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EDITORIAL - CROWN RESEARCH INSTITUTES

Yet again New Zealand's science community is experiencing uncertainty and change. A Ministerial Science Task Group is exploring the establishment of Crown Research Institutes (CRI's) to be formed from DSIR, MAF-Tech, FRI and the Meterological Service. Important decisions on the number, size and specific roles of CRI's are currently being made and these will be made known by mid 1991.

In this issue of Chemistry in New Zealand is the submission to the Task Group from NZIC in support of a Crown Research Institute in Chemistry. There is no certainty that an organisation with the practice of Chemistry as its central and dominant goal will exist in New Zealand in the future hence the need to make such a submission to ensure that it does. Something like this could not have been contemplated as little as a year ago.

This recent challenge to the profession of Chemistry raises a number of very important issues which include What is Chemistry? What is a Chemist? What does a Chemist actually do? What does the public think that a Chemist does? What do the politicians think that a Chemist does? What does an employer engage a Chemist to do? As Chemists we can all each in our own professional context easily give good answers to these trivial questions and feel quite certain that a CRI in Chemistry is a foregone conclusion. Realistically however no one of us will give the same answers to the above questions and when one considers the multiplicity of ways in which chemists are actually employed it is difficult to be dogmatic about the "purity" of chemistry. Some chemists are analysts or teach the subject or are engaged in research or are problem solvers for industry. Others however because of their employment in industry or elsewhere do little or no chemistry as such, but participate in the management of sometimes simple but often complex industrial processes. Some of these use a wide range of established or new technologies. Some of these technologies are complex and use little chemistry as such. The chemists may find that their work is overseen by non professional people or someone trained in another discipline. Often the hands on chemistry is done by appropriately trained technicians or factory operators. In this industrial context, chemical knowledge is only a part of a wider portfolio of science based and managerial skills needed to be successful. The purposeful use of science is what the person is engaged and paid to do. More often than not, membership of an industry related association seems more relevant than NZIC.

This recent move to create CRI's will directly affect us all one way or another as chemists and perhaps lead us to consider the best ways in which the NZ Institute of Chemistry can preserve the profession of Chemistry.

LETTER FROM THE PRESIDENT

Dear Member

In December issue I referred to the re-structuring of the Royal Society of New Zealand, particularly the move to form a Council representing a Federation of scientific societies. FOSTS (Federation of Scientific and Technological Societies) has now been established with a Council of twelve, including myself, representing the affiliated Member Bodies of the Royal Society. FOSTS has been accommodated within the current Royal Society structure for the moment and will soon have the services of its own Executive Officer (attached to the Royal Society Secretariat). The Chairperson of the Council of FOSTS is Dr M J Salinger, NZ Meteorological Service, Wellington, and his Deputy is Professor G C Wake, Department of Mathematics and Statistics, Massey University. A newsletter being prepared by the FOSTS Council will provide more details and will be reproduced in the Journal.

The meeting of Council in late February will be the first time that a full Council Meeting has been held as a telephone conference instead of Councillors gathering in Wellington as in previous years. Although the teleconference will reduce the time normally available for discussion the cost saving will be very welcome in our current tight financial situation. Some of the topics on the agenda will receive priority for discussion time - membership, financial condition and subscriptions for 1991/92, NZIC Journal and progress towards a joint NZIC/RACI Journal, Council relationship with Specialist Groups, and the future of our Annual Conferences. The outcomes of these discussions, which should be of great interest to members, will be described in the Council News item in the April 1991 issue of the Journal.

Regards

Harry Percival

LETTER TO THE EDITOR - CHELATION THERAPY

I would like to congratulate Dr Miller on her excellent paper of Chelation Therapy which appeared in the Chemistry in New Zealand magazine August 1990.

There are some points on which I would like to comment

1. In normal EDTA chelation therapy (CT) for the treatment of atherosclerosis and related diseases the EDTA is not administered as the calcium salt. The disodium magnesium salt is used, almost invariably as I understand it. The reason for incorporating the Mg (or Ca if it were used) is to avoid pain due the exothermic reaction when the Mg or Ca complex is formed. If Na_2 salt is used alone serum Ca forms the Ca complex immediately and the exotherm is painful). Experience has shown that magnesium is the most benign ion to incorporate with EDTA.

2. The author uses the term "fringe medicine" in respect of the use of CT for diseases related to impaired blood circulation. This is not fair. CT as a treatment for such ailments is used in about 23 countries and well over 500,000 patients have been treated, involving at least ten million infusions. The science of CT is now well understood and there is a well regulated official body which conducts courses and workshops, provides examination facilities and issues diplomas which are recognised internationally.

3. Dr Miller mentions nausea, diarrohoea and fat kidney damage. While this may have happened in early days it is exceedingly rare nowadays because the protocol has been so well established.

4. The idea that CT is used "to remove calcium from various parts of the body" to quote your phrase is quite incorrect. In earlier days, some 30 years ago when the beneficial effects of CT were first observed, this idea about calcium was put forward as an hypothesis. It was shown long ago to be wrong and it took some time for the actual mechanism to be elucidated. Dr Miller made brief reference to me in her paper but did not state the actual explanation of the action of CT. It is the elimination from the body of metals which are catalysts for the production of free radicals.

