



chemistry

in new zealand

Vol 51 No 6 December 1987



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Vol 51 no 6 December 1987

Front Cover Story



COVER STORY:

Aquatec: a fully automated system for water and waste-water testing, for routine determinations of ammonia, phosphorus, nitrate and nitrite. Based on the principle of flow injection analysis, Aquatec offers a fast, ready-to-use system with low reagent consumption and hence, low operating costs. For further information see page 179.

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Published by CATHEDRAL PRESS LTD, P.O. Box 9072, Newmarket. Phone 775-533

Advertising Manager Carl Roze. Phone Auckland 547-244.

Advertising Features

This Issue:

In this issue we look at products and services in the areas of water purification, analysis and quality control. The same themes are reflected in three technical articles on ion chromatography and its application to power station chemistry and the analysis of pulping liquors.

Next Issue:

In February 1988 we will continue with the water theme and look at filtration, pumps and valves. We also plan an instrumentation feature on FTIR, the newest and most powerful development in this "traditional" technique. Watch out also for the questionnaire for our 1988 Chemistry Yearbook.

PRIZES AND AWARDS

Arthur C. Kennett Memorial Award

The 1987 recipients of this award are three employees of the Adelaide Water Supply Department, Messrs. **RJ Good, GC Moore and CJ Wojciak**. They received their award for their paper entitled "Coping with deterioration of concrete surfaces in Adelaide's early filtration plants", which was presented at the 1986 ACA conference in Adelaide.

The Arthur C. Kennett Memorial Award is jointly sponsored by the NZIC and the New Zealand Branch of the Australasian Corrosion Association. The award is made each year for the best paper published under the auspices of the ACA and dealing with non-metallic corrosion.

ICI Prize 1987 — P.S. Rutledge

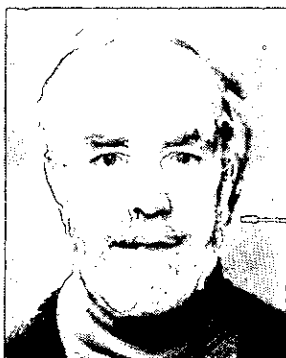
Associate Professor Stewart Rutledge received his BSc, MSc (1st class honours) and PhD (1961) degrees from the University of New Zealand and was awarded a DSc by the University of Auckland in 1986. After post-doctoral study at the University of Michigan, he held faculty positions at the University of Wisconsin (Madison) and Cornell University before taking up his present position at Auckland in 1967. He has held Auckland University and New Zealand Research Fund Fellowships, a Fulbright Scholarship, and Visiting Professorships at the University of Rochester and Stanford University. He was elected to the Fellowship of the New Zealand Institute of Chemistry in 1986, and is a member of the Royal Society for Chemistry.

For three years he served the Royal Society of New Zealand and the International Union of Pure and Applied Chemistry as the secretary of the New Zealand National Committee for Chemistry.

In areas of organic chemistry he has co-authored over 100 papers and patents and one book. Primarily his research has been directed towards syntheses of new chemotherapeutic agents and the development of new synthetic methods. However, in a number of areas, his work has also contributed insights into the mechanisms of the reactions involved. New syntheses of a range of important heterocyclic systems have been published. Efficient total syntheses of two potential anti-cancer agents have been reported, and another is well advanced. A new dibenzocyclooctadiene lignan lactone with significant *in vitro* antileukemic activity has been synthesised from a constituent of the Matai tree; and this natural product has also been converted into

analogues of clinically used anti-cancer aryl tetralin lignan lactone agents.

In collaboration with Professor RC Cambie and Associate-Professor PD Woodgate, work aimed at synthesising steroids and ambergris odorants from N.Z. natural products, and at isolating new natural products from endemic species has been published.



A variety of new reagents which produce 1,2- or 1,3-disubstituted systems by addition to olefinic bonds or opening of cyclopropane rings have been developed. New uses have been found for thallium(III) salts in organic synthesis including *in situ* generation of labile and otherwise expensive reagents. A variant of the classical Claisen rearrangement which has extended its usefulness with relatively electron deficient polyhydroxyquinones has also been developed.

Shell Prize for Industrial and Applied Chemistry 1987 — AG Charleston

Alan Charleston is currently Plant Chemist at N.Z. Fibreglass. However, the work for which he has been awarded the Shell Prize was carried out at the now defunct New Zealand Fertilizer Manufacturers' Research Association (NZFMRA).

Alan joined FMRA as a lab. assistant in 1970, was awarded the NZCS in 1973, and as a result of his work was promoted to Scientist in 1983. He gained corporate membership of the NZIC in 1980. In 1983 he was awarded a N.Z. Diploma in Science for work on the development of a theoretical model to aid in the design of a zero effluent discharge system for superphosphate manufacture.

In his work at FMRA Alan was involved in a wide range of investigations related to the evaluation of alternative raw materials and the understanding of processes involved in the fertiliser industry.

Published papers have included reports on analytical methods, solubility and reactivity studies of fertiliser materials, and a process

for the introduction of elemental sulphur into high analysis phosphate fertilisers. It is primarily this latter work for which he has been awarded the Shell Prize.

Recently in New Zealand, the emphasis in fertiliser use has shifted from single superphosphate to higher phosphate analysis products. However, these materials have very low sulphur levels and this nutrient is required by many New Zealand soils. The incorporation of elemental 'S', in a sufficiently fine form to be readily oxidised and become available to plants, is a problem which has perplexed researchers around the world. The technique developed at FMRA (Provisional Patent 213682) is an entirely new approach which has been very successful at the levels tested so far and shows considerable promise as technology that could find worldwide use.



Efforts in other countries to accomplish this, have led to failure or very limited success and yet the need for such a process is quite strong. The method is now being patented internationally and interest has emerged already from several countries.

RACI 1986 Rennie Medal

We note with pleasure that **Dr Martin Banwell** has been awarded the 1986 Rennie Medal by the Royal Australasian Chemical Institute. Martin is a graduate of Victoria University, Wellington, and a member of the NZIC. He lectured at Auckland for a short time and was on the Auckland Branch Committee. He is currently lecturer in the Department of Organic Chemistry at Melbourne University and President of the University Chemical Society.

The award is based on an excellent publication output associated with a program of organic syntheses and design of synthetic methodology. Particular reference has been to alicyclic systems of biological interest, strained molecules, carbenoid addition products and their controlled ring expansion to tropones and tropolones.

Forensic Society Award

Drs Charles Watt, Trevor Crosby and Peter Nelson, and Mrs Anne Kistemaker, all of the DSIR Research Centre in Mt Albert, Auckland, have recently been awarded the Philip Allen Memorial Award by the international Forensic Science Society. The award is presented each year for the best paper published in the Society's *Journal*.

In their paper, published last year, the four scientists reported one of the first documented uses of insect identification, in tracing the origin of an \$8.8 million cannabis haul. The presence of a number of insects not normally found in New Zealand was instrumental in proving that the cannabis had been imported, and also pin-pointed its origin to a specific part of South-East Asia.

The ICI New Zealand Science Fair

This Annual Exhibition for young scientists from intermediate and secondary schools throughout the country took place in the Michael Fowler Centre, Wellington on the week starting 30 September. A total of 32 entries were considered, based on the results of 17 regional competitions held earlier in the year. The fair also included a guest exhibit by **Miss Laura Magde** from Samuel Gompers School, San Diego,

California.

The winner of the first prize for which she received a medalion, cash prize, and the ICI Trophy, was **Nathalie Morris** (13) of Palmerston North Girls' High School. The title of her entry was "Here and There". This described the results of an experiment to investigate how accurately a person could locate sounds in the horizontal plane, and at what frequency location was most accurate.

SCIENCE AND SOCIETY: CHEMISTRY AND THE COMMUNITY

Dr B. Halton, Chemistry Dept., Victoria University, Wellington

The following is the text of Dr Brian Halton's Presidential Address to the NZIC Annual Conference in Auckland, Tuesday August 25, 1987

The Commercialisation of Chemistry

The restructuring of the economy by Government has had a dramatic impact upon our society and upon our profession. What we have seen thus far is that there are many aspects of our scientific endeavours which can be legitimately commercialised and to which the 'user pays' principle can operate. The theme of the Auckland Conference 'Commercialisation of Chemistry' has this as its primary objective. Nonetheless, Government, and also the scientific community, needs to be especially careful in identifying those areas in which the user should be expected to pay and those where the community has its responsibility to provide for the future. In my view the application of the 'user pays' principle requires today's generation to be taxed to provide the heritage for tomorrow. It is logical that the provision of a service for a third party be charged for and this provides for realistic 'user pays'. At the opposite end of the spectrum of activity in our profession is scientific work of a fundamental and exploratory nature. At the time the study is conducted it may be regarded as science for science's sake — seeking answers because the questions are still there. At the very least this might be regarded as a part of our culture. More frequently, however, it forms a realistic part of the university research effort, it provides an essential training ground for NZ's highly competent, adaptable, and valuable scientific researchers, and provides a measure by which our graduates can be assessed on an international basis.

The middle ground, basic research which might provide some return in the medium term (10-15 years), is an area of great concern, not least because a substantial number of Institute members are government scientists directly involved. The size of New Zealand and the almost absolute dependence of its major chemical companies on the parent overseas organisations for innovation and research requires that Government accept the prime responsibility for indigenous scientific development. Thus the DSIR and MAF have a vital and fundamental role in ensuring that appropriate basic research is carried out within a viable and meaningful budget, provided from taxes, as our responsibility to the New Zealand of tomorrow. In like manner, the role of the Research Associations is an essential component to the development of much of our industry for if the multinationals are eliminated from the count, the majority of the industrial science of this country is carried out by companies with fewer than 25 staff.

Arguments akin to those outlined above are now known to most including our politicians. Of the utmost concern is the fact that the scientific community in this country has no real voice with our legislators. The report "Key to Prosperity: Science and Technology", produced under the chairmanship of Sir David Beattie for the Minister of Science and Technology, has received little favour from Government thus far. Council of the Institute has been active in promoting the recommendations of the Beattie report to the politicians of both sides of the house. The Minister of Science has told us that the review process allowed extensive public debate which has been invaluable, and which also raised the public profile of Science and Technology. It is recognised that Mr Tizard has announced the creation of a Science and Technology Advisory Council. But we have yet to learn whether this is to be created from the best scientific minds in the country — as I suspect Sir David Beattie would have it — or whether it is to reflect the existing government divisions of science with representative appointments from both the DSIR, the MAF, the Universities, etc. Once again we have informed both the Prime

Minister and the Minister of Science and Technology of our firm views in favour of the first of these alternatives.¹ Despite this activity, and an encouragement for minority group involvement in science and technician training, the Government has been woefully silent on the essentials of the Beattie report. The provision of an S & T Research Council to fund, on a peer review basis, the research needs of this country has been evident for many years. In its absence the 'user pays' philosophy will dominate and strategic basic research will wither away at an untold cost to future generations of New Zealanders. With the Labour government elected for a second term it is hoped that the politicians (and in particular the Minister of Science and Technology), will now see their way clear to creating an environment where scientists and technologists can play their legitimate role in improving the prosperity of this country; if they do not then we must surely be on a disaster course. Indeed, as has been noted recently² New Zealand is in danger of slipping behind Greece, Finland and Turkey in R & D expenditure and could well take last place in the OECD list.

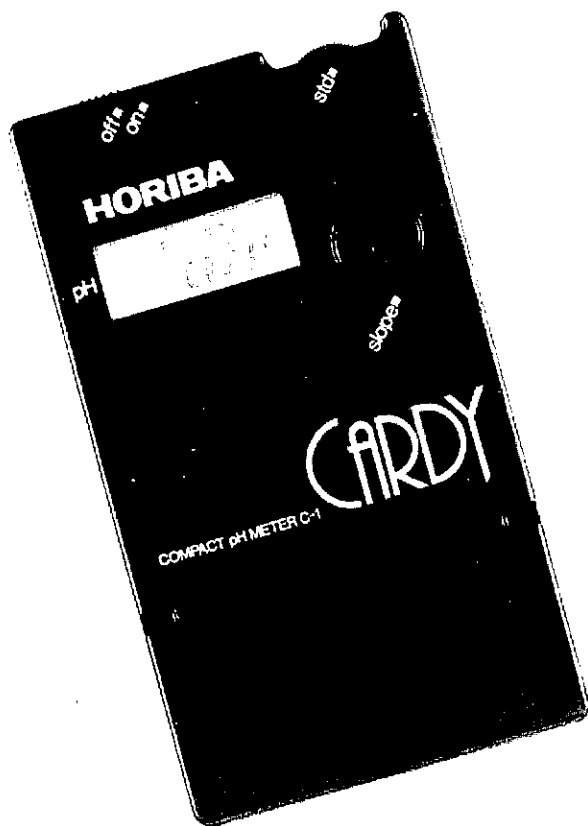
Public Perceptions of Chemistry

Much of our concern for the future of science stems from the impact chemistry has upon the community and the perception the community has of science and chemistry in particular. Chemistry may be seen to have three faces³. It is accepted as a pure science which provides knowledge and understanding. In its application it is known to be the servant of man giving us food, clothing, and shelter; it supplies ever-improving medicines to prolong and enhance the quality of life. However, this same Chemistry and Chemicals are unsavoury entities giving us 2,4,5-T and dioxin! The essence of this last face shows a progression from strychnine, arsenic and cyanide, the classical poisons of old, to the bugbears of today — noxious wastes, chemical carcinogens and mutagens and the fears of radiation. If you were to survey the lunchtime shoppers in the main street of any town on how they viewed chemistry, the sad fact is that the third of these masks is the one that would dominate.

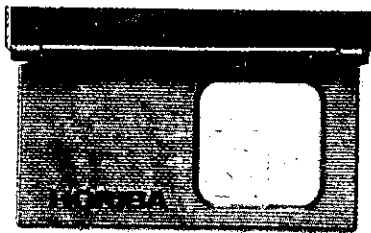
No-one can hide the fact that the industry has been the primary source of many of the environmental problems. Internationally recognised disasters such as Bhopal, Seveso and Chernobyl, as well as our own ICI fire, highlight concerns not only for human safety but also for the pollution of the environment that ensues. However, it must be noted carefully that the chemicals' industry has been painstakingly emphasising its environmental sympathy and expending considerable resources on finding better methods of waste disposal, of transport, and of storage — and of course Public Relations. The NZ Chemical Industries Council bears testimony to these facts. As Professor George Pimental has noted, however, the increasing dependence of society upon the products of the chemical industry can, and does, have a negative effect upon people's attitudes⁴. Thus even when the active critics are few in numbers they tend to be increasingly well organised and the presentation of their views is well orchestrated. Consequently, it is not always easy for the members of our profession to avoid being defensive about their work.

In this last context it is pertinent to note that Ivon-Watkins-Dow have announced the phasing out of 2,4,5-T production at New Plymouth. The farming community has voiced its concerns about the effectiveness of the likely replacement, the environmentalists have been reported as claiming a victory, and I am concerned that we should replace 2,4,5-T — a herbicide about

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which we have so much data by one about which we presumably know significantly less. Until 10 years ago when the Seveso incident occurred few, other than chemists, had heard of dioxin (2,3,7,8-tetrachlorodibenzo-*p*-dioxin). Today most people recognise the word but do not understand what it is; the concept of a "witches brew" with limitless power to harm seems close to the truth. Yet no study has shown that dioxin causes severe chronic effects and there is no known death from exposure to it. The production of unpleasant but non-fatal chloracne is not in doubt. Environmental issues tend to dominate science coverage in the media. The public receives its information this way and, unfortunately, high standards are not always maintained. A distorted picture of the truth may follow therefore. All too often we find a "zooming in" effect by the environmentalists where one particular aspect of an issue is exaggerated at the expense of balance. This serves to emphasise the necessity of having a population with an element of science literacy. Most people can understand that a toxic substance, which is lethal at high concentrations, can be diluted so that it becomes harmless. However, many fail to grasp that the ratio of something, no matter how small, to nothing is infinity, whereas twice almost nothing is still nothing.

Chemistry and the Media

The critics of chemistry seem to be increasingly well organised. In turn, we need to rethink our public image and our profile. However, for successful communication we require three things, namely a receptive listener, a coherent and comprehensive message, and a medium to transmit the message to the listener. Because of the uncertainties in long term health and environmental questions that are perceived to be associated with many chemicals, the population at large is rarely receptive. Media representatives are generally not as enthusiastic about positive publicity for science — and chemistry in particular — as it is deemed less newsworthy than the sensational. Yet everyone needs some understanding of science, of its accomplishments and its limitations, irrespective of their own occupation or socioeconomic background. Chemistry is the basis of everything living and non-living and it is important that people have an interaction with it. With much of the negative publicity that is the vogue the receptive listener is not always easy to find. Certainly, adverse publicity caused by industry itself does not help. Thus an NZPA report published⁵ in Wellington and headed "Chemical still awaits report" read, in part, as follows:

"Oil refining wastes that led to a scare on the outskirts of Hamilton last week are safe according to the Managing Director of the company that produced them. In all the reports we've got, and in our handling, we can only go by that — it appears to be safe."

This then continued:

"I just went out and dunked my hands in it, I had a number of cuts on my hands and I didn't feel a thing."

— and that was apparently the Managing Director of the company!

On the other hand, some of our industries have taken up the cudgel and, through their advertising agencies, have been positively promoting the benefits of chemicals. I have already referred to this⁶ in a guest editorial in 'Chemistry in New Zealand' but I repeat it here because such positive publicity can assist in educating the public. By way of example BASF, Alcan and Bayer can be commended for some of their recent advertisements which serve to promote chemistry in a small but positive way. Thus BASF in a series of advertisements have promoted chemical research, e.g. uv-absorbers in suntan lotions, paints and plastics. Alcan have cleverly inserted their own name in a dictionary listing which defines alum, alumina and aluminium, and Bayer have referred to their development of advanced plastics by their research team. Undoubtedly, these are a far cry from that which promotes NZ butter by stating "There are no additives or chemicals. Just butter — pure and natural" (my emphasis). By inference chemicals are nasty whereas natural compounds are positive and beneficial. What about digitalis, poison ivy or tutu — or better still the defense mechanism of the skunk? All pure and natural!

In such matters it is inordinately difficult to get the facts

across and to have an accurate ranking of priorities. Every human activity has associated with it a degree of danger and it is undoubtedly the job of our industries to minimise the possible dangers of each activity they involve themselves with. Today's world is based upon science and technology. To enjoy its fruits requires, more than ever, an understanding of what is hazardous and what is not — to rank carefully and objectively the risks that are involved. For example, Upton in 1982 ranked sources of risk (excluding dietary hazards) in the USA from the number of deaths per annum⁷. The top six from the thirty types mentioned were smoking (150,000 deaths), alcohol (100,000), motor vehicles (56,000), hand guns (17,000), electric power (14,000) and motor cycles (3000). The bottom grouping with less than 10 deaths per annum ranked in order of importance were food colouring, food preservatives, pesticides and spray cans. These are below 0.01% of alcohol related deaths. The perceived risks as evaluated by the public varied dramatically with the population group examined. Pesticides were generally ranked among the top half whereas swimming with 2000 deaths and number seven on the list was frequently regarded as the least hazardous. Rated top by all was radiation which, as nuclear power, caused 100 deaths.

Science Education

The information provided above serves to re-emphasise the necessity of having a population with an element of science literacy. As already stated, everyone needs some understanding of science, of its accomplishments, and of its limitations. The establishment of New Zealand National Chemistry Week (NCW) serves to target a part of this Institute's responsibility in this area. From the experience gained from the (admittedly) limited inaugural events of 1987, I am confident that a national chemistry event will serve as a focal point for the population at large and provide a realistic image of chemistry. The NCW poster and essay competitions have had a very beneficial effect in having school pupils recognise the wide ranging facets of the chemistry profession and many positive comments in this regard have been received. Despite the efforts that this Institute has made, and will continue to make, the provision of a basic understanding of science is not a luxury that we should debate but a vital investment in our future well-being. Such science literacy is properly the domain of our educational system so that the decision makers of the future will be able to recognise the limitations of scientific investigation, the managements the relationship between fundamental and strategic research, and our consumers the relevance of "scientifically proven" benefits attributed to a specific product.

