the University of Tubingen, West Germany, visited on his way to the IUPAC Conference on Physical Organic Chemistry to be held in Auckland. He was to deliver a plenary lecture at the IUPAC meeting, but spoke to the Department on "Synthesis and Properties of Conducting Bridged Macrocylic Metal Complexes".

Prof A. D. Campbell from the Chemistry Department will spend 10 days in the U.K. in September. He will attend meetings of the Bureau of the IUPAC to be held in Oxford, the visit Kratos Analytical Instruments and V. G. Analytical Ltd. in Manchester, both being manufacturers of mass spectrometers.

From the Nutrition Department, *Dr Joan McKenzie* attended the 5th Symposium on Trace Element Metabolism in Man and Animals, held in Aberdeen, Scotland. She then visited Imperial College, London, the Department of the Environment, then the Ministry of Agriculture, Fisheries and Food to discuss cadmium studies with workers there.

Graduates from the Biochemistry Department are spreading far and wide. *Dr Matt Templeton* has gone to the Plant Diseases Division of D.S.I.R. at Mt Albert, *Dr Solyendra Ram* has joined *Dr Tony Robertson* at the University of Auckland, and *Al Ivens* has moved to the Applied Biochemistry Division of the DSIR in Palmerston North. *Dr Geoff Krissansen* has been recruited to *Dr Michael Crumpton's* section at the Imperial Cancer Research Fund Laboratories in London. (Dr Crumpton was a U.K. Biochemical Society Visitor to the Department in 1983). After first working in universities overseas, *Dr Tim Stewart* and *Bob Kay* have moved recently to the commercial world of genetic engineering, and the Genetics Institute, Boston, respectively.

In spite of devaluation, two staff members from Biochemistry have left for study leave in the U.S.A. *Assoc. Prof. Merv. Smith* has gone to work with his former student, *Dr Barrie Carter,* at the National Institute for Arthritis, Diabetes and Digestive and Kidney Diseases, N.I.H., Bethesda, while *Dr David Russell* has gone to Purdue University to pursue his interests in the controlling enzyme of steroid biosynthesis relevant to many compounds in plants and animals.

(Continued on p. 137)

NOTICES

INSTITUTE TIE AND SCARF

The Institute has for sale attractive ties and scarves incorporating the new NZIC logo. They are manufactured by Parisian Ties Ltd in polyester fabric and are quality articles — excellent value at $10 each.

Ties are available in navy blue, dark brown, and maroon, with the logo in gold. The scarves are a light beige colour with a border of the NZIC logo in black.

A limited stock received by airmail is available now, with the remainder expected shortly by sea. Orders should be sent to the Registrar (Box 29-183, Christchurch) with your remittance, or enquire through your Branch Secretary.

RONALD HICKS MEMORIAL AWARD

The N.Z. Water Supply & Disposal Association has established a trust fund in memory of Ron Hicks to recognize his enthusiasm and hard work in establishing a sound basis for sewage and industrial waste treatment and water pollution studies in New Zealand.

Members of the NZIC are invited to contribute to this fund, which will be used to make regular awards for work either published or presented as a conference paper, in the area of sewage treatment or water pollution studies.

Donations should be sent to: "Ronald Hicks Memorial Trust", C/o NZWSDA, Box 4088, Hamilton East.

GAS CHROMATOGRAPHY COURSES WAIKATO TECHNICAL INSTITUTE

Further courses in this joint-venture of the NZ Chromatography Group and WTI are planned for later this year. Dates of the courses are: Basic GC Course 20-23 November 1984. Course fee: $100.00. Capillary Course 27-29 November 1984. Course fee: $150.00.

Attendance at the Capillary course is restricted to those who have already attended a Basic course or who are experienced in GC use.

So far over 100 scientists and technicians from Whangarei to Bluff have attended these courses and we have had a very favourable response. In fact, some places on this year's courses are already booked!

The courses are well supported by the trade who loan modern instrumentation for students to use, generally three students/instrument so the courses are very practically oriented.

Enquiries or bookings to: Dr P. Robinson, Waikato Technical Institute, Private Bag, Hamilton.

PRELIMINARY NOTICE — RETIREMENT OF PROF. J. N. SMITH

Professor J. N. Smith, the first Professor and head of the Biochemistry Department at Victoria University of Wellington retires early in 1985.

It is hoped to organize a gathering of former students during March 1985. This will include a scientific meeting, with opportunities for contributed papers, and will include a social function.

People interested please contact the Biochemistry Department, Victoria University of Wellington.

Further information, including the date and a preliminary programme will be published in the December issue of 'Chemistry in New Zealand'.

CONFERENCES

Further information about the following conferences may be obtained by contacting the editor.

Asian Chemical Conference, 1985. Singapore 8-11 April. Themes — Analytical Chemistry, Computers in Chemistry.

IAWPRC — Arctic Water Pollution Research. Yellowknife, Canada 28 April-1 May, 1985

IUPAC Symposium — Non Crystalline Order in Polymers, Napoli, Italy 27-30 May, 1985.

IUPAC 28th Microsymposium on Macromolecules — Polymer Composites. Praque, Czechoslovakia 8-11 July, 1985.

8th International Conference on Chemical Education. Tokyo, Japan 23-28 August, 1985.

CHEMECA 85. Perth 25-28 August, 1985. Theme — Innovation in the Process and Resource Industries.

10th International Mass Spectrometry Conference. Swansea, UK 9-13 September, 1985.

INDUSTRIAL PEOPLE

Efrem Tham has left ANATECH to join 3M (NZ) Ltd in Auckland, as Process Engineer.

D. M. Wilson has transferred from the Biochemistry Department of Greenlane Hospital to the Steroid Laboratory of the Post Graduate School O & G, National Womens Hospital, in Auckland.

Neil Debenham has left the position of R & D Chemist with Revertex to take up the position of Laboratory Technologist with UEB.

Mr Bruce Collier, from New Zealand Cement Holdings' Burnside Works, has recently been overseas for 3 months. Six weeks were spent attending a course on cement technology at the Technical Centre of Holderbank Management and Consulting Ltd. in Switzerland. Both before and after this course, he spent time visiting cement plants in the Philippines, Switzerland, Denmark and in Canada.

LETTER TO THE EDITOR

Dear Sir,

In a recent High Court hearing regarding a serious assault case in Auckland, a member of my laboratory was accused by defence counsel of fabricating scientific evidence, deliberately calculated to mislead and deceive the jury. Expert defence opinion was proffered condemning D.S.I.R. evience "because if the evidence put up is allowed to stand in this case, then the whole system of justice is threatened" (New Zealand Herald, 27 September 1984). Such accusations, understandably attracted considerable coverage in the New Zealand Press.

It is my intent to publish the work of the two D.S.I.R. scientists involved, both of whom are members of this Institute, in this journal.

P.E. Nelson.
Government Analyst.

OTAGO UNIVERSITY

Continued from Page 135.

