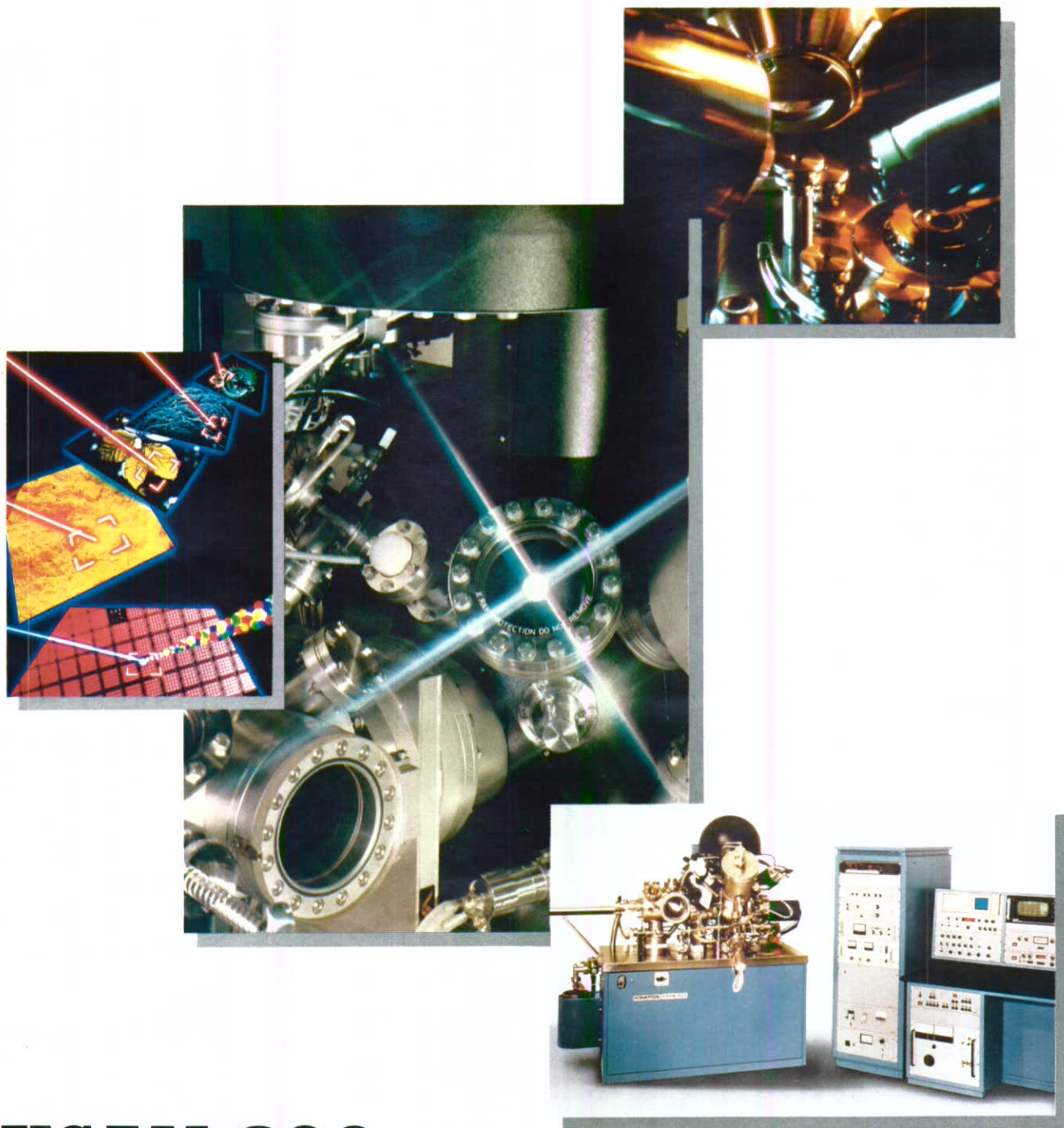




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Vol 52 No 4 August 1988



XSAM 800

The Modular Approach
to Surface Analysis

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XSAM 800
The Modular Approach
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FRONT COVER STORY

Kratos Analytical's XSAM 800 — the complete system that advances with your surface analysis requirements.

The multitechnique XSAM 800 combines the entire range of surface techniques (XPS, AES, SAM, SIMS and ISS) in a single instrument, without compromising the performance of any one. It provides detailed chemical information on the top most atomic layers of a material with both extremely high sensitivity and spatial resolution.

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Editor: Bruce Graham, c/- Dept of Health, 2 Edenvale Rd, Mt Eden, Auckland.

Branch Editors:

Auckland: Dr Roger Whiting, Auckland Technical Institute, Private Bag, Auckland.

Waikato: Nick Robinson, c/- Chemistry Dept, University of Waikato, Private Bag, Hamilton.

Manawatu: Dr Cecil Johnson, Applied Biochemistry Division, Private Bag, Palmerston North.

Wellington: Dr Lawrence Porter, Chemistry Division, DSIR, Private Bag, Petone.

Canterbury: Dr Selwyn Maister, Christchurch, Polytechnic, P.O. Box 22-095, Christchurch.

Otago: Dr Jim McQuillan, Chemistry Department, University of Otago, P.O. Box 56, Dunedin.

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Advertising Features

This Issue:

In this issue we feature an article on surface analysis along with supporting product information. We also look at the latest developments in instrumentation, and ancillary equipment for HPLC.

Next Issue:

In October our featured products will be laboratory balances and atomic absorption spectrophotometry. And if you're wondering about the Yearbook — it should be out in September.

EDITORIAL

This and That

This is not so much an "editorial" as a collection of various pieces of miscellany that have passed our way in recent times and seemed worthy of mention in a wider forum. We suggest you regard it as symptomatic of an editor suffering from the mid-winter woes and looking eagerly towards a satisfactory conclusion to the search for a suitable successor. In other words, rather than regale you with the ramblings of this tired mind we offer instead, the ramblings of others.

Queens Honours

Terry Hitchings addressed this topic on these pages in February. We have received a response from Dr. Jim Sprott, now resident in Canada who writes in support of the points made by Terry, and in particular of the need for (or wisdom of) bestowing knighthoods at will on members of the judiciary.

Dr Sprott also writes:

Members will have noted the Honour granted to Mr L.S. Spackman, Honorary Fellow of this Institute, on the occasion of the awards for the Queen's Birthday. I was delighted with this, knowing as I do the vast contribution to chemistry, micro-biology, public health,

electronics and industry which Spackman made, far above what he was ever paid to do. This was a well-deserved award if ever there was one.

We did indeed note this award and extend our warmest congratulations to Mr Spackman.

The Latest in Allergies?

A recent addition to the NZ publishing scene is The Food Technologist, official organ of the NZIFST. In their May 1988 issue is an item reproduced from the British Medical Journal and headed "Fabric dyes: Are they in the consumer's interest?"

The article is in two parts; a note describing the hazards of fabric dyes — increased cost to the consumer, effects on mental health, lack of adequate toxicity testing (including the "cocktail effect" of multicoloured clothes), etc., etc... and a second more lengthy note revealing that the first was a spoof (for those who failed to recognise it as such), and describing some of the ridiculous responses received from various members of the public (who did!).

The first note claimed to be issued under the auspices of DRAB, the Dye Related Aller-

gies Bureau. DRAB is a subsidiary of the Food Additives Research Team (FART). The responses to it have to be seen to be believed, but may come as no surprise to anyone who has to deal with the crackpot anti-everything brigade, in their day to day work. Recommended reading for all. We only regret space does not allow us to reproduce it here.

Conferences, and The Public Image of Chemistry.

August is of course Conference month, and by all accounts the turnout at Palmerston North will be very good. In the Northern Hemisphere, April/May appears to be the time for such gatherings, and in the June issue of Chemistry in Britain there is a report on the gathering held by the RSC. Two points are of note.

The first is the impression one gains of the amount of high-powered, up to the minute chemistry being presented, invariably with the odd Nobel laureate in attendance, and in the areas considered to be the 'frontier science' of the day. (We experienced something of this ourselves in 1974, when in one half day symposium three out of the five lectures were given by Nobel Prize winners). Now we know that NZIC conference budgets can not run to such lengths; nor do we dispute that much of the material presented is "state of the art". My point is more that we should not overlook this aspect in the planning for our conferences. All too often the cry these days is for "relevant" or "applied" material, but in such a diverse group as the NZIC any such material is only likely to be "relevant" to a few members at any one time. We should not overlook the fact that "Chemistry" is the tie that binds us together, and the major developments in the subject should be of interest to all. Variety and topicality are what's needed. They appear to be

present to a reasonable extent in this year's Conference. Let's keep it that way.

The second point from the RSC report relates to the public image of Chemistry, and the media. On this occasion the hand slap is for members of our own profession.

Apparently, prior to the conference the Society went to great efforts to inform the media, and managed to arouse a great deal of interest, London "dailies" and all. In support of this all speakers were requested to supply synopses of their papers so that appropriate details could be forwarded to the Press. Less than a third of all speakers obliged. In addition during the conference, two speakers refused to make themselves available to a national newspaper correspondent, and a video crew was ejected from one of the lecture theatres. It wouldn't happen here, would it?

Drug Trials, and Pacificchem '89

Finally two items to be noted rather than discussed.

We have recently received from the Registrar information on a US Program for screening of possible agents for the treatment of epilepsy. Anyone who believes they have in their possession the latest miracle cure may have it tested for free with the assistance of the National Institutes of Health. Contact the writer for further details.

Pacificchem '89 will soon be upon us, so if you want to spend part of December next year in Honolulu it's time to start making your plans now. Up to eighty symposia are being organised, brief details of which may be obtained from Registrar.

We will not be attending this year's Conference, but hope that those of you who do will find it a rewarding and enjoyable occasion.

Bruce Graham



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Orders, with payments should be sent to Rodney Norris, Auckland Branch Treasurer, C/- PO Box 2224, Auckland. (make cheques payable to NZIC, Auckland Branch).

SURFACE ANALYSIS — AN INTRODUCTION

Information on the surface composition of a material is becoming increasingly important for a wide range of industries. An obvious example is in the area of semiconductor manufacture, where accurate surface characterisation is essential for the efficiency of multi-layer microcircuitry. However, surface analysis techniques are being applied to a whole host of other industries as well as the more traditional areas of pure research.

Only when the internal features can be identified and quantified down to atomic level, and then related to the physical characteristics of the material can those materials be reproduced reliably and uniformly. Progress in materials science, and in particular surface analysis, is currently the most useful tool for guaranteeing such reproducibility.

The sample for analysis is bombarded by electrons, ions or X-rays in an ultra high vacuum (UHV) environment. The subsequent emission from the sample of other particles or radiation can be analysed to provide detailed chemical information on the upper most atomic layers of the substance. Researchers are thus able to identify and examine minute quantities of any impurities or trace elements.

The Techniques

A number of different surface techniques are available today. Because mobility within the sample, of either the incident or

emitted particles, is very limited, the actual depth of analysis is usually restricted to 10nm or less. However, ion etching of the sample can be undertaken to expose new layers for analysis, thus providing elemental information at varying depths, a depth profile. The three most common surface techniques — X-ray photoelectron spectroscopy (XPS), Auger electron spectroscopy (AES) and secondary ion mass spectrometry (SIMS), are commonly used to provide depth profiles in this way.

In XPS, the sample is irradiated with X-rays which excite photoelectrons from the core levels of surface molecules. An electrostatic energy analyser is used to detect and measure the escaping photoelectrons, the binding energies of which can then be determined. It is the binding energies which are characteristic of the chemical state of the surface atoms.

In Auger electron spectroscopy, the sample is bombarded with a beam of electrons causing a secondary electron emission from an inner electron shell, in turn producing a rearrangement of the outer electrons in atoms. The excess energy thus produced is then released either as a photon or is transferred to a second outer shell electron (the Auger electron) for surface emission. Analysis of the energy distribution in the Auger spectrum can thus determine the surface elements and their concentrations. As the incident electron

beam can be focused to a sub-micrometer diameter, very localised analysis can be undertaken using AES.

Secondary ion mass spectrometry (SIMS) is a more sensitive technique for depth profiling. In this case the excitation source is a primary ion beam of low energy. The secondary ions dislodged from the sample are mass analysed using a quadrupole mass spectrometer. The whole range of elements from uranium to hydrogen can be detected in this way, and moreover, in the so-called "dynamic" SIMS mode, continuous ion etching produces depth profiling up to several micrometers into the sample.

The Marketplace

According to the London-based Market Intelligence Research consultancy, annual sales of surface analysis instrumentation worldwide totalled \$99 million in 1985 and are expected to grow to \$123 million by 1990. Companies buying the systems include some of the giants of the electronics, chemical and petroleum industries.

There are a number of manufacturers producing surface analysis instrumentation worldwide. These include — the Physical Electronics Division of the Perkin Elmer Corporation (U.S.A.), Surface Science Instruments (U.S.A.), I.S.A. Riber (France), Cameca (France), Leybold Heraeus (West Germany), Jeol (Japan),

Kratos Analytical (U.K.) and V.G. Scientific (U.K.).

The first surface analysis instrument in New Zealand is a Kratos Analytical XSAM 800 XPS/Auger spectrometer at the University of Auckland. This has been installed in the School of Engineering alongside related instrumentation in a laboratory to be known as the Research Centre for Surface and Materials Science.

The XSAM 800 has the unusual capability of incorporating more than one of the surface techniques on a single machine. This multitechnique approach, pioneered by Kratos allows for unrivalled flexibility in surface analysis without compromising the performance of any one technique. As XSAM 800 is modular in design, it can be custom built to satisfy the most specific surface requirements. By the same token, as surface analytical needs advance, XSAM 800 can be readily upgraded, both in terms of additional techniques and more sophisticated sample handling, treatment and manipulation accessories.

Kratos Analytical also manufacture a range of surface instrumentation each dedicated to one of the main surface techniques. The Cambridge Mass Spectrometry Division of the company produces instrumentation for Laser Ionisation Mass Analysis (LIMA), a newer and more specialised surface technique providing rapid high sensitivity laser mass analysis and Time-of-Flight SIMS.

Kratos Analytical — Experts in Surface Analysis and Mass Spectrometry.

Kratos Analytical, based in Manchester, England, is one of the very few companies worldwide that is dedicated completely to the design and manufacture of analytical instrumentation. The company is concerned specifically with two of the most rapidly expanding technologies, — Surface Analysis and Mass Spectrometry.

Products from the company are used in almost every industry — the pharmaceutical, food, oil, automotive, aerospace and semiconductor industries being but a few. Approximately ninety percent of the turnover goes to overseas customers.

Although Kratos is a name known for less than fifteen years in the field of analytical instrumentation, it has a pedigree stretching back over forty

years when, as A.E.I. Scientific Apparatus, the company was one of the first in the world to enter the field of analytical instrumentation involving high vacuum technology.

The Surface Analysis Division currently manufactures a range of instruments for XPS (X-Ray Photoelectron Spectrometry), AES (Auger Electron Spectroscopy), SAM (Scanning Auger Microanalysis), ISS (Ion Scattering Spectrometry) and SIMS (Secondary Ion Mass Spectrometry). Briefly, these techniques provide detailed information on the elemental composition of the outermost atomic layers of a solid by precisely measuring the energy of electrons or ions emitted from a sample placed in a UHV (Ultra

High Vacuum) environment. Information can also be obtained on the chemical binding state, precise sites of atoms in relation to crystal structure, surface homogeneity, spatial distribution and the state of adsorbates.

The product range currently available includes not only instrumentation dedicated to a single surface technique, but also the multitechnique XSAM 800 which combines XPS, SAM, SIMS and ISS in one package without compromising the performance of any one technique. As XSAM 800 is modular in design, it can be custom built to satisfy the most specific surface requirements. By the same token, as surface analytical requirements advance, XSAM 800 can be readily upgraded,

both in terms of additional techniques and more sophisticated sample handling, treatment and manipulation accessories.

Kratos Analytical's advanced DS800 Plus Data System offers total control of the entire range of surface analysis instrumentation. Instrument automation, spectral depth profile and image processing (with full high resolution colour graphics display and hard copy output) are all handled by the unrivalled, user-friendly software. The data system can be configured to exactly suit the customer needs in terms of hardware and software.

Cont. on page 1

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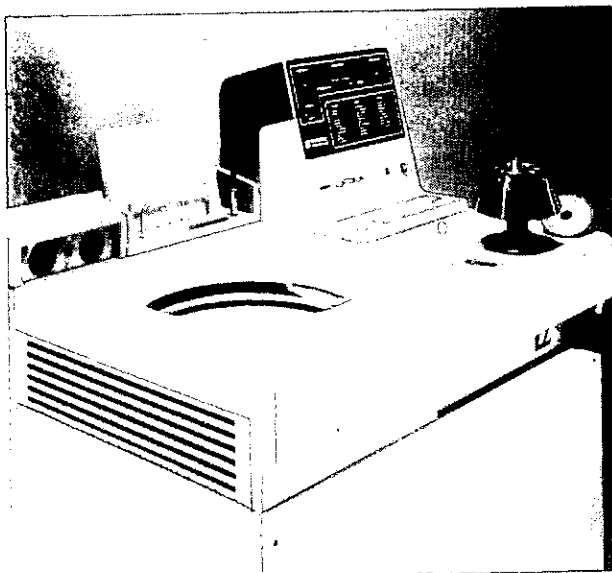
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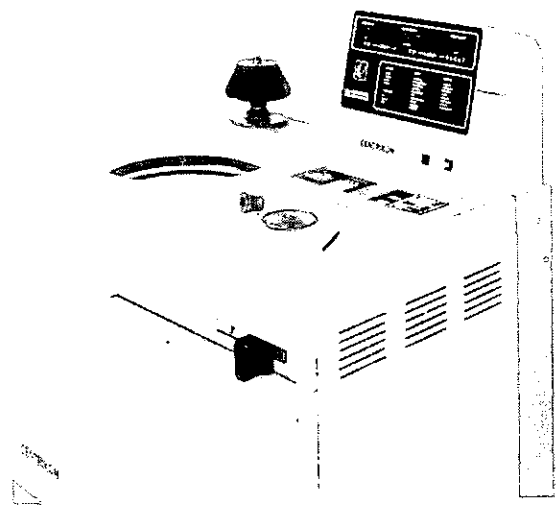


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THE ANALYSIS OF SURFACES

Dr J.B. Metson,
Department of Chemistry, and Research Centre for Surface and
Materials Science, University of Auckland.