It is essential that moves in this direction be made and it is to be hoped that the various educational reviews currently under way and being planned will allow for a system of education whereby the inherent curiosity of the 11-13 year old is stimulated rather than stymied. Not only will this then allow for a more general interest in matters scientific but also it should serve to encourage students to select science options when given the choice. In the biotechnology era that is about to thrust itself upon us, it seems likely that this country will not have the trained scientific personnel to respond nor will it be able to attract such people from overseas.

Of course the concerns the NZIC has for science education in general, and chemistry in particular, triggered Council to establish its Chemical Education Trust whereby the promotion of chemistry, and chemistry teaching, can be backed by a financial response to specific projects and general needs. Nevertheless, it is the politicians and our education administrators who should acknowledge the need for a better basic science education. It is not possible for our schools to teach everything; priority in what they do teach should be to those things that cannot be taught in the home. The science and mathematics programmes are of course prime examples and it is vital that science and maths teaching time currently available be preserved rather than reduced.

In recent times much attention has been paid to the Vere-Jones/Clark report⁸ with particular emphasis being given to numeracy skills and mathematics teaching. This is not too surprising because any mention of maths takes the average individual back to the old adage of the three R's — reading, 'riting and 'rithmetic. Science teaching is in an equally precar-

ious position. Data collected by the Education Department and the Post-Primary Teachers Association on secondary school teacher shortages at the beginning of the 1987 academic year, and published in June⁹, make for interesting reading. Of a total shortfall of 368 teachers, Maths and Calculus were 53 or 14% of the total shortage. Science was 58 teachers (16%) short and English 40 short. Physical Education with 20 vacancies was next in order of ranking.

Urgent attention needs to be paid to the conditions of employment of our teachers in general and our science teachers in particular. Other statistics are hidden in the figures quoted. For example, leaving aside the number of teachers who have left the profession for other things, it would be interesting to know how many degree qualified chemistry teachers (all of whom would have a first year (Stage 1) University Mathematics course as a minimum) are now teaching maths. It must be a great temptation to many science teachers to throw out their white coats and teach subjects that do not have the burden of a laboratory subject, because technical assistance is at a minimal and inadequate level, and the budget for laboratory management is pitiful. It is time that our education administrators address these problems and strive for a system where senior school subjects are taught by enthusiastic and properly qualified staff. Even at the early stages of college it is especially important that good science be put across by subject conscious and capable teachers. It is very laudable for Government to extol the virtues of a 1:20 staff to pupil ratio in our primary schools. However, the needs of our secondary educational system must not, and cannot, be ignored.

Recent discussion on assessment procedures and the value or otherwise of the external examination system has been extensive. What is vital to the well-being of this country is that the moves to equality of opportunity in education do not result in mediocrity for all. As I have asked elsewhere¹⁰: "Is equal opportunity the chance for every student to reach individual standards or is the same (and presumably lower) standard to be achieved by all?". The best education for the best may not necessarily be the best education for all, but there are strong arguments to say that it is. Surely, for the talented student education is better than training, both in the interests of society and in the interests of the student himself. In our efforts to encourage students and influence the population at large, I cannot do better than to conclude with a quotation from Henry A. Bent¹¹:

"We need to show what only chemists can show with enthusiasm and care and talk about with love and insight — flames, precipitations, neutralization, displacements, electrolysis. If chemists don't do with students what only chemists can do with students, how are students going to know what chemists really do?"

References

1. The Minister of Science and Technology announced the composition of this six member council under the chairmanship of Mr R. Arbuckle on August 28. It is pleasing to note the inclusion of Professor R. Mathews, Hon. FNZIC, on the Council.
2. Sir David Beattie on addressing the Auckland Manufacturers Association as reported by NZPA in the "Evening Post", Wellington, 16 August 1987.
3. Hammond, G.S. 'The Three Faces of Chemistry' in Chemtech, p. 140, March 1987.
4. 'Opportunities in Chemistry' — the Pimental Report commissioned by the U.S. National Academy of Sciences and the National Research Council's Board on Chemical Sciences.
5. "The Evening Post", Wellington, 18 June 1987.
6. Chemistry in New Zealand, **50**, 166 (1986).
7. Upton, A.C., Scientific American, **246** (2), 29 (1982).
8. Vere-Jones, D., and Clark, M.J., 'Science Education in New Zealand: Present Facts and Future Problems', The Royal Society of New Zealand, Miscellaneous Series, 1987.
9. "The Evening Post", Wellington, 17 June 1987. The datum quoted for science is not correct. The PPTA advise that 58 science teachers were needed at 1 March 1987.
10. "Comment" in Chem NZ No. 34, 1987.
11. Bent, H.A., in Chemtech, p. 166, March 1987.

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DETECTION IN ION CHROMATOGRAPHY

Paul R. Haddad

Department of Analytical Chemistry, University of New South Wales, Kensington, NSW Australia.

Professor Haddad was one of the principal speakers at the ion chromatography workshop organised earlier this year by the NZIC Chromatography group (see June issue, p76). The following article is based on Professor Haddad's workshop address. A second paper from the workshop, that by Nath Pritchard and Steve Ofield, appears elsewhere in this issue.

INTRODUCTION

A lack of sensitive and reliable detection methods was a dominant limitation to the early progress of ion chromatography as an extension of classical open column ion-exchange chromatography. In recent times, many new detection methods have emerged, based on such diverse properties of inorganic ions as conductance, UV absorbance, redox properties, complexing abilities and refractive index. A schematic classification of these detection methods is given in Fig. 1 and the reader may consult several reviews and books on ion chromatography¹⁻⁵ for more extensive coverage of the theory of these techniques.

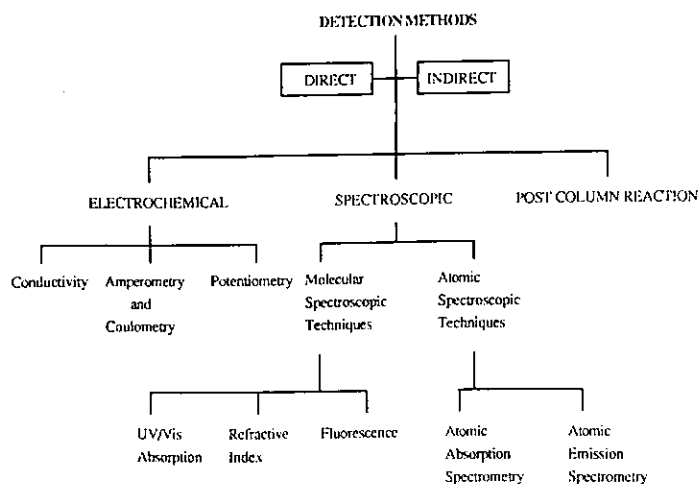
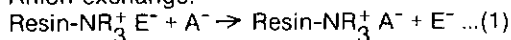


Fig.1 Classification of detection methods used for ion chromatography.

Direct and Indirect Detection Methods

Fig. 1 shows that each detection method can be applied in a direct or indirect mode. The meanings of these terms can be seen by reference to typical anion and cation-exchange equilibria, as given below; for simplicity only univalent species are considered:

Anion-exchange:



Cation-exchange:



Here the ion-exchange resin contains either a quaternary ammonium functionality (anion-exchanger) or a sulphonic acid functionality (cation-exchanger) and the eluent consists of an appropriate competing ion, depicted as E^- or E^+ , respectively. Eqns (1) and (2) illustrate the fact that when solute ions elute from the ion-exchange column, they replace in the eluent an equivalent number of eluent ions so that electroneutrality of the eluent is maintained. When a property of the eluent (rather than a solute property) is monitored by the detector, then changes in detector signal will occur upon elution of a solute ion which has a dissimilar value of that same property. If the eluent has a lower value of the measured property than the solute ion, the detection method can be described as *direct*, whereas cases where the eluent has a higher value of the measured property can be described as *indirect* detection methods.

ELECTROCHEMICAL METHODS OF DETECTION

Conductivity Detection

Conductivity detection has long been the mainstay of detection methods for ion chromatography and has the advantages of universal response to ionic species and simplicity of operation. In its simplest form, the detector response equation (in this case for an anion-exchange system) is:

$$\Delta G = \frac{(\lambda_{\text{S}} - \lambda_{\text{E}}) C_{\text{S}}}{10^{-3}K} \dots (3)$$

where ΔG is the conductance signal, λ_{S} and λ_{E} are the limiting equivalent ionic conductances of the solute and eluent anions, respectively, C_{S} is the concentration of the solute anion and K is a constant (called the *cell constant*) with units cm^{-1} , which takes into account the physical dimensions of the cell.

This equation shows that the conductivity signal is proportional to the solute concentration and to the difference in limiting equivalent ionic conductances between the eluent and solute ions. A similar relationship has been derived for the conductimetric detection of cations after ion-exchange separation⁶. These relationships show that sensitive detection can result as long as there is a considerable difference in the limiting equivalent ionic conductances of the solute and eluent ions. This difference can be positive or negative, depending on whether the eluent ion is strongly or weakly conducting. Table 1 shows values of the limiting equivalent ionic conductances of some common inorganic anions and cations, as well as those for some typical eluents.

Widely used eluents in which the limiting equivalent ionic conductance of the eluent ion is low include phthalate⁷ and gluconate-borate⁸ which give direct detection (in terms of the definition given earlier) of eluted solute ions. That is, an increase in conductance occurs when the solute enters the detection cell (Fig. 2). Aromatic bases have been shown to be useful eluent components for the separation and conductimetric detection of alkali metal and alkaline earth cations⁹. An alternative strategy is to use a highly conducting eluent and to monitor the decrease in conductivity which accompanies the elution of a solute ion. This is an indirect detection mode and has been applied to the detection of anions in a potassium hydroxide eluent¹⁰, alkali metal cations in a dilute nitric acid eluent⁴ (Fig. 3), and transition metal and alkaline earth cations using ethylenediamine/tartrate¹¹.

TABLE 1
LIMITING EQUIVALENT IONIC CONDUCTANCES OF
SOME COMMON SOLUTE AND ELUENT IONS

Cations		Anions	
H^+	350	OH^-	198
Li^+	39	F^-	54
Na^+	50	Cl^-	76
K^+	74	Br^-	78
NH_4^+	74	NO_3^-	71
Anilinium	5	Benzoate	32
Benzylammonium	32	Phthalate	38

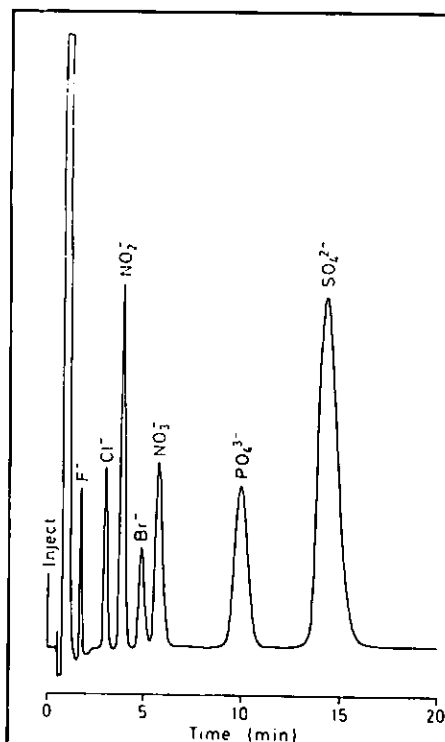


Fig. 2 (left) Direct conductivity detection of anions in non-suppressed ion chromatography using an eluent with low background conductance. Column: Waters Associates IC PAK A. Eluent: 1.3 mM sodium tetraborate, 5.8 mM boric acid, 1.4 mM potassium gluconate (pH 8.5) in water-acetonitrile (88:12). Solute concentrations: 5-40 ppm.

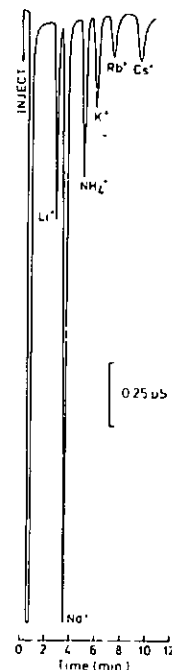


Fig. 3 (right) Indirect conductivity detection of cations in non-suppressed ion chromatography using an eluent with high background conductance. Column: Waters Associates IC PAK C. Eluent: 1.0 mM nitric acid. Solute concentrations: 10^{-5} M in each species, except for sodium which has twice this concentration.

Amperometric Detection

Over the last few years there has been an increase of interest in the use of amperometric methods in ion chromatography, especially when high selectivity and sensitivity are required. It has only recently been shown that the amperometric detection of inorganic ions can be improved through the use of electrode materials which mediate or participate directly in the electrode reaction.

For example, iodide, cyanide and sulphite may be sensitively detected using a silver electrode polarised at small positive potentials¹². Sulphite, which does not exhibit the same complexing ability as cyanide or iodide, must be oxidised directly at a higher potential and the sensitivity of detection is diminished in comparison to the complexing anions. These observations suggest some mediating role of silver, even for the oxidation of sulphite, and for this reason silver is the most widely used electrode material for the detection of inorganic anions.

Some effort has been directed towards the development of an indirect amperometric detection method for ion chromatography. In one successful approach¹³, 1mM salicylate was used as eluent and it was shown that the electroactive component of the eluent need be present at only a very low concentration, suggesting that other eluent components could be added to improve resolution. A further indirect method has been reported¹⁴ in which pyrrolidinedithiocarbamate was added as a post-column reagent in the cation-exchange separation of metal ions, using amperometric detection at oxidative potential to monitor the dithiocarbamate concentration. Reaction of the dithiocarbamate with eluted metal ions to produce electroinactive complexes formed the basis of the indirect detection method.

Potentiometric Detection

In potentiometry, the potential of an indicator electrode varies with the concentration of a particular ion in the solution in contact with the indicator electrode, in accordance with the Nernst equation, giving a logarithmic relationship between electrode potential and solute concentration. The most familiar potentiometric devices are glass electrodes for the measurement of pH and ion-selective electrodes for the determination of inorganic anions and cations.

The main drawbacks of potentiometric detectors (particularly ion-selective electrodes) in ion chromatography are the slow response of many electrodes and the fact that they respond at best to only a few different species. This inherent selectivity arises both from the nature of the indicator electrode and also from the presence of an ion-selective barrier which separates the indicator electrode from the surrounding

solution. This barrier is deliberately chosen to be as selective as possible and therefore naturally restricts the ions which are detected by the indicator electrode. Such selectivity is advantageous when it is required that the electrode respond to one ion in the presence of others, but is particularly disadvantageous in chromatographic applications where a broader range of electrode response is desired.

Because of the above considerations, it is not surprising to note that potentiometry with ion-selective electrodes has found few applications in ion chromatography, and these have generally involved those indicator electrodes which show relatively general potentiometric response. Examples include a silver/silver chloride electrode for the detection of halides¹⁵, a silver/silver salicylate electrode for the detection of halides and thiocyanate¹⁶, a silver sulphide membrane electrode for the detection of sulphide and cyanide¹⁷ and an iodide electrode for the detection of iodide, thiocyanate and thiosulphate¹⁸.

The only general purpose potentiometric detector capable of sensitive detection of a wide range of solute species is based on the use of a metallic copper wire or tube as the indicator electrode¹⁹⁻²⁵. Detector response arises from changes in the concentration of cuprous or cupric ions at the electrode surface which occur when a solute species comes into contact with the electrode. The main strength of the metallic copper electrode detector is the fact that it provides a certain degree of selectivity yet can respond in a variety of different modes to a wide range of species. It is this latter capability which differentiates the copper electrode detector from previously reported potentiometric sensors.

SPECTROSCOPIC METHODS OF DETECTION

Molecular Spectroscopic Techniques

The detector response equation for an anion-exchange system coupled with a UV absorption detector is¹²:

$$\Delta A = (\epsilon_S - \epsilon_E) \cdot C_S \cdot l \quad \dots\dots\dots(4)$$

where ΔA is the absorbance change caused by the elution of a solute, ϵ_E and ϵ_S are the molar absorptivities of the eluent and solute anions, respectively, C_S is the solute concentration and l is the path length. Eqn (4) shows that the detector absorbance depends on the solute concentration, the detector cell path length and the difference in molar absorptivities between the solute and eluent anions.

In the simplest case, the solute ion absorbs more strongly than the eluent ion, resulting in direct detection. This approach has been widely applied to anions such as nitrite, nitrate, bromide, bromate, iodide, iodate, periodate, thiocyanate and

thiosulphate. Some anions, such as chloride, fluoride, sulphate, phosphate, perchlorate and cyanide do not show appreciable absorption of UV radiation except at very low wavelengths. Some degree of detection selectivity therefore exists which enables common interferences such as high levels of chloride or sulphate in samples to be minimised or even eliminated. Alternatively, choice of a low wavelength such as 190 nm permits direct UV absorption to be used as a more general detection mode and this approach has been applied to the detection of common anions in atmospheric precipitation²⁶.

Eqn (4) suggests that indirect detection will result when the eluent ion absorbs more strongly than the solute ion. This approach has developed into one of the most widely used detection methods in ion chromatography, and has been called "indirect photometric chromatography²⁷" and "vacancy detection". In this approach, the eluent ions are chosen to have high molar absorptivities in the UV region and if the background absorbance of the eluent is monitored at a suitable wavelength, a decrease in absorbance will occur on elution of a solute ion which has a molar absorptivity lower than that of the eluent.

The sensitivity attainable with this method will depend on a number of factors. In the first place, it is clear from Eqn (4) that if the molar absorptivity of the eluent is maximised by selection of the wavelength of maximum absorption, the absorbance change accompanying solute elution is also maximised. However, this can create problems by providing such a high eluent background absorbance that the detector is incapable of being zeroed. Furthermore, photometric error is reduced if the detector is operated in the approximate absorbance range 0.2-0.8, so it is desirable that the background absorbance be maintained within this range. A further factor is that the detector baseline noise increases with the eluent concentration, so that the signal to noise ratio (and hence the sensitivity of the method) improves as the eluent concentration is reduced²⁷.

The technique is very well established for anion chromatography, with eluents such as phthalate²⁸, nitrate²⁹, sulphobenzoate³⁰, benzenetricarboxylate^{28,31} and toluenesulphonate³² being typical. Recently, the same approach has been used with iron (II) phenanthroline³³, molybdate⁵ and 2,4-dihydroxybenzoic acid³⁴ as eluents. This success has inspired research into the development of similar methods for the detection of cations. Eluents based on inorganic cations such as copper (II)²⁷ and more recently cerium (III)³⁵ have achieved some success, and aromatic bases have also been applied as eluents for the separation of alkali metal and alkaline earth cations¹¹ (Fig.4).

Indirect detection is also applicable to refractive index and fluorescence detectors. In the former case, anions can be detected after ion-exchange separation by monitoring the refractive index of an eluent containing an aromatic acid such as phthalate³⁶. In this detection mode, the background refractive index of the eluent is not restricted (unlike the indirect UV detection mode) since measurements are conventionally made by comparison of the column effluent with pure eluent contained in a reference cell. Sensitivity is therefore limited only by the performance of the detector used. A further distinction between the indirect UV and refractive index detection modes is that the latter can be used with quite concentrated eluents and is therefore suitable for use with columns of relatively high ion-exchange capacities.

An indirect fluorescence detection procedure for ion chromatography has been devised^{37,38} in an attempt to utilise the high sensitivity of fluorometric measurements. Here, sodium salicylate was used as a fluorescent eluting ion for anion-exchange chromatography and decreases in the background fluorescence were used to detect eluted solute anions. A modulated double-beam laser-excited fluorometric detector was designed in an attempt to overcome the inherent flicker noise of the laser source. The detection sensitivity for anions was at the sub-ng level.