However, the points mentioned above do not detract from the value of her paper, which I have taken the liberty of quoting to others.Despite all the developments of CT there are some very interesting prospects for the future. One of these is the use of CT as a means of controlling Alzheimers Disease. Research in various countries, but especially in Canada, has shown that there appears to be a link between aluminium in the brain and Alzheimers Disease, and in fact several patients have been given CT in Auckland for this distressing complaint, with very encouraging results.

It is not suggest that CT will restore memory to Alzheimers patients but it seems that the development of the disease can be halted.

Of course, EDTA is not the ideal chelatant for aluminium and it seems possible that compounds of the oxamine type would be more suitable. There is a very important field of research to be explored along these lines.

It is equally important that we re-examine the use of aluminium salts, in particular those of the aluminium chlor-hydroxy lactate type, which are used in products generally described as "underarm deodorants". I see also that zirconium salts are used for the same purpose, yet how much is known about the long term effects of this metal in a form which is readily absorbed into the bloodstream.

One of the real benefits of CT is the new appreciation which we have of the damaging effects of very low concentrations of polyvalent metals.

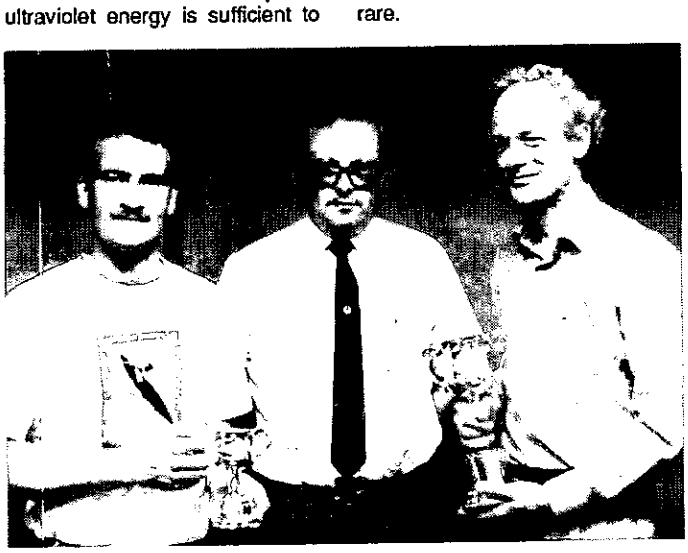
Yours sincerely
T.J. Sprott

BRANCH NEWS

WAIKATO BRANCH NEWS

"Ozone Depletion" was the focus for a successful public meeting in early August, the second for 1990, at which the guest speaker was Dr. Steve de Mora of Auckland University. The meeting was arranged to cater for the interests of Schools in the region and was held in the auditorium of Hillcrest High School.

Dr. de Mora gave a lucid account of the atmospheric chemistry and meteorology which produces the infamous "Antarctic Ozone Hole". In the stratosphere ultraviolet energy is sufficient to release chlorine from chlorofluorocarbons (CDC'S) and the chlorine reacts CATALYTICALLY with ozone to produce oxygen, thus causing massive depletion of the ozone-layer. The ozone reduction approaches 50% overall and reaches 90% at 18km altitude. He explained that the stability of the atmosphere and the presence of polar stratospheric clouds (PSC'S) containing condensed nitric acid combine to make hole formation more significant than in the Arctic where conditions are less stable and PSC's rare.



Branch Chairman Nath Pritchard flanked by Terry Smith, winner of the Student Paper award at the 1990 Conference and Professor Roy Daniel, Dean of the School of Science and Technology at the University of Waikato, after presentation of the respective 50th year Commemorative trophies at the Branch AGM.

The success of the evening could be judged both by the numbers attending on a cold wet night and by the extent of informal discussion which continued well after the official closure of the meeting.

"Women and Chemistry" proved a stimulating subject for a talk by Dr. Irene Irving to a branch meeting held at the end of August. Dr. Irving coordinates communication activities of the CSIRO Institute of Industrial Technologies. She ranged widely over the role of women in Chemistry and indeed in society at large and is clearly concerned with the lack of women at senior academic and management levels. She emphasised the urgent need for suitable role models for young women and clearly identified the necessity of reaching a "critical mass" of female graduates as a prerequisite to future progress. The audience appreciated her entertaining and forthright delivery while controversial aspects of her topic added zest to an enjoyable evening.

In September Drs Peter Dawson and Roger Hill addressed the branch on "The Changing Role of Private Laboratories". Both are very experienced chemists with many years of running their own consultancies and were able to give unique perspectives on private sector laboratories.Dr Dawson concentrated on the history of private laboratories in New Zealand giving fascinating well-research background information deserving wider dissemination. Dr Hill described the current competitive situaton and outlined the circumstances which necessitated the formation of the NZ Association of Consulting Laboratories of which he is President.

The joint presentation was very successful and resulted in extended discussion by an appreciative audience.