Introduction

Surfaces and the reactions occurring on them, form a major part of the chemistry which surrounds us, from corrosion to catalysis and aesthetic appearance to abrasion resistance. Thus the incentives to understand and ultimately modify surface composition and chemistry are particularly strong.

Techniques available for the characterisation of solid surfaces range from a careful look in strong light to an intimate examination of individual atom positions with a scanning tunnelling microscope. Between these two extremes lie a vast array of methods for the examination of surfaces in precise structural and chemical detail.

Recently the Centre for Surface and Materials Science at the University of Auckland has taken delivery of an Auger electron/photoelectron spectrometer offering, for the first time in New Zealand, two of the primary methods available for the chemical characterisation of surfaces. This venture has been supported by the University Grants Committee, New Zealand Steel Ltd., the Building Research Association of New Zealand, The Industrial Processing Division of DSIR, the Lotteries Board, New Zealand Aluminium Smelters and a variety of other minor contributors.

The Centre has been set up to service in-house research within the University, industrial research and troubleshooting projects and importantly, to act as a training ground for graduate scientists and engineers. Those directly involved with the research centre, represent interests as diverse as geochemistry, catalysis and metallurgy. The techniques chosen for the first stage of development represent the "mainstream" methods used in analysing surfaces. They are discussed below with specific examples of their application from projects currently underway within the Centre.

X-ray Photoelectron Spectroscopy (XPS)

Both XPS and Auger Electron Spectroscopy (AES) utilize the limited mean free path of low energy (0-2000 eV) electrons generated within the solid by X-ray or electron beam bombardment, to derive information from the uppermost atomic layers. Mean electron escape depths vary as a function of kinetic energy as shown in Figure 1. It is apparent that analysis depths in the 1-5 nm range and submonolayer sensitivity can be routinely achieved in both methods. For XPS, the soft

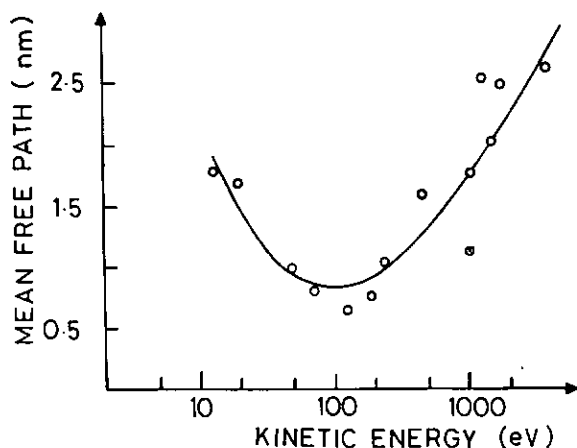


Figure 1. Variation in mean free path of an electron before inelastic scattering, as a function of kinetic energy in a variety of solids. Drawn from the data of M.W. Roberts and J.C. Riviere.

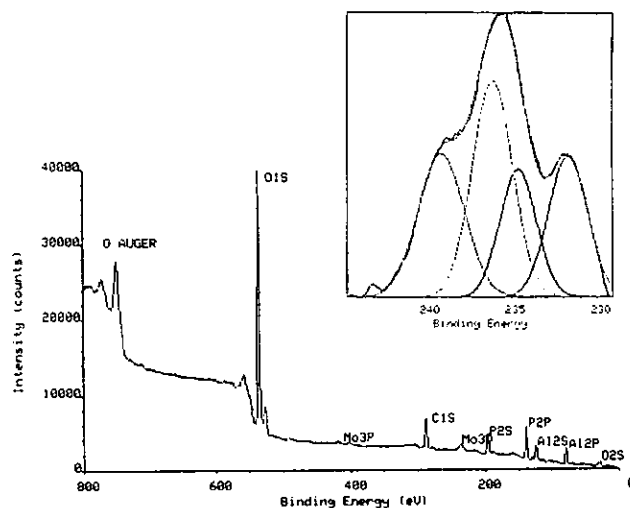


Figure 2. The XPS spectrum of a used Mo doped aluminophosphate catalyst. The inset shows a high resolution scan across the molybdenum 3d region.

X-ray bombardment sources available on the Auckland instrument are Al or Mg K α and monochromatized Al K α .

Electrons ejected from bound states in the solid following collisions with incident X-ray photons, are characterised by an energy given by the relationship derived by Einstein.

$$KE = h\nu - BE$$

KE = measured kinetic energy

$h\nu$ = incident photon energy

BE = binding energy of the ejected electron

A peak observed in the XPS spectrum is labelled by the element and orbital from which the electrons originated. Accurate BE positions not only identify the element, but also its chemical environment. The C1s peak from a simple hydrocarbon is observed around 285 eV and approximately 4 eV higher for $>C=O$. With line widths of 1 eV or less, detailed chemical information is thus readily resolved.

Orbital cross-sections are also accurately known, so the technique is immediately quantitative. Figure 2 shows the XPS spectrum of an aluminophosphate catalyst support doped with molybdenum. Table 1 shows the resulting analysis.

Table 1: Quantitative analysis of a used Mo doped aluminophosphate catalyst

Element	Factor	Area (eV)	Quant Factor	Atomic conc %	Mass conc %
O1S	537.00	215543.	0.61	50.67	40.61
C1S	288.50	28830.	0.24	17.22	10.37
Mo3D	235.90	11020.	2.04	0.77	3.73
P2P	139.00	26432.	0.26	14.58	22.63
Al2P	79.50	12855.	0.11	16.76	22.66

A subsequent scan at high resolution was used to determine the oxidation states of the Mo. Where materials are reasonably homogenous between surface and bulk, or when surface layers have been removed (e.g. by sputtering), XPS analyses agree well with other analytical methods. Real sur-

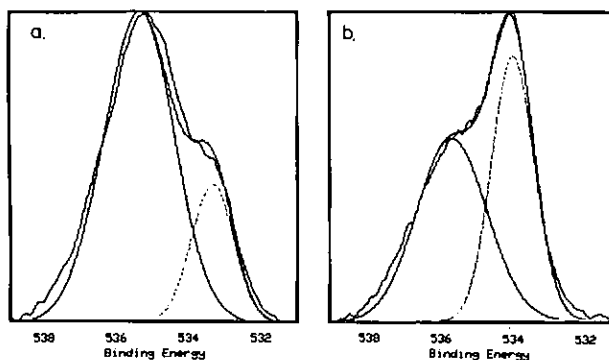


Figure 3. Two narrow scans across the O1s region of a steel specimen (a) as received, (b) after removal of 100 Å by Ar⁺ sputtering.

faces are usually a more complex system of segregation, oxidation and adsorption. In Figure 3, the structure of the oxygen is peak from an annealed, cold rolled steel surface is examined. Oxygen from adsorbed water is resolved from a second component associated with Fe₂O₃. The removal of ~100 Å by argon ion etching causes a significant increase in the Fe:O ratio and the dominance of the oxygen peak associated with the oxide, rather than that from the adsorbed water.

A sample from a more controlled laboratory environment may show rather simpler surface oxygen chemistry but complex metal chemistry. Figure 4 shows the platinum 4f region of a borohydride prepared colloidal platinum sample. Two spin-orbit doublets are resolved, the low binding energy component corresponding to platinum metal and the second doublet to Pt²⁺, thought to be associated with an oxide layer on the metal surface.

Auger Electron Spectroscopy

The emission of a photoelectron leaves behind a vacancy, often in a core level and thus an unstable electronic configuration. The vacancy is usually filled by the elevation of a less tightly bound electron into the vacancy shell with the accompanying relaxation energy being emitted either as a characteristic X-ray, or by the ejection of a second electron known as an Auger electron after Pierre Auger, who first identified the process. Auger electron emission is much favoured for the lighter elements, and competitive with X-ray emission for heavier elements. However unlike the X-ray, Auger electrons have a very limited mean free path in the solid, making the technique extremely surface sensitive. Again the energy of the electron is characteristic of the element and more particularly the energy separation of the

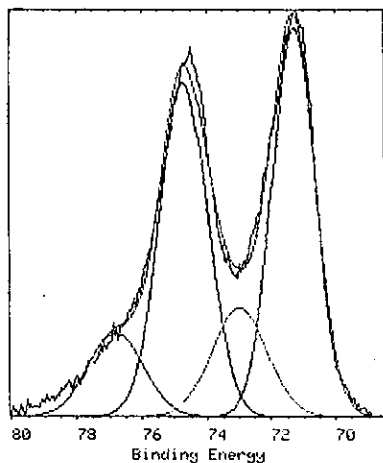


Figure 4. The platinum 4f region of a borohydride prepared colloidal platinum sample.

three shells (initial vacancy, filling electron and leaving electron). Peaks are thus designed by the element and shells e.g. the Cu LMM transition is observed at ~920 eV.

There is as much, if not more chemical information in the position of the Auger peak as there is in the XPS peak shift, however the natural linewidth of the Auger transition is in general, far larger than that of the XPS event. This masks available chemical information and makes XPS the technique of choice for investigating surface chemistry, as illustrated earlier. However Auger electrons are effectively generated by focussed electron beam bombardment, giving spatially resolved information in the Auger spectrum. The focussed beam allows electron imaging of the surface being examined and thus the analysis area can be selected with submicron accuracy. The most powerful expression of the technique is the ability to scan the beam across the surface and by monitoring peaks in the Auger spectrum, map the surface distribution of an element.

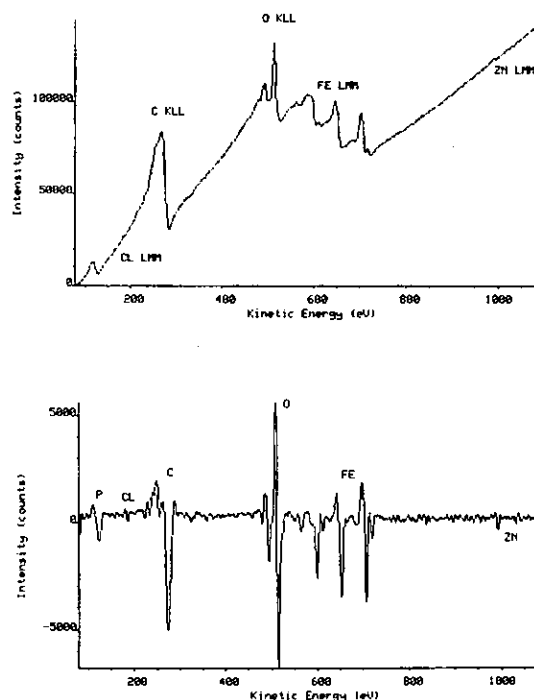


Figure 5. An Auger spectrum recorded from a fracture surface of a high tensile steel nail. The lower spectrum displays the differentiated form, useful in removing the sloping secondary electron background.

Figure 5 illustrates the Auger spectrum of an interior section of a fractured high-tensile steel nail. The presence of zinc (the nails were zinc plated) on the interior fracture surface, indicates significant zinc migration and is of interest in investigating the brittle nature of this particular sample.

Instrument Configuration

Both techniques require the collection and energy analysis of low energy electrons. The preservation of electron trajectories and energy, together with maintenance of atomically clean sample surfaces, requires ultra-high vacuum conditions. A combination of Ion and Turbomolecular pumping maintains vacuum in the 1×10^{-10} Torr region in the analysis chamber, with slightly higher pressures in the preparation chamber. Samples are introduced through an interlock system into the preparation chamber and transferred onto an XYZ manipulator for analysis. The area of interest on the sample is laser aligned at the focal point of bombarding sources and the electron extraction lens. The latter collects and focuses electrons on the entrance slit of a 180° hemispherical analyser (see Figure 6.)

The monochromatised Al source allows high resolution XPS spectra to be obtained. In general observed line widths

are dominated by the line width of the X-ray source. The optimum ~ 0.8 eV line width delivered from the Mg anode can be comfortably reduced to ~ 0.55 eV using the Al anode and quartz mirror monochromator — at the expense of considerable intensity. Monochromatized Al $K\alpha$ radiation also lacks the high energy Bremsstrahlung and thus offers reduced backgrounds and signal to noise advantages which compensate somewhat for the reduced sensitivity.

Auger electron spectroscopy utilizes an all electrostatic, 10 kV electron gun, with a LaB_6 filament. The effects of stray magnetic fields on the trajectories of low energy electrons imposes the requirement for an all electrostatic column and ultimately limits spatial resolution. Typical beam currents at high resolution are in the nanoamp range with spot sizes down to $\sim 0.2 \mu m$.

Also mounted on the main chamber, is a 0-5 kV argon ion gun, which serves both as a sputter cleaning device to remove adsorbed contaminants and an ion milling system to "depth profile" samples. Typical sputter rates of $2 \rightarrow 20 \text{ \AA sec}^{-1}$ are achieved with this device.

The provision of a completely separate preparation chamber provides considerable potential for direct interfacing of sample treatment facilities with the instrument. A high-vacuum fracture stage is of most immediate interest. This device prevents oxidation or other chemical modification of the highly reactive fracture surfaces before analysis. The second likely facility is a catalyst reaction vessel, where samples can be extracted from simulated industrial reaction conditions and transferred for analysis without atmospheric exposure.

Conclusion

The capability of current surface analytical methods is remarkable for the wealth of information and chemical detail available. The Research Centre for Surface and Materials Science has made New Zealand's first major venture into this field with the acquisition of an Auger electron/X-ray Photoelectron Spectrometer. The instrument has an extremely broad spectrum of potential applications in New Zealand,

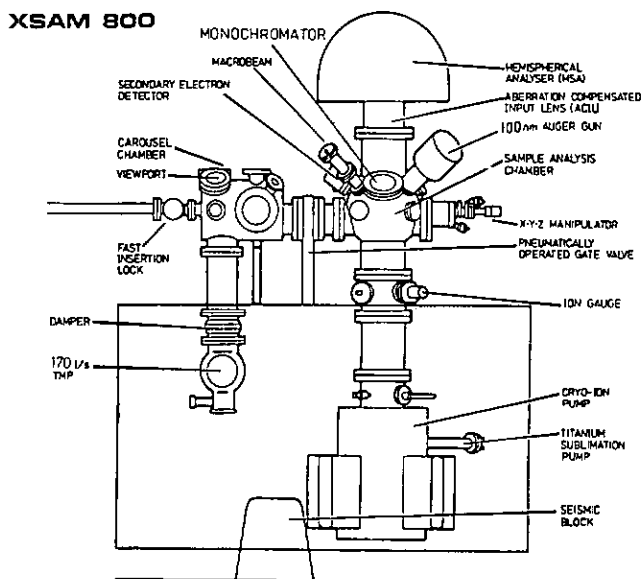


Figure 6. A diagram of the basic layout of the Kratos XSAM800. Macrobeam indicates the Argon ion gun, while monochromator assembly is mounted on the port shown.

considering the obvious research potential and remembering that the evolution of such instrumentation overseas has been largely driven by industrial use.

We are as yet, at an early stage of development of the facility, however even from the studies currently underway, there is clearly an interesting future in this rapidly expanding field.

Acknowledgements

I am indebted to my colleagues Professor R.P. Cooney, Dr R.F. Howe, Dr J.J. Ward and Mr M.R. Mucalo for the use of the spectra shown.

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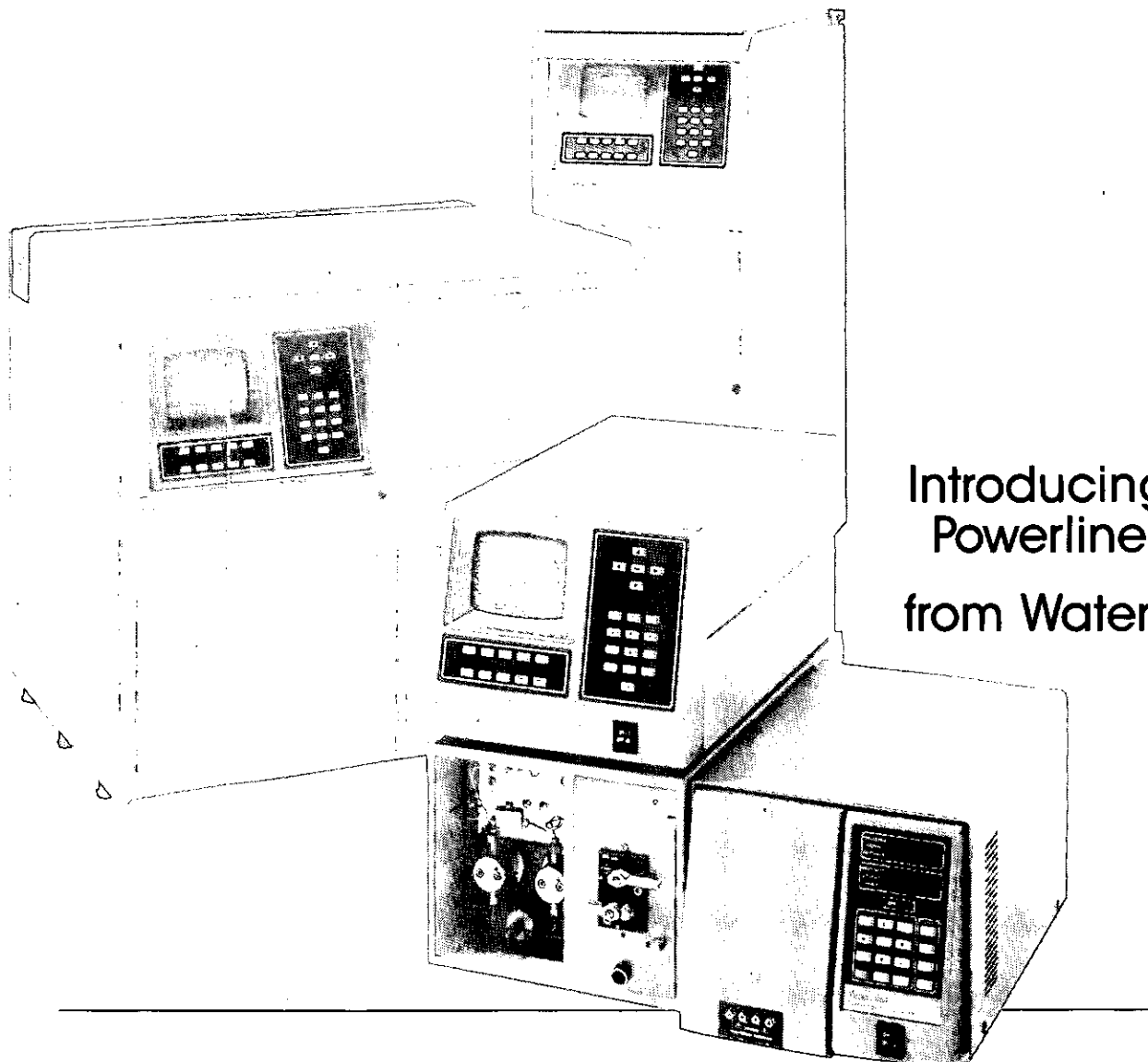
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A PROCESS FOR THE INTRODUCTION OF ELEMENTAL SULPHUR INTO HIGH ANALYSIS PHOSPHATE FERTILISERS.