Graduates from the Biochemistry Department are spreading far and wide. *Dr Matt Templeton* has gone to the Plant Diseases Division of D.S.I.R. at Mt Albert. *Dr Solyendra Ram* has joined *Dr Tony Robertson* at the University of Auckland, and *Al Ivens* has moved to the Applied Biochemistry Division of the DSIR in Palmerston North. *Dr Geoff Krissansen* has been recruited to *Dr Michael Crumpton's* section at the Imperial Cancer Research Full Laboratories in London. (Dr Crumpton was a U.K. Biochemical Society Visitor to the Department in 1983.) After first working in unviersities overseas, *Drs Tim Stewart* and *Bob Kay* have moved recently to the commercial world of genetic engineering, joining Genentech, San Francisco, and the Genetics Institute, Boston, respectively.

In spite of devaluation, two staff members from Biochemistry have left for study leave in the U.S.A. *Assoc. Prof. Merv. Smith* has gone to work with his former student, *Dr Barrie Carter,* at the National Institute for Arthritis, Diabetes and Digestive and Kidney Diseases, N.I.H., Bethesda, while *Dr David Russell* has gone to Purdue University to pursue his interests in the controlling enzyme of steroid biosynthesis relevant to many compounds in plants and animals.

INDUCTIVELY COUPLED PLASMA IN AN INDUSTRIAL LABORATORY

I. Johnson
Environmental Chemist, N.Z. Steel.

Due to the competitive situation existing in today's markets, industry has to compete by producing high quality goods at the right price. The steel industry is no exception, having to compete in both export and domestic markets with low cost products from other countries. The industry in meeting rigid specifications therefore has to rely on the chemist to measure many different elements (some important, some less so) at widely different concentrations in a wide variety of samples. The process control of blast furnaces and steel converters is usually based on information from rapid analytical systems, X Ray fluorescence (XRF) and Optical Emission Spectroscopy (OES) with spark excitation being most frequently used.

Wet chemistry methods cannot usually complete with XRF and spark OES in the process control because of the short turnaround time required. However instruments requiring sample dissolution have found widespread use for product control as well as application to a variety of non metallic materials including ores, slags, sludges, dusts and environmental samples. Flame AAS has been successfully used for these purposes in the steel industry since 1963. With the advent of plasma sources, both direct current plasma (DCP) and inductively coupled plasma (ICP), atomic emission spectrometers have been used for this type of analysis. In the last decade it has become increasingly obvious that while ICP substantially enhances the capabilities of the spectroscopist it is complimentary and does not replace methods such as AAS and XRF.

N.Z. Steel Laboratory Analyst Jeremy Batchelor at the controls of the ARL 3520 ICP.

ICP or AAS?

Simultaneous ICP has the distinct advantage of being able to analyse up to 60 elements at one time and therefore is applicable to high throughput, routine analytical tasks. Where the requirements are maximum flexibility due to non routine analysis on smaller numbers of samples commercial sequential systems are available. These have only slight increase in sample throughput when compared to the modern fully automatic computer controlled units AAS for sequential analysis. AAS is limited still by the number of hollow cathode lamp holders available on the turret.

In contrast to AAS which has a linear range of only about 10^3, ICP has a dynamic range of 10^5. This is due to the source being optically thin and there is therefore little chance for unexcited atoms to absorb light from excited atoms. the range is particularly important as it allows both high concentration elements and trace elements to be determined in the same sample solution.

Within the literature detection limits are often quoted but from experience the statement by Greenfield that 'The present league table of detection limits must be extremely valuable to those people, who spend their lives analysing distilled water' appears valid. Usually we have found ICP detection limits to be an order of magnitude better than flame AAS however there are some exceptions eg K, Ru, Pb and Ag. Within our industry an important point in favour is the ability of ICP to analyse both refractory elements and the rare earth elements (R.E.E.). This combined with the wavelength range of the ICP system which extends to include spectral lines in the vacuum ultraviolet region to 165nm allows analysis of a much greater number of elements. The ability to analyse for B and P as well as elements like Ce and La in combination with other elements after a single sample digestion saves manpower, analysis time and consumable use.

There are, however, problems with ICP in analysing a wide range of samples. In ICP spectral interferences of four types occur; direct overlap, wing overlap, recombination continuum, and stray light. Direct overlap results from the rich spectra produced by the plasma and is especially noticeable when the matrices contain Fe and REE's. Wing overlap results from line broadening due to the high temperatures obtained in the plasma and the excitation mechanism. Recombination continuum occurs when a free electron combines with an ion to yield a neutral atom which results in the emission of a continuum. Stray light results from intense spectral lines and can be minimised by good instrument design and manufacture. These spectral interferences can be minimi.ed by the selection of an instrument with a diffraction grating of adequate resolution and the careful choice of analytical lines and operating conditions depending on the sample matrix. Matrix concomitent signals can be corrected by use of either on-peak or off-peak background correction.

Transport interferences are another major problem as changes arise from uptake rate due to the viscosity and other physical properties of the sample and standard solutions. These can be minimized by matching physical properties of samples and standard, mathematical corrections, the use of an internal standard and by feeding the nebulizer with a peristaltic pump. Unlike flame AAS, solute volatalization, vapour phase interferences and compound formation in the flame are not major interferences in ICP.

With the MIRAN 980 Infrared Spectrometer virtually nothing is beyond measure.

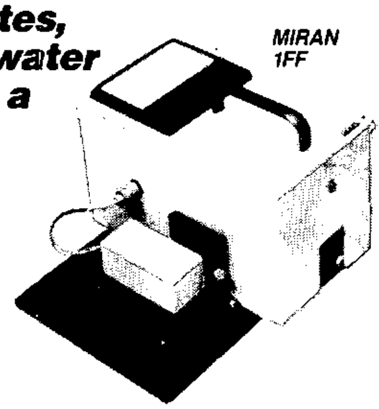
FOXBORO

Edible oils, paints, pastes, polymers, even 100% water can be measured with a precision of one part per thousand.

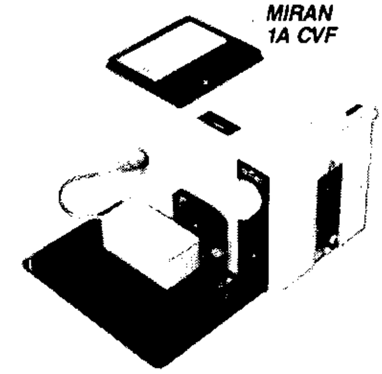
No other quantitative analyzer is as versatile, accurate, and easy-to-use as the MIRAN 980. Designed to accept sample cells from transmission-type to our patented 20 metre variable long path gas cell, multi-component analysis can be performed on a wide variety of gases, liquids, and solids. And it's done with the unmatched precision of one part per thousand and accuracy of 1% relative over the entire measurement range.

We've also made it user-friendly. An operator-interactive keyboard prompts the user (in English) through the analysis set up routine. The MIRAN 980 micro-processor makes analysis as easy as pushing a single button. And it's fast. For example, to analyze and print out concentrations of a 10 component material takes only 70 seconds, and it's done without the need for sample preparation.