At the October branch meeting Dr. Dick Williams spoke on "Molecular Biology - Where Ruakura fits in". He is effectively the founder of formal molecular biology research at Ruakura and hence ideally placed to give an overview of its present and future status. He emphasised that his expertise lies in animal, not plant, research and explained the limitations of traditional agricultural tecnology, which generates only marginal progress in productivity. Some basic techniques used in genetic manipulation were well illustrated and he showed how these are potentially capable of generating dramatic advances in all areas of animal research.

His talk was highly successful and the technicalities conveyed clearly to an audience with little expertise in this important area of scientific advance.

ATI NEW HEAD OF APPLIED SCIENCE

Dr A (Tony) C Herd FNZIC has been appointed to the position of Head of Applied Science at Auckland Institute of Technology. Tony has been with ATI for twelve years as lecturer and senior lecturer and has been journal editor and Auckland Branch Chairman. He was last seen in the journal playing with a helium filled condom.(Chem NZ 54(3) 57 1990)All his colleagues wish him well in his new endeavours.

BAYER OPENING

On February 21 Bayer NZ Ltd opened its new distribution centre in East Tamaki. The site was opened by the Governor General Dame Cath Tizard and the opening was attended by Dr Ernst-Heinrich Rohe of Bayer AG.

The new centre represents the one of the most advanced dangerous goods handling and storage facilities in New Zealand. As well as complying with the regulations of Manukau City the plant has been built to Bayer's own standards which represent the best aspect of good practice in Germany.

Interesting technical aspects of the site are the concrete floors which are each poured in one piece (up to 640 m2) without joins and with raise edges. This prevents drainage of spilt materials into the water table in the event of a mishap. The storage racking has in rack sprinklers throughout so that each level has a sprinkler directly above it. The racking itself stands in lowered sections of flooring so that the fork hoist wheels cannot actually touch the racking and any spillages are contained and do not spread over the floor to be driven through by hoists.

The result of this is a plant that the New Zealand Fire Service describes as a model for other companies to follow.

GREEN CRITERIA

Canadian "green" criteria to be modified for New Zealand manufacturers.

Canadian criteria for environmentally-friendlier products looks set to provide the basis that local task groups will use in setting "green" criteria for the New Zealand manufacturing market.

The task groups, established as part of the Government's Environmental Choice New Zealand programme, have been set up to study the imported criteria and assess their suitability for use in New Zealand.

The task groups are to study Batteries, Engine Oil, Paints, Recycled Plastic Plastic Products, Recycled Paper and Household Detergents as the first of the product categories examined under the Environmental Choice NZ programme.

"The Canadians have been labelling environmentally-friendlier products since 1988 and have criteria for 14 product categories which New Zealand can draw upon. They are currently working on 10 others."

"Further to that, schemes are operating in Japan, United States and Europe, so there is plenty of world-wide criteria available," says TELARC Director, Dr Jack Garside.

Compatibility between the Canadian and New Zealand schemes was one of the reasons the Canadian criteria were chosen.

"The schemes operate in a similar fashion and carry their respective Government endorsements. There has been a lot of work done already and we see no point in re-inventing the wheel."

"We would hope that New Zealand manufacturers could expect the first draft criteria to be released in May this year. Members of the public and interested parties will be invited to comment before the final criteria is set," says Garside.

TELARC is a statutory authority that was given the task of operating the product labelling scheme in July 1990 and have since established a management advisory committee to define product categories and criteria.

The scheme is voluntary for products in New Zealand and is the only "eco-labelling" scheme in New Zealand to carry Government endorsement.

For further information contact:
Fiona Mackenzie
TELARC
Private Bag
Remuera
Auckland 5

SCI-MED CHANGES

Sci-Med is pleased to advise you of the company's recent employment of David Marston as its Wellington based Service Engineer.

David attended Canterbury University where, in 1985, he gained a BSc in Chemistry and also studied Physics (electronics). For the last five years he has worked in the Instrument Section of the Chemistry Division, D.S.I.R. at Gracefield, Petone, as an electronics scientist. Whilst there he worked in many areas of electronic and mechanical instrumentation both in servicing and design roles, specialising in NMR.

We feel his employment will contribute greatly to Sci-Med's total customer commitment in the Wellington and Palmerston North region.

We also take this opportunity to advise you of our new Wellington regional office. Graeme and David will be operating from 147 Jackson Street, Petone after the 1st December 1990. The phone, fax and postal addresses will remain unchanged. If in the vicinity, please feel free to drop in.

Yours sincerely

Andrew Pearce
NZ SALES MANAGER

CONFERENCES

CHEM ED 91
CHEMICAL EDUCATION CONFERENCE

CHALLENGES FOR THE 1990'S
May 13-15 1991

AUCKLAND COLLEGE OF EDUCATION

The conference will bring together secondary and tertiary Chemistry educators to:- promote Chemistry as a worthwhile subject to study- discuss ways in which the importance of Chemistry in daily life can be reinforced- provide information that will help students bridge the secondary/tertiary/workplace interface-, provide up-to-date information on curriculum materials and recent developments in Chemistry through lectures, seminars, and site visits- demonstrate effective computer software and interfacing in Chemistry- illustrate effective strategies for teaching and learning Chemistry.