Alan G. Charleston, NZ Fibreglass Company, Auckland.

Alan Charleston was the 1987 recipient of the Shell Prize for Industrial and Applied Chemistry. This paper describes some of the work for which he received the award, and which was carried out at the now defunct NZ Fertiliser Manufacturers' Research Association in Auckland.

Introduction

An adequate supply of sulphur is essential for good plant growth and the lack of it has been shown to be a yield limiting factor in some soil types world wide!

When single superphosphate is applied to correct phosphate deficiencies, as has been the dominant fertiliser strategy in New Zealand for more than 100 years, the sulphur present (ca 11% S as calcium sulphate) is sufficient to correct many sulphur deficiencies as well.

In severely sulphur deficient situations, or on soils from which sulphur is readily leached, elemental sulphur may be added, which, when relatively finely divided, is readily oxidised by soil micro-organisms and provides plants with sulphate throughout the growing season. This is particularly useful on soils where high rates of leaching lead to temporary sulphur deficiencies between applications of single superphosphate².

It has been suggested, on the basis of extensive agronomic field trial evidence, that the particle size of elemental sulphur should be predominantly $< 0.15\text{mm}$ for cool-temperate regions and $< 0.25\text{mm}$ for warm-temperate regions, when applied annually, and $< 0.25\text{mm}$ and $< 0.5\text{-}1.00\text{mm}$ respectively when applied biennially to pastures.³

Molten sulphur may be added to single superphosphates to produce a product containing relatively fine sulphur (40-80% $< 0.15\text{mm}$) because of the high temperatures (110-115°C) which prevail during the early stage of its production.

Higher analysis fertiliser such as triple superphosphate and reactive phosphate rocks acidulated with sub-stoichiometric amounts of phosphoric acid, i.e. partially acidulated phosphate rocks, contain no useful levels of sulphur. Previous efforts to introduce elemental sulphur into these materials where the heats of reaction are substantially less than that obtained during single superphosphate production, have met with mixed success.

Attempts have been made to disperse molten sulphur into phosphoric acid with the intention of using the resultant emulsion to acidulate phosphate rock⁴. The molten sulphur, however, tended to coalesce in heavy puddles even with vigorous stirring in the presence of a wetting agent. A process whereby molten sulphur is sprayed under pressure onto triple superphosphate during granulation has been described⁵. Although a satisfactory product was obtained, production problems, including explosions at the oversize grinding mill in the granulation circuit, caused its manufacture to be discontinued.

It was considered that a promising approach to the problem could be a variation on the molten sulphur/phosphoric acid emulsion method, i.e. to disperse molten sulphur in cool (ambient) phosphoric acid and to use the resulting stable slurry to acidulate phosphate rock.

This paper describes the development of this idea from a small scale batch process to a pilot plant continuous process which had a throughput of approximately a quarter of the size required for a full scale industrial model.

Experimental and Results

A. Laboratory scale batch process

A laboratory blender (Waring-model PB-5A) was used to

provide vigorous stirring to a quantity (370g) of phosphoric acid (71% H_3PO_4 w/w made from Jordan phosphate rock) or water, contained in a 1 litre borosilicate glass vessel. Molten sulphur (111g) was poured into the liquid over a period of 20 seconds through a teflon funnel with a 3.2mm outlet. This enabled the molten sulphur to be accurately poured onto any part of the vortex formed in the liquid by the blending unit.

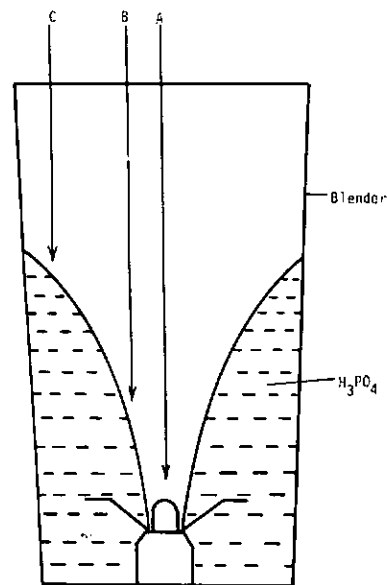


Figure 1. Schematic diagram showing the three points at which molten sulphur was added to phosphoric acid.

The sulphur was added to a sample of phosphoric acid at the three points indicated in Figure 1 and to water down the centre of the vortex. After dispersion the suspensions were wet sieved through nylon filter fabric (58 μm aperture) with water. The size distributions of the $> 58\mu\text{m}$ materials were determined by wet sieving on BSS test sieves while the $< 58\mu\text{m}$ materials were recovered by settling after being well washed with water. The size distribution of the dispersed samples are shown in Table 1.

Table 1. Size distribution (% passing stated sieve size) of sulphur dispersed in water and phosphoric acid using waring blender.

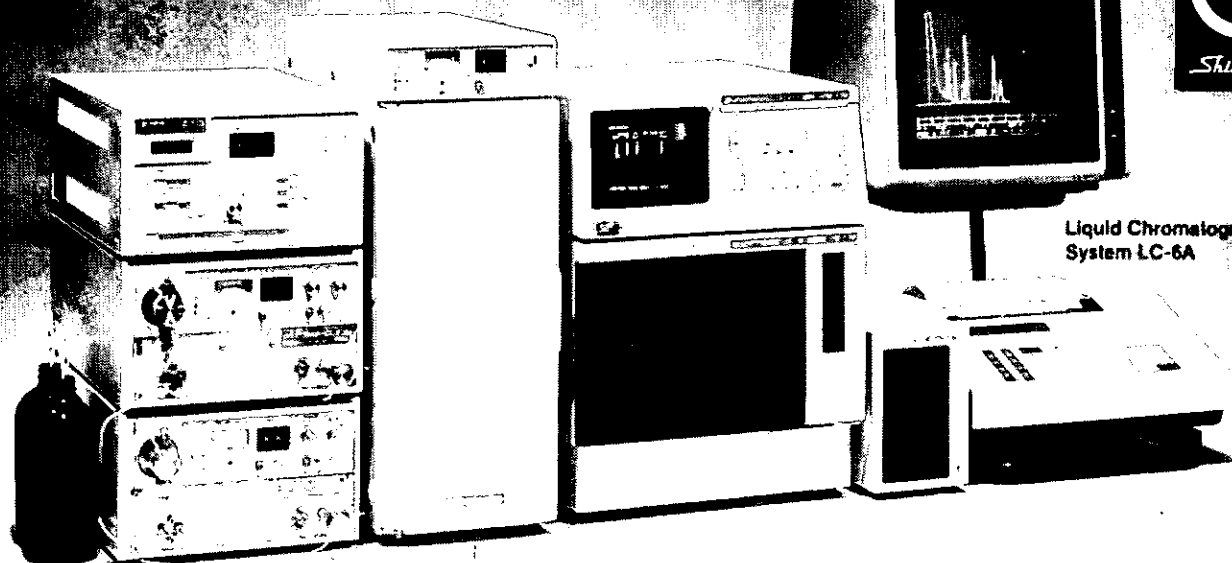
Diameter (mm)	H_3PO_4			H_2O^d
	A ^a	B ^b	C ^c	
2.00	100.0	98.0	97.6	99.8
1.00	100.0	93.7	91.8	99.5
0.50	99.6	66.5	63.3	96.7
0.25	88.0	43.0	33.9	79.1
0.15	68.3	29.1	23.8	56.2
0.075	36.6	18.9	14.6	23.7
0.058	28.2	16.0	12.1	—
mpd (mm)	0.10	0.32	0.38	0.13

^{a-c}Molten sulphur added to phosphoric acid at positions shown in Figure 1.

^dMolten sulphur added to water down the centre of the vortex.



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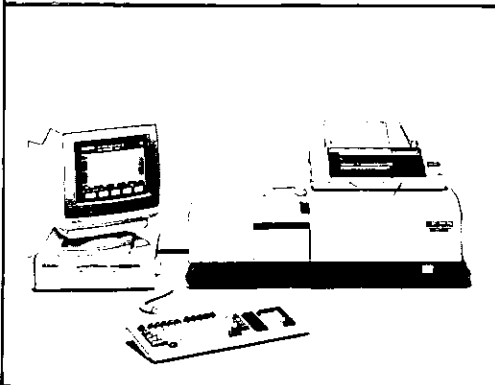
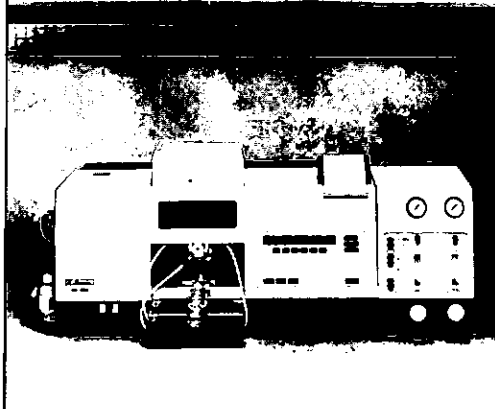
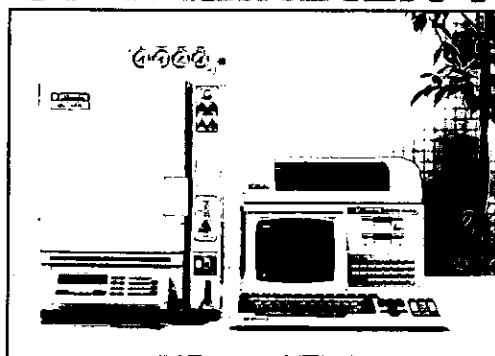
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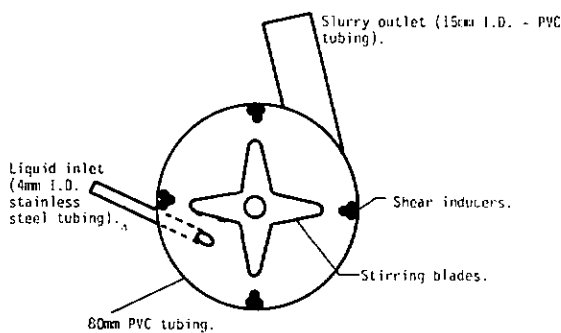


Figure 2. Plan view of sulphur dispersal unit designed for continuous operation.

B. Laboratory scale continuous process

A blending vessel was constructed to allow the dispersal of molten sulphur in H_3PO_4 on a continuous basis for use in a triple superphosphate pilot plant. It was designed to be driven by a blender motor used in the earlier batch preparations and is shown in plan view in Figure 2.

The liquid was introduced via a stainless steel tube which was angled up through the base of the dispersal unit. The height of the slurry outlet was varied until a satisfactory vortex was obtained when the unit was running. The final height chosen was 45 mm from the bottom of the slurry.

Early attempts at sulphur dispersal without the shear inducers resulted in very little shear as the liquid rotated freely within the shell of the unit and hence, the sulphur produced was too coarse to be of any use (1-1 mm). Shear inducers were made by gluing three PVC rods (3mm dia.) together in the triangular pattern shown in Figure 2 and then attaching these to the inside of the dispersal unit at four equidistant points around its circumference. The clearance between the blades and the shear inducers was 5mm.

A series of sulphur dispersions in 70% w/w works grade phosphoric acid (or water) were carried out using this unit.

Table 2. Size distributions (% passing stated sieve size) of sulphur dispersed in phosphoric acid at various S: H_3PO_4 ratios using the continuous dispersal unit.

Diameter (mm)	S: H_3PO_4 (w:w)		
	0.06	0.33	0.45
2.00	99.7	100.0	100.0
1.00	99.3	100.0	100.0
0.50	98.0	98.7	97.3
0.25	87.3	78.2	66.6
0.15	70.3	58.9	48.4
0.075	41.3	29.4	20.4
0.058	33.6	22.0	11.4
mpd (mm)	0.095	0.125	0.160

Table 3. Size distributions (% passing stated sieve size) of sulphur dispersed in water at various S: H_2O ratios using the continuous blender unit.

Diameter (mm)	S: H_2O (w:w)		
	0.30	0.60	0.90
2.00	99.5	99.7	99.3
1.00	98.5	98.2	98.1
0.50	91.8	89.0	88.6
0.25	64.6	62.2	55.9
0.15	39.2	38.7	32.2
0.075	17.7	17.7	12.0
mpd (mm)	0.190	0.192	0.220

The S: H_3PO_4 ratio was varied from a low value (0.06:1) to a maximum level (determined by the thickness of the resulting S- H_3PO_4 slurry of 0.45:1). The size distributions of the dispersed sulphur are shown in Table 2. Although the higher S: H_3PO_4 ratios result in coarser sulphur, it is still within the range necessary for relatively rapid oxidation in the soil. The S: H_2O ratio was varied from a low value (0.30:1) to a maximum level of 0.90:1. The size distributions of the dispersed S are shown in Table 3.

A S- H_3PO_4 slurry was produced on a continuous basis using the sulphur dispersal unit described above, and this was used to prepare a sulphurised triple superphosphate on a pilot plant scale. A 50:50 blend of Christmas 'A' and Nauru phosphate rocks (48 kg.hr^{-1}) was acidulated with a S: H_3PO_4 slurry (23 kgS.hr^{-1} , $79 \text{ kg } 71\% \text{ H}_3\text{PO}_4.\text{hr}^{-1}$) over a period of 30 minutes. No problems were encountered, and the conditions pertaining throughout the run were similar to those obtained using phosphoric acid alone, although an increase in initial rate of reaction was noted. This was probably due to the increased H_3PO_4 temperature ($\Delta T \sim 20^\circ\text{C}$) resulting from the cooling of the molten S.

The sulphur was extracted from the triple superphosphate and its size distribution measured. The results are shown in Table 4. The triple superphosphate contained 17.4%P (of which 93% was water soluble) and 15%S.

Table 4. Size distribution (% passing stated sieve size) of sulphur extracted from sulphurised triple superphosphate prepared on pilot plant scale.

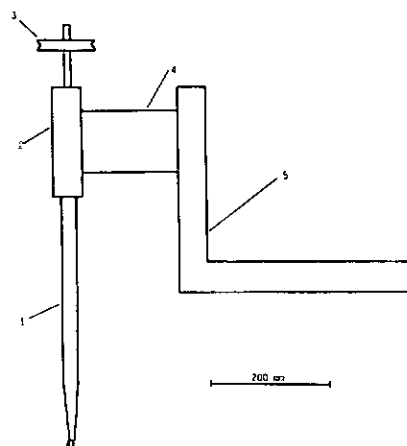
Diameter (mm)	% passing stated sieve size
2.00	99.9
1.00	99.3
0.50	95.2
0.25	75.7
0.15	57.0
0.075	29.1

C. Pilot plant scale continuous process.

The two modes of molten sulphur dispersion described above both utilised a drive unit situated below the dispersal vessels. This would clearly not be satisfactory in an industrial situation as the liquid seals around the shaft would require constant attention to maintain their integrity. Thus any industrial unit would need to be driven from above.

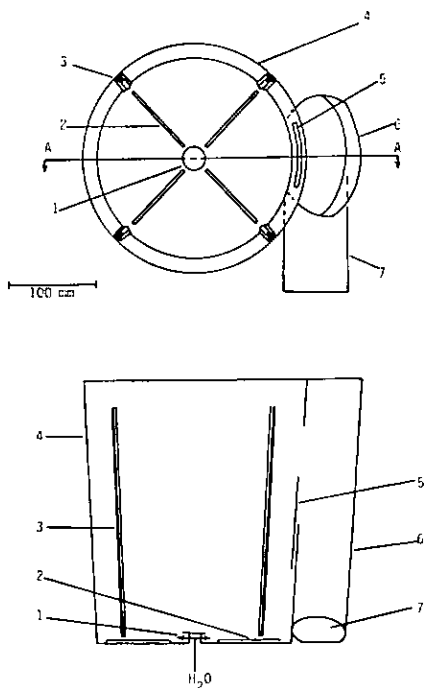
A stirrer assembly was fabricated from mild steel as outlined in Figure 3.

The shaft was turned from a length of 25mm diameter round stock, as accurately as possible to minimise vibration at high speed. The unit was operated at 6,000 rpm and was powered by a 1.1kw 3 phase 2 pole electric motor.



- 1) Stirring shaft (turned from 25mm \emptyset mild steel).
- 2) Bearings (IKF R-12-22).
- 3) Pulley for power transmission from motor.
- 4) Bearing block support (12mm mild steel plate).
- 5) Stirring assembly mounting bracket (50mm x 5mm mild steel channel) belted to stout bench.

Figure 3: Stirrer assembly.



- Key to Figure 3:
- 1) H₂O inlet.
 - 2) Horizontal baffles (4x) made of 5mm Ø rod.
 - 3) Vertical baffles (4x) made of 3mm Ø rods brazed together.
 - 4) Dispersal vessel.
 - 5) Adjustable weir.
 - 6) H₂O:S slurry receiver.
 - 7) H₂O:S outlet.

Figure 4: Plan and cross-sectional views of vessel used to disperse molten sulphur in water.

The stirring blade was made from 2.0mm stainless steel sheet and was based on the shape of the blender blades used previously.