MIRAN 1FF



MIRAN 1A CVF



Our line of MIRAN spectrometers includes two single component laboratory analyzers which can be used at plant QC labs to assure the standards established with the MIRAN 980 are continually met.

So whether you're measuring the surfactants in detergents or the solids in adhesives, the MIRAN spectrometers will do it with unmatched accuracy and precision, time after time.

MIRAN 1 FF Fixed Filter Laboratory Analyzer — with factory-installed single wavelength filter for repetitively monitoring one component at a single wavelength.

MIRAN 1 A CVF General Purpose Laboratory Analyzer — with circular variable filter for repetitively monitoring various components at more than one wavelength.

W. Arthur Fisher Limited

Auckland: P.O. Box 12 747 Penrose Ph. (09) 592-629 **New Plymouth:** P.O. Box 514 Ph. (067) 88-128
Wellington: P.O. Box 30 951 Lower Hutt Ph. (04) 694-702 **Christchurch:** P.O. Box 4158 Ph. (03) 67-692

NORRIE 1936

For further information circle 11 on Reader Reply Card

Applications in the Steel Industry

Raw, Intermediate and Auxiliary Products — where these products are in the solid form routine analysis is usually carried out by OES or XRF. These techniques, however, are highly dependent on matrix composition and certified standards are often difficult to find. Where matrix problems occur or small runs are involved ICP is a satisfactory alternative. Synthetic standards can be prepared readily and by matrix matching analysis of a wide range of materials such as Ferroalloys, coals, lime and zinc may be analysed.

Liquid products used in the industrial process are regularly checked by ICP. The analysis of inlet, outlet and recycled water is possible around the clock. ICP has also been applied to the analysis of oils after dilution 1:10(v:v) with xylene for wear metals and it has been found that oils of different viscosities and natures can be analysed using the same calibration. ICP is also used for the analysis of galvanic baths for quality checks on a routine basis.

Quality control of the End Product: The application of ICP to the analysis of the end product in the iron and steel industry is already well established. ICP has two functions, the first being as a check on other techniques such as OES in a regular quality control programme and the second being the analysis of trace element concentrations. A regular quality control programme requires a certain percentage of results produced by OES/XRF to be analysed using wet techniques. Any variations in the OES or XRF can therefore be monitored by a backup method. The main advantage, however, lies in the detection limits of ICP which even after sample dissolution are in the vicinity of μg/g. Elements such as arsenic, boron and tin have become increasingly important in high quality steel characterization.

Trouble Shooting: As with every industrial laboratory there are often samples brought in about which little is known. This is particularly so in our laboratory eg small samples related to rust complaints are brought in. The ability of ICP to do a qualitative scan over 30 relevant elements is quite important. The scan takes 200 seconds and involves an uptake of less than 8ml. Matrix adjusted standards can then be produced allowing a quantitative analysis to be carried out.

Environmental and Occupational Health Analyses: The primary purpose in the purchase of the ICP was to allow multielemental characterization of waters and solid wastes released within the industrial plant and allow optimization prior to release into the environment. It is very clear that ICP is a powerful look for Multielemental analysis in environmental and biological samples. ICP has successfully been applied to the analysis of industrial waste waters. Either a suitable sample decomposition is used or the elements to be determined are complexed (eg with APDC) and the complexes extracted with organic solvents. For elements such as As, Se, Cd and Pb and ICP detection limits are too high to allow their direct determination and ICP — hydride techniques or extraction methods are required.

Monitoring elemental emission in fumes and air quality control can be done by ICP analysis of collected dust samples following dissolution. This is particularly important in the occupational health field. Samples can be collected in respirable size ranges on filters, digested and analysed at extremely low concentrations.

Conclusion

The use of ICP in the industrial laboratory provides a very powerful technique for the analyst. It must, however, be emphasised that ICP does not compete with either XRF or AAS but forms a complimentary technique. The versatility offered by sequential ICP can prove a greater benefit than the sample throughput offered by simultaneous ICP especially in NZ commercial laboratories where a wide range of analyses is carried out. If a choice between AAS and ICP is to be made thoughtful consideration of laboratory requirement, instrument capabilities and instrument cost must be made.

ICP — THE INSTRUMENTS

Compiled by A.C. Herd, Auckland Technical Institute

To complement the articles on ICP emission spectroscopy in this issue, Chemistry in New Zealand has surveyed the instrumentation available in New Zealand. Most of this information has been taken from manufacturer's brochures and the reader reply card should be used for more detailed information. It was originally intended to quote approximate prices, but because many of the instruments permit a range of configurations not all agencies were prepared to quote even "ball-park" figures. Those figures that are given must be taken as approximate only.

ALLIED, JARREL-ASH

Agents Sci-Med (N.Z.) Ltd, for further information circle **12** on the reader reply card.

Atomscan 2400

Prices for this sequential ICP range from a base price of $86,000 to a fully configured price of $125,000 (Fig. 1).

Figure 1. The Jarrel-Ash Atomscan 2400

While incorporating all the features of its predecessor, this latest ICP has added a high resolution monochromator plus an enhanced data acquisition system for accommodating the most difficult sample matrices.

The *AtomScan 2400* uses a magnetically driven torsion bar and transducer feedback device to drive the diffraction grating at a rate of 1000nm/sec.

This approach to grating movement provides very fast and precise wavelength positioning with a step size of only 0.0005nm. Wavelength repeatability of 0.004nm standard deviation is typical.

Other standard facilities allow you to create, store and edit multielement analytical programs, as well as run autosampling devices, perform diagnostics and write final reports.

ICAP 9000 and 1100

Configurations for these simultaneous ICP systems range from $130,000 - $230,000 and $160,000 - $290,000 respectively.

These spectrometers are able to analyse samples containing up to 61 preselected elements at the rate of one sample per minute.

A "Spectrum Shifter" permits each defector to view in 63 steps, the region ±0.10nm on either side of the line centre. This assists in making appropriate background and interelement corrections (Fig. 2). Sequential capability can be added as can an autosampler or delivery systems to handle high solid or corrosive samples.

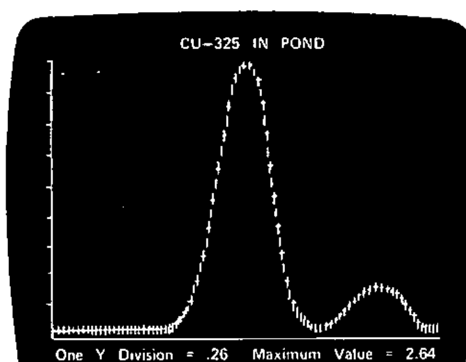


Figure 2. The Spectrum Shifter scans across analytical wavelengths for use in methods development.

ARL, BAUSCH & LOMB

Applied Research Laboratories has a representative engineer in New Zealand. Circle **13** on the reader reply card.