Contributed papers, workshops and displays are invited. There will be ample time for discussion and interaction between delegates through the conference, and during the social programme.

Come and meet your colleagues with a common interest in the teaching and learning of Chemistry.

For further information write to:
CHEM ED 91 CONFERENCE
Auckland College of Education
Symonds St PO
Auckland

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A two day strategic and influential conference considering the contribution required from Science and Technology to the economic growth of New Zealand to the end of the 20th century and beyond.

High profile international and local speakers with opportunity for direct input, challenge, debate and idea formulation will examine business opportunities and the Science and Technology policies and effort required to achieve economic success.

Micael Fowler Centre
Wellington
19/20 June 1991

"Changes have been made - are they the right ones - are they going to serve the future needs of science users and practitioners alike...?"

Not since the 1985 Government sponsored Science & Technology Summit have these issues been canvassed in an open conference environment.

Programme Synopsis

The conference will follow a four session, two day format

Session 1. Current Organisation of S & T in New Zealand

Official opening - Key Government Speaker

Two Keynote addresses - High profile local speakers reviewing recent developments and present structures.

Panel Discussion - Chaired floor discussion with Keynote speakers and additional panelists

Lunchtime Speaker - Prominent overseas speaker

Session 2. Views on Possible Future Scenarios

Six prominent speakers each uniquely placed to expound their personal views with positive suggestions for debate.

Panel Discussion - Chaired floor discusson with panel comprises of six previous speakers.

Dinner Speaker - A high profile International speaker

Session 3. Sectoral Commentary

An opportunity for speakers from specific sectors of the economy to expound views pertaining to each sector. Sectors covered will be - Education, Finance, Government, Manufacturing, Maoridom, Media, Agriculture, Forestry,

Energy, Science Management, Service Industries, Social Sciences, Trade Unions.

Panel Discussion - Chaired floor discussion with panel comprised of the previous sectoral speakers.

Lunchtime Speaker - A high profile International speaker.

Session 4. Review

Review and final comment by some of the key players

The Ministry of Research, Science and Technology

The Foundation for Research, Science and Technology

Private Enterprise

An International Observation

Keynote Wrap-up Speaker

For further information write to:
SCI-TECH * 200
P.O. BOX 11890
WELLINGTON

NZIC/NZBS 60th Anniversary Conference
26-28 August 1991, University of Canterbury, Christchurch

A feature of this years conference will be a series of symposia on a variety of branches of Chemistry and Biochemistry. Each symposium has a Chairperson who has been asked to arrange the program for the symposium. Offers of papers may be made to symposia chairpersons. There will

also be the opportunity to offer papers on topics not covered by the symposia topics.

Being the 60th Anniversary Conference, the organising Committee has asked Denis Hogan, to organise a session entitled History of the NZIC. The special speaker in this symposium will be Professor Ian Rae, Dean of the Faculty of Science at Monash University. Ian will be well known to readers of Chemistry in Australia with his Letter from Monash column. He has also recently started to contribute a similar column to Chemistry in New Zealand. He has been asked to speak on the role of a chemical society in today's world and NZ-Australian relationships. An outline of the development of the NZIC will be given by Denis Hogan spported by a panel of other speakers.

Michael Hartshorn will chair a symposium on Reaction Mechanisms. The special speaker in the symposium will be Professor Athol Beckwith, from the Research School of Chemistry, The Australian National University. The symposium topic encompasses areas of both Inorganic and Organic Chemistry. This is reflected in the choice of invited speakers from around New Zealand - David Buckingham, Don House, Brian Halton, Laurie Main and Charmian O'Connor.

Molecular Modelling is a relatively new area of Chemistry. The wider availability of very high speed processors and high resolution graphics facilities has meant that this new tool can be used routinely in many chemical laboratories. One of the Conference Plenary Speakers, Professor Clark Still, From Columbia University, New York will contribute to this symposium. He is the author of the programs Model and Macromodel. Other overseas contributors will include Dr James P. Snyder, Senior Fellow and Head of Drug Design for G.D. Searle Research and Development, Dr Gerald M. Maggiora, Director of Computational Chemistry, The Upjohn Company, and Professor Eija Osawa, Toyohashi University of Technology. New Zealand Contributors will include David Parry, Geoff Lane and the group of symposium chairperson Jim Coxon.The new Canterbury Chemistry Department IBM RS/6000 computer will be demonstrated.

The other symposia promise to be of a similar high quality. This wil be a NZIC Conference not to be missed!

OBITUARIES

MICHAEL DAVID LOWE

Mike Lowe, a long-serving respected member of the Waikato Branch Committee, died at his home in Hamilton on Saturday 17 November at the age of 49.

Mike was Australian born and grew up in Newcastle NSW, where he studied at the University of New South Wales, while working as a technical cadet for Conzinc Rio Tinto. He later joined the Sulphide Corporation, where he was fortunate in being associated with Max Amos who was a pioneer in the development of Atomic Absorpton Spectrophotometry.