After considerable experimentation a dispersal vessel based on a 10 litre polypropylene bucket fitted with the shear inducing elements, liquid inlet and slurry outlet over an adjustable weir as shown in Figure 4 was developed.

Sulphur (ca. 20 kg) was melted in an electrically heated mild steel vessel and delivered to the dispersal unit via FEP tubing. The flow was controlled using an electrically traced gate valve.

All of the development work on this unit was carried out using water as the cool liquid owing to the lack of suitable facilities to handle large quantities of phosphoric acid under pressure. As the earlier small scale experiments showed that liquid sulphur is more finely dispersed in phosphoric acid than water, a unit producing sulphur of an acceptable fineness with water should perform even more satisfactorily when phosphoric acid is used as the dispersing medium.

The various items of equipment were assembled as shown in Fig. 5 with the mixer blade being positioned in the center of the dispersal vessel with a narrow clearance (ca 5 mm) being maintained between it and the horizontal baffles.

During operation, the electric motor and the water were turned on and the dispersal unit was allowed to run for about 60 seconds while the vessel filled with water and the vortex stabilised. Liquid sulphur (ca 145°C) was then introduced via the FEP tubing at the point indicated in Figure 5. Sampling of the S:H₂O slurry commenced 1 minute after the start of sulphur addition and continued at 1 minute intervals thereafter. The water flow rate was maintained at 20 kg min⁻¹ for all runs. If the same volume flow of 70% H₃PO₄ were to be processed (i.e. 30 kg min⁻¹) the amount of sulphur dispersed at an S:H₃PO₄ ratio of 0.33:1 would be 600 kg hr⁻¹. This corresponds to 6t. hr⁻¹ of a fertiliser containing 10% S or 12t. hr⁻¹ of one containing 5% S. i.e. the amount of scale up from the present unit to one of an industrial size is only in the order of four to eight fold.

It was found that the vortex needed to be high enough to ensure that the water below the mixing blade did not contain

large amounts of entrained air as this led to solid sulphur adhering to the bottom of the dispersal vessel and the formation of excessive quantities of large (>1mm) particles of compacted sulphur being present in the S:H₂O slurry. The height of the adjustable weir was altered until this was achieved. An optimum height was found to be 190mm from the bottom of the dispersal vessel. This ensured the absence of large quantities of entrained air in the water under the mixing blade while maintaining a vortex shape which was wide enough to permit the easy access of the molten sulphur to the base of the vortex. Failure to add the sulphur at this position (i.e. to the side rather than the base of the vortex) led to increases in the amounts of coarse (>1mm) sulphur found in the S:H₂O slurries.

Two experiments were carried out with a shaft speed of 6,000 rpm and S:H₂O ratios of 0.19:1 and 0.34:1. The size distributions of the sulphur in the resulting S:H₂O slurries are shown in Table 5. The sulphur is considered fine enough to be agronomically available⁴.

Table 5.

	Run A	Run B
Shaft speed (rpm)	6000	6000
H ₂ O Flow Rate (kg min ⁻¹)	20	20
S:H ₂ O	0.19:1	0.34:1
Size distribution (% stated size)		
4mm	99.8	99.9
2mm	99.3	99.5
1mm	96.1	95.8
0.5mm	84.9	80.6
0.25mm	60.3	51.8
0.15mm	40.9	32.7
m.p.d. (um)	195	225

Summary

The development of a process for producing finely divided sulphur in a slurry with phosphoric acid has been described.

Starting with a crude, small scale (ca. 100g sulphur/batch) process based on a laboratory blender, the process was developed through a larger continuous process (ca. 400 S/minute) to a pilot scale continuous process (ca. 6 kg S/minute) which incorporated many of the features required on a full scale unit.

The factors which were found to be important in the operation of a dispersal unit were the nature of the shear inducing elements in the dispersal vessel, the height of the slurry vortex and the position at which the liquid sulphur was introduced.

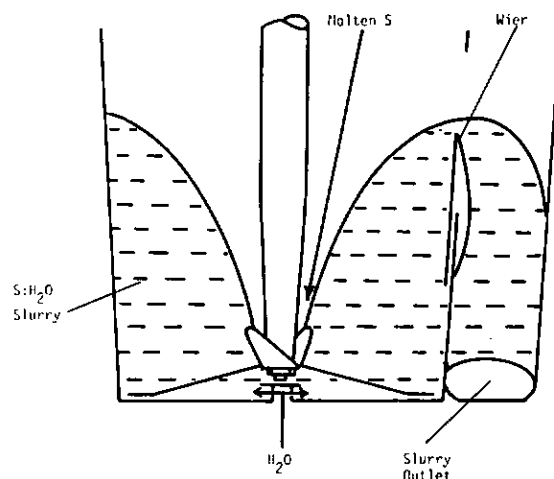


Figure 5: Point of molten sulphur addition to sulphur dispersal unit.

References

1. Bixby DW and Beaton JD (1970) Sulphur-containing fertilisers. Properties and applications. Technical Bulletin 17. The Sulphur Institute.
2. During C (1984) Fertilisers and soils in New Zealand Farming 87-89. NZ Government Printer.
3. Sinclair AG, Boswell CC, Cornforth IS, Lee A, Morgan C, Morton J, Nguyen L, Saunders WMH, Shannon P, Smith RG and Whelan G (1985) Agronomic requirements for sulphur in New Zealand pastures. Proc. 20th Technical Conference NZ Fertiliser Manufacturers' Research Assn.
4. Wiczorek GA, Breen AV and Hardesty JO (1964) Addition of sulphur to concentrated superphosphate. Farm Chemicals (December) 24-32.
5. Bixby DW and Kilmer VJ (1975) Sulphur resources available to the fertiliser industry, the fertilisers made, their role, and the problems involved in their manufacture. Sulphur in Australasian Agriculture. 231-241 Sydney University Press.

GOLD PRODUCTION BEGINS AT WAIHI

Gold production has commenced again at the Martha Hill mine in Waihi, 110 years after it was first discovered in the area. With its first pour of bullion on 16 May 1988, the Waihi Gold Mining Company has resurrected an operation which previously ran from 1879 until 1952 and produced 12 million tons of ore worth 28 million pounds sterling in the currency of the time.

The resurgence of interest in Martha Hill began in 1976 when Waihi Mining and Development, a joint venture between Mineral Resources (N.Z.) Limited and Green and McCahill Mining Limited, obtained a prospecting licence over the hill. It was this initiative which led to the mine that was officially opened in 15 June 1988.

Geological Background

On Martha Hill precious metals occur in a system of near vertical quartz veins in andesitic volcanic rock. These veins are thought to represent the roots of a fossil geothermal system active approximately 12 million years ago in which hot circulating fluids altered the minerals in the rock to clays, and deposited the quartz containing gold and silver.

Mining

Martha Hill is mined by open pit methods. The final pit will cover an approximate surface area of 24 hectares and will be 700 metres long, by 400 metres wide at ground level. The pit will descend to a depth of 200 metres from the highest point on the hill.

Generally mining is undertaken with backhoes loading into trucks. Bulldozers fitted with ripping attachments are used to rip large areas of waste rock so that it can be loaded by front end loader into trucks. Some areas of the pit require blasting. Ore and waste rock removed from the pit are transported on a single conveyor to the treatment plant and waste disposal area respectively. Open pit mining and conveying operations are confined to a maximum of 12 hours a day. In order to develop the open pit it is necessary to dewater the existing mine workings. An average of 5500m³ of water is pumped every day. Some of this water is used in the ore treatment process and the remainder is treated prior to discharge to the Ohinemuri river.

Processing

The precious metals are recovered from the ore by the Carbon in Pulp (C.I.P.) method. Cyanide is used to leach the gold and silver from the ore after it has been ground and mixed with water and lime. The precious metals are then absorbed onto activated carbon which is later removed from the circuit. The gold and silver are chemically stripped from the carbon and recovered by electrowinning.

The precious metals are smelted to produce bars of bullion which are sold for refining. The tailings left after the leaching circuit are pumped in a slurry to the tailings and waste disposal area. Processing of ore is a 24 hours operation as is the disposal of tailings.

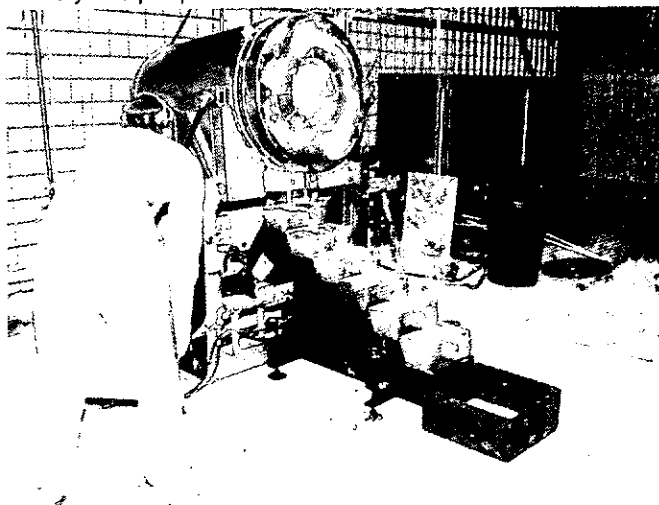
Tailings and Waste Disposal

The Waihi Gold Mining Company uses a land based method of tailings disposal. This involves retaining the tail-

ings within embankments engineered from mine waste. Additional waste rock from the mine is used for contouring the embankment structures.

Production

Approximately 3,500,000 tonnes a year of ore and waste rock are mined from the open pit to produce 55,000 oz of gold and 300,000 oz of silver annually. The mine employs approximately 150 people.



First bullion pour, 0020 16th May 1988

Restoration

On completion of mining the appearance of Martha Hill will have changes from a low rounded hill to a crater-like lake set in a steep sided amphitheatre. Final rehabilitation proposals provide for beaches and lagoon areas at the west and east ends of the lake to allow for recreational use.

The tailings and waste disposal area will be rehabilitated to pasture over the life of the mine and on the completion of mining will be completely restored to an acceptable land use. Future land use options include a return to the previous dairying use, recreational uses or combination of dairying, forestry and horticulture.

In preparation for future rehabilitation the company established trial vegetation plots on mine waste and tailings. In some cases topsoil was spread prior to planting, in others the plants were put directly into waste or tailings. The progress of plants was monitored and very successful results were obtained. For example, dry matter yields for pasture trials in the best cases exceeding 14,000 kg of dry matter per hectare.

Environmental Monitoring

From the time evaluation of the Martha Hill resource began in 1979, environmental monitoring has been carried out. Environmental monitoring will continue over the life of the mine to ensure mining licence, water rights and clean air licence conditions are being met. Studies carried out to date have included monitoring noise levels, dust in the atmosphere, vibration to assess the effects of blasting, rainfall and other meteorological measurement, groundwater levels, water quality, river discharges, animal, bird and plant life as well as social indicators.

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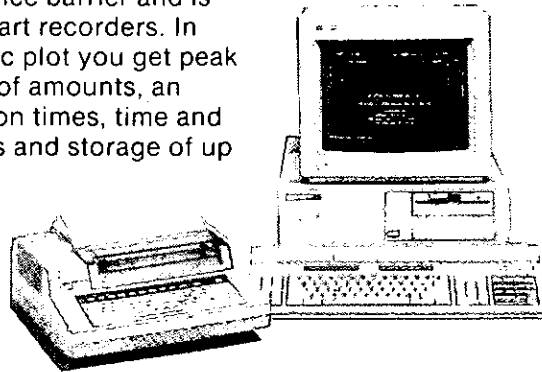
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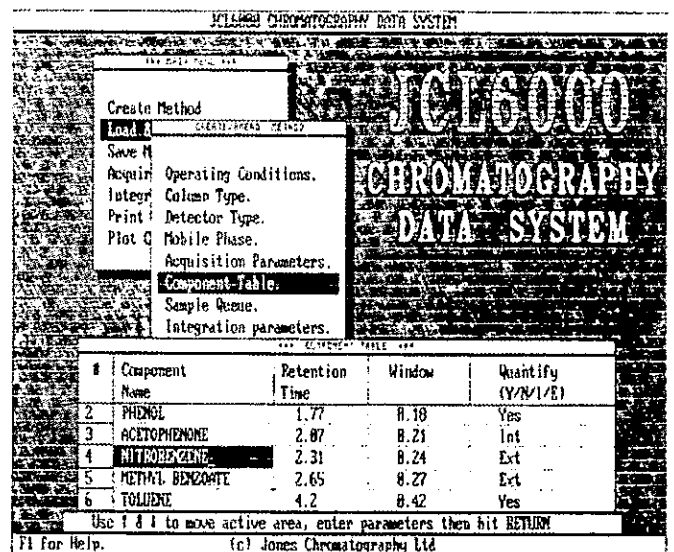
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NZIC Annual Report 1987-88

On behalf of the Council we present the Annual Report for the 57th year of operation of the New Zealand Institute of Chemistry, for the period ending 30 June, and the Annual Accounts and Balance Sheet for the year ending 30 April 1988.

Institute Administration

The clear indication at the 1987 Annual General Meeting of majority support for the increasing subscription to provide for a professional secretariat was actioned by Council in February. Subscriptions for the 1988/89 year were raised to \$110 from \$77 (including GST) for Members and Fellows.

The Development Fund established in 1986 from reserves, augmented in 1986 and 1987 by levies of \$5 and \$6 per member, other than students, allows appointment in 1988 of an Executive Officer, responsible through the President to Council, with supporting staff and facilities. Six invitations were issued on 30 June to tender by the end of July for consideration and action by Council in August.

In addresses to members the President has outlined the basis for and the background to the preparation of the tender and job specification documents. Copies were sent to all Branches. The retirements in August 1988 of the Registrar and General Secretary after 28 and 8 years' service respectively have spurred this reorganisation.

With the assumption of the membership registration and receipt and payment duties of the Registrar by the Executive Officer and staff, Council is considering the addition of an elected General Treasurer to its officers responsible for financial policy.

Awards, Prizes and Honours

The following awards were made to members of the Institute by Council Honorary Fellowship: Professor J.F. Duncan and R.E.F. Mathews. ICI Prize: Assoc. Professor P.S. Rutledge, University of Auckland. Shell Prize for Industrial and Applied Chemistry: A.G. Charleston, NZ Fibreglass, Auckland (ex NZ Fertiliser Manufacturers' Research Association). 1988 NZIC-RACI Visiting Speaker Award: Dr D.M. Bibby, Chemistry Division, DSIR, Wellington (jointly with the RACI). Chemical Education Award: M.A. Perkins, Cambridge High School,

Cambridge. Student Paper Competition: S.C. Smith, University of Canterbury. Chemical Essay Prize: no award.

The A.C. Kennett Memorial Award made jointly with the Australasian Corrosion Association through its New Zealand Branch was awarded to Messrs R.J. Good, G.C. Moore and C.J. Wojciak of the Adelaide Water Supply Department.

Chemistry V AAVA Prize: Debra K. Nairn, Chemistry Division, DSIR, Mt Albert.

The President was accorded Honorary Fellowship status for his term of office by the Royal Australian Chemical Institute and the Canadian Institute of Chemistry. Similarly, Mr R.F. Ryan, President, RACI and the President, ICI, were elected Honorary Fellows of NZIC during their term of office.

We have pleasure in recording: the award of the Order of New Zealand to Professor R.E.F. Mathews; the award of a QSM for public service to one of our Foundation Members, Mr L.S. Spackman; a Royal Society of Chemistry Centenary Lectureship to Professor W.R. Roper; the RACI Rennie Medal to Dr M.G. Banwell; The Phillip Allen Memorial Award by the International Forensic Society to Dr P.E. Nelson et al; a Prince and Princess of Wales Award to Mr L.H. Boulton. Congratulations are offered to Associate Professor W.A. Denny, Dr P.G. Roughan and Dr C.C. Winterbourn on their election to Fellowship of the Royal Society of New Zealand and to Miss J.J. Gibson, Manawatu and Miss M. Service, Waikato, on winning Young Scientists Awards.

Conference

The Institute is grateful to Dr Peter Nelson (Chairman), Paul Farr (Secretary) and the Committee for organising the Joint Conference with the NZ Biochemical Society at the Sheraton Hotel and the University of Auckland, August 24-28, 1987.

The Conference theme "Commercialisation of Chemistry" was a response to the "user pays" philosophy current in New Zealand science, designed to attract participation by industrial chemists and their employers.

The Committee broke new ground in the employment of a professional organiser. Audited accounts showing a surplus of almost \$3,000 were presented to Council's February meeting.

As this was the first Conference held since the introduction of GST, negotiations with the Inland Revenue Department continue.

Overseas speakers were Professors George Pimentel, Immediate Past President of the American Chemical Society, David Williams, University of Wales Institute of Science and Technology, Ronald Kydd, University of Calgary, Derek Saunders, Cranfield, UK, Fred Plapp, Texas A and M University, Drs William Hancock, Genetech Inc., Nicos Nicola, Melbourne, Robert Bucat, Perth, David Cowan, London.

Non-Corporate Grades of Membership

As reported p.165, December 1987 issue of "Chemistry in New Zealand", a ballot of Corporate members of all six Branches was in favour of the motion that "The three Non-Corporate grades of Technician, Graduate and Associate be amalgamated into one Non-Corporate grade henceforth to be known as Associate". Council resolved to adopt this motion in February. Henceforth the Graduate and Technician categories of membership will not appear in the membership statistics of the Annual Report. Arrangements are in hand for the necessary rule changes.

Recruitment

Membership continues to rise — by 31 compared with 19 last year — despite the increases in subscriptions designed to build a fund for better service to members through a more expensive central secretariat service to Council officers, committees and Branches.

Services to members such as the salary survey, the "Jobs for Chemists Survey" published in June, the Chemists' Support Package, Survey of Consultants' fees, new policy contributions to Branches for student travel, a recent adjustment to the formula for calculation of Branch grants to assist our smaller Branches et al are the result of effort by individuals and a rising subscription income. Council's resolution to appoint a marketing officer to aid recruitment by Branches will be reviewed in August 1988.

Chemical Education

The first Annual Report of the Chemical Education Trust was published in the June issue of "Chemistry in New Zealand".

The 1987 National Chemistry Week was reviewed in the October 1987 issue.