ARL 3510

This is a sequential instrument, featuring a one-meter high resolution Czerny-Turner mount. It is an improved version of the ARL 3500 of which more than 200 were sold worldwide.

3500 AES Series

This series allows the choice of six excitation sources, ICP, spark, DC arc, glow discharge lamp, hollow cathode lamp or rotrode stand and spark source. The 3520 is a sequential spectrometer which can position on any emission line in less than 1.5 seconds. The 3560 incorporates a simultaneous polychromator which can handle up to 60 elements. The 3580 combines the high throughput of the 3560 with the flexibility of the 3520 in a simultaneous/sequential instrument. (See also the Front Cover Story).

BAIRD

Agents, Wilton Instruments (Division of Smith Biolab Ltd). Circle 14 on the reader reply card for further information.

Plasma Spectromet

Base price around $200,000. Claimed to be the first instrument designed specifically for ICP, the Spectromet features a polychromator capable of analysing up to 60 elements simultaneously. Flexibility is provided by possible computer controlled stepping motor drive of the entrance slit over 2mm. This can provide information on difficult matrices, background levels and spectral overlap. Non routine elements are accommodated by an operator controlled monochromator. To exploit the full analytical capabilities, the instrument has been coupled to a Plasmacomp II Graphics Computer System.

Plasma/AFS

Price around $80,000. This unique instrumental development utilises the ICP as an atomization cell for the observation of atomic fluorescence. (Fig. 3).

This design exploits the advantages of the ICP as an excitation source while the AFS observation technique eliminates the problems of spectral interferences. The Baird instrument can be configured for the simultaneous determination of up to 12 elements.

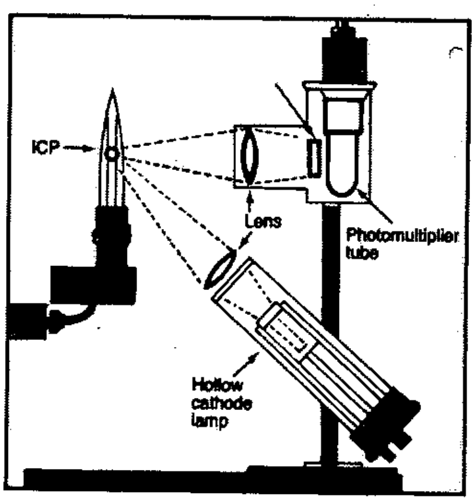


Figure 3. Each element module of the AFS instrument contains a hollow cathode lamp, a pm tube, an optical filter and lenses.

JOBIN YVON

Agents, Alphatech Systems Ltd, circle 15 on the reader reply card for further information.

JY-38

A sequential spectroanalyser offering resolution better than 0.01nm. Able to analyse 5 to 20 elements per minute. Computing facilities can be either PDP11 or a microcomputer (Fig. 4).

JY 32

The simultaneous system in the range. Simultaneous spectrometry is also provided by the JY-48, which can be used as an ICP system alone or in combination with a spark source.

JY-70 and JY-86

These are combination simultaneous/sequential systems, allowing the simultaneous running of routine samples and the ability to analyse non-routine elements in the sequential system.

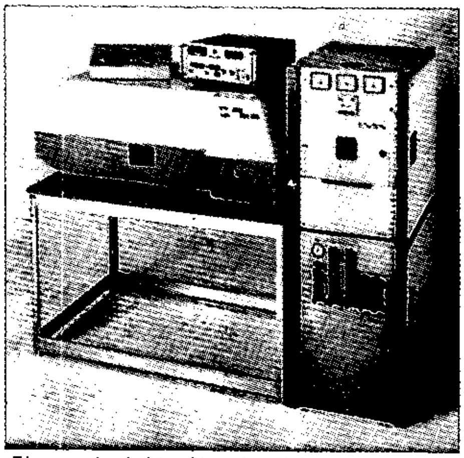


Figure 4. Jobin Yvon's JY38P sequential spectroanalyser. Also exists in a spark version.

LABTAM

Agents, Advanced Electronics Ltd, circle 16 on the reader reply card.

Labtam International Pty Ltd (formerly Labtest Equipment S.E. Asia Pty Ltd) is a Melbourne based company and several of their systems are in operation in NZ.

Plasmascan 8410

This is a sequential scanning ICP-AES which utilizes a high resolution (0.004nm) rapid scanning vacuum monochromator with a wavelength range 170-820nm, dispersion of .37nm/mm over 170-310nm.

Grating is directly driven by computer providing a minimum step size of 0.00025nm.

Plasmascan 8420

This version of the Plasmascan incorporates two scanning monochromators back to back.

Plasmalab 8430

A simultaneous ICP-AES which can analyse for up to 64 elements in each sample. It incorporates a 1 meter vacuum polychromator covering the range 170-820nm. First order dispersion is .66nm/mm, 2nd order .33nm/mm.

Plasmalab 8440

Is a combined simultaneous/sequential ICP-AES using a vacuum polychromator for up to 64 elements in conjunction with a scanning monochromator which can be tuned to any wavelength/s of interest. Monochromator position is computer controlled as for the Plasmascan.

Hardware accessories include an automatic sampler, hydride generator and microsampler injector. Both Plasmalab systems can also be equipped with a dual stand for mounting ICP and Arc/Spark sources. Changeover takes approximately 1 minute.

The Labtam computer has 256K RAM (expandable to 4Mbyte), 1.6Mbyte disk storage (expandable to 56Mbyte plus), high resolution graphics and CP/M-86 operating system (expandable to multi user, including Unix).

PERKIN-ELMER

Agents, John Morris Scientific Ltd, circle 17 on the reader reply card.

ICP/6500

This sequential system is capable of analysing more than 20 elements per minute. It permits analyses in the 170-190nm range without additional components and is linked with a professional EVERYWARE computer with 16-bit Motorola MX8000 microprocessor for instrument control. (Fig. 5)

PHILIPS

Agents, Philips Electrical Industries of NZ Ltd, circle 18 on the reader reply card.

At the time of going to press, Philips were just about to announce details of a new ICP system. Details will appear in future issues of Chemistry in New Zealand.

SCIEX

Agents, Northrop Instruments & Systems Ltd, circle 19 on the reader reply card.

Sciex Elan ICP/MS

Systems available from approximately $450,000.

The ions produced in an ICP argon torch are sampled through a differentially pumped interface into a mass spectrometer. These ions are separated electronically by a quadropole mass filter and finally registered through a high sensitivity pulse counting system. The system features full multi-elemental analytical capability with detection limits for most elements from 0.1 to 10ppb. Rapid elemental analysis is obtainable with an average of 30 elements per minute. Isotope ratios can also be determined for tracer studies and isotope dilution work. Isotopic abundance measurements can be carried out every five minutes at the 0.5% precision level. The technique gives inherently simple spectra in contrast to ICP/atomic emission spectra.