In 1967 he joined the staff of Ruakura Agricultural Research Centre, working with Dr. Ron Henzell's group until 1973. Mike was a significant member of this small innovative group which was concerned with insect control and insecticide analysis. He was an early user of gas chromatography for the determination of DDT residues and was involved in pioneering studies of pheromones, especially in relation to control of grass grub beetles. Between 1969 and 1972 he was co-author of several publications in the latter field and sole author of a paper on gas chromatography. He also collaborated with Dr. E.P. White on the structure and estimation of Tutin in Coriaria species which resulted in a joint publication in 1972.

He transferred in 1973 to the Spectrochemical Laboratory at Ruakura where he spent 10 years of high analytical and scientific productivity. During this period he was author or co-author of 8 papers and 8 major Conference and Seminar presentations mainly involving the NZIC but including the Institute of Physics and an International Conference on Atomic Spectroscopy. He received special recognition for his novel work on Inductively Coupled Plasma emission and particularly for the design and assembly of the first ICP system at Ruakura, which he built largely from cheap surplus equipment. His scientific ability was publicly recognised in 1981 when he was selected as joint winner, with Dr. Max Sutton, of the NZIC Golden Jubilee Rocklabs Prochem (International) Award.

Mike left Ruakura in 1983 to set-up a private analytical laboratory in partnership with Mr. Harry Dewes, a well known local veterinarian. The laboratory was primarily concerned with the analysis of plant materials and animal tissues and allowed him to expand his interests in animal health, especially as it related to mineral status and intake. He employed both routine methods for monitoring animal progress and pursued less conventional, innovative investigations of mineral levels in keratinous tissue such as hair and hoof parings to assess the nutritional status of grazing animals. Regrettably much of his most recent work is unlikely to be published as a result of his untimely death.

Mike was a highly respected and popular member of the Waikato Chemistry community with wide ranging interests not only in science but in antiques, mechanics, classic cars and was for many years a volunteer ambulance officer with St Johns. He was a first rate teacher and communicator and his final talk to the Waikato Branch "A horse with no feet and other tales" in May 1989 is remembered with warmth and interest. He is remembered above all for his enthusiasm and technological inventiveness and thoroughly merited his elected to Fellowship of the New Zealand Institute of Chemistry in early 1990. He is sadly missed both as a friend and colleague and our deep sympthy is extended to his wife Judy and children Amanda and Michael.

DR HENRY ROTHBAUM

(2 June 1926 - 11 December 1990)

After a long illness, borne with great fortitude, Dr Peter Rothbaum passed away on 11 December 1990. He will be sadly missed by the many people who knew him as an enthusiastic scientist, noted for his ability to apply the results of his research to problems of importance to New Zealand, as well as by those who had contact with him through his love of music.

Peter Rothbaum was born in Vienna, Austria, on 2 June 1926 and came to New Zealand, via a short stay in an English Cathedral Choir School, at the age of 15 to complete his secondary education at Hutt Valley High School in 1942. He was awarded an Alexader Crawford fellowship in 1944 and a Sir George Grey fellowship in 1945 and gained a BSc in Physics and Chemistry from Victoria University College in 1945, and a MSc in 1946. In 1950 he was awarded a BA in Mathematics and Philosphy.

Peter joined the Physical Chemistry Section of the Dominion Laboratory (which later became DSIR Chemistry Division) in 1947. His first research was into spectrographic analysis, timber preservatives and the problems associated with New Zealands early salt production industry. This was followed by metallurgy and corrosion studies. In 1954 he worked for a few months at the CSIRO Division of Industrial Chemistry, Melbourne, prior to taking up a National Research Fellowship to complete a PhD in 1956 at the University of Liverpool, UK on the topic of "Cyclic Electrolysis".

Peter returned to the Physical Chemistry Section of the Dominion Laboratory in 1957, working on the properties self-heating of bales of damp wool, a problem causing great concern to the export trade. This work led him to propose a theory explaining the age old mystery of spontaneous ignition of haystacks. A subsequent investigation of the ignition hazards of sulphur powder used in aerial topdressing led to a life-long interest in fertiliser chemistry, with research into the development of fertilisers for sulphur-deficient New Zealand soils and research on novel fertilisers.

In 1964 Peter was awarded a UK-DSIR Senior Research fellowship to work at the National Physical Laboratory in England for 2 years in the area of electrochemical synthesis. On his return to the DSIR, he joined the Geochemistry Section of Chemistry Division, where he continued his research into fertilisers by exploring the uses of low-grade ores and the accumulation of heavy metals in soils fertilised by phosphate fertilisers. His work on sulphur fertilisers led to the commercial production of degradable sulphur pellets which can be safely used in aerial topdressing. He showed that, while uranium from phosphate fertilisers accumulated in the upper soil horizons, cadmium did not. This alleviated the considerable concerns of the time, regarding toxic heavy metal build-up in fertilised soils.

His other work included the use of red phosphorus as a slow-release phosphate fertiliser, the extraction of uranium and the recovery of refinery-grade alumina from Christmas Island phosphate ore. This latter process was patented and led to the construction of a

plant in Western Australia for the extraction of alumina from Christmas Island C-phosphate. As a result of his expertise and interest in the field of fertiliser research, he became a member of the Management Committee of the NZ Fertiliser Manufacturers Research Association in 1981.