These initiatives, in addition to the Chemical Education Award, Chem V AAVA Prize and Branch Prizes for University and Technical Institute students, the ongoing preparation of Chem NZ, now produced in Wellington by Gary Burns of Victoria University and his committee, the imminent publication of Volume II of "Chemical Processes in New Zealand", in Auckland by John Packer and his colleagues, the Manawatu Branch Education Trust disbursements to schools in its area and the Chem 13 News Exams arranged by Mark Perkins are other examples of the considerable and growing commitment of NZIC to promoting secondary and tertiary teaching of Chemistry.

Public Affairs and Science Policy

Dr Joyce Waters and the members of the Public Affairs and Science Policy Committee have responded to the request of the President of the Royal Society of New Zealand for help in submissions to the Science and Technology Advisory Committee established by the Government in response to the Beattie Report. The chairman of this Committee (STAC), Mr R. Arbuckle, is a chemist, formerly chief executive of ICI New Zealand. Professor R.E.F. Mathews, Hon FNZIC, is a member.

The importance of obtaining consensus amongst the diverse group of chemists and biochemists who are members of NZIC, on a limited number of projects of national economic significance, has been raised by a former President. Branch discussions and submissions to NZIC's Annual General Meeting are possible contributions to progress towards such consensus.

Finance

The audited balance sheet shows an excess of expenditure over income of \$2,412. Overall this is quite a good result but the balance sheet should be read with several qualifying factors in mind. These are: \$8,003 is still due from Inland Revenue Department arising from GST payments for the 1987 Conference — assuming IRD accept the full claim; there are unfunded

Continued next page

INCOME AND EXPENDITURE FOR YEAR ENDED 30TH APRIL 1988

1986/87	1987/88	1986/7	1987/8
\$	\$	\$	\$
EXPENDITURE		INCOME	
ADMINISTRATIVE AND SUNDRY EXPENSES		76,363	Subscriptions 81,433
1,825	Accountancy/Audit Fee 2,077	3,165	Interest Received:
	Ballot Costs 553		— Bank of New Zealand 722
	Branch Expense Grants		— BNZ Finance Ltd 2,011
9,615	— Re Capitation Fees 9,905	31	— Local Body Stock 31
3,000	— Re Student Travel 3,000	189	— Royal Society of New Zealand
3,006	Computing, Address Labels etc 2,135	264	— UDC Group Holdings
	Conference Registrations 990	1,370	— AGC (NZ) Ltd.
641	— Council Donations	5,019	
	Prince & Princess of Wales		2,764
3,000	Science Awards Scheme 2,000		Conference Surplus
120	Chem 13 Exam Expenses		— Auckland 2,873
9,552	Honoraria & Allowances 8,903	2,553	— Dunedin —
987	ANZAAS Conference Contribution —	546	— Genetic Manipulation —
	National Chemistry Week Expenses 1,832		— A.N.Z.A.A.S. Conference Refund 413
1,773	Overseas Visitors Expenses 2,069	137	Sale Ties and Scarves — Net Surplus 40
10,547	Printing, Stationery, Stamps 8,653		Excess of Expenditure Over
550	Prizes 496	4,838	Income for Year 2,412
	Subscriptions		
631	— Royal Society of N.Z. 631	<u>\$89,456</u>	<u>\$89,935</u>
160	— S.A.N.Z. 190		
50	— I.P.E.N.Z. 50		
614	— F.A.C.S. 300		
60	— N.Z Futures Trust 60		
10,170	Travelling Expenses 9,800		
<u>491</u>	Depreciation 355		
56,792		53,999	
PUBLICATIONS			
22,110	Journal — Publisher 20,855		
2,000	— Editor 2,249		
1,161	Chem NZ 817		
	Sundry Publications 2,278		
1,510	Sundry Publications for Resale 2804		
<u>26,781</u>		<u>25,916</u>	
2,027	Less: Publication Sales 3,087	79,915	
<u>24,754</u>		10,020	
81,546	TOTAL EXPENSES:		
7910	Proposed Transfer to Development Fund (\$6/Member)		
		<u>\$89,456</u>	<u>\$89,935</u>

These accounts must be read subject to the attached notes.

NEW ZEALAND INSTITUTE OF CHEMISTRY (INC) NOTES TO FINANCIAL STATEMENTS

STATEMENT OF ACCOUNTING POLICIES:

General Accounting Policies

The measurement base adopted is that of historical cost. Reliance is placed on the fact that the entity is a going concern. Accrual accounting is used to match expenses and revenue.

Particular Accounting Policies

The Financial Statements have been prepared on a GST exclusive basis.

Goods and Services Tax These accounts have been prepared on a G.S.T exclusive basis.

Subscriptions Arrears and Sundry Debtors are stated at expected realisable value.

Depreciation Has been charged using the straight-line method based on an estimated 5 year economic life of the assets concerned.

Investments Are stated at cost or, where applicable, with the addition of interest compounded to date.

R. Neidlein in March. His itinerary included a meeting in Rotorua with members of the Waikato Branch based in that area.

Acknowledgements

The Council is deeply appreciative of the time, expertise and effort given voluntarily by many members. To those who have participated and assisted with our programmes, Council offers sincere thanks. Please consider the 1988 Branch elections and decide in which way you can best promote NZIC and our profession in the period of change and development before us.

T.R. Hitchings, President
J. Rogers, General Secretary
26 July 1988

RSC GRANTS AND FUNDS

Associate Professor John Packer, as local representative of the Royal Society of Chemistry, would like to advise readers of the various grants and funds which are available from that organisation.

New Zealand receives a limited amount of money each year from the Royal Society of Chemistry which can be used to help to pay some of the expenses of members of the Society visiting and giving lectures in New Zealand, or to help in some way related to the Society. This finance is divided into three portions, and Profes-

sor C.E. Phillips at Canterbury and Professor R.J. Ferrier at Victoria disperse the allocation for the South Island and lower North Island respectively.

In addition to this, a number of other grants and funds are available for which New Zealand members of the RSC may wish to apply. These include:

The RSC Research Fund, to assist members in their research by the provision of grants for e.g. the purchase of chemicals and equipment, running expenses, etc.

The Corday-Morgan Memorial Fund, to assist members to

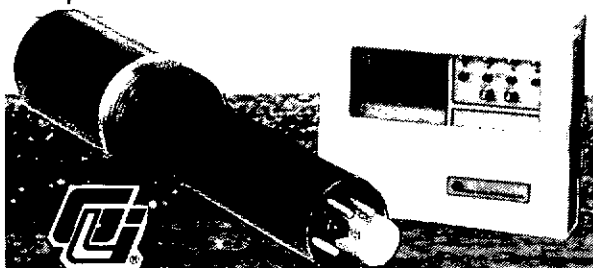
visit chemical establishments in another Commonwealth country — usually as an additional stopover to an existing trip. (Non-members of the RSC may also apply for this).

Grants for Visits to Developing Countries — similar to the Corday-Morgan Memorial Awards, but for visits to developing countries.

For further information on the above, or other matters relating to the RSC, contact Associate Professor J.E. Packer, Chemistry Department, University of Auckland, Private Bag, Auckland.

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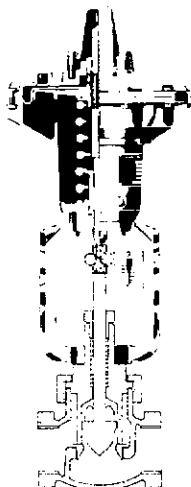


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NEW ZEALAND INSTITUTE OF CHEMISTRY CHEMICAL EDUCATION TRUST

INCOME AND EXPENDITURE ACCOUNT FOR THE PERIOD TO 30TH APRIL 1988

INCOME	
Interest Receivable	5,168.86
LESS EXPENSES	
Legal re Trust Formation	908.20
Postages & Bank Fees	85.80
Publicity	<u>223.96</u>
	1,217.96
NET INCOME	<u>3,950.90</u>
Proposed Distribution to Branches	<u>2,400.00</u>
RETAINED BY TRUSTEES	<u>\$1,550.90</u>

BALANCE SHEET AS AT 30TH APRIL 1988

CURRENT ASSETS	
Bank of New Zealand —	
Cheque Account	6,682.22
Interest Accrued	<u>501.25</u>
	7183.47
INVESTMENTS	
A.G.C. (N.Z.) Ltd	
Debenture 17% due 22.9.89	15,000.00
Equiticorp Holdings Ltd	
Debenture 16.5% due 29.1.91	<u>21,000.00</u>
	36,000.00
TOTAL ASSETS	<u>\$43,183.47</u>
REPRESENTED BY:	
TRUST CAPITAL	
Initial Settlement from N.Z.I.C.	20,000.00
Donations and Pledges	
Received Subsequently	<u>19,232.57</u>
	39,232.57
Add Retention to 30.4.88	1,550.90
	40,783.47
PROVISION for Distribution to Branches	<u>2,400.00</u>
	<u>\$43,183.47</u>

NEW ZEALAND INSTITUTE OF CHEMISTRY CHEMICAL EDUCATION TRUST NOTES TO FINANCIAL STATEMENTS

STATEMENT OF ACCOUNTING POLICIES

General Accounting Policies

The measurement base adopted is that of historical cost. Reliance is placed on the fact that the entity is a going concern.

Accrual accounting is used to match expenses and revenues.

Particular Accounting Policies

Investments

Have been stated at cost, or where applicable, with the addition of interest compounded to date.

Goods and Services Tax

These accounts have been prepared on a G.S.T. inclusive basis.

AUDITOR'S REPORT

We have audited the financial statements of the New Zealand Institute of Chemistry Chemical Education Trust in accordance with accepted auditing standards, and have carried out such procedures as we considered necessary. In our opinion, the financial statements give a true and fair view of the financial position of the Trust as at 30th April 1988.

AINGER TOMLIN
Chartered Accountants

Christchurch

NZIC OFFICERS AND MEMBERSHIP 1987/88

NZIC Elected Officers:

President: T.R. Hitchings; 1st Vice-President: Dr D.R. Llewellyn; 2nd Vice-President: Dr J.M. Waters; Hon. General Secretary: Dr J. Rogers.

Branch Delegates to Council:

Auckland: Dr S.J. de Mora; Waikato: Dr R.T. Gallagher; Manawatu: Dr A.K.H. MacGibbon; Wellington: Dr R.S. Whitney; Canterbury: Dr B.E. Williamson; Otago: Dr K.A. Hunter.

Officers Appointed by Council:

Registrar: D.J. Hogan (31/12/88); Admin. Secretary: Mrs N.E. Wignall (31/12/88) Journal Editor: Dr B.W.L. Graham; Hon. Librarian: Dr E.W. Ainscough; Archives Officer: Dr R.F.C. Claridge (31/12/88); Marketing Officer: P.G. Best (31/12/88).

Obituary:

We record with regret the deaths of the following members: D.S. Adcock, C.J. Highley, R.T.W. Learnan (Auckland), R.B.S. Rao, C.R. Tilly (Waikato), O.K. Sewell (Manawatu), K.S. Birrell (Wellington), M.T. Hunter, D.J. Tennent (Canterbury), M.V.B. King (Otago).

COUNCIL COMMITTEES:

Standing:

President T.R. Hitchings; Delegate from President's branch, Dr B.E. Williamson; Gen. Secretary, Dr J. Rogers; Registrar (ex-officio).

Finance and Honours:

President, T.R. Hitchings; 1st Vice-President, Dr D.R. Llewellyn; 2nd Vice-President, Dr J.M. Waters; General Secretary; Registrar.

Membership:

Dr G.J. Wright (31/12/88); Dr R.J. Furkert (31/12/89); P.G. Best (31/12/90).

Publications:

Dr R.T. Gallagher; Dr R.A. Franich; T.K. McGhie, N.A. Decon.

Editorial:

Editor, Dr B.W. Graham; Dr W.A. Denny; Dr A.C. Herd; D.M. Fenton; Dr J.H. Carside; Dr P.E. Nelson; Dr R. Whiting; C.L.H. Stonyer.

Public Affairs and Science Policy

Dr J.M. Waters (31/12/90); Dr I.D. Watson; Dr M.T. Brimble; President (ex-officio).

Chemical Education:

C.W. Valpy; Dr R.S. Whitney; W. Freitag; Dr W.R. Sharman; Dr W.C. Tennant.

Environmental:

Prof. R. Laverty; Dr P.W. Larking; Dr R.A. Smith; Dr G.F. Laws; Prof A.D. Campbell; Dr W.A. Temple; Dr K.A. Hunter; (Corres.M.): Dr S.J. de Mora, Auckland; Dr F.B. Shorland, Wellington.

Hazardous Chemicals:

Dr J.L. Love; Prof R.B. Keey, Dr M. Gray (Corres.M.): R.H. Hopgood, D.J. Ogilvie (Auckland); Dr W.P. Judd (Waikato); Dr G.A. Lane, Dr D.F. Newstead (Manawatu); Dr W.A. Temple (Otago); A.A. Turner, Dr G.P. Irwin (Wellington).

Representatives to other bodies:

AAVA: W. Freitag (31/3/88); N.R. Edmonds
SANZ: Dr H.J. Percival (NZIC is not represented on the new SANZ Council)
RSNZ Member Bodies management C'tee: Dr H.J. Percival.
UNESCO NZ c'tee: Dr G.R. Burns.

Membership:

During the year the following changes in membership have occurred:

Hon Fellows 2	
Fellows elected from membership 3	
Members (new 22, elected from Graduate 20, Associate 3, Technician 1.)	
Associates (new 3, elected from technician 4, Graduate 1.)	
Technicians 6	Deaths 10
Graduates 32	Resignations 40
Students 45	Struck off 27

MEMBERSHIP STATISTICS: APRIL 30 1988

BRANCH	HON.F	FELLOW	MEMBER	ASSOC.	GRAD.	TECH.	STUDENT	TOTAL
Auckland	10	76	261	31	51	12	41	482
Waikato	5	24	90	6	24	1	5	155
Manawatu	0	31	99	7	5	2	5	149
Wellington	8	68	224	6	26	0	17	349
Canterbury	8	68	113	5	26	2	10	232
Otago	1	49	50	1	12	1	2	116
Overseas	4	29	140	3	16	2	2	196
TOTAL:	36	345	977	59	160	20	82	1679

Branch Membership:

April 30	1985	1986	1987	1988
Auckland	406	424	466	482
Waikato	148	164	152	155
Manawatu	148	151	154	149
Wellington	344	349	339	349
Canterbury	214	215	227	232
Otago	133	131	123	116
Overseas	195	195	187	196
Total:	1561	1588	1629	1679

Specialist Groups:

Group	Secretary	NZIC	Non-NZIC	TOTAL
Analytical	DJ Hogan	51	2	53
Chemical Education	DT Howarth	177	365	542
Chromatography	DR Webster	122	154	276
Electrochemistry	AJ McQuillan	29	27	56
Fats and Oils	SF Hobbs	27	14	41
Geochemistry	B Christensen	36	85	121
Inorg. & Organometallic	G Bowmaker	77	25	102
Organic Chemistry	A Abell	84	4	88
Polymer Chemistry		49	28	77
Thermodynamics	GR Hedwig	15	3	18
X-Ray Crystallography	GJ Gainsford	24	3	27

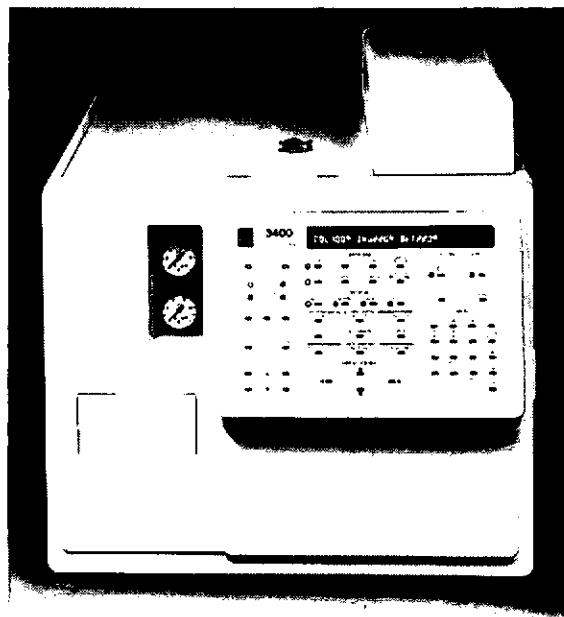
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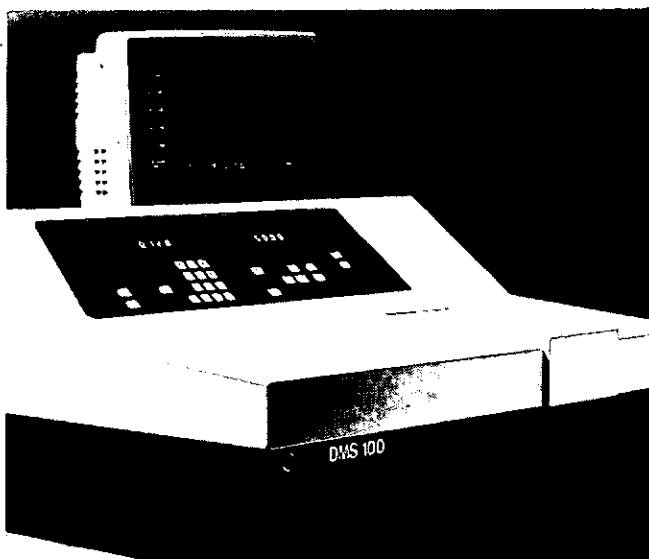
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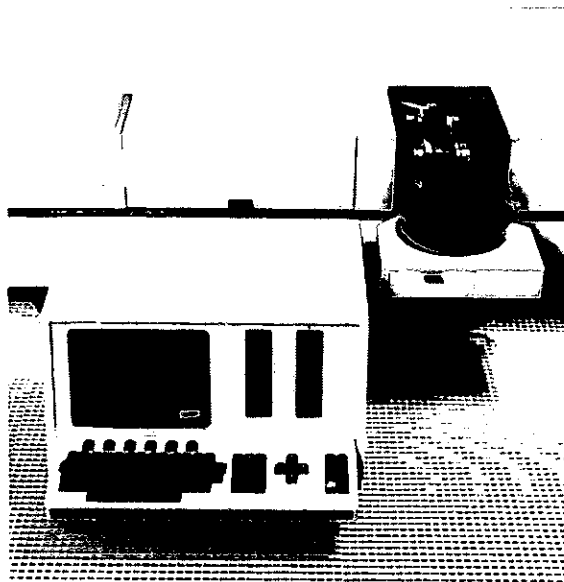
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LETTER FROM AUSTRALIA

Readers of "Chemistry in Australia" will be familiar with the "Letter From Monash" contributed by Ian Rae, which appears in each issue. There is much about our over-Tasman sister publication that we have considered with envy for some time now, and Ian's 'column' is not the least of these. We were therefore delighted to receive the following contribution from Ian, and have asked, hopefully, for more.