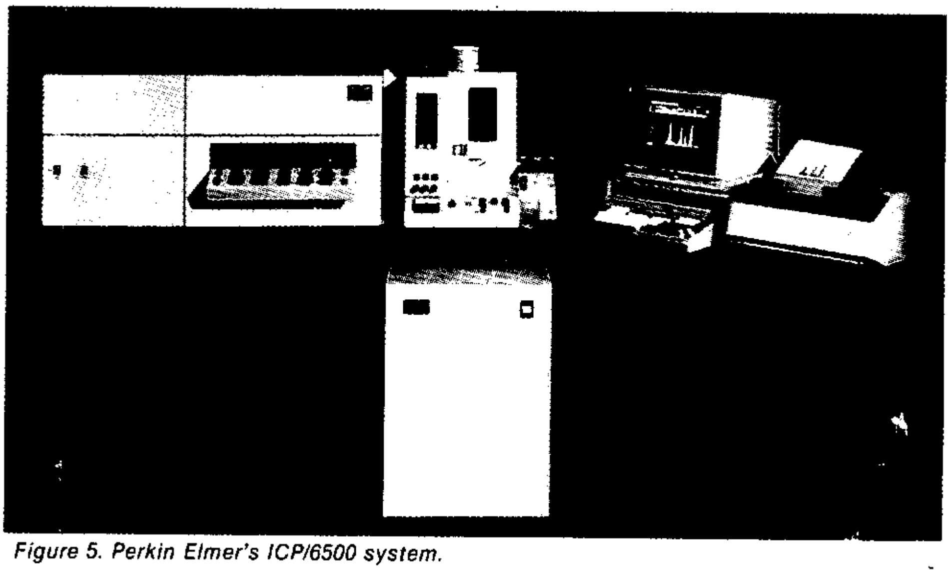


Figure 5. Perkin Elmer's ICP/6500 system.

For further information circle 43 on Reader Reply Card

PRODUCT NEWS

CONTROLLED RATE TEMPERATURE TO −120°C

The Bio-Cool Mechanically Controlled Rate Freezers provides a reliable and convenient means of obtaining precisely controlled cooling and heating rates for a variety of applications. The Bio-Cools are available in three temperature ranges to −45°C, −75°C and −120°C with cooling rates between 0.1°C/minute and 2.2°C/minute and with control accuracy of ±0.1°C. Up to sixteen segments of temperature control are available. These units are ideal for us in low temperature biology applications.

For more information please request FTS SYSTEMS INC Bulletin Bio-Cool, Controlled Rate Freezers from the New Zealand agents: NZ agents Kempthorne Medical Supplies Ltd, circle **25** on the reader reply card.

LABORATORY FUME CABINETS

Insapipe Industries Limited manufacture the High Tech range of fume cabinets which have been designed to give maximum flexibility to suit specific laboratory requirements. The standard model can be adapted to suit safety and perchloric conditions and is complete with a comprehensive range of associated laboratory equipment.

All construction welds are electrically spark tested to ensure total weld integrity.

A complete installation service is available if required.

Complementary to the fume cabinets is a range of laboratory bench tops and sinks in chemically resistant polypropylene or PVC.

For further information circle **22** on the reader reply card.

CATALOGUES AND BROCHURES

Copies of the 1984-5 Aldrich chemical catalogue is available on request from Labsupply Pierce (NZ) Ltd or by circling **40** on the reader reply card.

An illustrated brochure from Beckman Instruments, Inc., describes the company's Futura II pH electrodes and tells how to choose the right electrode for specific applications and measuring conditions. The brochure also describes buffers, cables, adaptors and other accessories.

A table provides electrode recommendations by sample requirements. Also included in the brochure are specifications, part numbers and ordering information. Circle **41** on the reader reply card.

Alltech Associates announce the availability of two Chromatography Catalogues P from Machery Nagel, of West Germany, and Gasukuro Kogyo, of Japan. With the addition of these sources, Alltech is able to complement their main Catalogue, which has been distributed to New Zealand scientists, to give the widest possible range of Chromatography supplies, including some items not listed in the Alltech Applied Science Catalogue No. 60. Circle **27** on the reader reply card.

PROTEIN A REAGENTS

Protein A, FITC-Protein A, Protein A-Sepharose® CL-4B and Protein A-Sepharose® 6MB (Macrobeads) from Pharmacia Fine Chemicals are known and used world-

wide for their very high purity, extreme stability and batch to batch consistency.

Whether you are working in IgG purification, hybridoma screening, antibody quantification, mitogenic stimulation, rosetting, plaque assays, antigen quantitation and localisation, cell surface studies or cell separations, choose Protein A reagents from Pharmacia. Reference lists of more than 400 application titles involving free-labelled and immobilized Protein A in the various fields of biochemistry, immunology, haematology, clinical chemistry and cell research are available on request.

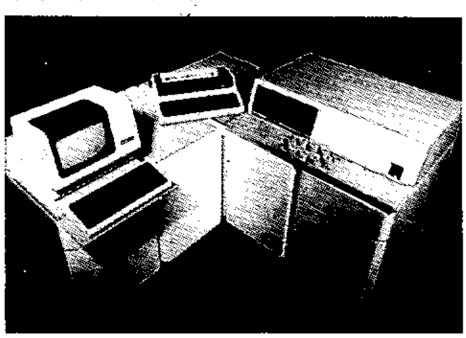
NZ agents Watson Victor Ltd, or circle **28** on the reader reply card.

XRF SPECTROMETER

Applied Research Laboratories introduced a new series of X-Ray Fluorescence Spectrometer, the 8400 Series.

The 8400 merges the versatility of a scanning sequential spectrometer with the speed of a multichannel, simultaneous XRF analyser in a single compact instrument.

Ideally suited in both process control laboratories and research, this instrument can be applied to many different materials including metals, minerals, chemicals, agricultural products, ceramics, petrochemicals and more.



The ARL 8400 family incorporates a breakthrough in design with the gearless goniometer drive. This feature results in faster goniometer movement and more accurate mechanical positioning, while eliminating the mechanical limitations normally associated with geared goniometer designs.

The ARL 8400 family can be configured either as sequential with up to three goniometers, simultaneously with up to fourteen monochromators or as a combination of both. All goniometers and monochromators are mounted in a single vacuum tank for improved instrument reliability.

For further information circle **29** on the reader reply card.

SHIMADZU AAS

The Shimadzu AA670 Atomic Absorption Spectrophotometer designed to provide total automation in AA, now complements the range of atomic absorption spectrophotometers available from Sci-Med (NZ) Ltd. This range includes both single and double beam as well as dual channel instruments.

The AA670 is comprised of three units, the spectrophotometer, the graphic printer/plotter and control unit and the automatic gas control unit.

The powerful microprocessor in the AA670 provides a Cook-Book of optimum sets of operational parameters for 61 elements. Operational parameters for up to 10 specific analyses including the concentration of the standard sample can be stored in file. This enables the AA670 to be set up automatically by a single entry via the keyboard. The 8 lamp turret makes this an ideal instrument for laboratories performing large numbers of multi-element analyses.