Atomic Spectroscopic Techniques

The chief advantage gained by coupling atomic absorption or emission spectroscopic techniques with ion chromatography is that speciation of solutes can be achieved. For

example, a range of arsenic species has been separated and detected in this manner³⁹ and free chromate has been determined in the presence of chromium⁴⁰.

Atomic emission spectroscopy has been used in a new detection scheme called replacement ion chromatography⁴¹, which is reported to have the potential for very low detection limits and universal applicability. Here the counter cation associated with an eluted anion is stoichiometrically replaced in a cation-exchange column by a cation which shows good flame photometric response (e.g. lithium). The replacement column is situated after the separation column and the eluent from the replacement column is directed into a flame photometer. The resulting signal observed for lithium emission at 670 nm provides an indirect but quantitative measure of the eluting anion concentration. Similarly, the concentrations of eluted cations can be determined after their replacement in the eluent with lithium. The detection limits attainable with this technique are in the micromolar region and are comparable or superior to those of conventional conductivity detection.

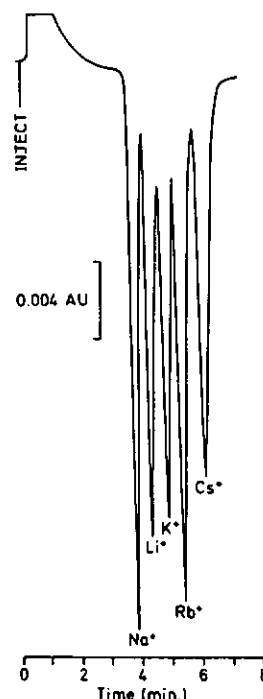


Fig.4 Indirect UV absorption detection of alkali metal cations using an aromatic base as eluent. Column: Waters Associates IC PAK C. Eluent: 0.5 mM 2-methylpyridine at pH 5.5 Solute concentrations: 0.14-2.7 ppm. Detection wavelength: 262m.

DETECTION USING POST-COLUMN REACTIONS

Post-column reactions involving colour formation have been applied to ion chromatography. The ideal colour forming reaction should be fast to eliminate the requirement of inclusion of a reaction coil into the system and to enable the reagents to be mixed with a simple tee piece giving 90° impingement of the flowing streams⁴².

A simple detector designed specifically for the detection of cations after post-column reaction with PAR has recently been described⁴². This device is miniature (approximately 25mm in length) and incorporates an LED light source and a photocell, both of which are mounted directly onto the ends of the detector flow-cell. The detector was found to give minimal contribution to band broadening and provided sensitivities of about 10 ng/ml for transition metal ions.

Post-column reactions have been much more widely applied to the detection of cations than is the case for anions; indeed it is fair to say that there is no better method for the detection of transition metals and lanthanides. The colour forming reagent should give a low background absorbance, together with high molar absorptivities for as large a range of cations as possible. Many reagents have been evaluated for their suitability as colour forming reagents in post-column reaction detection and these include broad spectrum reagents such as dithizone, Eriochrome Black T, 4-(2-pyridylazo)-resorcinol (PAR),

xylene orange and Arsenazo dyes. The most widely applicable reagents are PAR and Arsenazo I or Arsenazo III which together provide rapid colour reactions with most elements of interest⁴³.

CONCLUSION

Many significant developments in detection methods for ion chromatography have occurred in recent years, primarily in the areas of amperometric, potentiometric and indirect UV absorption detection. These developments have enabled sensitive detection to be achieved with detectors commonly found in chromatographic laboratories and have diminished the dependence of ion chromatography on conductivity detection.

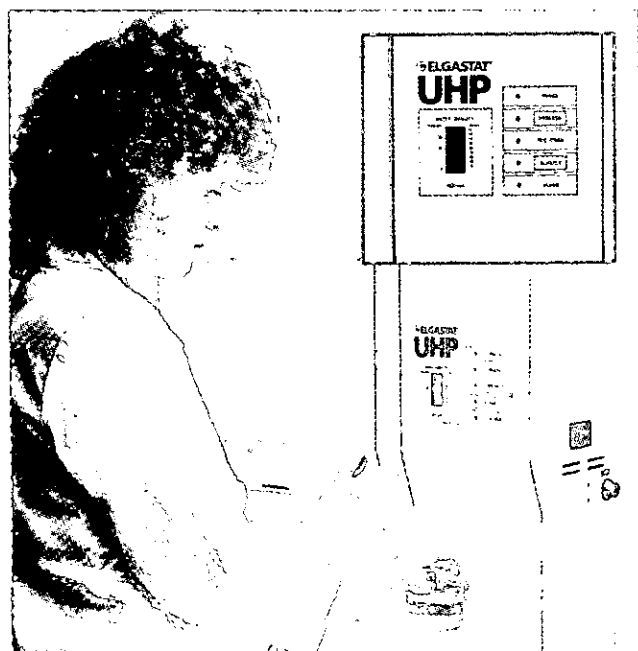
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A PRACTICAL APPLICATION OF ION CHROMATOGRAPHY

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Introduction

Huntly Power Station, a part of Electricorp, is the largest power generating station in New Zealand. It is situated on the west bank of the Waikato River, in the town of Huntly, some 90 kilometres south of Auckland. The station comprises four generating units, each rated at 250 megawatts, giving an installed capacity of 1000 megawatts. The station is described as a thermal power station, its four boilers are designed to burn either Waikato coal or natural gas derived from the Maui Field. The steam produced in the boilers at about 180 bar pressure is delivered to the turbogenerators at 538°C and 166 bar pressure.

Power Station Chemistry

Huntly Power Station boasts a permanent chemical staff of 10 with one or two transient chemical trainees at any one time. The chemical technicians work in two well-appointed laboratories and four chemical analyzer rooms. Each generating unit has a chemical analyzer room.

The duties of a power station chemist are many and varied. For simplicity's sake these duties can be gathered into four general areas of activity:

- * The quality control of waters.
- * The quality control of fuels; coal, gas and oil.
- * The condition monitoring of oil; lubricating and insulating.
- * Environmental impact monitoring; gaseous discharges to the atmosphere, aqueous discharges to the river, particulate discharge to the station environs.

The main topic of this paper is the quality control of waters.

The quality control of waters is a very general term. On a power station, such as Huntly, the expression has to cover and describe many waters; from raw water abstracted from the Waikato River, to ultrapure conductivity water produced in the station's demineralisation plant. The underlying purpose of the water chemistry is to minimise the rates of corrosion of the many systems that go to make up a power station; primary cooling, secondary cooling, condensate, feedwater, boilerwater, steam, airconditioning, and many others. Systems which can be made up of a number of dissimilar metals. Systems which operate at N.T.P. Systems which operate at 538°C and 166 bar pressure.

The analytical techniques used in the laboratory of necessity cover the whole gamut of modern instrumental analysis; spectroscopy, AAS, electrochemistry, specific ion, conductimetry, etc.

The analyses undertaken encompass all the contaminants found in water; soluble and insoluble, both organic and inorganic, which could initiate or perpetuate corrosion of those systems previously referred to. The analyses also cover the conditioning chemicals used at Huntly to minimise any system corrosion.

The levels of detection required of the contaminants or determinands, dictate the technique to be used for a particular analysis. At the high temperature, pressure and steaming rate found in the generating units at Huntly contaminants are measured in microgrammes per litre, or more commonly in the less scientific term of parts per billion — ppb. At this level the detection of offending cations is relatively easy; sodium by specific ion, iron

and copper by AAS or colourimetry. The detection of offending anions, however, at the ppb level is not so simple. Of interest to the power station chemist are; sulphate, chloride and organic acids. In power generation circles ion chromatography has long since been recognised as the analytical tool for this work.

Requirement

The need of microgram levels of detection is necessitated by the operating conditions of the Huntly generating units previously alluded to. The boilers are fed with ultrapure water, conditioned with ammonia and hydrazine, the steam produced is used to drive the turbines. The steam is then condensed and proceeds forward firstly as condensate, secondly feedwater, back into the boiler to complete the circuit. Within this circuit are two possible sources of potential corrosion initiators. Raw river water leakage inwards from mechanical failure of the main condensers, and corrosion products already produced, e.g. magnetite, can be recycled to provide nucleation centres for further corrosion. To alleviate these two potential sources of contamination the Huntly units have what is known as "full flow condensate polishing". The condensate produced is passed through a large vessel containing cationic and anionic exchange resins. This performs two functions; the physical removal of particulate matter and the chemical removal of dissolved salts. The levels of sulphate and chloride passing forward from the condensate polisher are normally within the sub-microgram level. It has to be known accurately to assess polisher regeneration efficiency and the loading of potential corrodants being carried into the boiler.

A specification was drawn up. The fundamental requirement was that the instrument supplied would be capable of determining sub-microgram per litre levels of the anions sulphate and chloride in high purity water systems. From 'overseas' utility experience it was felt that if the instrument successfully accomplished this basic requirement the rest would be easy. A number of suppliers provided instruments for bench evaluation. Early work confirmed that the requirement was practicable. It was fairly obvious, however, that a concentration technique would have to be employed to overcome the kinetic problems associated with passing relatively large volumes of sample through a small analytical column. This technique is described by some suppliers as 'trace enrichment.'

System

Once the requirement had been defined the next stage was to discuss with the instrument suppliers the system that would best fulfil that requirement. As is ever the case, the project was restrained by the available funds. What was therefore finally purchased was the best available system for the price. It was not the cheapest, by some few thousand dollars, but it had the backing of an experienced support group.

The supplier recommended conductivity as the mode of detection most suited to the application. Naturally if funds had been available both UV and conductivity options would have been advantageous.

The system as was conceived: Waters 590 microprocessor controlled pump, 2 valves, T/E YoYo, analytical column with Waters TCM, Waters 430 detector and Waters 730 data station.

With commissioning the system became: Waters 590, 2 valves, T/E loading pump, T/E YoYo analytical column with Waters TCM, Waters 430 and a Waters 740 data station. The most significant difference being the 740 data station which had the chromatogram playback facility.

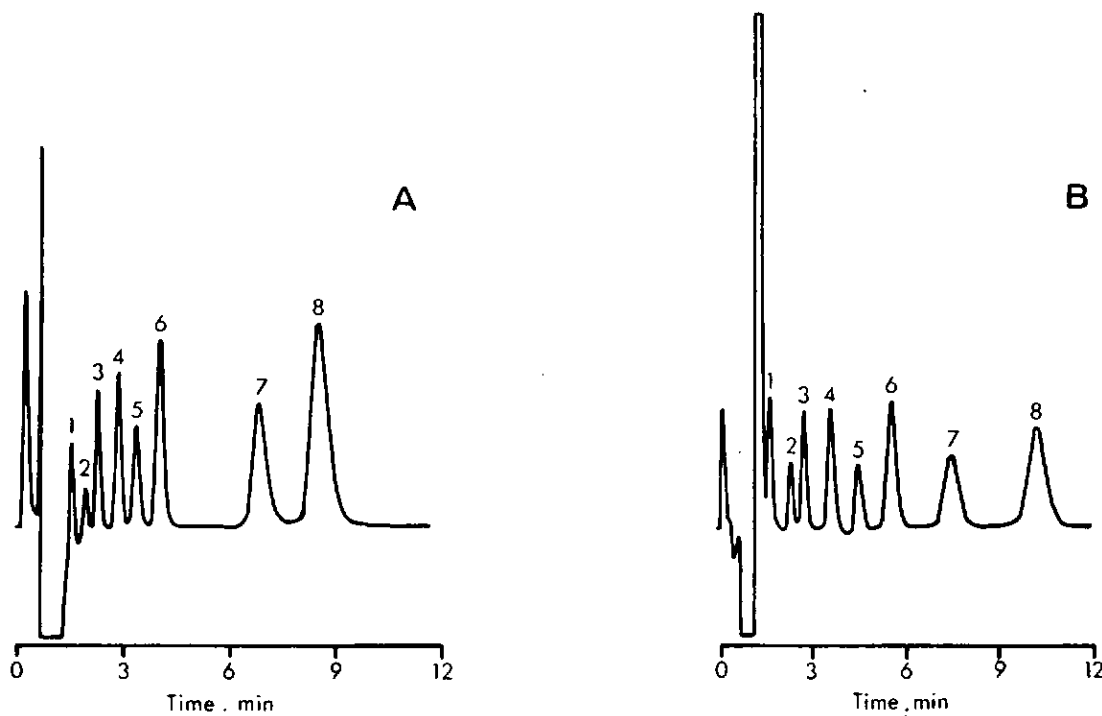


Fig. 1. Comparison of eluents. A- *p*-HBA, 1.2 cm³/min, 560 psi. B-borate/gluconate, 1.2 cm³/min, 814 psi. Peaks 1 to 8 are, respectively, fluoride, carbonate, chloride, nitrite, bromide, nitrate, phosphate, and sulphate.

Eluents

Very little experimental work has been done on site in the eluent field. The station has largely relied upon the supplier's recommendations. Waters carried out tests on site with:

- * 2mM potassium hydroxide.
- * Borate/gluconate.
- * 2mM *p*-hydroxybenzoic acid, (*p*-HBA).

Station staff have done a little work with a modified borate/gluconate eluent sourced from Yallourn P.S. in Victoria.

Some work was done with borate/gluconate. Waters felt that the chemistry of the early eluting species could be improved upon. Fluoride, for example, had tended to merge into the system peak. They recommended the station use *p*-hydroxybenzoic acid, and this has proved fairly successful. The water dip is somewhat more pronounced with *p*-HBA when compared with borate/gluconate. This disadvantage is, however, more

than offset by the increased sensitivity obtained with the *p*-HBA. A comparison of the two eluents is made in Fig. 1 where the enlarged peak area for sulphate in the *p*-HBA chromatogram clearly illustrates the increase.

The possible use of toluene sulphonic acid was mooted but not followed up.¹

Commissioning

As might be expected the commissioning stage was not without its problems. It was only the second ion chromatograph in the country. The first being the DSIR Water Laboratory Dionex of early vintage. No comparisons could be drawn with the two systems. DSIR could be of no practical help to either the station or the suppliers in the setting up of the system. The station was also attempting very low level analysis, never an easy exercise irrespective of the technique.

Early problems of baseline noise and drift were overcome with the inclusion of pulse dampening and a pressure increasing device. A simple statement to make, but the remedial actions took many weeks to effect results.

A problem of lack of correlation between ppm and ppb cross referencing work was resolved by physically measuring the volume of a sample loop. The loop was found to be about 89 microlitres instead of a 100 microlitres. It proved to be the right length but the wrong ID. Again a fairly simple problem but one which took weeks to track down.

System pressure increases were initially thought to be due to degradation of pump seals. This was resolved by the inclusion of a filter in the appropriate place.

Perhaps the most interesting of what might be referred to as commissioning problems was with trace enrichment. We had no great difficulty measuring the anions sulphate and chloride at the ppm range. However the system had not been bought for such work. As soon as the ppb work was attempted the system would not show the necessary stability. It was felt that the system might be susceptible to extraneous air currents from the air-conditioning, or just plain draughts. From the station's knowledge of ion exchange kinetics this was eminently possible. The relevant sections of the system were lagged with expanded polystyrene, much to the disgust of the supplier and his principal, but with remarkable effect. The chromatograms in fig. 2 clearly show the effects of temperature and of holding the T/E YoYo inlet and outlet in the hand. Rubber gloves were tried to eliminate any thought that the problem was static electricity. It

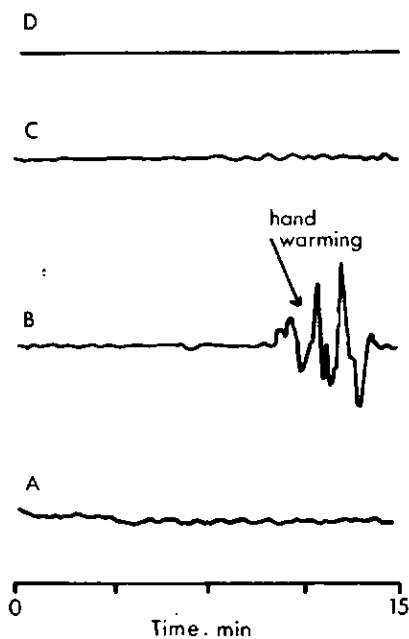
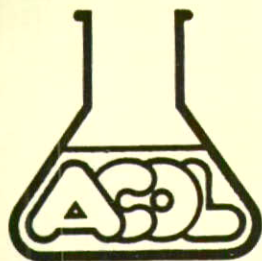


Fig. 2. Temperature effects on baseline stability. A — baseline without lagging. B — effect of handwarming. C — associated pipework lagged. D — cartridge and pipework lagged.



ANALYTICAL CHEMISTRY WORKSHOPS

Auckland Technical Institute - NZIC (Auckland Branch)

The Auckland Technical Institute is planning to run a number of practical workshops on analytical chemistry techniques in 1988. These courses will involve the use of material from the British "ACOL" scheme - Analytical Chemistry by Open Learning. ATI has been approved as an ACOL Centre, to provide tutorial and practical back-up. A series of excellent self-teach texts have been produced by John Wiley & Sons and it is intended to post the relevant text to participants one month before the 3-4 day practical session.

These courses will be ideal for graduates or NZ Certificate holders who need an intensive course in a particular analytical technique, both theory and practical.

Workshops planned for 1988 include AAS, IR, and an intermediate GC course. It is anticipated that these courses will be oversubscribed and in this event, NZIC members will be given preference. We would also like feedback on the market requirements and the reply strip at the bottom includes a full list of the ACOL texts. Return of the strip would be appreciated so that we can establish a mailing list. Please photocopy and circulate to colleagues who may be interested.



Please return to Bruce Fraser, Applied Science Department, Auckland Technical Institute, Private Bag, Auckland.

Name Phone

Address

Qualifications NZIC Y/N

1) I am interested in the following ACOL workshops for 1988. (Tick)

AAS ☐ IR ☐ Intermediate GC ☐

2) Future ACOL courses in which I might be interested. (Tick)

Samples and Standards
Classical Methods
Instrumentation
Gas Chromatography
Electrophoresis
IR Spectroscopy
NMR Spectroscopy
Mass Spectrometry
Radiochemical Methods
Clinical Specimens
Diagnostic Enzymology
Quantitative Bioassay
UV-Vis Spectroscopy
Measurement, Statistics and Computation
Fluorescence and Phosphorescence Spectroscopy ...
Assessment and Control of Biochemical Methods.....

Sample Pretreatment
Using Literature
Chromatographic Separations
HPLC
TLC
AA and Emission Spectroscopy
X-ray Methods
SEM and X-ray Microanalysis.....
Electroanalytical Methods
Potentiometry and ISE's
Polarography/Voltammetry
Thermal Methods
Microprocessor Applications

(over)

OTHER POST-GRADUATE/POST-CERTIFICATE COURSES AT ATI

Certificate In Applied Chemistry (Analytical Chemistry)

This course is validated and moderated by the Royal Society of Chemistry in England. Covering advanced analytical techniques and applications it includes a number of lectures from specialist speakers and visits to a range of analytical chemistry laboratories. The course is eight hours per week (tentatively timetabled on Mondays 12.30-8.30 pm for 1988) with 2 hours theory 6 hours practical/visit as the average breakdown for the first three terms. The fourth term is devoted to a project, on an analytical problem, preferably employment related. The two three hour theory exams are set locally but moderated by the RSC and on successful completion, the certificate will be issued by the Royal Society of Chemistry. A great opportunity to refresh your analytical expertise while extending your range of contacts.

NZ Diploma in Management Services

A two-year, part-time course is now being offered to those who wish to qualify themselves in the field of operations management (i.e. industrial engineering, systems analysis, data processing, financial reporting and control, personnel management and training). This AAVA course is biased towards science and engineering and has an entry requirement of a New Zealand Certificate or equivalent.

NZ Diploma in Surface Coatings Technology

Certificate in Cosmetic and Manufacturing Chemistry

Certificate in Corrosion Technology

New Zealand Diploma in Science



If further information is required on any of the above courses, please tick the appropriate box(es) and return to Bruce Fraser, Applied Science Department, Auckland Technical Institute, Private Bag, Auckland.