The bicentenary of European settlement in Australia, which is being celebrated throughout 1988, has produced an orgy of historical reviews and presentations. It came at a time of increasing interest in our history, with eager family historians swelling the membership lists of genealogical societies around the country.

The Royal Australian Chemical Institute was not unaffected. In 1987 it established a History and Archives Committee under the leadership of Dr John Spink, of CSIRO. Although full Divisional status is some way in the future, the Committee is quite active and organised an

afternoon session at the national convention in August. Spink has also co-operated with the Australian Science Archives Project, based at the University of Melbourne, to preserve microfilm essential documents.

RACI will also hold a one-day history meeting in Melbourne in November 1988. This year is also a centennial one for ANZAAS — the Australian and New Zealand Association for the Advancement of Science, who marked the occasion with a Jubilee Congress in Sydney last May. The heyday of chemical contributions to ANZAAS seems to be over, with only occasionally a chemist taking part in some more socially-oriented program.

The tide of chemistry at ANZAAS was once at the flood, and this history is the subject of one chapter in the commemorative volume *The Commonwealth of Science*. RACI is arranging for offprints of this chapter to be made available at a small charge for those who do not wish to purchase the full volume.

Interest in history of chemis-

try is not confined to chemists, however, and a major contributor is Professor Roy MacLeod, of the University of Sydney, who edited the ANZAAS volume. MacLeod is a well-known historian who focusses his work on the interactions between Britain and the Empire (later Commonwealth). He has written, for instance, about the work of A.E. Leighton, who recruited over 100 Australian chemists to work in British munitions factories during World War I. Leighton was an Englishman who had come to Australia before the war to head munitions work, but was recalled in 1914. After the war, he returned to Australia to continue his work, which he did with conspicuous success which extended to his coming out of retirement to head Australian munitions work in 1939-1945.

The munitions chemists in World War I worked under the direction of South African (although American-born) K.B. Quinan. Most of the Australians returned home, but no official records of their service have survived, leaving MacLeod to sift News and obituary columns in journals, augmented by personal memoirs and some details from the Australian Archives.

I don't know whether any New Zealanders were involved in this work, but something similar happened in World War II days when New Zealand chemists came to Australia to work in munitions factories. Again, there are no official records, but I wonder if there are untapped sources of information in New Zealand? I would be interested to hear from anyone who knows of New Zealand chemists who took part.



Ian D. Rae

BOOK REVIEW

CHEMISTRY FOR SIXTH FORMS by A.H. Woof, D.T. Howarth and R.C. Rendle. Longman Paul Ltd, 1987, 679 pages. ISBN 0-582-85728-7

'Chemistry for Sixth Forms' has been written for the current sixth form syllabus. For most students studying chemistry at this level, this will be their first study of the subject and for many their last! Some will go on to the seventh form and first year university. Only a minority will go on to study chemistry at a higher level. It is with these thoughts in mind that I read this book.

My first impressions were that it is an attractively produced and printed book with lots of pictures (some in colour). The many biographies of famous chemists and extension inserts will challenge and excite the curious student. The first 20 chapters, in the main, cover the core material of the syllabus and the last 5 chapters cover material which can be used for options (Consumer

Chemistry, The Chemistry of Foods, Aspects of Soil Chemistry, Fluoride and Lead — Two Health Issues, and Copper and its Compounds). Chapter 18 (Some Aspects of Industrial Chemistry) is an interesting one and is intended to be used as a source of information rather than used as a whole. The book also has a separate Teachers' Guide.

It is good to see the number of references in the text to chemistry as it is carried out in this country (e.g. sulphuric acid production, the Mobil process and so on) but it is a pity the authors did not use as an example of a protein structure, in Colour Figure 2, one determined in New Zealand by Dr Ted Baker at Massey University, rather than haemoglobin. Further links to New Zealand could have been provided in Dorothy Hodgkin's biography, as a number of well known New Zealand chemists have spent time working in her laboratory.

I tried the sections in Chapters 5 and 15, on oxidation-

reduction reactions, on a group of students with little or no chemistry background. In general their reaction was favourable and they found it a good introduction to the topic which improved their understanding and confidence. The extensive problems provided were very helpful but several students did not like the introduction of fractions into chemical equations as in $Mg + \frac{1}{2}O_2 \rightarrow Mg^{2+} + O^{2-}$

Any criticism of the book is related to the syllabus the authors were forced to follow rather than the book itself. I still think there are too many theoretical concepts being introduced into what is, as mentioned above, the first and probably only serious study of chemistry for most pupils. Have you ever seen V-shaped water molecules or two atoms colliding? Let's not kid ourselves that chemistry is physics! How often do we hear that chemistry is a "hard" subject? It does not have to be but it will remain so while the syllabus is crammed with far too much material both

theoretical and factual. I feel that it will be the brighter students that get the most from this book.

The book is a significant contribution to chemical education in New Zealand. I congratulate the authors on its production and hope it is widely used in all New Zealand schools.

Andrew Brodie,
Massey University.

IUPAC Affiliate Membership Scheme

Readers are reminded that IUPAC Affiliate Membership is available through the Registrar, NZIC. Benefits of the scheme include free subscription to "Chemistry International", reduced fees at IUPAC conferences and discounts on IUPAC publications. For further information contact the Registrar, PO Box 29-182, Christchurch.

UNIVERSITY NEWS



B. R. Penfold

Canterbury

At the end of May **Professor Bruce R. Penfold** retired from the staff of the Chemistry Department of the University of Canterbury after a 39 year association. His earlier student years were so scholastically distinguished that he was able to take extended leave and obtain a PhD degree from Cambridge University where he specialised in X-ray crystal structure analysis. In carrying out this work he became one of the first New Zealanders to have working experience with computers. His subsequent academic career was profoundly influenced by this experience.

Back at Canterbury during the spartan 1950's he introduced X-ray powder diffraction and then had a single crystal camera built in the Department so that full structure analyses became possible, even if very time consuming. After his first study leave, an extended period with later Nobel Laureate, Professor William Lipscomb at the University of Minnesota and at Harvard University, he joined forces with an engineer and persuaded a sympathetic geographer, who was also the Vice Chancellor, that the University had to find some way to get its own digital computer. An IBM 1620 was eventually purchased with considerable assistance from the Mobil Oil Company. The universities of New Zealand, who all used it or envied it, were launched on an inevitable development which has proven to be supremely important in all technological disciplines, very important in most others and an essential tool in university administration and secretarial work.

Bruce marshalled the computer programs and attracted students to address problems in structural chemistry at an increased tempo. Many who had their first experience with him, and before the days of more formal computer training, have made successful careers

in applications and management of computers in diverse areas within chemistry and also well outside of it.

Research funding improved during the 1960's so that by 1969, Bruce was able to obtain the then huge grant, (\$85,000) to buy New Zealand's first computer controlled automatic single crystal diffractometer, thereby initiating a new era in the productive application of this technique. Now, 20 years down the track, one person can produce data for 180 analyses a year.

The 1970's saw Bruce very much in demand for administrative work inside the University, on many committees, including the University Council, and outside on the Royal Commission on Chiropractic Professionalism. He has been involved in the wider scientific communities including ANZAAS, the Royal Society of New Zealand, the Society of Crystallographers in Australia and the International Union of Crystallography, and also served a period as chairman of the Curriculum Committee for 6th form chemistry syllabus revision.

Ever mindful of the inexorable impact of silicon chips, Bruce has, during the 1980's put a lot of effort into the development of instructional teaching programs based on micro computers. During his seven years as Head of Department he has also moved all secretarial, accounting and inventory work onto these machines.

Outside of chemistry Bruce has made his considerable experience available to many community organisations, in particular in the music and sporting worlds. He goes into retirement as current President of the New Zealand Hockey Association and with a new personal microcomputer. Doubtless these will become intertwined.

Professor G.H.N. Towers, Department of Botany, University of British Columbia, Vancouver, will be an Erskine visitor in the Department of Plant and Microbiological Sciences in July/August this year. His expertise is in the fields of phytochemistry, medical and ethnobotany, photobiology and chemical ecology.

Auckland

Dr Geoff Duffy has been appointed to a personal chair in the Department of Chemical and Materials Engineering at the University of Auckland.

His research in the flow and

behaviour of wood pulp fibre suspensions has led to improvements in the design of pulp-handling equipment around the world. He has designed and developed systems for pulp and paper plants in New Zealand, Australia, the United States, Sweden, Denmark and Finland.

Professor Duffy, who is 49, was born in Australia. He gained a Bachelor of Science from the University of New South Wales and a PhD from Auckland, has taught at the University since 1969 and been an Associate-Professor since 1976.



Prof. Duffy

He has published over 85 papers and reports, holds five patents and has produced 13 special reports for the paper industry. He was made a Fellow of the Royal Society of New Zealand in 1987. He has his own consulting company.

Professor Duffy has just completed 2½ years as the foundation Director of PAPRO (Pulp and Paper Research Organisation of New Zealand) and will continue his close association, as a member of the Research Advisory Committee of PAPRO.

Waikato

The Chemistry Department's move into Apple Macintosh Computer hardware has seen the acquisition of some sophisticated software to match. The programs ChemDraw (Version 2) and Chem3D allow high standard reproduction of two and three-dimensional images. As a result, the overall standard of thesis and research paper presentation should improve markedly.

The university's Science Education Research Unit has had some notable visitors over the last two months. **Dr John K. Gilbert** of the Department of Educational Studies, University of Surrey, visited SERU for two weeks at the beginning of June, and also visited the Department of Education in Wellington. **Dr Reinders Duit** of the Institute

for Science Teaching Studies, University of Kiel, Germany, was on campus for two weeks to discuss LISP (Energy) and other research.

A student of the Chemistry Department for the last seven years **Chris Adams** recently completed his D.Phil thesis on kinetic studies of chalcone epoxides, and is contemplating post-doctoral research in Adelaide.

Dr Lyndsay Main and **Dr Tony Cartner** have just returned from 12 months leave in Cambridge and York/Edinburgh respectively. Both will have heavy teaching commitments and 1989 Conference organisation to look forward to over the next six months.

A recent graduate of Waikato, **Dr Louie Gommans**, has found a job! Louie will be working in the Coil Coating Division of New Zealand Steel as a Development Technologist.

Dr Chris Hendy departed in late June for a years leave, at Columbia University, New York.

Massey

Dr Martin Banwell from the Department of Chemistry, University of Melbourne, recently visited the Department of Chemistry and Biochemistry and gave a lecture on the synthesis of some tropane natural products. Dr Banwell now has a number of affiliations with Massey, having previously been a colleague of **Drs Joyce Waters** and **Margaret Brimble** at Auckland University and having been a fellow student with **Dr David Officer** at Victoria University. Consequently, his visit was an enjoyable one both personally and professionally.

Otago

The Chemistry Department is to introduce a new format for second year courses in 1989. Several papers will be offered which integrate aspects of analytical, applied and biological chemistry reflecting research moves in this direction.

Professor Edward Goldberg of the Department of Chemistry, Scripps Institute of Oceanography, La Jolla, California was a visiting lecturer in the Chemistry Department for a month from 20 June. Professor Goldberg is a noted authority on marine chemistry, particularly global marine pollution and was one of the founders of the "Mussel Watch Program". He recently chaired the CHEMRAWN IV (Chemistry Research Applied to World

Continued next page

BRANCH NEWS

Waikato

Associate Professor Malcolm Carr of the university's science education research unit is a member of the Royal Society Standing Committee on Science Education, representing NZIC. This committee organised a forum on Science Education in Wellington on May 12th. **Professor Peter Fensham** of Monash University was an invited speaker, and the forum aroused considerable interest and discussion. The Standing Committee has met several times, most recently on June 15th.

The Waikato Branch was visited by the current Institute President, **Terry Hitchings**, on June 22nd. A low attendance at the meeting was disappointing, but was compensated for by some lively discussions after the formal part of the evening was over.

Manawatu

On 15 and 16 March, **Professor Richard Neidlein** from the Institute of Pharmaceutical Chemistry in Heidelberg, West Germany, visited Palmerston North as part of his four week lecture tour of New Zealand. His first lecture, to the Branch, highlighted the development of the pharmaceuticals industry in West Germany. The following day, at Massey University he eloquently described some of his own work, showing how strained "unnatural" molecules can be exploited for the synthesis of new useful heterocyclic species.

During his stay, Professor Neidlein held discussions with

chemists at the DSIR, DRI and Massey University.

On 17 May, **Dr Kenneth MacKenzie** (Chemistry Division, DSIR, Gracefield) gave a most interesting talk on "Ceramics — Materials of the Past, Present and Future". Dr MacKenzie traced the history of the discovery of low-tech ceramic products such as pots, vases, porcelain, glass and cement. Only in recent years has an understanding of chemical reactions involved in forming some of these products come to light. Techniques such as X-ray crystallography, solid state NMR and X-ray fluorescence have yielded much valuable information. Dr MacKenzie, along with others, was instrumental in pioneering the application of solid state Si-29 NMR studies in obtaining an understanding of the structure of meta-kaolinite obtained from heating kaolin. Present ceramics, such as TiN, Si₃N₄, TiO₂, ZrO₂, and SiO₂ (finely divided from geothermal fluid) and their uses in cutting tools, piston crowns etc. were discussed. Finally, future ceramics for the engineering and electronic industries were briefly mentioned.

Mr Terry Hitchings gave his Presidential Address, entitled "1988 — A Turning Point in the Affairs of the Institute", to a dinnermeeting of the Branch on 9 June. He also presented the Branch's 300 — level prizes to students of the Department of Chemistry and Biochemistry of Massey University. **Roger Cresswell**, who completed a BScHons degree last year and is currently studying aspects of the inorganic chemistry of copper complexes for a PhD, was awarded the chemistry prize. The biochemistry prize was awarded jointly to **Catherine Day**, a PhD student studying molecular biology, and **Julian Reid**, a technician who is continuing part-time with his BSc course on sequencing proteins.

After briefly discussing the development of the Institute of Chemistry, its current structure and activities, Mr Hitchings outlined the problems that the Institute is now facing. He pointed out that it is difficult to compare the Institute with similar organisations overseas. As an example, all of the income of the Institute comes from member subscriptions whereas this form of income is but a small part of the operating cost of, say, the American Chemical Society which has a large publishing and information dissemination activity. Finally, Mr

Hitchings discussed the increase in member subscriptions of other professional organisations and of trade unions and the need to provide an improved secretariat.

Mr Hitchings also visited the Hawkes Bay Section in Hastings on 8 June and Taranaki Section in New Plymouth on 21 June.

On 29 June, **Dr Margaret Lawton**, Section Leader of the Criminalistics and Forensic Biology Section of DSIR's Chemistry Division, Auckland, presented a most timely address to the Branch titled "DNA Typing in Forensic Science". Dr Lawton outlined the development of forensic science (which she described as the science-law interface) in New Zealand, with emphasis on the various procedures of blood typing. She described the procedure of DNA typing (commonly known as "DNA" fingerprinting") and improvements now being developed to enhance this method of crime detection. This meeting proved to be a success for the Branch, attracting a large and enthusiastic audience of members as well as students from Massey University and the Manawatu Polytechnic.

Otago

Branch members enjoyed their annual social event on 2 June. This consisted of a wine tasting evening at the University of Otago Staff Club.

The R.E. Corbett Lecture was given on 16 June by **Dr Murray**

Munro of the Chemistry Department, University of Canterbury. The topic of his address was "The Search for Antiviral and Antitumour Activity: are New Zealand Marine Invertebrates a Source?"

Canterbury

45 branch members, in two groups, recently visited Giessen's Wine Estate just south of Christchurch. The groups were shown the whole wine making process from picking the grapes to drinking the final product. The latter was conducted in a most convivial atmosphere with a knowledgeable sommelier in attendance.

GOVT DEPTS.

Chemistry Divn, DSIR, Christchurch

Dr Richard Vannoort has gone on study leave to HOLLAND for a year. He will be studying supercritical fluid chromatography with Professor Frie of Amsterdam University.

Dr Michael Taylor, **Mr Peter Hentschel** and **Dr Rob Martyn** went to an International Forensic Science Symposium in Brisbane during May. Dr Martyn went on to visit laboratories in Adelaide, Melbourne and Sydney.

Dr Jeffrey Plowman recently returned after 6 months with the Division of Horticultural Processing in Auckland.

NOTICE

NZIC Annual General Meeting, 1988

The Annual General Meeting of the New Zealand Institute of Chemistry will be held at 6 p.m. on Thursday 25 August, 1988 at the Hokowhitu Campus — Manawatu Polytechnic/Teachers College — Palmerston North.

Agenda

1. Welcome by the President, Mr T.R. Hitchings.
2. Apologies
3. Minutes of the 1987 AGM.
4. Matters arising.
 1. Chemical Education Trust.
 2. Non-Corporate Grades of Membership.
 3. Secretariat.
5. Annual Report for period to 30 June 1988.
6. Finance — 1987/88 statement of Income and Expenditure and Balance Sheet for year ending 30 April 1988.
7. Election of Officers: President, First Vice-President, Second Vice-President, General Secretary.
8. Prizes: Easterfield, ICI, Shell, Chemical Education, Chemical Essay, NZIC/RACI Visiting Speaker.
9. Honorary Fellowship.
10. General Business.

J. Rogers
General Secretary.

UNIVERSITY NEWS Continued

Needs) meeting held in Keystone, Colorado and sponsored by IUPAC.