All the data, such as operational parameters, working curves and processed data are automatically printed out. This feature eliminates the cumbersome job of making working curves and tabulation operational parameters.

The automatic determination of the working curve can be determined with up to 6 points, abnormal values can be excluded to ensure high reliability.

The AA670 can automatically delete any abnormal values in repeated analysis and calculate and print out the average, coefficient of variation of normal values.

The automatic gas control system provides complete safety coupled with ease of operation. The AA670 provides these features and many more.

For further information please contact Sci-Med (NZ) Ltd or circle **30** on the reader reply card.

RHEODYNE INC

Sci-Med (NZ) Ltd have been appointed NZ agents for Rhedyne products.

Rheodyne supply a complete range of valves for liquid chromatography; from the universally accepted model 7125 sample injection valve to a wide range of high pressure switching valves for tandem column selection, tandem, enrichment injection etc.

In addition Rheodyne supply a wide selection of lower pressure teflon valves to facilitate such tasks as; solvent changeover, system flushing, fraction collection, RI detection, reference cell flushing, solvent recycling etc.

Valves may be supplied with actuators if desired to allow the user to build up a completely automated system to any desired configuration.

Sci-Med has a supply of Technical Notes from Rheodyne describing: high and low pressure valve switching applications
— sample clean-up and enrichment techniques
— a note on improving accuracy and precision with sample injectors, and others
— Also available for new and existing users of Rheodyne valves are replacement parts lists and exploded diagrams for the Rheodyne model 7125 Syringe loading injector.

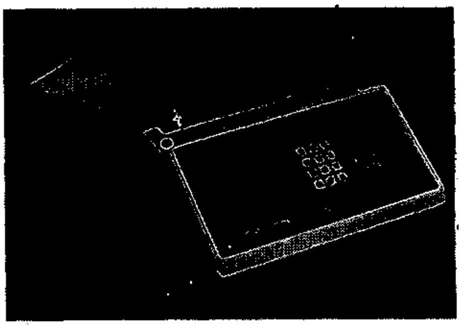
PRODUCT NEWS

— The above literature is freely available from Sci-Med (NZ) Ltd.

For further information circle **31** on the reader reply card.

HIGH-ENERGY FLOW DETECTOR DETECTS RADIOACTIVITY IN LABELLED MOLECULES

Beckman Instruments Inc's Model 170 Radioisotope Detector analyzes high-energy beta particles such as 32_P and gamma-emitting isotopes such as 135_I.



This compact detector can be used with HPLC systems or low pressure chromatography systems. Separations are done on HPLC columns, effluents are passed through the detector and radioactive peaks are analyzed. The system is easy to program and convenient to use. The sophisticated software automatically finds the peaks, prints out integrated CPM data for each peak and controls a fraction collector for automatic pooling of peaks. The Model 170 works without cocktails or other chemicals.

NZ agents Alphatech Systems Ltd, circle **32** on the reader reply card.

ICP STANDARD

'E Merck produce an ICP multi-element standard solution. The standard contains 19 elements at different concentrations, with the spectral sensitivity at the wave lengths used having been taken into consideration.'

Product Number 15474 is available from Labsupply Pierce (NZ) Limited.

For further information, circle **33** on the reader reply card.

GEL PERMEATION CHROMATOGRAPHY PACKAGE

Northrop Instruments & Systems Limited announce a new complete package for gel permeation chromatography. The system combines chromatographic performance, UV/Vis and/or RI detection with high sensitivity and advanced GPC results, calculation and report presentation.

The complete system is designed for size-exclusion chromatography with polymers (such as acrylics and epoxies, plastics and proteins).

Working with the Hewlett Packard 1090 liquid chromatograph, this system provides high flow stability, even at low flow rates, essential for accurate GPC results. Hewlett Packard GPC columns are available in a wide variety of packings, covering the use of aqueous and organic solvents and exhibiting exception stability, efficiency and reproducibility.

Narrow and broad standard calibrations may be defined. The narrow-standard calibration uses the retention times and molecular weights of up to 18 standards to calculate the curve: piecewise, first, second and third order.

The broad-standard calibration transforms the polystyrene calibration into the sample calibration curve. This is achieved by using the known Mw and Mv of a single standard sample having a wide molecular-weight distribution.

Various Hewlett Packard printers and plotters are available for results documentation. With the Hewlett Packard 1090 GPC software, it is possible to produce summarised reports of several runs.

Contact Northrop Systems and Instruments Ltd or circle **34** on the reader reply card for further information.

ELDEX PUMPS

Alltech associates N.Z. announces the availability of the Eldex range of HPLC Pumps, with pressure capabilities of up to 5,000 psi and flow rates from 0.05 to 100 ml/min. There is hardly a solvent delivery requirement that cannot be met by an Eldex pump.

Eldex pumps use brushless non-arcing motors, and most are synchronous motor driven, which do not vary in speed with line voltage fluctuation.

The materials in the liquid end of Eldex pumps are carefully chosen for corrosion resistance, the piston being sapphire, and the inlet and outlet valves incorporating sapphire seats and ruby balls.

PRODUCT NEWS

The standard piston seal is an ultra-high molecular weight polyethylene with excellent chemical compatibility characteristics. The stainless steel spring inside both seals *is gold-plated* for additional corrosion resistance.

The liquid end housing is made of type 316 stainless steel because of its superior resistance to corrosion.

Users all over the world are using Eldex pumps, which are well known for their high performance over long periods of use.

For further details circle **35** on the reader reply card.

ULTRA TECHSPHERE HPLC COLUMNS

Sci-Med announces the availability of a new high efficiency series of HPLC columns from HPLC Technology.

The Ultra-Techsphere 5 micron columns are guaranteed to give in excess of 75,000 plates/metre — claimed to be the highest ever offered by a commercial HPLC column manufacturer.

The manufacturer uses a spherical silica base material that has been more closely controlled, in terms of particle size with a high degree of Carbon loading (ie: 13 %ODS), a surface area of 200 m²/gram; and finally a 3 phase capping procedure. This end capping minimises accessible silanols and at the same time produces a column material with a much longer life and durability. This combined with their long experience and highly advanced packing techniques, produces ultra-high efficiency columns such as Ultra-Techsphere.

Available phases include: Silica, C8, ODS, NH_2, CN, Ion-pair. Available with analytical or semi-prep dimensions.

For further information contact NZ agents Sci-Med (NZ) Ltd or circle **36** on the reader reply card.

BENCHTOP CENTRIFUGE

The Centaur 2 from MSE incorporates a host of safety features that have been developed to meet the highest safety standards; including a 5mm thick guard ring, a four-point burst-proof lid fixing, a lid interlock which prevents access to the moving rotor, bolt down security and an out of balance detector.

Centaur 2 is extremely versatile. With a wide accessory range including 2 angle and 3 swing out rotors, Centaur 2 can also accommodate most existing Minor and Minor 'S' rotors.