RSC Certificate in Analytical Chemistry

☐

NZ Diploma in Management Services

☐

NZ Diploma in Surface Coatings Technology

☐

Certificate in Cosmetic and Manufacturing Chemistry

☐

Certificate in Corrosion Technology

☐

NZ Diploma in Science

☐

was undoubtedly a temperature related problem. So much so that the supplier provided lagged tubing for the T/E YoYo inlet and outlet to the valve and redirected a pump fan away from the YoYo.

During the commissioning phase numerous problems were thrown up, faced and resolved. Although scientifically interesting the trouble shooting took time and diverted the operator from the real world of quality control analysis. Nevertheless, even during this sometimes frustrating phase there were successes:

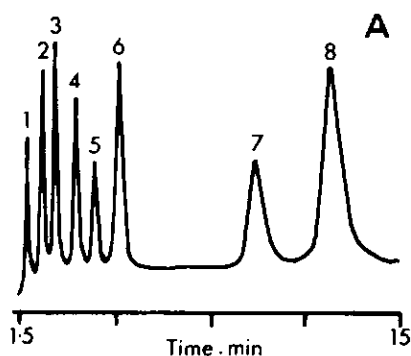
- * The suppliers brought to the site a potential client, armed with soil extracts. He left, happily, clutching good chromatograms, albeit in the ppm range. Good enough to purchase such a system.

- * The station undertook a survey of its ash sluicing systems. The work included sulphate determinations in highly alkaline waters. These were performed successfully on the IC.

Analytical

Flows

The system flow rate was set up and standardised at 1.2 ml. per minute. This flow rate is the maximum allowed on the analytical column.



station chemist is conductivity. This is an all-seeing blanket parameter. It has been refined to conductivity after cation exchange, in which the sample is passed through a column of cation exchange resin. Any ammonia present is stripped out leaving a conductivity attributable to dissolved salts. In the condensate, after polishing, the feedwater and condensed streams this 'After Exchange Conductivity' is the order of 0.07 to 0.10 microSiemens per centimetre at 25°C. These condensates and steams could fairly accurately be described as approaching ultrapure standards.

Analysis of samples from around a Unit circuit has been undertaken and has confirmed to Station that the levels of sulphate and chloride therein are indeed low. An example is shown in Fig. 3. A calibration standard run illustrates reasonable chemistry and the following sample of condensate from Unit 1 extraction pump illustrates the cleanliness of the system. The chromatogram would suggest a sulphate level of 0.41ppb, and a chloride level of 0.06ppb. The spec. requirement of sub-microgram levels is clearly achievable.

Running Problems

As with any complex or sophisticated system problems are to

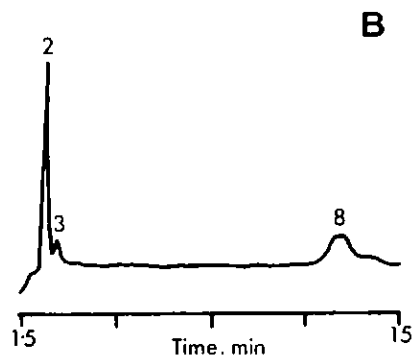


Fig. 3. Sample analysis. A — calibration standard, ppb levels. B — sample, Unit no. 1 extraction pumps (peak numbers as Fig. 1).

Because of the original requirement for the IC very little work has been done in the ppm non-trace enrichment mode. What had been done was satisfactory, a 100 microlitre aliquot being the standard sample for analysis. Efforts have been concentrated in the trace enrichment field.

Trace enrichment was set up initially to load at 2 ml. per minute. This has been increased to 5 ml. per minute. Site work has shown no significant loss in recovery or resolution at this rate. Work done by Haddad *et al* would suggest that this could be satisfactorily raised to 8 ml. per minute.

Preconcentration onto the trace enrichment column, TEC, has been carried out in the reverse flow mode and elution in the normal flow mode.

Samples

In each Unit Chemical Analyzer Room online analyzers provide 24 hour information to the unit operator via the central computer systems. A parameter commonly used by a power

be expected. The IC has been no exception. The fundamental problem has been one of short life of the analytical columns. This has been brought about by pressure build up in the system and specifically in the analytical column itself. Pressure has increased, on one occasion, from 200-300psi to nearly 2000 psi in a matter of days. This pressure increase results in a marked deterioration in the quality of the chemistry produced in chromatogram form.

Early work suggested deposition on the analytical frits from pump seal degradation. Work done in Australia, utilising scanning electron microscopy (SEM) and EDAX has identified pump seal particles on the frit. Coarse filters were introduced after the pump and before the analytical column in an endeavour to eliminate the problem.

The problem persisted. A contact with Yallourn Power Station in Victoria, a site with an identical IC setup, suggested a common problem. SEM, of a frit from a Yallourn anion column showed the frit to be covered with a 'skin.' X-ray analysis of that

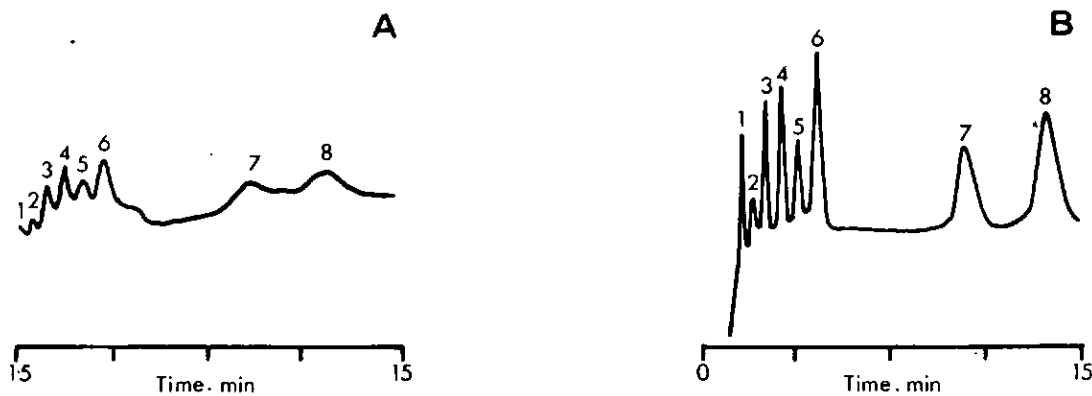


Fig. 4. Column cleanup with caustic. A — before. B — after. Calibration standard, peak numbers as previously.

'skin' showed it to be predominantly silica.⁴ It was inferred that the Huntly problem could be similar, colloidal silica in the influent raw water. The recommendation from Waters was the inclusion of a 0.22 micron membrane filter which it was felt would stop virtually anything; organic or inorganic. At that stage anything smaller than the *pseudomonas diminuta* bacteria was inconceivable.

The problem persisted. Work is now being developed along the lines of using charged filter media for particulate removal and bio-filtration for dissolved organics.

Column Cleanup

From the work done it became fairly obvious that the anion analytical columns were becoming fouled. Changing frits on the columns had had no long term effect. It was a question then of fouled with what?

Waters recommended a column cleanup procedure utilising 0.1M sodium hydroxide. This was used on a column to little effect.

An anion analytical column was compared to the station's demineralisation plant. Problems encountered on the main plant and its ion exchange kinetics should be translatable down to the miniature version; the anion analytical column. Indeed fouled columns have been cleaned up to good effect using 1M sodium hydroxide as shown in fig. 4. The yellow-brown effluent produced suggested organic contamination. Clean up has been taken a stage further using 3% hydrogen peroxide, again to good effect.

The work on column clean up is as yet inconclusive but would suggest that columns could be recovered. It could be hypothesised that the shorter than expected service life of the anion columns could be due to some form of anion fouling. But the known problem of colloidal silica should not be lost sight of.

Acknowledgements

The authors wish to thank the station manager at Huntly Power Station for the opportunity to prepare and present the paper. They also thank their colleagues in the laboratory who have contributed to the overall effort. A mention must also be

made of the patience of Conway Bishop, Alphatech and of the assistance of Jeff Kibby, until recently of Waters Associates, over the past two years.

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Continued from page 158

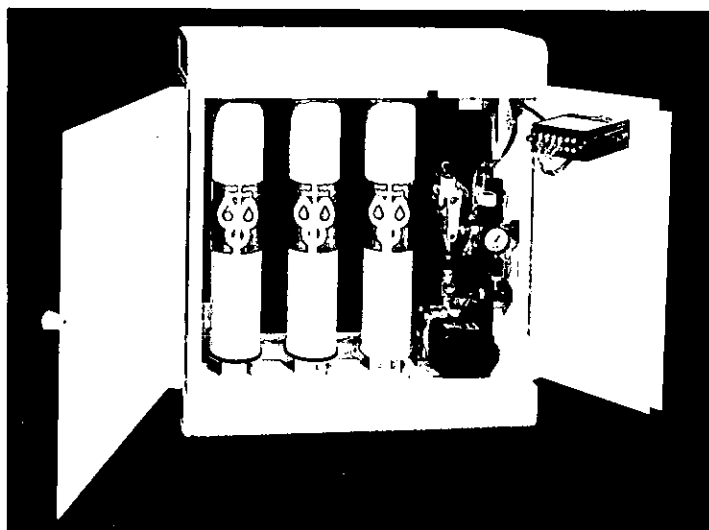
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THE APPLICATION OF TECHNOLOGY TO DEVELOP AND IMPROVE THE ANALYSIS OF PULPING LIQUORS

John P Leader and Harry Lim H.K.
NZFP Technology Limited, Auckland

Background

This paper presents a case study, which exemplifies the need for technologists in the commercial environment to approach each situation in a sound and practical manner by working closely with the end users to service their requirements.

One of the major contributors to the economic viability of a pulpmill is the efficiency of the recovery of the pulping liquors; and a key factor of this is the nature of the liquors themselves. Moreover, the composition of the pulping liquors is also an important parameter with regard to the quality (especially the strength properties) of the pulps produced.

There are four characteristic pulping liquors — white (180 gl⁻¹), green (200 gl⁻¹), pink (230 gl⁻¹) and black (13 gl⁻¹) to consider, with pH ranging between 10.5 and 13.5. The latter is a specially challenging matrix as it contains mostly organic material.

The ions of major interest are bicarbonate, chloride, sulphide, carbonate, sulphite, sulphate, oxalate and thiosulphate. These ions are present in varying proportions for the different streams. Conventional wet chemistry techniques often require several days to analyse the sulphur containing anions; however, masking and precipitation techniques are required to separate them, which is time consuming and can be inaccurate.

Such a system is not practical as the composition of the pulping liquors is never in a steady state condition. Clearly, a faster and more powerful analytical technique is required. In August 1985 an ion chromatograph was purchased. Unfortunately, the IC techniques known at the time required the use of at least two different eluent systems, and so still required several hours for the required analysis.

NZFP Technology System

Objective

The overall objective of our development work was to minimise the time per sample determination. For simplicity and speed, there was also the need to be able to handle all our samples on the same instrument configuration and counter-ion system, to avoid delays of changing and re-equilibrating the instrument.

Difficulties

The ions of interest had similar retention times, and both fast and slow eluters were present in the same sample. Hence, a compromise had to be found between peak separation and peak broadening.

Sample stability also posed a problem, especially in dilution. The pulping liquors were very high in chemical content and required dilution of 500-1000 times before analysis, using deionised and distilled water polished in a four bowl Milli-Q system to very low conductivity. An associated problem with this was that the "ultra-clean" dilution water was then very prone to rapid absorption of CO₂ and O₂ from the atmosphere.

Key Factors

Several eluent systems were evaluated, including KOH. The pH of this eluent was 11.7 and the anions of interest were more stable in alkaline conditions. However, this eluent was very prone to CO₂ absorption from the atmosphere.

The eluent system finally chosen was borate/gluconate. For our purposes, a 1.0 uM concentration with a pH of 8.4, rather than the usual 1.3 uM, gave the optimal results.

In order to minimise the presence of CO₂ and O₂, several options were evaluated, including nitrogen-filled glove boxes. In

the end, a system was developed with helium sparging, and thereafter maintaining a helium cover over the eluent. The system proved to be simple, inexpensive and very effective. Helium, which is virtually insoluble and inert, was also used to displace air from the head-space of the volumetric flasks prior to mixing during sample dilution.

An antioxidant was found to be necessary, especially for sulphite stabilisation. The antioxidant used was found to stabilise the sulphite ions, and prevent them from being oxidised to sulphate, for well over 12 hours prior to and during analysis.

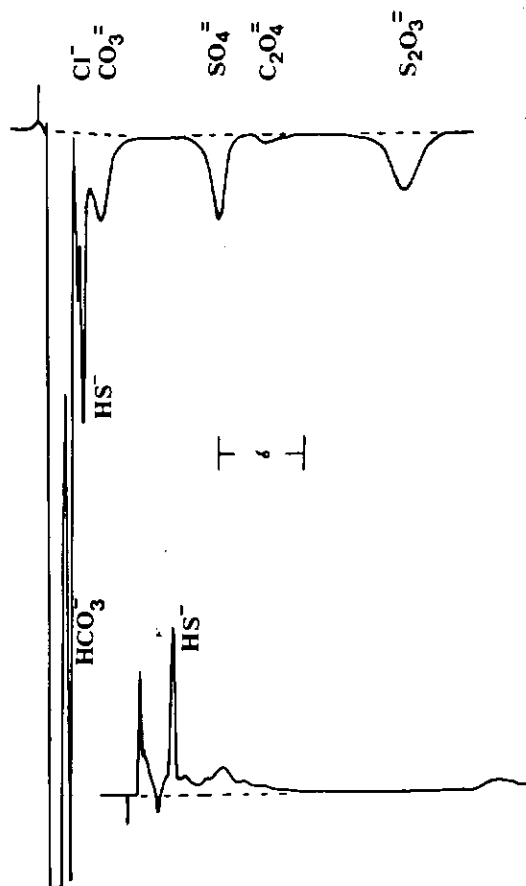


Fig. 1. Typical black liquor analysis

Final Result

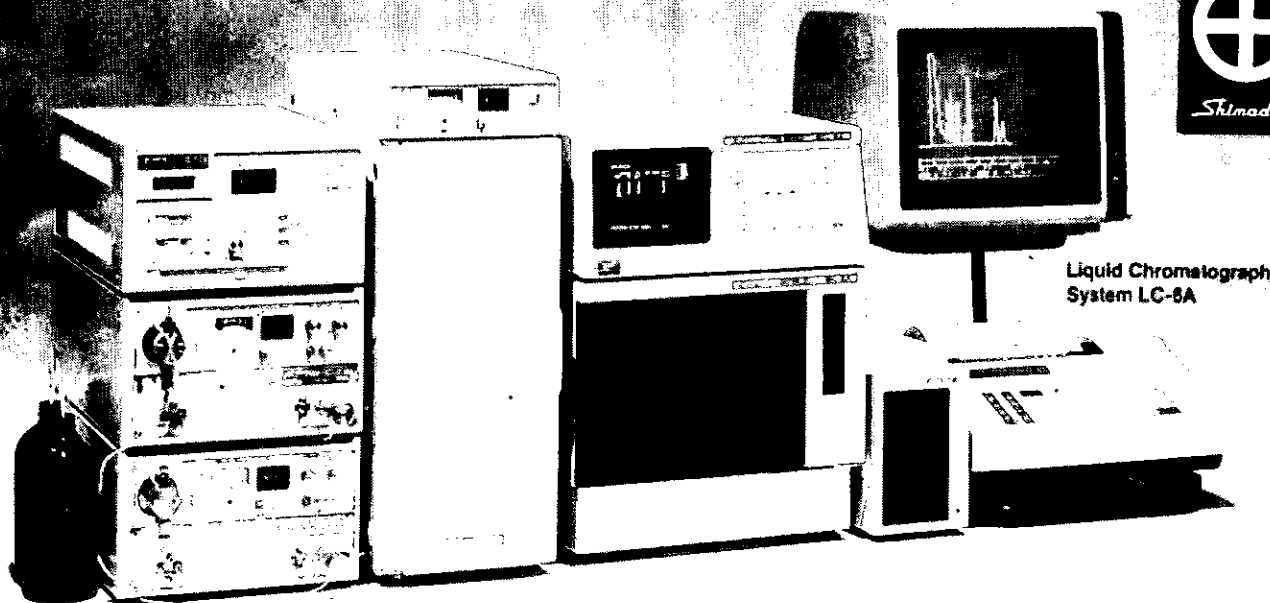
A typical black liquor sample analysis is shown in Figure 1.

Peak height is the preferred method of quantisation. Sulphide is present as HS⁻, and although it elutes very close to chloride on the conductivity chromatogram, a good resolution and determination is still possible. If there is any doubt, it is counter-checked using the HS⁻ peak on the UV detector, where the chloride peak does not pose any problem.

The analysis can now be carried out in 20-40 minutes.

Conclusion

An in-house chromatography technique for analysis of pulping liquors has been developed after modifying and improving upon existing technology. The system allows the analyses to be carried out quickly, so much so that the composition of the pulping liquors can now be monitored continuously, which is what the pulpmill requires.



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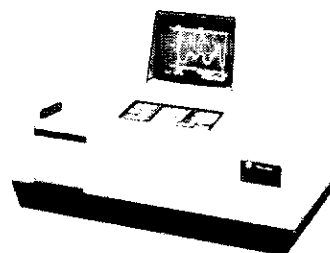
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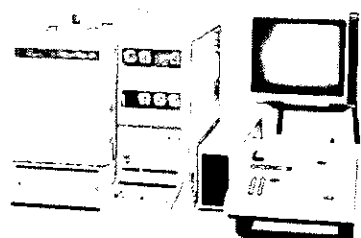
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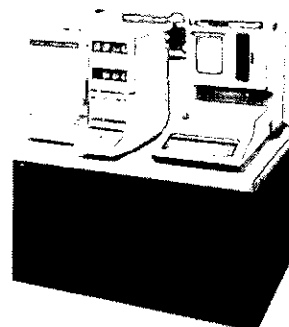
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CONFERENCE 1987 – WHO WENT?

C.L.H. Stonyer

The theme of this conference was "Commercialisation of Chemistry", and considerable efforts were made (as in the 1981 Golden Jubilee conference also held in Auckland) to attract not only industrial chemists but also the managers of companies employing chemists, or having a significant interest in chemistry. The thought that top people would expect a "top" venue was part of the reason that the Sheraton was chosen for the first day, when no specialist subjects were discussed. Hundreds of carefully worded invitations were sent to Chief Executives, and some even sent us personal replies declining our invitation. How successful our efforts were can be judged from Table 1 (Monday). Of course there may have been some who were not in Table 1 because they came for more than one day, but then not all the 10 were industrialists.

The best day for single day attendance was Friday, which hardly counts as a conference

day because it was three concurrent workshops: many people may have come to this day had it been held at any time — Auckland branch has a good record of attracting people to one-day meetings and workshops.

Table 1: Numbers registering for one day only (Total Registrants 299)

Monday	10
Tuesday	13
Wednesday	12
Thursday	13
Friday	52
Total	100

Table 2 shows the employment origin of registrants, unfortunately not broken down into chemistry and biochemistry. It may be of some satisfaction to the organising committee (which included the writer), to see that industry supplied more registrants than any other category. Comparison with the figures in "Who goes to Conferences" —

Duncan McLennan, *this journal*, p.51, June 1982, shows that the basic reason is the sharp decrease in attendance from university people. The non-university teaching profession sent almost the same dismal number as in 1982 — this must

be one area we could improve on!

In Table 3 there is the breakdown of people by addresses. Unfortunately our data does not show whether members were NZIC or NZBS, so they are all called "members". A striking feature this year (compared with 1982) is the sharp decline in numbers and in the proportion

of people coming from Wellington and the South Island. In all three of these branches the greatest decline is from members — perhaps those who did not come are victims of the "user pays" problem already.

Success or Failure?