Peter's research interests also included the study of problems related to geothermal energy production, specifically the utilisation of low-grade heat, the kinetic and chemistry of polymerisation and deposition of silica from geothermal waste water and the removal and recovery of silica and arsenic from geothermal waters.

Peter had a deep love of music, he was a keen viola player and had played professionally. He was an active chamber music player all his life and contributed to the furtherance of his beloved music, most recently in the Hutt Valley Chamber Music Society, where his informed and well written programme notes were widely appreciated. His interest in the violin extended well beyond playing in his favourite quartets. A report that the varnishes used by Stradivarius contained silica led him to develop, with a local violin-maker, an experimental sodium silicate-containing varnish for use on violins.

Peter had a forthright manner and an impatience with bureaucratic processes. Throughout his career he was reluctant to take on administrative positions that would, in his perception, interfere with research. However, he was eventually persuaded to take up some management responsibilities and in 1979 he became a Group Leader, of the Geochemistry and Inorganic Materials Sections of DSIR Chemistry Division. In 1981 he became Deputy Director and retained this post until he retired in 1986. His management style was to lead by personal example, his obvious enthusiasm for research and intellectual honesty inspiring his colleagues.

After his retirement, Peter continued to work on processes for the recovery of lithium, and on the deposition of silica from geothermal waters, and sought continued improvements in his process for the recovery of alumina from Christmas Island phosphates.

Peter published widely during his professional career, with more than 80 scientific papers to his credit. In recognition of his work in Chemistry, Peter was awarded the NZIC-ICI prize in 1967 and in 1980 the NZIC Industrial Chemistry prize. In 1986 he was awarded Honourary Life Membership of the NZIC.

Peter had long been interested in the place of science in society and in retirement, through the NZ Association of Scientists, he organised a successful one-day symposium on "Images of Science" in May 1989. He edited the Proceedings of this symposium for the "New Zealand Science Review", but sadly the progress of his illness made it impossible for him to read this issue when it appeared.

In many respects Peter had the qualities of a "renaissance man" and his death is a great loss to New Zealand. He is survived by his wife, Joy, and son, Martin.

DR ROY PENROSE HANSEN

On 30 March 1990, Roy P Hansen died at the Palmerston North Public Hospital, aged 76 years. He made major contributions to our knowledge of the fatty acid composition of ruminant and plant fats through the skilful adaptation of newly developed analytical techniques.

Born in Hastings on 6 December 1913, educated at Wanganui Technical College and Victoria University of Wellington (VUW), Roy graduated BSc (Chemistry) in 1941. From 1936 to 1940 he played rugby for the VUW 1st XV, NZ Universities and Wellington Provincial teams. He was Club Captain of the VUW Club for nearly 15 years on his return from war service and was a founder of the Old Greens, a club for former VUW rugby players. Roy was also a successful member of the Star Boating Club in Wellington before going overseas and was a New Zealand Blue for rowing as he was for rugby. He represented the 2nd NZWF, during the early part of the North African campaign, in international rowing eight events on the Nile.

As a part-time student he worked in the Lands and Survey drafting office, but later transferred to the Department of Agriculture (now MAF) Chemical Laboratory. Here his interest in the chemistry of fats produced hid first publication - Studies on the Fat of the Bacon Pig (E.J.A., 1944, 12, 103), and determined his future career. This was soon to be interrupted, however, by World War II. He quickly joined the armed forces and proceeded as a Sergeant Major with the 25th Infantry Battalion to the Middle East. To join in active service he dropped his rank to Sergeant, but was captured in July 1942, during the defence of the El Alamein line and transferred via Italy to Germany where he remained a prisoner for three years.

In 1946 Roy joined the newly established DSIR Fats Research Laboratory (later Division and finally renamed Food Chemistry Division in 1966). On retirement of the Division's Director, Dr F. Brian Shorland, in December 1969, the Food Chemistry and Plant Chemistry Divisions were combined and renamed Applied Biochemistry Division. Eight Staff transferred to Palmerston North, of which five formed the Lipids Group with Roy as their leader. His interest in the chemistry and biochemistry of branched-chain fatty acids derived from phytol culminated in his staying on for a year after his retirement in 1975 to write an extensive review on this subject (N.Z.J.S. 1980 23, 259).

When Roy started his career, fats were believed to be made up of n-even numbered carbon saturated and unsaturated fatty acids, the only exceptions being iso-valeric acid (oils from the heads of dolphins), cyclopentenoid acids (chaulmoogra oil) and branched-chain acids in tubercle bacilli lipids and wool grease (Hilditch, T.P., 1949. The Chemical Constitution of Natural Fats). This was reflected in the principal method of analysis namely, ester fractionation by distillation and crystallation (J.A.O.C.S., 1951, 28, 375: B.J., 1952, 52, 207). Roy and Dr Shorland were understandably astonished when they oxidised (with permanganate) an acetone solution of unsaturated C18 methyl esters derived from butterfat, there remained a substantial saturated neutral liquid fraction (J.N.Z.I.C., 1950, 14, 142). Solid methyl stearate was expected as the esters had been prepared by partial crystallisation. They were led to believe that fatty acid mixtures derived from some natural sources were much more complex than was commonly accepted.