Centaur 2's stop/start switch means that there is no need to reset the speed between runs, the 0 to 30 minute timer enables runs to be accurately reproduced.

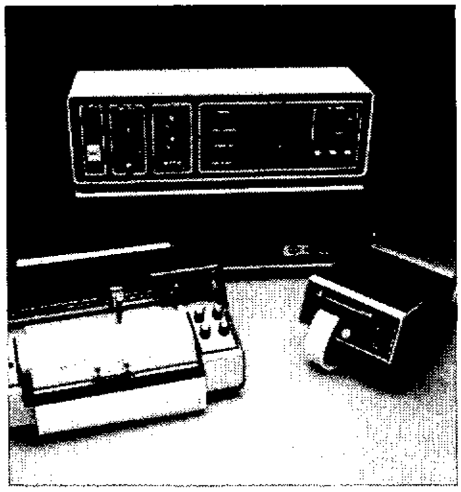
The new digital speed indicator allows the operator to determine the setting far more quickly and accurately than on conventional analogue instruments.

A wide removable bowl facilitates both easy access and cleaning.

NZ agents Kempthorne Medical Supplies Ltd, circle **37** on the reader reply card.

RADIOACTIVITY DETECTOR FOR HPLC

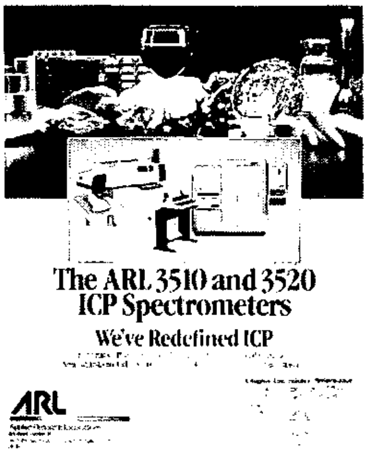
The NE ISOFLO from Nuclear Enterprises is a high efficiency, low background radioactivity flow meter. It is designed specifically for the dynamic measurement of alpha, beta, and gamma emitting, labelled elutates from a liquid chromatography column or liquid or gaseous effluent line.



The ISOFLO is available as a system with an APPLE II personal computer and data handling package. Results are presented in graphic and alphanumeric form convenient for inclusion in reports and published papers.

When the ISOFLO is used in conjunction with the APPLE II the system can operate automatically in conjunction with an auto sampler and/or fraction collector. Sole NZ agents, Sci-Med (NZ) Ltd, circle **38** on the reader reply card for further details.

FRONT COVER STORY



INTRODUCTION

Applied Research Laboratories (ARL) has for the past 50 years been a leading manufacturer of analytical spectrometers. The beginnings of ARL was in 1934 when Dr Maurice Hasler developed the first commercial grating spectrograph for use in research and quality control.

ARL in now a multinational supplier of spectrochemical instrumentation in the fields of Inductively Coupled Plasma, Optical Emission and X-Ray Fluorescence.

ARL is represented in New Zealand by its' Auckland based field service engineer.

INSTRUMENTATION

The Applied Research Laboratories 35000 Series Inductively Coupled Plasma Spectrometers. A high speed, automated, elemental analysis system offering superior detection limits, high linear dynamic range, fast analysis time and virtual freedom from interelement effects.

The ARL 3510 ICP is an integral, low priced, high performance, sequential monochromator in a classic one metre, high resolution Czerhy-Turner mount, covering the wavelength emission range from 165-800nm.

Incorporating a solid state RF generator and single board microprocessor controller, the ARL 3510 ICP uses a self guiding operator interactive software on a colour graphics system.

To compliment the ARL 3510 ICP, a full array of ICP's are offered.

The heart of the ARL 3520 ICP is a newly designed sequential monochromator in a one metre Paschen-Runge mount. This direct reading spectrometer can position on any emission line in less than 1.5 seconds with a positioning error less than one fifth of the natural passband of atomic emission lines.

This gives the ARL 3520 performance only previously obtainable from the simultaneous polychromator.

The ARL 3560 ICP is the simultaneous polychromator, also using the one metre Paschen-Runge mount. This instrument gives high sample throughput of up to 60 elements, enabling multielement analysis in as little as 17 seconds.

The ARL 3580 ICP is the ultimate in simultaneous/sequential instrumentation offering the high throughput of the ARL 3560 and the flexibility of the ARL 3520.

The ARL 35000 ICP series has a variety of computer hardware and software packages available to allow tailoring of the automation system to meet the users specific data processing needs.

For further information circle **39** on the reader reply card.

GENERAL NEWS

EIGHTH AUSTRALIAN ANALYTICAL CHEMISTRY DIVISION CONFERENCE

The Eighth Australian Symposium on Analytical Chemistry will be held at the Southern Cross Hotel, Melbourne, from 15-19 April 1985. The theme of the conference will be 'Choosing the Right Method — the practical chemist's dilemma'. This theme will strike a chord with all practical chemists who well know the difficulties these days in selecting, from an array of potential methods, the one that is best for their particular situation.

Plenary speakers are:

Prof. Larry Sternson, University Kansas, USA — Pharmaceuticals

Dr Olle Lindsjo, Outukumpu Oy, Pori, Finland — Mining and Metallurgy

Prof. John P. Riley, Liverpool University, UK — Environment

Dr J. Lawrence, Health & Welfare Dept. Ottawa, Canada — Ecotoxicology/Occupational Health

There are also a number of Australian and overseas speakers presenting review papers on a number of related topics.

Contributed papers are invited on any aspect of analytical chemistry. Abstracts must be received by no later than 1 December 1984.

Ten workshop sessions will be included in the conference programme.

Requests for the Registration Circular and Abstract form should be sent to 8AC, ACTS, GPO Box 1929, Canberra, ACT, 2601, Australia.

PHILIPS OPENS PROFESSIONAL SERVICE CENTRE

Philips opened a new Professional Service Centre in Auckland at the end of August. The new complex is designed to cope with advances in the professional electronic market and to provide customer back-up services. Divisions of Philips that are involved include Electro-acoustics, Data Systems, Medical Systems, Scientific and Industrial, and Telecommunications.

NEW PREMISES FOR DU PONT

The head office of Du Pont (New Zealand) Ltd has moved from its central city office to new premises at Manukau City in South Auckland.

The attractive office complex on Ronwood Avenue has an adjoining warehouse for products imported by the company from worldwide Du Pont sources.

The New Zealand subsidiary of the USA-based E.I. Du Pont de Nemours & Co Inc was established in Auckland in November 1979, its head office in the National Mutual Centre, Shortland Street, and with warehousing facilities at several different locations.

The company supplies a range of agricultural chemicals, industrial chemicals and pigments, explosives products, polymer resins for engineering plastics, adhesive manufacture and packaging applications, pharmaceutical products and a range of textile fibres used by the apparel, soft furnishing and carpet industries as well as high technology industrial products.