We should address this question not only to those who came, but also to those who did not. From the financial point of view, the very small profit that was made is highly satisfactory, because non-attendees will neither pay for nor benefit from it, but from the point of view of those who missed the many excellent lectures it must be disappointing. A detailed report will go to Council, and the writer (amongst others) hopes that much firmer guidelines will be given to conference committees on many aspects such as objectives, organisation, expense, publicity, competitions, exhibitions, venues and other matters, on which the committee had to make some difficult decisions.

Table 2: Employment origins of registrants

	1987	1982
Industry	92 (31%)	82
University	83 (28%)	192
Research Associations	23 (8%)	28
Technical Institutes	10 (3%)	8
Secondary Teaching	5 (2%)	5
Other government	79 (26%)	97
Consultants, unemployed, etc	7 (2%)	21
	299	433

Table 3: Home addresses of attendees

	Members	Non-mbrs	Total	%
Auckland	83	37	120	40
Waikato	32	13	45	15
Manawatu	44	7	51	17
Wellington	28	12	40	13
Canterbury	18	5	23	8
Otago	7	1	8	3
Overseas	2	10	12	4
			299	100

COUNCIL NEWS

Mr T R Hitchings presided during a telephone meeting of Standing Committee on Tuesday 17 November 1987. Council will meet in Wellington Monday/Tuesday 22/23 February 1988 at the Royal Society of New Zealand.

Membership

The First Vice-President, Dr D R Llewellyn, advised Standing Committee that in October he had conducted, as instructed by Council, a ballot of corporate members on 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".

734 envelopes were received. There was no name or branch given on 75 envelopes. From the postmark the branch was identified for 64 envelopes and the figures for these are shown in brackets in the table below. It

was not possible to identify the origin of 11 envelopes. There was one informal vote and one vote was disallowed.

The results are as follows:

Branch	In Favour	Not
Auckland	163 (16)	30 (3)
Waikato	57 (5)	7 (0)
Manawatu	69 (3)	8 (1)
Wellington	117 (13)	42 (4)
Canterbury	71 (7)	39 (4)
Otago	42 (8)	12 (0)
Unidentified	(6)	(5)
—Totals	577	155

Standing Committee resolved that these results be forwarded to Council, branch

chairmen and to the Editor for publication in "Chemistry in New Zealand". The Membership Committee was asked to draft appropriate rule changes for submission to branches and Council for consideration and action in February 1988. (Rule 16.16).

Honours and Awards

Mr Robert F Ryan, CIG Ltd, Sydney, President of the Royal Australian Chemical Institute, was elected an Honorary Fellow of NZIC for his term of office.

Members and Branch Committees are reminded that entries for the Easterfield ICI, Shell, and Chemical Education awards close with the Administrative Secretary, PO Box 29-183, Christchurch, on 30 April 1988. The rules for these prizes and awards were published in the 1987 Yearbook.

Entries for the NZIC/RACI Visiting Speaker from Australia

to New Zealand in 1989 and the Chemical Essay Prize close on 30 June 1988 with the Administrative Secretary, PO Box 29-183, Christchurch.

Salary Survey

Standing Committee resolved to recommend to Council that no salary survey be conducted in 1988 to allow members and branch committees to submit suggestions for changes to the design of the 1987 survey reported by Wendy Singers in the October issue of the Journal.

J Rogers
General Secretary
November 1987

We regret that due to the timing of the Standing Committee meeting we are unable to include details of membership changes with this report. These will appear in the February issue. Ed.

GOVT DEPTS AND RESEARCH INSTITUTES

DSIR Chemistry Division, Gracefield

Chemistry Division took delivery of a VG 70-250S high resolution and high sensitivity mass spectrometer on 6 October. It will be housed in the Organic section and will be run by **Lawrence Porter and Carolyn Sheppard**. It will be used as a general Divisional analytical facility with special emphasis on high sensitivity applications such as TCDD analyses for the Health Department.

John Patterson, Doug Sheppard, and visiting Post-Doctoral Fellow **Alan Dick**, will be visiting Antarctica in the summer season, travelling down in December. They will be attempting to monitor Hg levels in the snow and in the Mt Erebus geothermal area. **Jenny Webster** visited the Dry Valleys in October to study the trace metal composition of the water of Lake Vanda.

Simon Buckland has joined the Food Section. **Kevin Brown** and **Roger Newman** have returned after periods of study leave. **Helen Harvey** retired on 14 August after her second period of service at CD. We all wish Helen well.

N.Z. Dairy Research Institute

Dr Geoffrey Page has been appointed Director of the Institute in succession to the current Director, **Dr Peter Robertson**,

upon his retirement. **Dr Page**, who will take up the appointment in January 1988, graduated from London University (UK) in 1970 where his field of study was organic chemistry.



He is at present a Senior Lecturer in Food Technology at Massey University, a post which he has held for the past two years.

Prior to emigrating with his wife to New Zealand in 1985, he spent four years with Unilever NV in the Netherlands, and seven years with Unilever Research in the UK. **Dr Page** has also worked in the sugar confectionary industry and has held a Postdoctoral Fellowship in the USA.

N.Z. Oceanographic Institute

Dr Geoff Glasby has been awarded the degree of Doctor of Science by Oxford University.

NZ/Australian Government Food Analysts Meeting

On 3 and 4 November, Chemistry Division DSIR hosted a meeting of NZ and Australian government food analysts at Mount Albert Research Centre. These meetings are held every 2 years and this is the first occasion that NZ has been the venue. The Australians came from the Australian Government Analytical Laboratories (AGAL) in Sydney, Kingston (Tasmania), Adelaide and Perth, and the State laboratories in Brisbane, Adelaide and Perth. The New Zealanders were from Chemistry Division DSIR (Auckland, Wellington and Christchurch), MAFQual (Lynfield) and the Department of Health (Auckland).

The programme included a wide variety of technical papers and discussion on chemical analysis of foods, and some operational topics such as relationships between laboratories and their clients.

The "locals" were interested to hear of the Australian problems with pesticide residues in export beef and the enormous commitment of analytical re-

sources which has been necessary to monitor and control the situation.

Before and after the meeting, various Australian representatives visited Chemistry Division (Auckland), the Division of Horticulture and Processing, MAFQual (Lynfield), MAFTech (Ruakura), the Health Department NECAL laboratory and the Auckland Public Health Laboratory.

Company News

Heather Symes has left Croda Chemicals and taken up a position with Bayer New Zealand Ltd.

John Reece has retired from Swift New Zealand Ltd.

New Staff at John Morris Scientific

Mr Brent Cunliffe has joined our Auckland branch in the Regional Sales position. **Brent's** prior experience is in the foods industry from laboratory QC, R&D and production aspects.

Miss Christine Snoeijer has joined our Wellington branch. **Christine's** prior experience has been associated with dental technology, plus medical and scientific sales.

BRANCH NEWS

Auckland

The annual Chairman's Dinner was held at Waipuna Lodge on 26th September. The event was attended by 50 members and guests who enjoyed a delightful buffet dinner and then adjourned to hear **Prof David Hall** talk on the reasons behind the restructuring of the British universities. Although he did not go into details **Prof Hall** indicated that this had profound implications for the New Zealand universities.

The AGM for the Auckland branch was held on 27th October in the University Department of Chemistry Common Room. The meeting was attended by 50 members and a few non-members. At the meeting the ICI Prize was presented to **Assoc. Prof Stewart Rulledge** by **Mr Geoff Lawes** of ICI and the Shell Prize was presented to **Mr Alan Charleston** of AHI Fibreglass by **Mr Alan Hope** of Shell. **Dr John Rogers** presented an Honorary Fellowship to **Prof Dick Mathews**. The new Branch Chairman is **Dr Robert Winchester** and the Secretary **Dr Dianne Webster**.

The highlight of the evening was an address by **Simon Upton**, MP for Raglan, who spoke on the

economic dominance of the world by Japan and its implications for our education system. He made the point that while we should not try to copy the Japanese society our tendency to ignore the language and culture of our biggest trading partner smacked of arrogance. With Japan now the major economic power in the world we will increasingly find our own culture to be that of one of the minor powers. It would seem logical that we should put more effort into teaching Japanese and science, to better equip our industry to compete in the new economic climate which is emerging.

Manawatu

Dr John Blunt, (Chemistry Department, University of Canterbury), described the work of his interdisciplinary group of researchers on the identification of potential antiviral and anti-tumour agents from marine invertebrates, to a branch meeting on 16 September. Since 1982, the group has collected about 3000 marine invertebrate samples

from various areas of the South Pacific, extracted the samples and assayed the extracts for activity against selected viruses and tumour cell lines. Important aspects of sample collection, documentation and extraction techniques were described by **Dr Blunt**, as well as assay techniques and the structures of many of the compounds that have been determined. This was a most interesting presentation.

Chemical education will be highlighted in the coming year in the Manawatu Branch. This follows from the election of **Dr Alan Furness**, tutor in chemistry at the Manawatu Polytechnic, as Chairman of the branch at its AGM on 21 October. Other branch committee members include **Drs Alastair MacGibbon** (Secretary and Council delegate), **Julian Lee** (Treasurer), and **Cecil Johnson** (Branch Editor).

In her address to a meeting held after the AGM, the outgoing Chair, **Dr Joyce Waters**, discussed the properties of cluster compounds of gold and other heavy metals. These compounds contain at least three metal atoms in which metal-bonding is present. **Dr Waters** illustrated her

address with structures of compounds containing up to about 40 metal atoms! Many of these compounds are thermally unstable and thus may be used for the controlled deposition of gold (and other metals) onto surfaces. Because of this, and their other properties, **Dr Waters** said that in future they will play an increasingly important role in materials research for the development of advanced electronic equipment.

Otago

Bill Thomson has retired from his position as Chemist at McLeod Brothers Ltd and so has **Neil Scrymgeour** from his position as Chief Chemist at Cadbury Schweppes Hudson Ltd. Both **Bill** and **Neil** have been active on the Otago Branch committee over some years and **Bill** is a former chairman.

Dr Beverley Bell addressed the Branch on 17 September on "The Form 1-5 Science Review" and **Dr Keith Hunter** gave his Chairman's Address on "Computers in Chemistry — Some Bits and Pieces" at the 22 October Annual General Meeting. **Dr Barry Peake** is the new Branch Chairman.

UNIVERSITY & TECHNICAL INSTITUTE NEWS

Dr Gordon Rodley

Gordon Rodley took early retirement from the Chemistry Department, University of Canterbury in April this year. He joined the staff as lecturer in 1963, after completing a PhD with Professor Sir Ronald Nyholm at University College London. He became a Reader in 1978.

During his 24 years at the University there were three main areas in which Gordon displayed his strong original approach to research and teaching. Firstly his study of reactions and structures of models for the oxygen carrying property of hemoglobin was one of the first in the field, and was fruitful in further investigations at Canterbury and overseas. Secondly in a historical and ingenious approach to model building Gordon tackled the problem of the twining together of the two α -helical strands of DNA. He, with collaborators, came up with an alternative side-by-side (SBS) model, which shook the scientific world, and has fostered studies around the world to resolve the issue. Lastly Gordon approached his teaching of undergraduate students with originality and sensitivity. He was liked by students because of the attention he gave them.

More recently Gordon has used his breadth of understanding of science to become active in chemical investigations of the origins of life, an area he is currently involved in and in which he also makes use of his long standing interest in the interaction between science and religion.

Gordon has a strong feeling for the equality of people and was prepared to talk with patience and understanding about his work both formally and informally to people who lacked training in science.

As Dean of Science for a term and as a member of a number of university committees, Gordon became acutely aware of some of the formal barriers to freedom of expression in the university. For example he voluntarily became a Senior Lecturer from the more senior position of Reader in 1985. He attempted to practice the ideal of an open university community when working on his research problems. For this reason he interacted with many people outside the Chemistry Department in looking for solutions to his research problems.

Colleagues greatly miss Gordon's presence around the Department and in the wide university. He is a valued colleague who listens with interest and approaches all problems

with sincerity and ingenuity. It is hoped that in formal retirement he will still be accessible.

Jack Fergusson

Massey

Dr Robert Brooks has been appointed to a Personal Chair in the Department of Chemistry and Biochemistry. The University regards a Personal Chair as a mark of substantial distinction, reflecting professional eminence as demonstrated by outstanding scholarship, capacity for research and the ability to give leadership in fields connected to the Chair.

Professor Brooks is an expert in geochemistry, biogeochemistry and analytical chemistry. He has published prolifically in these fields, being the author of five books of which two have been translated into Russian. His current research interests include the study of plants which accumulate heavy metals, the use of plants in biogeochemical prospecting and the Cretaceous-Tertiary boundary event, an investigation to find evidence of meteoritic impact on the Earth 65,000,000 years ago.



In April next year Professor Brooks and **Dr Roger Reeves** will be going to the Brazilian state of Goias to collect rare metal-accumulating plants. Similar missions have taken these two chemists around the world from Sri Lanka to Corsica. Their current work is funded by a grant from the National Geographic Society, with additional contributions from several plant museums in the United States. The plants that they seek, known as serpentine plants, grow on soils largely hostile to other plant species because they contain high concentrations of nickel, magnesium and chromium. Many of the plants to be studied are under threat from open-cast mining and cattle ranching.

Dr Ian Watson has been appointed to the new position of Assistant Vice-Chancellor (Research). This appointment is in recognition both of Dr

Watson's personal contribution to the administration of research and of the importance the university attaches to the continued development and promoting of its research activities in the future.



Dr Watson currently holds a key position in the university as chairman of the Research Projects and Funding Committee. He is a member of the Research Policy Advisory Committee and the university's representative on the UGC Research Committee. Dr Watson is also a member of the Massey University Council. His area of research is the thermodynamics of solutions and he has published widely in this area. He is currently investigating peptide solutions in relation to understanding protein behaviour in water.

Dr Kathryn Crow, a senior research officer in the university's Alcohol Research Group, was awarded the Watson-Victor prize at the recent combined Annual Conference of the NZIC and N.Z. Biochemical Society, for her work on alcohol metabolism. The award, given by the N.Z. Biochemical Society, recognises Dr Crow's research on determining the factors involved in the regulation of alcohol metabolism. This work is central to understanding the effects of alcohol on the human body, particularly its effects on the liver which is the primary organ involved in removing alcohol from the body.

Another university success at this year's Conference was the first prize award to **Ms Kathryn Stowell** in both the open poster competition of the Institute and the student poster competition of the Biochemical Society. Ms Stowell is a PhD student in biochemistry working with **Dr John Tweedie**, and her poster described preliminary research into the gene coding for the human milk protein, lactoferrin.

Dr John Blunt, Chemistry Department, University of Canterbury, visited the Department of Chemistry and Biochemistry on 17 September and presented

a seminar entitled "Application of NMR Spectrometry to the Chemistry of Some Natural Products." Dr Blunt is well known for his work on the identification of antiviral and anti-tumor agents from marine organisms.

Victoria

Jim Johnston (Geochemistry) and **Dr T.W. Jordan** (Biochemistry) have been promoted to the position of Reader. **Professor Robin Ferrier** attended and spoke at the RACI 8th National Convention in Sydney in August. He has also been re-elected for a further term as Executive Dean of the Science Faculty. **Dr Stuart Smedley** has just returned from attending the meeting of the American Electrochemical Society held in October in Hawaii. **Dr Jim Johnston** has also been overseas in connection with his work with Fletcher Challenge on titanium dioxide. He visited the UK where he carried out some calcination tests and then visited a number of paper companies in the USA which are involved in the end use of titanium dioxide.

Canterbury

Dr Alison Downard has been appointed to a lectureship in the Chemistry Department. Dr Downard is a graduate of Otago University presently working with Professor Myer at the University of North Carolina; her research interests are in inorganic electrochemistry.

Dr Pascal Roussel has arrived from the National Research Council in Ottawa to take up a UGC post-doctoral fellowship with **Professor Leon Phillips** and **Dr Peter Harland**.

Otago

Professor Arthur Campbell retires at the end of this year and **Professor Brian Robinson** will take over as Chemistry Department Chairman. Arthur Campbell has made significant contributions to the Chemistry Department, the University of Otago and the wider community. Since his initial appointment in 1948 his chief interest has been analytical chemistry and he has directed the recently named Campbell Microanalytical Laboratory which provides valuable analytical service to New Zealand science. Professor Campbell is a former president of the New Zealand Institute of Chemistry and is a current Bureau member of the International Union of Pure and Applied Chemistry.

Continued next page

CONFERENCES

1988 ANNUAL CONFERENCE

Preparation is well underway for next year's Combined Annual Conference of the NZIC and the NZBS, which will be held at the Teachers' College in Palmerston North during 23-26 August. Activities within the specialist groups, together with three keynote symposia, will be the highlights of this Conference.

Dr Ben Selinger (Chemistry Department, Australian National University, Canberra), probably best known for his book "Chemistry in the Market Place", and **Dr Mark Florence** (Division of Energy Chemistry, CSIRO) whose main research activity is environmental chemistry, particularly the behaviour and determination of trace elements in natural waters, will present plenary lectures at the Conference. The other main plenary lecturers are **Professor Peter Colman** (Division of Protein Chemistry, CSIRO), who has made outstand-

ing contributions to research on protein structure and function, and **Professor Jeremy Knowles** (Department of Chemistry, Harvard University), well known for his studies of enzyme kinetics from an organic chemist's point of view. **Professor T. Kondo** (Faculty of Pharmaceutical Sciences, Science University of Tokyo) will present a specialist plenary lecture within the field of physical biochemistry.

Numerous other chemists and biochemists have indicated that they would be most interested to attend the Conference, if funding can be arranged for their visit. **Dr RL White** (The Exploratorium, San Francisco) has been invited to give a lecture on the presentation of science to public audiences. Invitations have also been sent to **Dr John Emsley** (Department of Chemistry, Kings College, University of London), a regular contributor to New Scientist with scientific articles (particularly on inorganic chemistry topics) of interest to a wide cross-section of the community,

and **Professor K Wieghardt** (Ruhr-Universität, Bochum, West Germany) who has published numerous papers on the macrocycles 1,4,7-trithiacyclononane and 1,4,7-triazacyclononane.

Controlled Release: Science and Technology 1988. Melbourne, 12-13 May 1988.

All aspects of controlled release science and applications will be covered in a symposium to be held in Melbourne, Australia, on 12-13 May 1988 at the Victorian College of Pharmacy. The organisers of this symposium are the Royal Australian Chemical Institute's Polymer Division in conjunction with its Medicinal and Agricultural Chemistry Division.

Four main themes will be developed at the symposium.

— Peptide, Protein and Antigen Controlled Release.

— Bio- and Eco-compatible Polymers for Controlled Release.

— Controlled release in Agriculture and Veterinary Medi-

cine.

— Implantable Controlled Release Devices.

The invited speakers include: — Professor Eric Tomlinson (CIBA-Geigy, Horsham, England)

— Peter Anderson (Incitec Pty Ltd., Queensland)

— Dr Ruth Duncan (University of Keele)

— Dr David Williams (Biochemical Engineering, Univ. of Liverpool)

A call is being made for research papers and short state-of-the-art reviews. The closing date for titles and 150 word summaries is February 1 1988, and 2 page extended abstracts will be required by March 1, 1988. Titles should be sent to the chairman of the organising committee, Dr Richard C. Oppenheim, Victorian College of Pharmacy Ltd., 381 Royal Pde, Parkville, Victoria 3052, Australia. Dr Oppenheim can provide further information on all aspects of the symposium.

UNIVERSITY & TECHNICAL INSTITUTE NEWS

Continued from page 167

Dr Keith Hunter of the Chemistry Department attended a CHEMRAWN IV (Chemistry Research Applied to World Needs) meeting on Chemistry Research and Technology Applied to the Ocean and its Resources held in Keystone, Colorado, 4-9 October. This meeting was organised under the auspices of IUPAC and 50 marine chemists together with 50 "classical" chemists were invited to discuss aspects of marine chemistry.

Over the past year **Mr Bill Thomas**, **Dr George Laws** and **Dr Rob McKeown** have retired from the Pharmacy Department. George Laws is a former chairman of the Otago Branch.

Auckland

Dr George Dawson from the University of Arizona will be visiting the Department from January to June 1988. His speciality is atmospheric chemistry and he will be working with **Dr Steve de Mora**.