Dr Lyall Hanton has recently obtained UGC funding for post-doctoral work on stacked metal complexes. **Justus Northolt** has returned to the University of Kassel, Federal Republic of Germany after spending three months working on FTIR spectroelectrochemistry with Dr Jim McQuillan and his research students.

The Nutrition Department was recently visited by **Professor Helen Guthrie**, Professor of Nutrition at Penn State University and President of the American Institute of Nutrition. Professor Guthrie spent one month in the Department sharing her expertise in the field of nutrition education and in public issues in nutrition.

CHEMICAL PROCESSES IN NEW ZEALAND

Volume Two

*Edited by J.E. Packer and R. Whiting.
Published by the New Zealand Institute of Chemistry.*

Volume two of "Chemical Processes in New Zealand" is now available. It contains 29 chapters, listed below, on topics different from those in the 1978 publication, which is now regarded as Volume One.

Chemistry in Agriculture

The Fate of Phosphate fertilisers in the Soil
Soil Acidity and Liming
Manufacture of Chlorotriazine Herbicides in New Zealand
Kapuni Ammonia-Urea Plant
Chemistry in the Wool Industry
Studies on Wax Esters in Fish
Processing of Crude Tall Oil and Crude Sulphate Turpentine
Sugar Syrups from Maize and Wheat

Energy

Synthesis of Automotive Fuels from Wood
The Manufacture of Methanol
Methanol to Gasoline — The Mobil Process
Re-Refining of Used Lubricating Oils in New Zealand
Refining Crude Oil

Environmental Chemistry

Air Pollution Monitoring
Chemical Treatment of Meat Processing Effluent
Geothermal Waters

Polymer Chemistry

Paints and Pigments

Metals

Anodising of Aluminium
Corrosion Protection of Metals
Chemical Cleaning

Chemicals

Production of Chlorine and Caustic Soda in the Kraft Pulping Industry
Fluosilicic Acid
Zinc Sulphate
Copper Sulphate

Batteries

The Manufacture of Lead-Acid Batteries
Dry Cell Production

Medicine

The Design and Development of Anti-cancer Drugs
The Clinical Chemistry Laboratory

The cost, including postage, is \$25 + GST (\$27.50 total). Copies may be obtained from Mr M.G.C. Gibson, 27 Galaxy Drive, Mairangi Bay, Auckland 10. (Make cheques payable to "NZIC Chemical Processes").

Copies will also be available at the forthcoming 1988 NZIC/NZBS and 1988 Scicon Conference, at an all up cost of \$25.

THERMAL ANALYSIS REVISITED

In our June issue we featured products available for thermal analysis. Since that time two further product ranges have come to light, as detailed below.

Perkin-Elmer

Perkin-Elmer offers a choice of two Thermal Analysis systems, the DELTA Series and the 7 Series, as well as a Differential Thermal Analysis instrument, the DTA 1700.

Both the DELTA Series and 7 Series Systems utilise the same thermal analyser modules which include the DSC 7 Differential Scanning Calorimeter, TGA 7 thermogravimetric Analyser and TMA 7 Thermomechanical Analyser.

Each analyser unit is completely computer controlled, providing real time data acquisition, sophisticated data analysis and data storage, multi-tasking operation and unattended operation. Single keystroke interactive software routines make for extreme ease of operation. Automatic calibration routines and system diagnostic routines are also software included. The major difference between the DELTA Series and the 7 Series Thermal Analysis systems is the computer and associated software that control the thermal analysers.

The 7 Series Thermal Analysis System, based on the Perkin-Elmer 770 Professional Computer as the system controller, permits simultaneous multiple operation of up to three thermal analysis instruments. The 7 Series is designed for laboratories having large workloads or performing research and development, quality assurance or materials characterisation studies.

The DELTA Series Thermal Analysis System, based on the Perkin-Elmer 3700 Data Station, provides complete computer control and data analysis for a single analyser. It is designed for laboratories with limited budgets or dedicated analyser requirements. Applications include quality control and materials characterisation studies.

The DELTA Series can be easily and economically upgraded to a 7 series configuration. Complete libraries of thermal analysis and general purpose software are available for use with both computers.

For further information please circle no. 8 on reader reply card.

System For Thermal Diagnostic Studies (STDS)

STDS is a unique laboratory system designed to probe the details of thermal decomposition processes. By combining a well-controlled and flexible thermal decomposition unit with the powers of GC-MS analysis, the STDS achieves unique experimental capabilities. This system can be applied to problems in hazardous waste incineration, fire safety, thermal stability of materials, optimization of catalytic processes, and many other areas.

A key feature of the STDS is the modular structure which permits customization of any of the components. The sample insertion area, for example, can be used for introduction of gaseous, liquid, solid, or polymeric samples. The high-temperature furnace (up to 1050°C) can be fitted with quartz test cells which are interchangeable and can be customised for the particular application. The sample insertion region and reactor are housed within an HP 5890 GC. The precise temperature control of the GC permits highly controlled admission of materials into the reactor and quantitative transport of materials throughout the system (no cold spots!). The thermal processor is interfaced to a control console which permits precise control of flows, pressures, residence times, temperatures, and gaseous atmospheres within the reactor chamber. Virtually any gas which is noncorrosive to quartz can be used in this system.

Downstream of the thermal processor is an in-line analytical system capable of cryogenic trapping, separation, and detection of thermal decomposition products. The thermal decomposition products can be separated using a capillary GC (e.g. HP 5890), a multidimensional GC unit, or even a supercritical fluid chromatograph (SFC). The detector for the unit could be an MS (e.g. the HP 5970B MSD) an FTIR (e.g. the HP 5965A IRD), a conventional GC detector, or a combination of the above.

The STDS has been developed by the University of Dayton Research Institute, and is available in New Zealand through Northrop Instruments.

For further information please circle no. 9 on reader reply card.

PRODUCTS FOR SURFACE ANALYSIS

Polymer Surface Analysis with SIMS

Until recently, surface analysis of polymers and other organics has been performed primarily by Electron Spectroscopy for Chemical Analysis (ESCA). ESCA is used because it provides the mild analysis conditions needed to ensure that the chemical structure of the organic remains intact throughout the analysis. ESCA also provides chemical bonding information not previously available with other surface analysis techniques. In contrast, Secondary Ion Mass Spectrometry (SIMS) has been used primarily for inorganic material analysis, especially in the semiconductor field where rapid depth profiling provides ppm-ppb detection limits for dopants and impurities.

Recently, however, SIMS has been used to examine contamination problems, surface chemical reactions and treatments, adhesion failures and biological materials. This technique produces molecular ion fragments, that are indicative of the particular chemical structure being analysed. These fragments provide unique fingerprints for different organic materials.

For further information please circle no. 1 on reader reply card.

New Surface Analysis Components Catalog Available From John Morris Scientific

A new catalog is now available to help customers select the

best surface analysis, molecular beam epitaxy, and vacuum components to suit individual research applications. Each section contains product descriptions, specifications, model numbers, related equipment, and ordering information. Special price lists, which include order numbers, brief product descriptions, and prices, are also available for domestic and international markets.

New Auger, ESCA, and SIMS Subsystems have now been added to the Physical Electronics components product line. These subsystems allow the latest PHI surface analysis technology to be incorporated into a customised system. Another new feature of the components product line is a Model 137 PC Interface Card, which allows operation of HI analyzer control electronics through an IBM-PC, XT or AT computer.

For further information please circle no. 2 on reader reply card.

Surface Analysis Equipment From VG Instruments

VG Instruments, represented in New Zealand by Advanced Analytical, offer a wide range of equipment for surface analysis, including the following.

STM 2000, Scanning Tunneling Microscope — an exciting new concept in surface characterisation which permits imaging of the electronic properties of surfaces on an atomic scale.

SIMSLAB MK III — a quadrupole-based instrument with

outstanding sensitivity and ion-optical gating for high performance depth profiling. Available with fast-atom bombardment for sample ionisation.

IX70S — for magnetic sector SIMS. Offering ultra-high vacuum and superb transmission, the IX70S offers a combination of outstanding speed and least possible detection limits. Mass resolution comfortably exceeds 25,000 to give you all the mass resolving power you need.

IX235, Time-of-flight SIMS — the most powerful instrument

for surface analysis currently available. Time-of-flight SIMS gives you a unique combination of chemical and spatial information for a broad range of applications.

All the above, plus the IX23L Laser microprobe, IX23F Field-ion atom probe microanalyser, and a wide range of ion guns, FAB sources, and bolt-on SIMS components, are available through Advanced Analytical.

For further information please circle no. 3 on reader reply card.

Kratos... from pg 79

The Mass Spectrometry Division concentrates most of its production in the high performance sector of the organic mass spectrometry market. The current product range includes the MS25 in various configurations, designed for GC/MS, and LC/MS, and SFC/MS application, while the MS25E has been specifically developed for environmental analysis.

The Concept modular mass spectrometer forms the basis of the remainder of the current range. This system allows high performance mass spectrometers to be configured exactly to meet the demands of a particu-

lar application within the laboratory. Unique to Concept is the possibility of extending or reconfiguring the instrument to meet future demands.

The Mass Spectrometry Division is also a world leader in high resolution mass spectrometry data systems. DS90 is a menu driven acquisition and processing data system, while the first 32 bit computing system for mass spectrometry, MACH 3, utilises a window based environment for data processing with a highly advanced man-machine interface.

For further information please circle no. 4 on reader reply card.

Acid And Slip-Resistant Quarry Tiles

A range of impact, acid and slip-resistant quarry tiles designed for flooring applications such as chemical processing plants, laboratories and dispensaries is being distributed by New Zealand Brickmakers. Imported from PGH in Australia, the tiles are slip-resistant even when wet and have a resistance to acids and other corrosive materials of 98.75 per cent.

For low maintenance and maximum hygiene, they are highly resistant to stains, easy to clean and can be supplied with matching coves. Used in conjunction with an epoxy grout, they significantly reduce the risk of fungus and bacterial growth.

The tiles are also aimed at conforming to the Code of Practice for the Reduction of Slip Hazards recently promul-

gated by the Standards Association of New Zealand.

Available in either buff or red, there is a choice of two surface treatments — matt and carborundum. The matt finish is recommended for floors which are constantly wet, such as breweries, and the carborundum finish for areas liable to become greasy.

Other uses include a wide range of food processing and preparation applications such as dairy factories, freezing works, canneries, commercial and institutional kitchens, and beverage plants.

The tiles are available from all Brickmakers Centres and other selected tile distributors. They come in three sizes — 230mm x 110mm x 25mm; 230mm x 110mm x 15mm; and 152mm x 152mm x 12mm.

PGH

ACID RESISTANT TILES



Suitable for Food Preparation, Industrial Wet areas, and Laboratories.

Exceptionally high dimensional tolerances, and have been tested at 98-75% acid resistance.

Finishes available include Unglazed Buff and Red (and Carborundum Impregnated) for excellent slip resistance and available in 230x110mm or 152x152mm sizes.

Contact Brickmakers on AUCKLAND 875-669, WELLINGTON 692-951, CHRISTCHURCH 795-140.

INSTRUMENTATION FOR HPLC

Five HPLC Modules For Liquid Chromatography

Northrop Instruments & Systems Ltd earlier this year introduced the Hewlett-Packard 1050 series of HPLC modules, allowing chemists to upgrade current modular HPLC systems to HP modules one at a time. The five modules have been designed to meet demanding requirements for accuracy, precision, sensitivity and reliability.

The five members of the HP 1050 series are:

1. Isocratic pump — the isocratic pump uses a serial dual-piston approach to solvent delivery, with variable-stroke volume to achieve flow stability across a wide flow range. Improvements in design and quality engineering add to the reliability and reduce the need for time-consuming maintenance.

2. Quarternary pumping system — the same single pump is the basis for the quarternary pumping system. Hewlett-Packard's own high-speed proportioning valve mixes the mobile phase at low pressure, which provides gradient capability for up to four solvents. A separate sol-

vent cabinet degasses and filters the solvents.

3. Variable-wavelength detector — the programmable variable-wavelength detector features high sensitivity, wavelength-switching and stop flow scanning. The detector's interchangeable cells meet the requirements of many different HPLC application areas.

4. Multiple-wavelength detector — the multiple-wavelength detector used diode-array technology for dual-wavelength monitoring scanning without stopping the flow. Chemists can obtain chromatographic data and peak-purity information simultaneously.

5. Autosampler — the auto-sampler's precision injection mechanism features programmable injection volume up to 400 microliters. Microprocessor control permits calibration routines independent of sample position and variable sample capacity (a 21-sample tray is included; a 100-sample tray is optional).

The five new modules are moved easily from one liquid chromatograph (LC) site to

another, so necessary in R & D laboratories where HPLC requirements may change frequently. QA/QC labs also benefit from modular versatility even when methods are fixed. Aging or unreliable modules can be replaced with Hewlett Packard quality as desired, increasing uptime and, more importantly, sample throughput.

Designed to be installed, operated and serviced by the chromatographers or technicians themselves, the Hewlett Packard 1050 series has kept the number of mechanical parts to a minimum, meaning there are fewer parts that can fail. There is no need for critical alignment or annual overhauls by the manufacturer.

Electronic diagnostics built into modules keep the user informed at all times, and signal when routine maintenance should be performed. The operator can access routine-maintenance parts directly when the front panel is opened, without removing the module from the stack.

New Diode Array Detection System For Liquid Chromatography From Philips Analytical
Philips Analytical has launched its new PU 6003 diode array system for liquid chromatography. Designed for use with the remarkably flexible PU 4021 or new PU 4120 diode array detector, the system uses Chromascan II — the most powerful software yet devised to solve the problems often encountered in liquid chromatography.

Chromascan II operates in the IBM environment and runs under multi-tasking Windows to get to the heart of the separation difficulty with exceptional ease. A range of peak purity tests are provided to assure total confidence in LC method validation. Additionally, a comprehensive set of data manipulation algorithms is available to prove even the most difficult of problems.

The user is always in command through storage, retrieval and documentation of all data, methods and manipulations to GLP standards. Full error logging and reporting alerts the analyst to any problems should they arise.

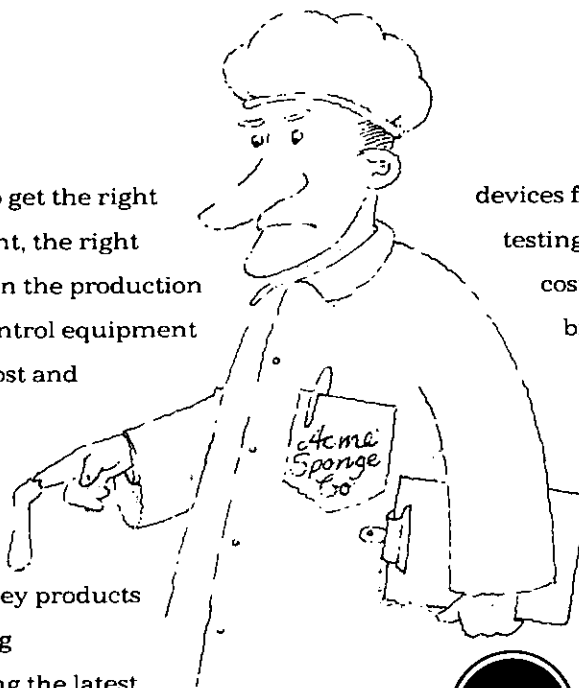
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devices for on-line weighing and testing that give you maximum cost savings. We also support our brands with expert backup service to minimise your downtime and maximise profits.

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INSTRUMENTATION FOR HPLC

graphics. Not only visually exciting, these graphics make on-screen work a joy and help enormously in a variety of operations, including the overlaying of normalised spectra.

Diode array data collection and display are coupled with a powerful integration package, giving a complete solution to the analyst's quantitation needs. And cost-effectiveness takes on a new meaning when a PU 6030 Data Capture Unit is added. Now data from any detector or any chromatograph may be integrated.

For further information please circle no. 5 on reader reply card.

Perkin-Elmer Releases Diode Array Detector For HPLC

Perkin-Elmer's new LC-235 detector combines diode array with UV technology in a stand-alone unit.

To its broad line of liquid chromatography instruments, Perkin-Elmer has now added the LC-235 Diode Array Detector, an instrument combining the power and flexibility of diode array technology with the high performance of a conventional, variable-wavelength UV detector in a stand-alone unit.

The LC-235 Diode Array Detector meets the needs of both research and routine analysis including pharmaceutical, chemical, environmental, polymer, biomedical, biotechnological, and any other analysis requiring liquid chromatography.

The dual-beam, high-energy optical system and optimised low dispersion flow cell provide low noise, minimum drift, and excellent detection limits.

The setup and operation of the LC-235 are simple and straightforward. The keypad/controller with LCD display uses eight function keys and clear prompts to make the LC-235 easy to use. The multitasking software allows both active and inactive methods to be edited while running the LC-235.

Special features include automatic peak purity determination; wavelength ratios; identification of wavelength of maximum absorbance; programmed and double-beam diode array optics, monitoring both sample and reference for all wavelength from 195-365nm.

For further information please circle no. 7 on reader reply card.

HPLC Equipment From Milton Roy

Since Laboratory Data Control was formed in 1969, the company has been at the forefront of Liquid Chromatography development. Early efforts centered on design and production of UV and RI detectors. In 1972, LDC became part of the Milton Roy Laboratory Group and added precision metering pumps to the product line. Today, LDC offers products that span the entire HPLC spectrum from the smallest tubing connection to state-of-the-art detectors and pumps to complete analytical and microbore liquid chromatographs.

CM4000 Multiple Solvent Delivery System

The CM4000 is a ternary gradient solvent delivery system capable of flow rates from 0.01 to 10mL/min. at pressures to 6000 psi. The CM4000 is fully gradient and flow programmable and can store up to 45 files in its onboard memory. An external slave pump can be controlled by the CM4000 for quaternary solvent delivery. All of the CM4000 programming capabilities can be externally accessed through integral IEEE488 and RS232C interfaces.