The new telephone number is 277-8080; telex NZ21880; postal address PO Box 76-256, Manukau City.

DIRECTORY OF METALLURGICAL SERVICES AND FACILITIES

DSIR is currently preparing a Directory of Metallurgical Services and Facilities. This will be a companion volume to the Directory of Analytical Facilities which has recently been updated.

The aim of the directory is to provide a comprehensive listing of Companies and Organisations in New Zealand which offer metallurgical related services, and the facilities available to carry out these services.

The Directory will be published by the Science Information Publishing Centre of the DSIR and will be available free of charge.

Chemistry in New Zealand readers are invited to take part and be included in the Directory. Questionnaires can be obtained from Donna Wynd, DSIR, Auckland Industrial Development Division, PO Box 2225, Auckland.

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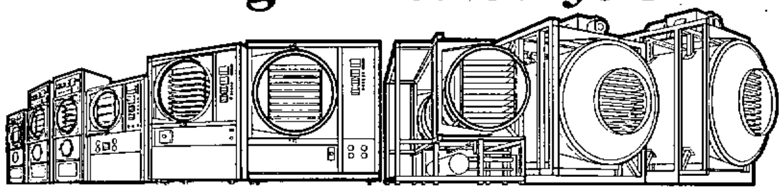

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The New Zealand Institute of Chemistry

and

The New Zealand Biochemical Society

Conference 1985

Christchurch New Zealand August 26-30 1985

Theme: Chemistry Becomes Computerized

Preliminary Notice

THE HOST CITY AND PROVINCE

Christchurch, with a population of 290,000, is the major population centre in the province of Canterbury and the largest city in the South Island of New Zealand. It was established at the base of the hills of Banks Peninsula on an alluvial plain which slopes gently from the sea in the east for some 65km to the foothills of the Southern Alps in the west.

Christchurch was named after the Oxford College of John Robert Godley, leader of the settlers who arrived in the "First Four Ships" in 1850.

The combination of the tree lined Avon river meandering through the city, the focal point of the Cathedral Square, the fine old buildings, and the many parks, gardens and recreation grounds give Christchurch a character of its own.

The well tended streets and gardens have earned Christchurch the title of "Garden City" and a reputation for being the most English city outside England.

Christchurch offers an abundance of attractions to visitors. For those wishing to dine out, an expanding number of restaurants cater for every taste. Cultural facilities include the Museum, Art Gallery and Arts Centre — an exciting use of the former University of Canterbury site which houses theatres, restaurants, a cinema, craft shops, and features Ernest Rutherford's den. The Town Hall, featured on this brochure, attracts a full programme of visiting national and international artists.

The city has a range of sporting facilities. Queen Elizabeth II Park, east of the city, was the venue of the 1974 Commonwealth Games and features heated indoor pools and a hydroslide. Hagley Park, in the city centre, caters for most organised sports and contains walking, jogging and cycling tracks.

Resorts within easy travelling distance of Christchurch include Akaroa, a picturesque resort of French origin on Banks Peninsula; Hanmer, a thermal resort north of Christchurch; and Methven, a winter resort close to the skiing facilities of Mount Hutt. Mount Hutt (104km from Christchurch) is one of the highest skifields in the Southern Hemisphere and has an unusually long season. The other commercial ski field close to Christchurch is Porter Heights (100km away).

Both fields are generally operating in August and within easy reach by day trip to Conference visitors. Fields such as Tekapo and Coronet Peak should also be considered by visitors able to travel further south before or after Conference.

WEATHER CONDITIONS

By late August the first signs of Spring should be appearing in Christchurch. However the weather is likely to remain cool (average maximum for August 12°C, average minimum +2°C) with some overnight frosts, although these are usually followed by sunny days. There may also be some wet days.

CONFERENCE VENUE — UNIVERSITY OF CANTERBURY

The University of Canterbury at Ilam is the venue for the Conference, and is conveniently located on bus routes between Christchurch International Airport and the city centre.

The growth of the University of Canterbury from a small liberal arts college to a modern autonomous university with a high reputation for the quality of its teaching and research has been matched by its physical expansion.

When it was established in 1873 it was only the fourth university institution in New Zealand and Australia. It was housed in graceful stone buildings elaborated with cloister and quadrangle, pinnacle and tower, near the city centre. These buildings are now the Arts Centre.

When the transfer of the University to Ilam was completed in 1974 it was much better housed, staffed and equipped than ever before. The spacious modern buildings, with a floor area of 130,000 square metres in a park like setting of 71 hectares have become the home for a community of nearly 10,000 students and staff. There are more than 420 academic staff in more than 50 different subject areas grouped into seven faculties: Arts, Science, Commerce, Engineering, Law, Music, Fine Arts and Forestry. Each year some 1500 graduates, about 200 of them with higher degrees, enter the workforce or undertake further training.

The conference sessions will take place in the science lecture theatres alongside the Chemistry Department in the heart of the campus.

CONFERENCE THEME: CHEMISTRY BECOMES COMPUTERIZED

The general theme of the conference will be "Chemistry Becomes Computerized," supported by plenary and invited lectures, technical displays and workshop sessions which will illustrate the variety of ways in which computers are being used by chemists in laboratory management, data processing, instrument control and other research areas. Computers in chemical education will also be given prominence.

The usual specialist group sessions will be available for the presentation of short papers and posters. The use of posters will be encouraged through the timetabling of sessions during which the presenters will give a very brief outline of the work described in their posters.

Another feature of the conference will be the Vaughan Symposium, honouring the retirement of Professor J. Vaughan.

SOCIAL PROGRAMME

The highlight of the social programme of Conference will be a Conference dinner held in the Christchurch Town Hall. The programme of social events for delegates and those accompanying them will also include the usual mixers and visits to local industries and other places of interest.

Those attending Conference will be able to use the University Recreation Centre (which offers tennis, squash, badminton, trampolining etc) and socialize at the University Staff Club based in the gracious Ilam Homestead. Both are sited on campus. If there is sufficient demand, skiing trips will be arranged to nearby Mount Hutt or Porter Heights on the Friday following the conference.

ACCOMMODATION

Accommodation is available in modern single rooms at the Halls of Residence on the campus and within walking distance of the conference venue. There are also a few double rooms. Tea and coffee making facilities are available. The Halls are on bus routes, both from the Airport and to the city centre. The estimated cost is about $24/day for full accommodation and meals. There is also a limited amount of motel accommodation available close to the venue. Early bookings will be essential for this. Please contact:

Dr J. R. L. Walker,
Botany Department,
University of Canterbury,
Christchurch,
New Zealand

FURTHER INFORMATION

Office holders on the organizing committee for the 1985 Conference are:

Chairman	Dr W. H. Swallow
Secretary	Dr P. W. Harland
Treasurer	Dr C. G. Freeman

For further information regarding the conference itself contact:

Dr P. W. Harland,
Conference Secretary,
Chemistry Department,
University of Canterbury,
Christchurch,
New Zealand

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