Dr Heimo Keller from the University of Heidelberg is visiting the Department until the end of March 1988. He is working with **Dr George Clark** on organic superconductors and two dimensional organic "metals". He has also been involved in the development of metal complexes with anti-tumour activity and will be giving a talk to the Cancer Research Laboratory on this topic.

ATI

Roger Whiting of Auckland

Technical Institute is taking technical refresher leave this term. He will be visiting various companies in the Auckland region. He will be particularly looking at techniques used in the cosmetics, toiletries and household products industries.

John Milligan is also taking technical refresher leave this term, and will be visiting a number of companies in the Auckland region.

A Coating Laboratory and Manufacturing (CLAM) System is being donated to Auckland Technical Institute by Logicon of Illinois, USA, through their agents Computerland of Manukau City, Auckland. The CLAM system is designed to streamline laboratory management and manufacturing planning for the surface coating industry but is eminently adaptable to other chemical industries. It is being donated to allow students on the Diploma of Surface Coatings course to become familiar with its use.

A number of post-graduate courses will again be offered by ATI in 1988, after their successful reception by both staff and students this year. The courses include the RSC certificate in Applied Chemistry, the Cosmetic and Manufacturing Chemistry certificate and the Diploma of Surface Coatings. Details of some of these courses were reported in *Chemistry in New Zealand*, December 1986.

HPLC Intensive Workshop Held 3rd-5th November at ATI

This event was run jointly by the ATI and the NZIC Chromatography group, and followed a similar format to those run at WTI in Hamilton. Even without advertising, the course was fully subscribed, and attended by about 30 motivated, syringe-wielding chromatographers.

Each day featured a morning and afternoon lecture on a particular aspect of modern HPLC, followed by experimental sessions over the rest of the day. Each day concluded with a recap of the various groups' experimental work, comparing actual and expected results. As this was accompanied by refreshments and nibbles, it provided a most convivial wind-up to each day's activities.

The practical programme included: practice in developing and optimising a separation; evaluation of column and system performance in terms of the above separation; examination of the effects of different solvents; water quality in HPLC, and detector linearity. In addition, a number of elective practicals were available requiring extraction and analysis of analytes from a number of real samples.

These types of courses are intended to be both instructive and enjoyable. Feedback suggests that these aims were met for students in this case.

Dr Ross N Speden

We note with regret, the death earlier this year of Dr Ross Speden. Dr Speden was a graduate of the University of Otago, gaining a BSc in 1955 and an MSc with first class honours in chemistry two years later. Three years of research for the Department of Medicine in Otago followed, before Dr Speden was awarded a Commonwealth scholarship to the Department of Pharmacology at Balliol College, Oxford, in 1960.

In 1963 he gained a PhD at Oxford in pharmacology before returning to New Zealand briefly for a period as a research officer at the Department of Physiology at the University of Otago.

Between 1964 and 1969 Dr Speden was the senior lecturer in pharmacology at the University of Adelaide before being appointed reader in pharmacology at the University of Tasmania in Hobart.

ATI and the NZIC wish to thank the following companies for their material support of the workshop.

Alphatech Instruments and Systems Ltd
Ajax Chemicals Ltd
BDH Chemicals Ltd
May and Baker N.Z.
Roche Products (NZ) Ltd
Wilton Instruments Ltd
Salmond Smith Biolab
Sci-Med (NZ) Ltd
AWA Scientific
Gibco (NZ) Ltd

BOOK REVIEWS

THE CHEMIST'S ENGLISH. Robert Schoenfeld. VCH Verlagsgesellschaft, Weinheim, Federal Republic of Germany, Second, revised edition, 1986. 173 pp. ISBN 3-527-26597-X or ISBN 0-89573-599-7 (VCH Publishers). \$A26.00.

A decade ago, I was introduced to the delights of the first of an amusing series of articles, published in the Proceedings of the Royal Australian Chemical Institute, which offered "food for thought to those who wish to improve the standard of presentation of scientific literature." This comprehensive series has now been compiled into one volume. It is written by a chemist in a form accessible not only to chemists but to scientists of other disciplines as well.

The rapid and immense increase in technical intercommunication using English often leaves both non-English speaking people, and those for whom English is their native tongue, with a lack of understanding of how syntactic structure affects content. Let me quote from Chapter XI of *The Chemist's English*.

Sitting in a London bus, Kekule had an idea. (1)

Sitting in a London bus, an idea struck Kekule. (2)

At first glance, it would seem that (2) conveys the information just as efficiently as (1), but closer inspection reveals that the idea is described as the one doing the sitting. Now ideas may occasionally sprout wings, but they never come supplied with the anatomical feature that would allow them to take up a sedentary position in a London bus.

There are 35 little essays (I would prefer to call them motifs) in this book of 173 pages, which illustrate the rules of the game of the chemist's English, but at no stage does the author announce the score. For many years, Bob Schoenfeld served well the scientific community in Australia and New Zealand in his position as Managing Editor of the Australian Journal of Chemistry. He is thus well aware that it is not possible to construct a rigid system of do's and don'ts on the shifting sands of language. In 1977, he illustrated this point with the following example.

In the early part of this century a most God-fearing and scholarly missionary wrote a widely acclaimed text, "Lessons in the Shanghai Dialect", in which the student is asked to translate some simple English sentences into Shanghai Chinese. The first of these reads as follows. *The two men con-*

stantly have intercourse with one another. In the 1970's this statement, which was originally written in all innocence, would have seemed prudish and squeamish. In the 1980's it further carries with it the horrendous connotations of AIDS, illustrating that no language ever remains in the same position.

Certainly, the book will teach the reader to avoid a number of annoying errors and so will enhance the literacy of a scientific report. However, it does not purport to be a book on grammar but rather an account of imagined conversations with a group of friends. The author is an experienced playwright and the scene-setting for each conversation reflects his profound understanding of and empathy with many cultures, races, creeds and languages.

There have been more than 30 rave reviews of this small volume and I can only concur with this widely expressed approbation. I believe this to be a book for the browsing customer, one which can be dipped into and savoured during the tea break. It should also be among the many reference books above every research worker's desk. My copy sits next to the dictionary.

Efficiency of communication is hard to quantify but I believe that Dr Schoenfeld has demonstrated that he is a master of the written word. He is not content with offering precise prescriptions for the chemist's grammar but shares with his reader his fascination and enthusiasm for a pictorial script, one which yields up its information in the shortest possible reading time. Anne of Green Gables would have related well with this kindred spirit and his exposition of the glittering resources of the Chemist's English.

Charmian J O'Connor

We note with regret that Bob Schoenfeld died on 24 November 1987. — Ed.

"CHEMISTRY SERVES THE SOUTH PACIFIC" editors; JA Bonato, JB Headridge, RJ Morrison. University of the South Pacific 1987.

This A5 book of 199 pages and 20 short chapters is aimed mainly at those in forms 6 and 7 of South Pacific regional schools and those in the Foundation Science year at USP. According to the preface the idea of the book came from NZIC "Chemical Processes in New Zealand". It has involved 23 authors, 11 from USP, nine from industry and three from Fijian government ministries

and covers natural products, edible fats and oils, soap manufacture, fermentations in village life, baking and breadmaking, cheese-making, beer, timber preservation, composition and analysis of foods, mineral exploration, gold extraction, processing nickel ore and phosphate rock, soil chemistry and fertiliser use, cement, ceramic glazing, manufacture of gases, natural waters, pesticides and instrumental analysis.

It has confined itself to South Pacific activities, but of course many of the processes there are much the same as elsewhere in the world and are therefore more widely applicable. To this reviewer the distinctive South Pacific angle in many articles was very interesting, the village fermentation, gold, nickel, phosphate rock being especially so. The chapters on natural products, the preservation of timber, soil chemistry and fertiliser use and pesticides give very good practical information. When the uninitiated read an article on an industrial process containing the jargon of that industry they can be mystified, but this problem has been alleviated by glossaries of special terms at the end of some chapters.

The editors appear to have done a good job in getting the level of chemistry right for students equivalent to our 6th and 7th formers. In this context I would have preferred the word fluorine replaced by fluoride in the phrase "reaction of fluorine with water to give hydrofluoric acid" in the processing of mineral rock, knowing some students at this level are confused at the difference. I found myself asking how do they collect the CO₂ in producing it by burning petroleum gas. There are relatively few errors in the book. Cystine is called cysteine on p.85, $H_{comb}(C_2H_2)$ is +ve on page 156, although it is clearly stated the reaction is exothermic, and figures 2 and 3 on the manufacture of gases are missing.

The idea of our "Chemical Processes in N.Z." came from a teacher seeking information on chemistry applied in N.Z. which he could present to his class. I am sure South Pacific teachers will welcome this book for the provision of much information which will help them show their pupils the relevance of chemistry, a most important task facing science educators today.

Copies of the book are available from the Institute of Pacific Studies, University of the South Pacific, Suva, at a cost of \$5.00.

REQUIEM FOR A GAS WORKS: by J.S. Pollard, University of Canterbury Publications Committee, 1987 — \$7.50

Apart from novels there are only a few books which I have read at a single sitting. Until I started on "Requiem for a Gas Works", I would not have guessed that a history of a gas works would ever be one of them. John Pollard has produced a fascinating work.

This is no simple dry-as-dust chronicle of the rise and fall of the Christchurch Gas Company and its plant. It has all the makings of a TV spectacular — technology, politics, intrigue, social comment, humour, explosions and a smattering of sex. It is lavishly illustrated and is written in a style which it would be difficult not to enjoy.

The book begins with a short chapter outlining the initiation of the Christchurch Gas Company. It then goes on to an account of the early history of the towns gas industry, followed by the initial setting up of the Christchurch Gas Company, the Works and the reticulation. Much of the remainder of the book is structured around the working biographies of people vitally concerned with the development of the Gas Works; Wright, the Bishops, English, Belton and Gorman. One is given an insight into the men, their interactions with the board, their interactions with the developing technology and their contributions to the technology of gas manufacture in Christchurch. The final chapters describe the decline of the industry, the works and the company with the increasing difficulty of coal supply, the introduction of naphtha as a source material and then the oil crises of the seventies. Finally in chapter 14 comes the demise of the company and the dismantling and successive interments and disinterments of the works site.

The typography and the overall presentation of the book and its illustrations amply complement the text. The book is clearly a labour of love on the part not only of the author but also of the printers.

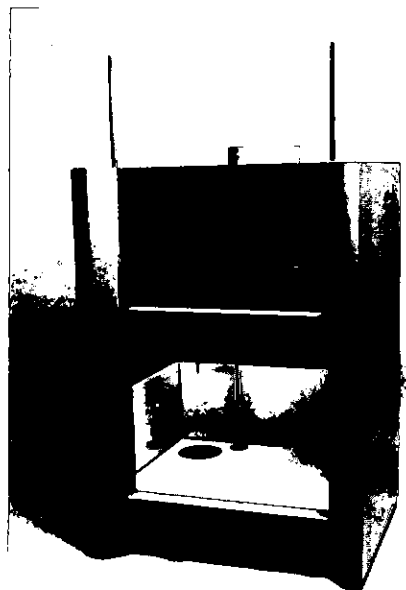
I was once told that the makers of Persian rugs always include a deliberate error somewhere in their work because "Only Allah Can be Perfect." True to his engineering background John Pollard has a safety factor — I found three typographical errors in the whole book!

JE Packer

Continued next page

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Book Reviews Continued from previous page

If you are interested in any of towns gas technology, the interaction of technology with society, people, a well told story or even quality book production you should buy this book. If you are interested in all of these you must buy it.

A.G. Williamson

ORGANO-CHLORINE SOLVENTS: HEALTH RISKS TO WORKERS. Royal Society of Chemistry, London 1986, 254 pp, £50.00.

This publication was prepared by an expert committee of the Royal Society of Chemistry for the Commission of the European Communities. It contains information on the health risk to workers for the following organo-chlorine solvents:

dichloromethane
 chloroform
 carbon tetrachloride
 1,2-dichloroethane
 1,1,1-trichloroethane
 1,1,2-trichloroethane
 trichloroethylene
 perchloroethylene
 1,2-dichloropropane
 p-dichlorobenzene

The basis of these reports was mainly material selected from published reviews (tertiary services) and books. The Royal Society of Chemistry Committee was of the opinion that in general, adequate reliable information was available concerning solvents, thus obviating the necessity to consult original work (primary sources). Unfortunately this policy may result in the omission of very recent studies, e.g. current research in the neurobehavioural effects of solvents, and furthermore, precise interpretation of primary data as reported in tertiary sources has not always been clear. Nevertheless the authors are to be commended for

acknowledging these problems and in certain instances have drawn attention to some difficulties of interpretation.

The book gives an extremely comprehensive coverage of the organo-chlorines mentioned above and includes data such as chemical names, trade names, identification codes, spectroscopic data and measurement techniques, storage, handling and use precautions, hazardous chemical data and toxicity and medical/health surveillance data including occupational health guidelines.

From the point of view of emergency service management of spills or fires involving these organochlorines, I should have liked to have seen the inclusion of UN numbers and Hazchem codes which allow for rapid identification and appropriate emergency action by emergency service personnel. I also feel that a little more detail could have been given in the sections dealing with emergency measures in the case of accidental spillage. In a few instances these deal primarily with laboratory size spillages and omit advice for the management and dispersal of larger amounts which is of course more applicable in an industrial environment.

Placing these minor criticisms aside however, I believe that this work is an extremely valuable reference book for any practitioner in occupational health and safety. It is a definite must for any organisation with personnel handling these solvents, as it provides all the necessary data for the health and safety people who are actively involved in minimising the health risks to workers.

WA Temple

New Polymer Publication

Engineering Science of Polymeric Materials

A New book on the properties of polymeric materials has just been published by the Polymer Division of the Royal Australian Chemical Institute. The author Dr Zbigniew Stachurski of Monash University, takes a novel but systematic approach which focusses on basic principles. Thermoplastics, thermosets and elastomers are covered in a unified manner.

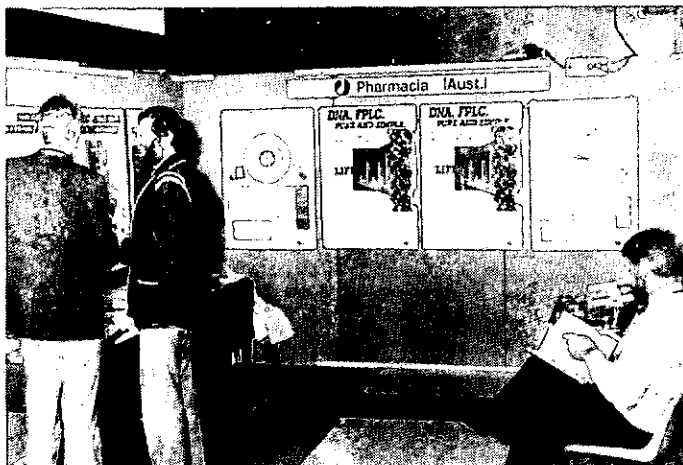
The widespread use of polymers results from their unique properties. So to make better use of polymeric materials you need to understand these properties. This book aims to provide an understanding to the fundamentals of this field.

This book will appeal to chemists, physicists and engineers concerned with polymers as well as providing a bridge between the makers and users of polymeric materials.

This book of about 240 pages in hardcovers, can be obtained from the RACI Polymer Division, P.O. Box 224, Belmont, 3216 Australia. The price for orders from inside Australia is \$AU45, and overseas is \$US50 (both include postage). Members of the NZIC qualify for a special rate of \$NZ50 (airmail postage included).

Note: A copy of the book has been received, and we expect to publish a review in due course.

— Ed.



Only four months in New Zealand in its own right, Pharmacia (Aust.) Pty exhibited for the first time



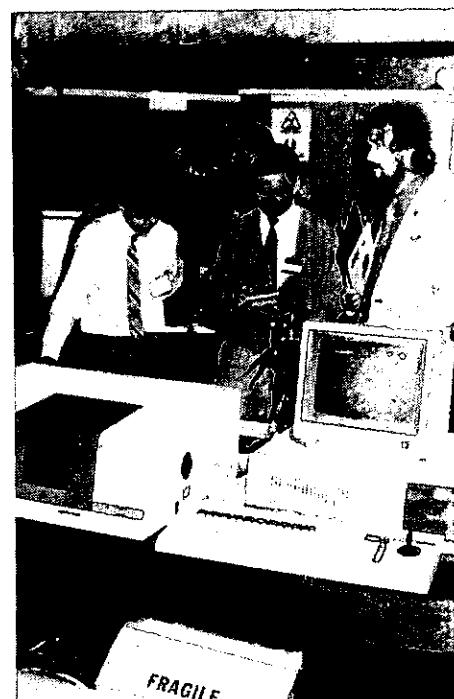
Two division of Salmond-Smith Biolab displayed their wares. A professional sales team made the very most of the opportunity



NZFP Technology Ltd personnel discuss their services with Geoff (Hush) Husheer from Napier (right)



David Pegman (left) of Alltech Associates Inc. spends time with a conference delegate during morning tea



Auckland branch NZIC Chairman, Steve de Mora, right, spent a good portion of his University departmental budget at C.I.T.F. Seen here on Salmond-Smith Biolab stand



Alphatech Systems Ltd waved the flag at C.I.T.F.



Kemphorne Medical Supplies displayed a diverse range of products on ground floor of students union building



NZIC stand saw a steady stream of enquiries which resulted in a couple of new members and the sale of some printed material



Dr John Rogers (centre) and Dr Jim Ellis (right) in earnest discussion with Mr C J Dangerfield of Watties Industries during a break.

Product Feature: Water Purification, Analysis and Quality Control

Most of us are concerned with water quality at some time or another, be it as a laboratory reagent, process chemical, or an industrial effluent in need of control. In this feature we look at some of the products and services available to help us meet our water needs.

PURIFICATION :

The three most common methods used for water purification are distillation, deionisation and reverse osmosis. A convenient way to compare these methods is by the quality of the water produced, as indicated by conductivity, and the contaminants removed. Operating cost and convenience are other important factors to consider.

Distillation can produce water with a conductivity of 5 uS/cm in a single pass, or as low as 1 uS/cm with multiple distillation units. It removes ions, bacteria and pyrogens, but volatile organics, gaseous contaminants, and contaminated aerosols may be carried over in the vapour stream. (Fluoride can be a particular problem with municipal supplies).

Distillation is a slow process, and electricity costs can make it relatively expensive. The advantages are that it can be used with water of any level of impurity, and the quality of the distillate and the cost of producing it is independent of that level.

Dionisation can yield a product with a conductivity of 1 uS/cm or less if strongly basic resins are used. If the more economical weakly basic resins are used, conductivity may be as high as 50 uS/cm due to weakly ionised species such as silica, carbon dioxide and organic contaminants, which are not removed.

Deionisation systems can be operated either as twin or mixed-bed systems. The former have the advantage of being easy to regenerate, but give a product of higher pH (compared to mixed bed) due to the leaching of sodium hydroxide. If feed water with a high organic content is to be treated, macroporous resins are desirable to minimise problems due to fouling of the pores.

Deionisation can provide water on demand, at a rate determined by the system size. As the resins are deactivated by the contaminants removed, cost is related to the quality of the feedwater used.

In reverse osmosis 90-95% of all ions are removed, along with all contaminants with a molecular weight above about 250. Under ideal conditions conductivities down to 10 uS/cm can be achieved, but the efficiency is related to feedwater quality and conductivities of 20-28 uS/cm are more typical. Running costs are low, and virtually independent of the level of feedwater contamination. The major factor is membrane life, which is dependent on initial selection of the membrane best suited to the task, and careful handling procedures.

Further aspects of reverse osmosis are described in one of the product items that follow.

Vaponics Pure Water Systems

John Morris Scientific are now the New Zealand agents for Vaponics pure water systems. Vaponics are well-known for their extensive range of steam-heated water stills, laboratory stills, sterilisers, reverse osmosis systems and multiple-effect stills. They give improved water purification for pharmaceuticals, medical and industrial processes.