SM4000 Programmable Wavelength Detector

The SM4000 programmable wavelength detector is a variable UV-VIS detector (190-700 nm) with sensitivity to 0.0005 AUFS. Time programmed wavelength and/or range changes, simultaneous dual wavelength ratioing and stop flow scanning are easily executed through the front panel keypad. Features such as auto-ranging and all manual functions are also executed through user-friendly software and dedicated function keys. All of the available functions of the SM4000 can be externally accessed through integral IEEE488 and RS232C interfaces. Up to 31 method files can be stored in the SM4000 internal RAM memory and are protected by a battery backup system.

The above items, plus a whole host of other pumps, detectors, and accessories are available through the New Zealand agents, Advanced Analytical.

For further information please circle no. 6 on reader reply card.

When your life is at risk you need more than a good nose.

NEOTOX is a tiny Portable Gas Detector with enormous capabilities. It will detect harmful gases long before they become dangerous, keeping you and your environment safe.

NEOTOX monitors Oxygen enrichment or deficiency, responds to the presence of Carbon Monoxide and detects Hydrogen Sulphide, providing audible as well as visual alarm signals. NEOTOX is pocket sized and operates reliably for up to 300 hours standard dry cell battery or a rechargeable power pack. NEOTOX is tough, economic and BASEEFA Certified Intrinsically Safe and is described fully in our latest literature.

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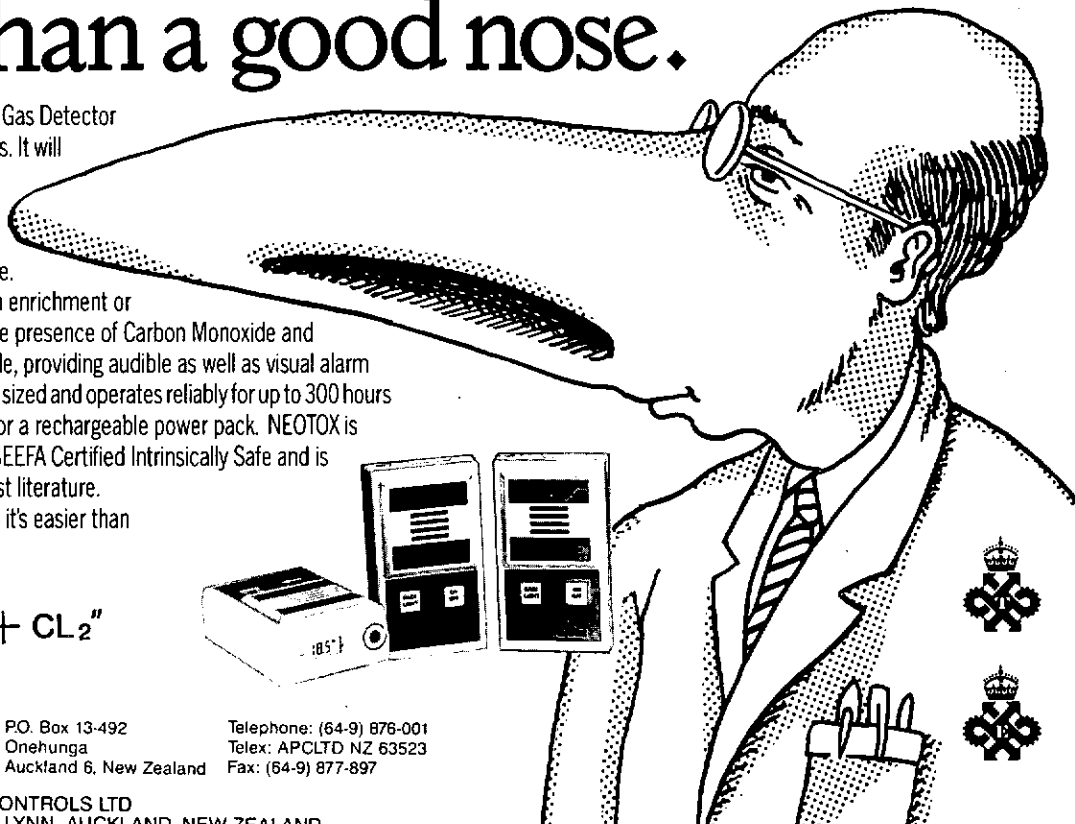
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New Horizons In Chromatography

Waters HPLC needs no introduction to NZ chromatographers. The following paragraphs summarise the advanced products released recently by Waters, which complement their existing wealth of LC pumps, detectors, injectors and columns.

Data

Networking Computer System

The Waters 860 Networking Computer System is a powerful, integrated system for processing and archiving chromatographic data. Waters VAX Reprocess Software allows the personal computer-based Waters 810, 820, and 840 data stations and 990 detector to have virtually instantaneous full LC and GPC data reduction and archiving to a DEC Micro VAX 2000 computer using DECnet/Ethernet local area networks. The Waters 860 system supports four graphics or text terminals and uses high-speed laser and graphic printers and plotters. Data can be processed at the rate of 10 to 15 chromatograms per minute and rapidly printed using a DEC LN03 laser printer. Data can be viewed from multiple printers and terminals, and the system supports a variety of terminals, printers, and plotters.

Chromatography Workstation with System Control

The Waters Maxima™ 820 Chromatography Data and Control Station allows single-keyboard control of up to four GC or HPLC systems, each with up to four detectors. A "data only" version for data acquisition without system control also is available. Advanced foreground/ background (multitasking) capabilities enable chemists to collect data in the background while using the foreground for third-party software applications and reprocessing of old chromatograms. Users have the ability to transfer raw data into ASCII, DIF, and Waters VAX Reprocess Software files. A built-in database manager allows users to generate summary reports and trend plots. The Waters Maxima™ 820 generate summary reports and trend plots. The Waters Maxima™ 820 is based on an IBM AT personal computer, with a choice of monochrome or colour monitors. Compatibility with full 16-colour EGA graphics and the ability to plot chromatograms on colour plotters are added features. Other capabilities include: on-screen, real-time display of chromatograms; multipoint internal and external

calibrations; the ability to plot calibration curves on a plotter; custom reports; automatic peak identification and methods development; the ability to add, subtract, multiply, and divide labelling of X and Y axes; and binary or tertiary gradient design and documentation.

Low-Cost Chromatography Workstation

The Water Baseline™ 810 Chromatography data and Control Station is a low-cost workstation with single-keyboard system control and mouse-driven software for liquid, gas, and ion chromatography applications. The Waters Baseline™ 810 provides data acquisition, processing, and control for single chromatograph with up to two detectors.

Photodiode Array

The Waters 990+ Photodiode Array Detector features a fast "spectral atlas" library to correlate samples against standards by UV-VIS spectra, has a four-channel analog-to-digital signal capacity to accept data from up to four external detectors, and monitors and acquires all UV-VIS wavelengths from 190 nm to 800nm to provide complete information about a sample. Based on an NEC APC IV Power Mate 2 personal computer with a 40 Mbyte hard disk for large memory capacity, the Waters 990+ saves both UV scans and chromatograms so that either UV spectra or chromatograms can be overlaid. The spectral atlas matches unknown samples against a user-generated library of standards on a correlation scale of 0-1000. The spectral

atlas allows any combination of up to four data categories to be used in the correlation; UV scans, retention time, relative retention, and retention index. The ability to add external detectors enables researchers to use additional detectors relevant to their field, such as adding a Waters 410 Differential Refractometer.

Biotechnology

The Waters 650 Advanced Protein Purification system features a totally non-metallic fluid path and a flexible, easy-to-use design for rapid isolation and purification of microgram to gram quantities of proteins on the same system using columns ranging from 5mm to 8cm in dia. A choice of flow rate ranges is combined with complete programmability for simplified methods optimisation and operation. Versatile detection is provided by a variable wavelength UV absorbance detector capable of operating in the 0.005-10 AU range. The Waters protein purification system uses Teflon, sapphire, quartz, and glass for all components in the fluid path.

The Waters Gen-Pak™ FAX column separates DNA and RNA within 1hr, with resolution equivalent to that obtained using gel electrophoresis. The 4.6mm x 10cm steel column features a fast anion exchange (FAX) resin-based medium that allows fast, high-resolution, high-recovery isolation and purification of DNA and RNA restriction fragments.

For further information please circle no. 10 on reader reply card.

HVDB

FOR SALE

Philips SP9 Atomic Absorption Spectrophotometer and data processor

This instrument was purchased in 1984 and has received regular servicing from Philips N.Z. Ltd., it is in good working condition and is now surplus to our requirements.

Price: \$8,000 o.n.o.

The equipment can be seen at the Hutt Valley Drainage Board's Depot, Waterman Street, Seaview, Lower Hutt.

Please contact: John Goldsmith
(04) 687-189.

Advanced Analytical to Exhibit at 1988 NZIC/NZBS Conference

Advanced Analytical will be one of the exhibitors at the Trade Display being held in conjunction with the 1988 NZIC/NZBS Annual Conference in Palmerston North, 23-26 August.

Advanced Analytical is a division of Advanced Electronics specialising in analytical instrumentation manufactured by such well know companies as:-

VG Instruments — who offer a full range of Mass spectrometers, GC-MS, MS-MS, Isotope Ratio/MS, UHV Components, Surface Analysis Equipment.

Tracor — Gas Chromatographs & Detectors.

Milton Roy/LDC — HPLC, Components & Systems.

Mattson — FTIR Spectrophotometers.

GBC — AA, UV/VIS Spectrophotometers.

Photron — HC Lamps.

Dohrmann — TOC, TOX, S & CE, Total Nitrogen Analysers.

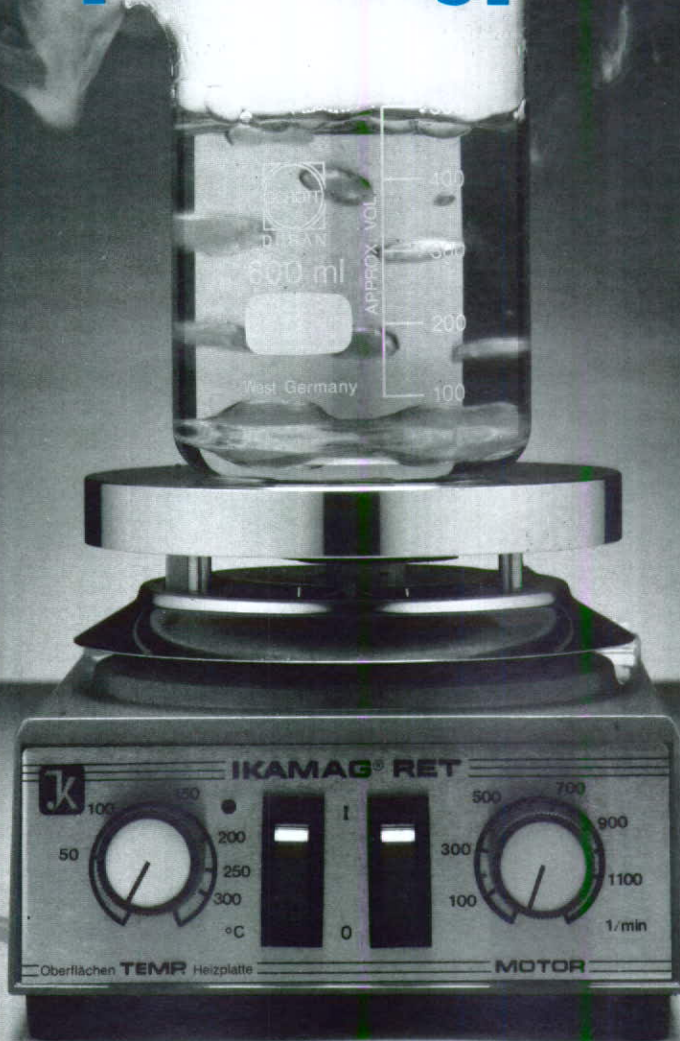
Labtam — ICP & ARC-SPARK Spectrometers.

Oxford Analytical — XRF Spectrometers.

The new Model 911 UV/VIS Spectrophotometer from GBC will be on display alongside the well established AA Spectrophotometer.

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What is IUPAC?

Formed in 1919, IUPAC is a voluntary, non-governmental, non-profit association of organizations known as national adhering organizations (NAOs). An NAO represents the chemists of a member country.

IUPAC has over 40 NAOs. Twelve other countries, known as Observer Countries, are also linked to IUPAC.

IUPAC is the recognised world authority on chemical nomenclature, terminology, symbols, units, atomic weights and related topics.

IUPAC provides advice on chemical matters to international agencies such as the World Health Organization (WHO), UN Food and Agricultural Organization (FAO), United Nations Education, Scientific and Cultural Organization (UNESCO), International Organisation for Standardization (ISO) and Organisation Internationale de Métrologie Légale (OIML).

Divisions and commissions

Some 1500 chemists throughout the world are engaged in the scientific work of IUPAC on a voluntary basis. These chemists work on IUPAC's committees and commissions. IUPAC has 32 commissions, which are grouped into the following seven divisions:

I Physical	IV Macromolecular
II Inorganic	V Analytical
III Organic	VI Applied
	VII Clinical

Each division has several commissions. For example, the Physical Chemistry Division has commissions on spectroscopy, electrochemistry and symbols; whilst the Applied Chemistry Division has commissions on food chemistry and atmospheric chemistry etc. The commission members elect a division committee which regulates the affairs of the division. Commission members may be 'titular' or 'associate'. The Union makes payment towards the travel and subsistence costs of titular members, but not associate members, to attend commission meetings or general assemblies. In due course associate members frequently become titular members.

Did you know?

- IUPAC sponsors about 30 **conferences** throughout the world each year. Amongst the most successful are the CHEMRAWN conferences: CHEMical Research Applied to World Needs.
- IUPAC is highly active in **chemical education**. For example, it organizes workshops and sponsors symposia on chemical education and publishes the *International Newsletter on Chemical Education*.
- **Chemical industry** throughout the world is closely involved in the work of IUPAC. IUPAC has links with approximately 180 Company Associates in over 20 countries.
- IUPAC has formal links with 30 regional and international organizations — Associated Organizations — concerned with chemistry and its applications.
- IUPAC **publishes** conference proceedings, definitive volumes of chemical data and compendia on nomenclature, quantities, symbols and units (the famous Green, Red, Blue and Orange Books).
- IUPAC publishes the scientific journal *Pure and Applied Chemistry* which cuts across disciplinary boundaries to present major research in all areas of chemistry.
- **News** about IUPAC, its chemists, its affiliate membership scheme, its publications, its recommendations, its conferences and its commission and committee meetings is published regularly in the IUPAC news magazine *Chemistry International*.

ABOVE ALL DID YOU KNOW THAT

- You too can become involved with IUPAC and thus have an opportunity of influencing the affairs of chemistry at an international and interdisciplinary level?

What are IUPAC's objectives?

IUPAC has four major objectives:

- to promote continuing co-operation among the chemists of the member countries;
- to study topics of international importance to pure and applied chemistry which need regulation, standardization, or codification;
- to co-operate with other international organizations which deal with topics of a chemical nature;
- to contribute to the advancement of pure and applied chemistry in all its aspects.

Have you become an IUPAC affiliate yet?

If you would like to learn about IUPAC and what it is doing and also have the chance of becoming involved in its activities, then we recommend that you become an IUPAC affiliate. The affiliate membership scheme was launched in 1986 in order to maximize the participation of chemists throughout the world in the affairs of IUPAC and also to disseminate information about its activities to a much wider audience. At present there are 7500 affiliates from 96 countries. These include 700 chemists from Third World countries, many of whom are sponsored by IUPAC grants.

What are the benefits of affiliation to IUPAC?

As an affiliate member of IUPAC you will:

1. Be visible as a potential recruit for the scientific work of IUPAC. The names and addresses and other details of affiliates who express an interest in the work of a commission are submitted to that commission.
2. Receive six copies per year of the IUPAC news magazine *Chemistry International*.
3. Be entitled to communicate directly on scientific matters with the officers of IUPAC commissions. Affiliates are kept informed of IUPAC's programmes and the names, addresses and telephone numbers of commission officers. Affiliates are thus able to provide an input at the early stages of the work of the commissions.
4. Be entitled to communicate with IUPAC division and commission members and other affiliates through the correspondence column of *Chemistry International*.
5. Be entitled to obtain 25% reduction on the cost of all IUPAC publications except the scientific journal *Pure and Applied Chemistry*.
6. Be entitled to 10% reduction or 'own members' rates on the registration fees of IUPAC-sponsored conferences.
7. Be entitled to wear the IUPAC tie or scarf.
8. Be entitled (where applicable) to reduction of income tax on your affiliate fee, according to existing arrangements made by your national chemical society (NCS) or negotiated by IUPAC.

How can you become an affiliate member of IUPAC?

It is only possible to become an IUPAC affiliate through your NAO or your NCS. All NAOs have been invited to operate the affiliate membership scheme. Those operating the scheme have set up their own mechanisms for registering affiliates. They will inform you how to register.

IF YOU ARE ALREADY AN AFFILIATE YOUR NAO OR NCS WILL INFORM YOU HOW TO RENEW YOUR SUBSCRIPTION.

A number of countries, particularly developing countries, do not yet have formal links with IUPAC. Chemists in these countries who are interested in becoming IUPAC affiliates should write to the Affiliate Affairs Secretary at the address below.

How much does affiliate membership cost?

The affiliate subscription varies slightly from country to country, depending on a number of factors including local handling and mailing costs and currency exchange rates. Your NAO or NCS will inform you about the current affiliate subscription.

Chemists from countries not already operating the scheme may apply for IUPAC affiliate membership directly to:

Affiliate Affairs Secretary
IUPAC Secretariat
Bank Court Chambers
2-3 Pound Way
Cowley Centre
Oxford OX4 3YF
UK



THE INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY (IUPAC)

Become an IUPAC chemist

- Join the IUPAC affiliate membership scheme
- Attend an IUPAC conference
- Learn about IUPAC recommendations

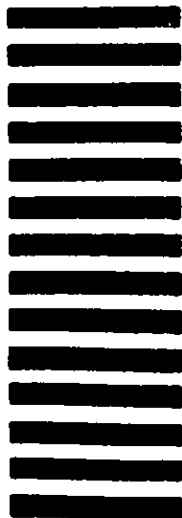
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Classification Data

Indicate total employed:

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What is your organisation's principal activity

What is your principal classification?

- MANUFACTURER
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 SUPPLIER LAB. EQUIPMENT
 RESEARCH
 OTHER

SPECIFY

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