The Discovery of Branched-chain Fatty Acids in Fats

This lead to the discovery in butterfat first of the iso and (+)-anteiso C17 acids (B.J., 1951, 50, 207; P.XIVth I.D.C., 1954; D.S.A., 1957, 19,167) and then of the C20 multibranched acid (B.J., 1951, 50,358; 1953, 55 662; N.Z.J.S., 1963, 6, 101) that was identified as phytanic acid (3,7,11,15-tetramethyl-hexadecanoic acid) (J.D.R., 1965, 32, 21), a metabolite of the alcohol phytol that forms part of the chlorophyll molecule. Lower homologues of phytanic acid, namely 2,6,10,14-tetramethylpentadecanoic acid (pristanic acid) (N., 1964, 201, 192; B.J., 1964, 93, 225) and 4,8,12-trimethyltridecanoic acid (J.D.R., 1969, 36, 77), were also identified as being present in butterfat.

These multi-branched fatty acids were also found in lipids from rumen bacteria (N., 1966, 210, 841; J.D.R., 1966, 33, 333), earthworms (L., 1974, 9, 825; J.S.F.A., 1975, 26,961), Antarctic krill (A.J.S., 1969, 32, 160, J.S.F.A., 1970, 21, 203) and sheep (N.Z.J.S., 1965, 8, 158; C. & I., 1965, 1258; B.B.A., 1968, 164, 550) and cattle depot fats (C & I~., 1965, 303). The acids were used in collaborative studies with Dr R. (Bob) Ackman (then at the fisheries Research Board of Canada in Halifax, Nova Scotia) for the diastereoisomeric analysis of isoprenoid acids from various sources (L., 1967, 2, 357; B.B.A., 1969, 176, 673).

The importance of this work was realised when humans with the rare genetic disorder known as Refsum's syndrome were shown to be unable to metabolise phytanic acids, which typically accumulates in tissue, blood and urine lipids (B.B.A., 1965, 106, 304; N.Z.J.S., 1968, 11,24). It was later shown that whereas small amounts of phytanic acid are rapidly catabolised by rats, larger amounts are toxic, being deposited in the depot fats (B.B.A., 1966, 116, 178, 1968, 152, 642; P.VIITH I.C.N., 1966, 5, 399). It had been previously shown that anteiso-heptadecanoic acid is successively ß-oxidised to yield lower homologues (B.J., 1957, 65, 438), but in the case of phytanic acid because of the presence of the ß-methyl side-chain removal of a carbon by -oxidation must preceed the ß -oxidation steps.

Other branched-chain minor components identified in butterfat, sheep and cattle fats included: even-numbered (C14, C16 and C18) iso- (C.&I., 1951, 839; 1956, 1149; 1959, 124; B.J., 1954, 58, 358; 1955, 61, 547; 1956, 64, 214) and odd-numbered (C13, C15 and C17) iso- and anteiso-acids (B.J., 1951, 50, 207; 1952, 52, 203, 581; 1953, 53, 374; 1954, 57, 297; 1955, 59, 350, 61, 141, 702; J.S.F.A., 1957, 6, 331; C. & I., 1953, 516; 1954, 1229) as well as long-chain cyclohexyl - containing components (C. & I., 1967, 1640; J.S.F.A., 1967, 225, 1967). In addition to the many branched-chain acids, the presence of trace amounts of methyl methoxystearate artifacts produced during esterification was indicated (C. & I., 1966, 288; L., 1966, 1, 316).

In a second collaborative study with Dr Ackman, who had developed appropriate high performance open tubular gas liquid chromatographic (GLC) systems, monomethyl branched-chain fatty acid homologues (C15, C17 and C19) other than those of the iso and anteiso series were isolated

by Roy from various ruminant fats and analysed on the high efficiency columns (L., 1972, 7, 683). The available evidence correctly indicated the presence of methyl groups on even-numbered carbons only, as later confirmed by GLC-mass spectrometric studies.

This was particularly important because subsequent work in Great Britain and the United States showed that the soft fat of intensively reared lambs could be attributed, in part, to the presence of these acids. They are formed by incorporation of methylmalonate (from propionic acid, a fermentation product of the feed grain) instead of malonate during biosynthesis of the acids. In a collaborative project with staff in the Animal Science Department of Massey University, Roy showed that the formation of these acids may be minimised by feeding lower proportions of grain (rolled barley) to lambs fed pasture for a short time after weaning. (N.Z.J.S., 1976, 19, 413; 1978, 21, 85).