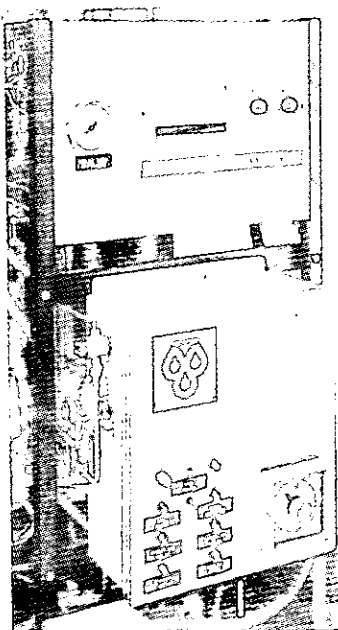
Systems available include low- and high-velocity single effect stills, electrically or steam-heated, with capacities from 20 to 450 litres per hour. The internal design provides automatic de-scaling, and an overflow dam prevents salt build-up. Demountable condensers allow easy cleaning and easy inspection. Stills and condensers are available in a range of materials including tin-coated copper, titanium, and stainless steel.

For laboratory use, units are available from 4 to 40 litres per hour, with built-in storage up to 180 litres. Continuous 24-hr operation is provided with monitoring of water feed and cooling water flow. Built-in resistivity meters provide a constant indication of distillate water quality.

Ion exchange systems are available for low- or high-pressure applications and flow rates up to 280 litres per hour.

A range of mixed-resin disposable cartridges are available to give removal of salts, silica,

low molecular weight organics, CO₂ and dissolved oxygen. Ultra-purity water can be achieved by the use of the so-called "nuclear" mixed resins. The systems are ideally suited to the polishing of distilled water, resulting in high-purity reagent water conforming to all ASTM specifications.



The Vaponics control system, for automatic still operation

Also available are high-purity steam generators for autoclave use, and ion-exchange systems for precious metal recovery.

For further information please circle 4 on reader reply card.

Technology of Reverse Osmosis

Reverse osmosis is a technique whereby a solution is split into purified and concentrated fractions via a semi-permeable membrane. The natural osmotic gradient set up by the semi-permeable membrane is reversed by a higher pressure which drives the lower molecular weight solvent through the membrane while the higher molecular weight contaminants are retained on the upstream side.

Three types of membranes are commonly used for reverse osmosis. These are:

- (1) cellulose acetate
- (2) polyamide thin film composite
- (3) polysulphone

Each membrane exhibits its own advantages and disadvantages; for example cellulose acetate membranes are relatively easy to manufacture and the price reflects this. However they are subject to bacterial attack and a narrow pH tolerance. Polyamide membranes are impervious to bacteria, exhibit a wide pH tolerance, but they are hydrolysed by chlorine. Protection against chlorine should be included in the pre-treatment. Polysulphone membranes are impervious to bacteria, exhibit a wide pH tolerance, but they are hydrolysed by chlorine. Protection against chlorine should be included in the pre-treatment. Polysulphone membranes are tolerant to exposure of up to 1000 mg/litre of chlorine, however it rejects low percentages of divalent ions. The pre-treatment should once again include a stage which aids the reverse osmosis membrane, e.g. a water softener.

Reverse osmosis can be used in either water purification or process applications. The quality of water purified by reverse osmosis is based on a percentage rejection of contaminants present in the feed water. For example, a polyamide composite membrane will reject the following percentages of contaminants.

Contaminant	% Rejection
monovalent ions	> 95%
polyvalent ions	> 97%
organic 300MW	> 99%
particles	> 99%
bacteria	> 99%
pyrogens	> 99%

This quality is suitable for a variety of applications, including renal dialysis, pharmaceutical preparations, general laboratory use, pre-treatment for micro-electronics, pre-treatment of boiler feed, make-up water for unstable emulsions, make-up water for water based resins and many more.

The volume output of a system can vary from 3.5 litres per hour and range up to 5000 litres per hour. For a correctly sized

Continued next page

WATER FEATURE

Continued from page 173

and correctly maintained system, the cost per litre for water can be extremely low, as little as 0.25 cents per litre. In a number of cases central reverse osmosis systems have replaced small individual water purifiers in laboratory complexes. The associated pay back period on the capital cost can be as low as six months through savings on energy costs and equipment maintenance.

An example of the associated saving through the inclusion of a reverse osmosis system is seen in the case of its use as pre-treatment for a boiler. The advantages for the placement of a reverse osmosis unit before a de-ioniser for boiler feed included:

- (a) De-ioniser produced 5 to 10 times more deionised water between regenerations.
- (b) manpower requirements were reduced.
- (c) reliability of product — water quality was improved with less associated water down time.
- (d) chemical requirements were lowered by 90-95%, reducing costs and minimising waste disposal problems.
- (e) life of ion exchange resins were extended.

Reverse osmosis is a cheap and effective means for producing purified water for a variety of applications. The technique of reverse osmosis has also been developed for processing different varieties of solutions. It is now used for processes such as removing alcohol from wine, antibiotic concentration, peptide concentration and desalting. Reverse osmosis for process applications is currently in its infancy. As yet there are many unexplored applications.

Reverse osmosis systems are available through Salmond Smith Biolab.

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

Hard Scale in Laboratory Stills Remedied by Magnetic Treatment

How often have you been daunted at the thought of once again having to remove the scale build-up from the inside of your laboratory still? Fitting a ½" CEPI unit to the water intake of your still now provides a permanent solution to this problem.

The CEPI process (Conditionment Electromagnetique Par Induction) consists of passing the water through a specially shaped, very powerful magnetic field. The electric potential thus induced in the

water modifies the crystalline structure of the hardness salts in solution so that during heat transfer they precipitate out as a fine amorphous non-clinging powder instead of an adhering hard scale.



The beauty of the CEPI treatment is that it requires no electric power, chemicals or supervision. Its capital cost is small and no maintenance is required due to the absence of moving parts.

The CEPI treatment does not affect the chemical properties of water so its potability is unimpaired. It will treat water up to 120°C and unlike chemical treatment it is just as economical to treat water that is only being used once before going down the drain, as it is to treat water being circulated.

Magnetic treatment of water to prevent the formation of hard scale is not a new technique although many people in New Zealand may not be familiar with it. Originally developed 30 years ago by EPURO Ltd., a Belgian water treatment company, it is now being used in over 50 countries throughout the world to protect a wide variety of industrial plant, such as cooling towers, refrigeration condensers, calorifiers, humidifiers, heat exchangers, sterilisers, compressor cooling circuits, ice-making machines and seawater cooling circuits.

Around 100 CEPI units are now successfully operating in New Zealand, the largest to date being 12.5 cm diameter. CEPI units are manufactured in sizes 1.2 cm through to 250 mm diameter, accommodating flow rates from 1 l/min-600m³/min.

CEPI units are available in New Zealand through Applied Instruments Ltd.

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

Pyrogen Free Water for the Laboratory

Elga Ltd of High Wycombe, England, have released a new system to produce ultra-high purity water for the laboratory. The unit is designed to produce ultra-pure water from standard distilled or deionised water at flow rates up to two litres per minute. Two models are available; the UHP which produces ultra-high purity water, and the UHP-P which produces pyrogen-free water. The water produced by these units can be used for a wide range of laboratory applications. Some examples are preparation of standard solutions, instrument calibrations, liquid chromatography solvents and bulk supplies for cell culture.

The UHP is fitted with a hygienic hollow fibre 0.05 micron ultra-microfilter to remove trace colloidal organics and micro-organisms. The UHP-P has an ultra-filtration membrane to remove all particles with a size equivalent to 10,000 molecular weight or above, ensuring pyrogen-free water. Either unit will produce organic contents equating to less than 0.0001 absorption units at 254nm, ensuring constant baselines with UV detectors or spectrophotometers.

A programmable rinse system included with the automatic operation of the UHP units maintains low TOC values. The UHP has been styled after the successful UHQ system and will complement

the decor of any laboratory. Convenience of siting is a feature because the units can be floor-mounted on or inside, the laboratory work bench.

Elga are represented exclusively in New Zealand by Sci-Med.

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

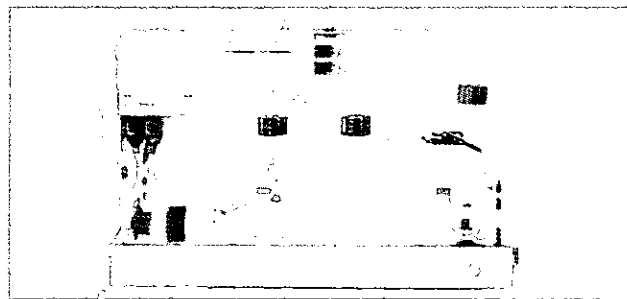
Pure Water at the Turn of a Tap

The Portals Deminimaster demineraliser operates on the mixed-bed ion exchange principle, making highly purified water available at minimum cost for even the smallest requirements. The Deminimaster is used in modern laboratories, processing plants, battery service stations, hospitals, pharmacies, households, etc.

Simply connect the hose provided to the water supply and turn on the tap. Deionised water is immediately produced. The battery-operated conductivity meter shows water quality and indicates when a new resin pack is required.

The Deminimaster produces water far purer than distilled water; no installation costs — simply connect the tap; fully portable; high impact plastic moulded body; no regeneration sequence — simply replace resin; no power required; compact; push button conductivity meter for water quality check.

For further information please circle no. 16 on reader reply card.



Jencons Autostill

Stills for Every Need

A range of 12 pure water systems for pyrogen free distilled water to British and other pharmacopeia requirements is available from Jencons Scientific through Salmond Smith Biolab. They are produced to meet every need, from single distillation and D-Ion to the double distillation and D-Ion, including a "No-Clean" still with water softener for areas with the hardest water.

Output ranges from 3 to 8 litres per hour and the Autostills will produce distillate up to

1umho/cm (0.1mS/m) conductivity.

Nearly all Jencons Autostills are fully automatic and come with their own fail safe systems. These include thermal cut outs and water, heater and aspirator cut off, ensuring maximum reliability at all times.

They can be purchased in either horizontal or vertical forms and anti-glare fire proof glass and toughened cases make the units both safe and attractive.

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

WATER FEATURE

ANALYSIS :

A wide range of methods is available for water quality analysis. In keeping with the theme of chromatography in the technical articles published elsewhere in this issue, our emphasis here will be mainly on that technique. However, do not overlook the cover story on the Tecator system, based on flow injection analysis, — the ideal approach for rapid determinations of a single analyte on a large number of samples. The interchangeable cassettes make the Tecator units a particularly versatile one for multiple analyte determinations as well.

Then of course, there are the on-line process analysers for variables such as TOC, and other equipment such as sample collection devices. All in their own way an essential part of various water quality analysers, and overall water quality control.

The Waters Approach to Ion Chromatography

Waters have for 20 years been leaders in the analysis of small molecules-amino acids, carbohydrates, organic acids etc — and pioneered the use of ion-pairing techniques in HPLC. More recently, in the past four years, they have developed non-suppressed (or single column) ion chromatography instrumentation and chemistry. Waters non-suppressed ion chromatography is a viable alternative to the older methods of suppressed (or dual column) ion chromatography, which were used in the first commercially-available instruments.

This article highlights some of the points of comparison that arise when considering the purchase of an ion chromatograph.

The first issue is one of sensitivity. Non-suppressed machines, in theory, have higher detection limits than suppressed instruments, in which the highly conductive hydrogen or hydroxide ions are the measured species. However, by the development of highly conductive mobile phases, such as nitric acid and potassium hydroxide, Waters eliminate this differential, employing a vacancy conductivity detection mode. In practice, Waters IC sensitivity, when measured against suppressed systems, is comparable in all cases, better in some, and can perform some analyses not possible on chemically suppressed systems. Sensitivity is dependent on several factors, including pump

noise, matrix, detector noise and suppressor noise if applicable; and reflects overall system performance.

The Waters M430 conductivity detector operates with the lowest total noise of any presently available conductivity detector. Noise levels even at high background conductivities (70-2000 uS) are directly comparable to the noise levels of suppressed instruments operating at 5-25 uS. This is achieved by true electronic suppression in which the background or eluent conductivity is measured by one set of electrodes, while a second electrode set measures the voltage due only to the separated ions. Thus the Waters approach can be described as electronic suppression rather than chemical suppression. Also, the M430 detector has an extremely wide dynamic range and can produce linear calibration curves even at low ion concentrations.

The use of vacancy conductivity detection actually expands the range of ions that can be determined. The following classes of compounds are examples of ions which can be determined by Waters IC, usually at the sub-ppm level. These are difficult or impossible to detect if a suppressor is used (post column reaction systems may be required): metals (Cu, Fe, Zn, Ni, Mn, Cd, Pb), weak inorganic anions (CN, SiO₃, S, HCO₃, CO₃, P₂O₇, P₃O₁₀), weakly ionised carboxylic acids (EDTA, NTA), phenols and phenoxy acids.

A further issue to consider is that of stainless steel vs. plastic construction. Waters decided to use a stainless steel system, as supported by the following points:

- * A survey of older ion chromatographs, all of which contain stainless steel pumps, indicated no chromatography problems due to metal contamination.

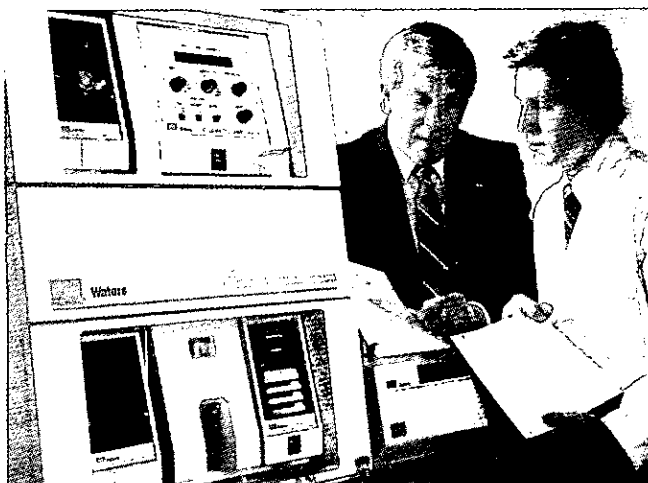
- * Waters eluents are all at millimolar concentrations and totally compatible with stainless steel.

- * Waters resin-based anion chemistry allows metals to pass straight through the column.

- * AA studies show that metal contamination generated by stainless steel is below the detection limit of IC.

- * Leaching of anions and metals from plastic and teflon present potentially severe problems for trace analysis.

- * Oxygen and light permeation of teflon tubing can cause problems in some cases; sometimes, oxygen scavenging procedures



are recommended with plastic systems (e.g. for sulfate).

- * Stainless steel pumps have some major advantages over plastic, including a ten-fold greater precision, and high pressure capabilities.

- * Finally, arguments against the use of stainless steel for ion chromatographs are nullified by the fact that Waters IC can analyse EDTA as a non-complexed ion.

With the appearance of a gradient-capable instrument for suppressed ion chromatography the borderline between IC and LC has become further blurred. Many people are interested in a system capable of doing gradient work in both IC and LC.

Published papers to date² show attempts at gradient IC on suppressed systems, using hydroxide/carbonate eluents, as requiring massive baseline

correction and entailing many practical problems. Currently under development in the Waters IC laboratory are chemistries for iso-conductivity gradients, which on Waters instrumentation will allow the flexibility of linear and non-linear gradient elution to be used as a further means of improving resolution in ion chromatography.

References:

1. IC Looks More and More Like HPLC, Donald R. Cannon, *Industrial Chemist*, 8, p. 32-36, 1987.
2. Gradient Anion Chromatography with Hydroxide and Carbonate Eluents using Simultaneous Conductivity and pH Detection, H. Shintani and P.K. Dasgupta, *Analytical Chemistry*, 59, p. 802-808, 1987.

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

New Ion Chromatography System from Tecator

Tecator now introduces a new ion chromatography system for the simultaneous analysis of anions and cations in water, soil and foodstuffs.

The Tecator Ion Analysis System combines single column ion chromatography with a highly sensitive conductivity detector to provide quantitative and qualitative information down to ppb levels.

The system consists of an analyzer, an HPLC pump and a wide assortment of columns for various kinds of analyses. The column, injector and detector of the analyzer unit reside in a thermostat-controlled enclosure to ensure maximum precision and reproducibility.

A comprehensive application library is supplied along with the system. One example of successful application of the Tecator system is the high speed analysis of sulphate in environmental complex.

High speed analysis can be obtained by using the Tecator

Anion-Guard Cartridge in place of the analytical column. With potassium-hydrogen phthalate as eluent three ions, chloride, nitrate and sulphate, can be separated and determined in less than one minute.

As a guard cartridge is used instead of an expensive analytical column, samples with a lot of impurities in the matrix can also be analyzed. The cost for consumables is kept low even at high sample throughputs.

The detection limit depends on the injected sample volume. Up to 0.5ml can be directly injected on the analytical columns without excessive band broadening. An injection volume of 0.1ml is sufficient to determine a minimum detectable concentration of 500 ppb sulphate.

Tecator are represented in New Zealand by the Wilton Instruments Division of Salmond Smith Biolab Ltd.

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

WATER FEATURE

Dionex IC — The Original System

Dionex ion chromatography determines a diverse range of environmentally critical compounds to sub ppb (parts per billion) levels in almost any sample matrix, achieving this with speed and accuracy unobtainable by traditional wet chemistry procedures.

Determination of common anions such as fluoride, chloride, bromide, nitrite, nitrate, phosphate, and sulphate often are desirable to characterise a water and/or to assess the need for specific treatment. Although conventional colorimetric, electrochrometric or titrimetric methods are available for determining individual anions, only ion chromatography provides a single instrumental technique that may be used for rapid, sequential measurement.

Ion chromatography eliminates the need to use hazardous reagents and effectively distinguishes among the halides (bromide, chloride, fluoride) and the oxides (sulphide, sulphate, nitrate, nitrite).

Dionex ion chromatography is not limited only to the analysis of anions; the modular nature of the system allows expansion to encompass the determination of cations, water

soluble inorganic and organic compounds, transition metals, cyanide and amino acids in virtually any type of sample.

A water sample is injected into an eluent stream, a good example being carbonate-bicarbonate; and the sample and eluent pass through a series of ion exchangers. The ions of interest are separated on the basis of their relative affinities for a low capacity, strongly basic, anion exchanger. The separated anions are directed onto a strongly acidic cation exchanger (micro membrane suppressor) where they are converted to their highly conductive acid form and the carbonate-bicarbonate eluent is converted to weakly conductive carbonic acid. The separated anions in their acid form are measured by conductivity. Identification and quantitation is by measurement of peak retention times and measurement of peak area.

Ion chromatography was first invented by Hamish Small, a research chemist with Dow Chemical Company, and the first commercial instruments were produced by Dionex in the mid-1970's. Dionex are IC specialists. The current range of instruments offer analysis capabilities for hydrophobic anions

such as iodide, perchlorate, phenols, carboxylates, and sulphates; hydrophilic anions, such as fluoride, chloride, and sulphate, and anions such as sodium, ammonium, metal, alkyl and arylamines, and the amino acids. Detection methods include the traditional conductivity, and uv-vis and fluorescence as well. Pre-concentration and automated operations are readily available with Dionex systems.

Dionex are represented in New Zealand by Thomas Hyde Limited.

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

Wescan IC — More Chromatography For Your Money

Flexibility is the key to a cost-effective analytical system, and Wescan's modular ion chromatography System I provides the maximum in flexibility at an affordable price.

The ion chromatography System I incorporates a high-pressure, low pulsation pump, a syringe loading valve loop injector, temperature controlled column/cell compartment, and a high sensitivity electrical conductivity detector.

The Wescan ion chromatography System I offers unparal-

leled flexibility in applications for:

Anions
Cations
Organic Acids
Metals
Surfactants

All these can be analyzed on the same basic system (using appropriate columns, of course). Column/eluent change is a matter of minutes.

pH Control

You control the eluent pH in single-column ion chromatography. Why is this so important? Because it allows you to control selectivity and sensitivity.

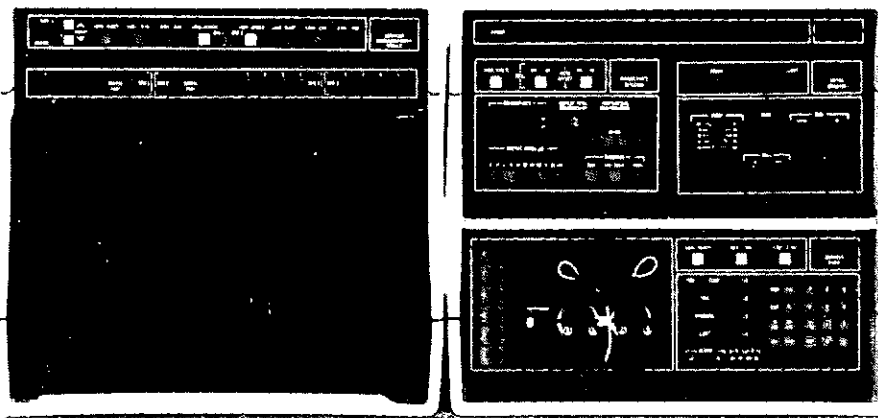
Selectivity

An example is the food/beverage industry where the analysis of samples can be complicated by interferences from organic acids. These interferences can be minimized by using a stronger eluent at lower pH. The decrease in pH results in protonation of the weak organic acids, and decreases their retention significantly. As a result, the organic acids elute well before inorganic anions. The latter, of course, are typically strong acids which remain dissociated even at low pH.

Who Uses Ion Chromatography For Water Treatment Chemistry?

THE VERSATILITY OF DIONEX ION CHROMATOGRAPHY IN WATER TREATMENT

Dionex Ion Chromatography is the most versatile and powerful analytical technique available to the water treatment industry. In one instrument, as shown below, a host of other analytical methods can be replaced or supplemented. Producers, formulators and users of water treatment chemicals have all found a multitude of uses for Dionex Ion Chromatographs. Among the most common applications are:



The Dionex Series 4000i.

PRODUCERS

- Quality control analysis of impurities in water treatment chemicals
- Characteristics of new water treatment compounds
- Stability studies/identification of degradation products

FORMULATORS

- Incoming materials quality control
- Assay of formulations for proper balance of active components
- Efficiency studies on new formulations
- Customer technical service/troubleshooting
- Mobile lab analysis for customers
- Competitive product analysis

USERS

- Monitor source water characterizations for changes
- Determine demineralizer bed breakthrough
- Optimize feed rates of treatment chemicals
- Environmental monitoring of hazardous treatment chemicals

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WATER FEATURE

Sensitivity

In the older, suppressor type of ion chromatography, anions are converted to their acid form before they are detected by the conductivity detector. This works fine for many sample anions, but weak acids such as borate, cyanide and silicate are not ionized and they can't be detected. In Wescan ion chromatography the anions are detected directly — without any complicated post-column chemistry.

Isocratic Operation

No gradients are used. This greatly simplifies the instrumentation, and lowers the cost and operator interaction. Of great importance is the minimization of re-equilibration time — more samples can be run per day.

Options

Because of the modular design of the Wescan system, upgrading to gradient operation is no problem. Systems are also available for dual channel operation, and alternative detectors include electrochemical and uv-vis. Post-column reaction units are also available. Wescan also offer custom

built units for sulphite and nitrogen (ammonia) analysis, and fully automated systems.

Wescan are represented by Alltech, New Zealand.

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

Automatic Liquid Sample Processor

The handling of large series of biological and environmental samples has recently led to the availability of powerful sample preparation and column switching methods. Implementation of these methods is now stimulating the development of automatic analytical instruments.

Primarily designed for HPLC, the Gilson 232-401 ASPI combines:

1. One or more piston volumetric instruments, linked to a septum-piercing needle.
2. XYZ-moving arms, holding the needle.
3. A holder for up to five thermostatted cuvettes, receiving different racks and various vials.
4. Two identical electrically actuated valves, for injection and further online switching.
5. A separate keypad controller, with specific commands

and general programming instructions.

This modular structure embodies the high level of multifunctionality required to cope with large series of complex analyses.

The model 232-401 has a 540 sample vial capacity for unattended injections, and a 216 vial capacity for unattended preparations and injections. This large capacity and the growing importance of chemical derivatization for analytical purposes both justify thermostatted cuvettes as standard accessories. They safely work in the temperature range of 0-40°C. Cooling preserves biological samples and permits the use of volatile solvents. Heating applies to precolumn derivatization. Temperature control contributes to more reliable results.

The model 232-401 ASPI is a controller of many protocols within the same run. Its flexible automation is especially important for HPLC analysis. Benefits of built-in common switching include easier coordination and programming, with lower solute dispersion in shorter connection tubing. The instrument accepts digital remote control by computers, or can itself function as a master module. It is compatible with many analyt-

ical instruments and with various sample preparation satellites. This new liquid sample processor is a powerful tool for automating complex routines, as well as for stimulating the user's innovative spirit.

Gilson instruments are represented in New Zealand by John Morris Scientific Ltd.

For further information please circle no. 11 on reader reply card.

General-Purpose Toxic Pollutant Sampler From ISCO

The Model 2700 sequential/composite wastewater sampler features direct tubing-to-bottle sample collection. Suction-line pre-purge and post-purge pump cycles eliminate sample cross-contamination. The unit has a completely sealed control box, corrosion-resistant construction and self-prompting keypad controls. It has six modes that enable it to perform true sequential and composite sampling with a variety of volumes, times and flows.

Isco products are distributed exclusively in New Zealand by the Wilton Instruments Division of Salmond Smith Biolab Ltd, P.O. Box 31-044, Lower Hutt.

For further information please circle no. 12 on reader reply card.

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Chemistry in New Zealand/December 1987/177

waterTECH

A service for domestic, commercial, agricultural, industrial and governmental people concerned with water quality

Geoff Mills and his Watertech team have the knowledge and experience to provide you or your organisation with a wide range of water-related services. These include water quality assessment and treatment, wastewater treatment, and testing services, on the scale of a single domestic situation through to major industrial complexes.

Water Treatment

- Domestic — Industrial — Agricultural
- Quality assessment — Treatment requirements
- Plant: operation, optimisation, upgrading
- Trouble shooting
- Operator training
- Monitoring
- Corrosion control

Training (Individual, group, on site)

- Water treatment
- Swimming and spa pool
- Wastewater treatment
- Laboratory

Swimming and Spa Pool

- Water quality
- Training
- System assessment

Wastewater Treatment

- Domestic — Industrial — Agricultural
- Plant operation and process control
- Trouble shooting
- Discharge monitoring
- Operator training

Environmental Water Quality

- Investigations and monitoring
- Water rights
- Treatment plant discharges

Laboratory Services

- Analytical service
- Monitoring and surveillance
- Establishment and training
- Pilot plant

Hazardous Wastes

- Characterisation
- Disposal assessment and impact
- Aquifer contamination

Leakage Detection and Control

- Water conservation programmes
- Water leakage surveys
- Pipes, fittings and cable location
- Costs and energy saving



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water management

Watertech Services Ltd Geoff Mills, Manager

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Branches at:

Christchurch — 71 Armagh St. PO Box 870, Phone (03) 67-406
Dunedin — 7 Bond Street. PO Box 4, Telephone (024) 770-813

WTB75

WATER

QUALITY CONTROL:

Quality Control

If your problem is water quality control, be it an industrial effluent or high purity water for process use, then perhaps you need the assistance of one of the specialists in this area. The following notes refer to some of the specialist services available in the water quality field. See also the various advertisements elsewhere in this issue, and don't forget the NZ Association of Consulting Laboratories, as reported in our previous issue.

Watertech — Water Management Specialists

Watertech is a new company established in January 1987 to offer an integrated approach to water management. It has brought together the skills of Geoff Mills, Kevin McNeill and Jim Bradley, who have all been involved in water related activities for many years. This team can give unique assistance to industry, agricultural groups, local government, central government, and private individuals.

Geoff Mills, Watertech's manager was for a number of years the Superintendent of the Ministry of Works & Development Water Treatment Centre at Bulls. He resigned from this position to set up Watertech in response to an increasing demand for an effective service-orientated organisation, able to offer a more comprehensive service than has traditionally been available. With Watertech, Geoff intends to work either independently, or alongside local operators and staff, to solve water quality, water treatment, water leakage, pool treatment and all problems associated with water. In Watertech, he combines with Jim Bradley and Kevin McNeill. Jim Bradley is known for his innovative approach to water and wastewater treatment as well as for his extensive involvement with on-going operation and maintenance of facilities. Kevin McNeill has 11 years experience in water, wastewater and environmental fields. Together they have a wealth of experience which will be available New Zealand wide.

Watertech offers a coordinated range of services to industries, local authorities and other organisations operating treatment plants. This includes plant evaluation, plant upgrading, plant performance, optimisation and monitoring programmes. The optimisation programme in particular can

achieve significant results in efficiency, and in many cases considerable savings result.

Watertech's service to industry includes advice on specialised water treatment processes to meet specific needs individual industries may have in their line of business. Wastewater treatment, process control and monitoring to achieve both water right standards and minimum plant operating costs is also a field of increasing interest.

Water corrosion control of plant and piping systems is a field in which Geoff Mills' experience is also keenly sought



Geoff Mills, Manager, Watertech

after. Geoff Mills has been closely associated with the development of the New Zealand pool standard and has had wide experience with a variety of treatment systems for pools and spas. This includes evaluation of equipment types and their application. Services such as poolside monitoring, trouble shooting, operation and maintenance management and equipment appraisal, are all aimed at saving money by improving efficiency.

Watertech is also able to undertake water conservation programmes including electronic water leakage detection. This is an integral part of the firm's commitment to assisting clients save resources and money. New Zealand literature indicates an average unaccounted-for loss from distribution systems of about 25% — a significant cost in terms of utilisation of manpower, chemicals, money and energy. Geoff Mills and Watertech are able to reduce this waste.

For further information please circle no. 13 on reader reply card.

For further information please circle no. 25 on reader reply card.

Aquatec® — The New Water Analyzer

Aquatec is a fully automated system for water and waste water testing. Routine determinations for ammonia, phosphorus, nitrate and nitrite are made with speed and accuracy. The system is easy to use and has been developed with the requirements of water laboratories in mind.

System configuration and operation principle

The Aquatec system has been designed with the utmost care to make laboratory work as simple and reliable as possible. It consists of a sampler, an analyser that mixes samples with reagents and measures the product absorbance, and a control unit that calculates and presents the results. The sampler is optional and functions merely to automate the sample introduction.

Aquatec is a continuous flow analysis system based on the principles of Flow Injection Analysis (FIA), a technique which is now firmly established and proven. The FIA concept has been successfully applied in Tecator FIAsstar systems, used in water laboratories around the world.

Modern technology combined with a powerful analytical technique (FIA) makes Aquatec a unique analyzer. Aquatec saves time and money and minimises the risk of errors in the water laboratory.

High speed analyses of ammonia, phosphorus, nitrate and nitrite.

Aquatec is based on "micro-

conduit technology" with method cassettes that are designed specifically for each ion to be measured. There are method cassettes for ammonia, phosphorus, nitrate and nitrite.

Each cassette contains the reagent bottles along with the manifold for the desired test. The manifold itself is the size of a credit card. The cassettes are equipped with a unique connector system for easy method change. It takes less than five minutes to switch from phosphate to nitrate.

With Aquatec it takes only 2-3 minutes to start up before analyzing samples at a rate of 60-100 samples/hour.

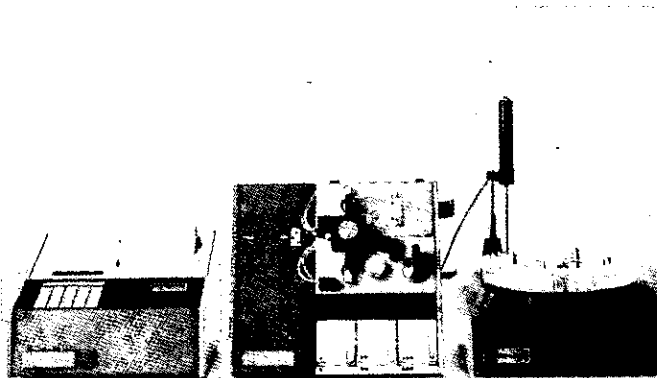
Aquatec can also be used as a flow through spectrophotometer, for direct spectrophotometric measurements of Cl, Fe, Al, and the many other standard wet chemical tests.

Aquatec simplifies standard methods

Aquatec works with standard reagents and chemistries. The reagent bottles are clearly marked, which eliminates the risk of confusion and erroneous positioning in the cassette.

Prewieghed amounts of reagents are available with the system. Thus many potential mistakes are eliminated in preparing reagents.

To prepare reagents, simply empty each vial into the corresponding reagent bottle, fill it up with water and sulphuric acid or hydrochloric acid when instructed. The volume of the reagent bottles is 200 millilitres and this



is enough for a whole working day, without having to refill.

The phosphate reagent kit is sufficient for approx. 7000 analyses, making the cost per analysis approximately \$US0.03. Corresponding figures for the combined nitrite/nitrate kit are approx. 7000 analyses, \$US0.03 per analysis, and for the ammonia kit approx. 8000 analyses or \$US0.01 per analysis.

Included in the nitrite/nitrate method cassette are, among other things, pre-packed ready-to-use cadmium reductors, which are easily mounted on the cassette. By this means exposure to cadmium is kept to a minimum.

Working with Aquatec

Aquatec incorporates a microprocessor, to take care of data administration, evaluation and communications. The programs are self-instructive and quickly learned by the operator.

Calibrations play an important role in all types of chemical

analyses and are essential for good analytical results. With Aquatec, calibration is easily performed by simply entering and storing new values. A total of 15 calibration curves can be stored in the Aquatec memory, for different methods and ranges. Each curve has room for up to 10 calibration standards, resulting in accurate analytical results.

Summary

Aquatec comes as a simple-to-install, ready-to-use system. Its operation can be quickly learned.

Aquatec's compactness, speed of operation, ease of use and low reagent consumption result in appreciable savings in time and money.

The Aquatec system represents a significant advance in analytical instrumentation for water and waste water analysis.

For further information please circle no. 17 on reader reply card.

Low-Maintenance Process TOC

Ionics process TOC water analysers now incorporate a unique fluidic carbonate removal system (CRS) to cut maintenance times.

Total organic carbon measurement has wide applications in effluent monitoring, and is well suited to determining process efficiency and possible water pollution. The TOC of a sample is normally measured by first removing inorganic carbon by acidification and sparging using a carbonate removal system. Unlike conventional CRS systems the new Ionics analyser has no peristaltic pumps, nor tubes which require regular and close attention. Instead a controlled vacuum governs the movement of the sample through the instrument. The new CRS has sample wash and rinse features which ensure no carry-over between samples and inorganic carbonate removal efficiency of better than

99.5%. Moreover, new Ionics process TOC monitors have automatic sample dilution. The results in cleaner, less corrosive samples and again lower maintenance requirements.

For further information please circle no. 14 on reader reply card.

Bringing Simplicity To Oxygen Meters

The technicians have been searching for a long time for a simple portable oxygen meter usable in not only biological waste treatment plants but also in laboratories and for BOD tests. HI8543 is the optimal solution to these demands. It uses only one electrode with a conic profile specially adapted for BOD bottles, but its waterproof body makes it equally as good for immersion tests.

For further information please circle no. 15 on reader reply card.

CONSULTING SERVICES

DANGEROUS GOODS AND HAZARDOUS MATERIALS CONSULTANT

The need for an independent consulting service in the dangerous goods and hazardous materials field has been well publicised recently. With six years experience in administering the Dangerous Goods Act and a considerable knowledge of other Regulations and standards, I am now offering the following services to private companies and local authorities dealing with hazardous materials:

1. Storage & handling proposals & problems.
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4. Training in handling hazardous materials and in administering the Dangerous Goods Act & Regulations.
5. Confidential, unbiased advice on dangerous goods/hazardous materials incidents.

If you wish to commission my services for any of the above situations in Auckland and in the Waikato, please contact me on (09) 817-5962 or (071) 292-724.

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NEWS

Analytical Workshops at ATI

With the increasing sophistication of analytical chemistry instrumentation there is an increased need for intensive practical workshops on specific techniques. To this end, the Auckland Technical Institute has been corresponding with the UK organisation ACOL — Analytical Chemistry by open learning. This new training scheme has been developed at Thames Polytechnic by the Heads of UK Polytechnic Chemistry Departments under the manpower services commission's "Open Tech" project. In collaboration with John Wiley & Sons, ACOL has produced a series of distance learning texts in analytical chemistry for self-study (see insert in this issue for a full list of titles).

These self-paced learning texts are extremely well designed and include self assessment questions at strategic places to ensure that the reader has understood the major points.

Earlier this year, the Auckland Technical Institute was approved as an ACOL centre, to provide tutorial and practical back-up to the self-paced learning texts. ACOL Material can be used in a variety of ways and ATI intends to run a number of practical workshops on various instrumental techniques in 1988. The appropriate text will be posted to the student well in advance of the workshop date and up to 20 students will get together for 3 or 4 days of intensive practical sessions.

Current plans for 1988 include AAS, Infrared spectroscopy and intermediate GC.

A mailing list of those interested in these or other ACOL courses is being compiled, and completing the ACOL insert in this issue will allow us to assess market needs and keep people informed.

Company News

First Perkin Elmer Ion Trap GC-MS System Sold

Sci-Med announces that it has sold the first Perkin Elmer Ion Trap™ GC-MS system in New Zealand. The system was purchased by the Chemistry Department at Otago University and will be installed during December 1987.

The instrumentation consists of a Perkin Elmer 8420 gas chromatograph with the new model 800 ITD. The 800 ITD has many new features including being able to scan the full mass range during a GC run giving precise identification of trace components at very low levels.

NZFP Technology — Consulting Services

NZFP Technology Limited is a technical service and development based consultancy company offering a range of services to the forest products and other industries.

The company has achieved steady growth by improving the quality and efficiency of its range of services and expanding these to meet the needs of the market and the individual client. We work closely with our clients helping to identify their needs and to define their requirements. Each task is undertaken and completed in close co-operation with the client to ensure that project objectives are met. We apply a commercial approach to a given problem in order to ensure that the project yields a profit return to you, the client.

Major services include all aspects of pulping, bleaching and papermaking technology, packaging, building products, fire testing, environmental and occupational health, analytical and quality assurance.

NZFP Technology Limited offers services in the technical and management aspects of environmental control in the following main areas.

a) Effluent Management — The assessment of product and chemical losses including the development of chemical loss control schemes and the assessment of effluent treatment system performance.

b) Water Rights Management — The monitoring of receiving water quality and the development of resource statements and negotiation with statutory bodies.

c) Atmospheric Emission Investigations — The assessment of atmospheric emissions including soluble and non-soluble particulates, and sulphur and chlorine gases. We also undertake investigation into process and pollution control equipment and negotiation with statutory bodies.

d) Occupational Hygiene Assessment — The assessment of toxic atmospheres and a chemical hazard information database including asbestos materials and noise level assessment.

The laboratory facilities include specialised equipment which enables us to test a wide range of organic and inorganic materials. We specialise in analysis of wood preservatives (boron, copperchrome-arsenate and light organic solvent preservative), soil and foliage for nutrient deficiencies, water quality and minerals.

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If you would like to receive further information on how we can help with your Process Filtration project, simply fill out the reply paid card or phone (09) 418 3039.

Yours Sincerely



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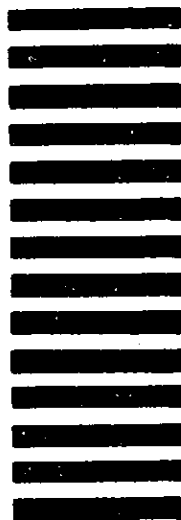
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