Fats Also Contain n-Odd Numbered Fatty Acids

In addition to the branched-chain fatty acids, irrefutable evidence was provided for the occurrence of n-odd numbered fatty acids which, as mentioned above, was at the time generally disclaimed (Hilditch, 1949, loc. cit.). However, the volatile fatty acids of beef and mutton fat showed a consecutive series of n-saturated components from C2 to C10 (N., 1954, 173, 1093; B.J., 1953, 54, 14; 1956, 63, 702; J.S.F.A., 1953, 4, 351). In butterfat, sheep and beef fats higher (C11, C13, C15, C17 and C19) pure n-odd saturated fatty acids were isolated, the C15 and C17 components predominating. The total n-odd numbered acids approached 2% of the total fatty acids (N., 1954, 174, 39; 1955, 176, 882; 1957, 179, 98; B.J., 1953, 54, 14, 1954, 58, 513, 516; 1955, 59, 350; 61, 702; 1957, 65, 18: C & I., 1955, 92; J.S.F.A., 1957, 6, 31; J.D.R., 1959, 26, 190; N.Z.J.S., 1963, 6, 101). As well as these saturated isomers, the monoene cis-heptadec-9-enoic acid was also isolated and identified (B.J., 1960, 77, 64).

It must be emphasised that compounds identified by Roy were painstakingly isolated (from kilogramme amounts of starting materials) by a combination of vacuum distillation of the methyl esters, low temperature crystallisation and silicic acid chromatography. The purity of the acids was checked by combustion analysis, saponification equivalent, iodine value, x-ray powder diffraction and, where possible, mixed melting point. Although the results were at first received with some scepticism this was dispelled when more powerful GLC and mass spectrometric analytical methods were developed.

Roy showed that the overlapping of of GLC peaks (J.C., 1959, 2, 547) could result in the wrong interpretation of the fatty acid composition (N.Z.J.S., 1963, 6, 101). For accurate analyses of mixtures it is necessary to use at least two columns of different polarity. It was at this stage that other investigators were beginning to use GLC to confirm the discoveries made in the Fats Research Laboratory. Unfortunately, it seems that few if any investigators now bother to isolate the fatty acids, or to do even a preliminary separation, but rely almost solely on GLC on a single column as an adequate means of describing fatty composition.

The presence of n-odd saturated fatty acids in plant fats was shown by the isolation of n-helptadecanoic acid from tall oil (C & I., 1959, 1516) as was incidentally the presence of the branched-chain (+)-14-methyl hexadecanoic acid (J.S.F.A., 1957, 7, 482).

Some of the analyses are notable for the range of fatty acids identified using x-ray diffraction, showing the occurrence of n-odd and even numbered carbons from C10 through C26 in ox kidney fat and in butterfat (J.S.F.A., 1958, 7, 391; J.D.R., 1959, 26, 190). In contrast, tall oil contained even numbered n-C18 to n-C24 only (N.Z.J.S., 1959, 2, 366).

Investigations into the Unsaturated Fatty Acids

Pioneering work in the Fats Research Division on the effects of ruminal hydrogenation on the composition of ruminant fats heightened interest in the unsaturated fatty acid components. The occurrence of trans and cis isomers of oleic (cis-octadec-9-enoic) acid was already known from the hydrogenation of linolenic acid of plant fats used in the manufacture of margarine. The occurrence of vaccenic (trans-octadec-11-enoic) acid in butter had also been long known. The occurrence of trans-octadec-16-enoic acid was inferred by other workers, but it was isolated in the Fats Research Laboratory in 1961 from butterfat (B.J., 1961, 81, 233). Using GLC data obtainedd on the pure methyl ester the presence of this acid in sheep and ox kidney fats was indicated (N., 1963, 198, 995).

Roy's interest in the analysis of tall oil (J.S.F.A., 1957, 7, 482, N.Z.J.S., 1959, 2, 366; C. & I., 1959, 1516; N.Z.S.R., 1960, 17, 114) led to the isolation, not only of the anteiso and n-odd numbered fatty acids mentioned above, but also to the study of unusual unsaturated fatty acids. These were indicated in a preliminary study of the fatty acid composition of the ether soluble lipids of the pinewoods of P. radiata and P. nigra (N.Z.J.S., 1966, 9, 801). From the seed oil of P. radiata there was isolated the uncommon fatty acids; cis-5, cis-9, cis-12 octadecatrienoic acid and cis-5, cis-11, cis-14 eicosatrienoic acid, which comprised ca. 17% and 2% respectively of the total fatty acids (N.Z.J.S., 1966, 9, 801; 1969, 12,324, 865;T., 1968, 51, 48). Because of different reactivities of the double bonds in these compounds, analytical methods for their location are fraught with many difficulties.

Transfer to DSIR Applied Biochemistry Division

The work on the seed oils of three cultivars or sweet lupin seeds (J.S.F.A., 1974, 25, 409; N.Z.J.A.R., 1976, 19, 343) is a further example of Roy's excursions into plant lipids. Besides the main components (oleic, 55%; linoleic 13% and linolenic, 11%) the amounts of n-saturated C12 through C26 together with 15:1, 17:1, 20:1 (11) 20:2 (8,11), 20:3 (8,11,14) and erucic acid 22:1 (13) were determined. At that time the presence of linolenic acid was considered unfavourable as it gave rise to off-flavours.

Roy's careful approach to his analytical work is illustrated by his detection of triglycerides, a major lipid component, in earthworm lipids (L., 1974, 9, 363), whereas other studies had indicated that these compounds were absent. The triglycerides are rapidly hydrolysed by tissue lipases unless adequate precautions are taken. By freshly extracting the lipids and applying sound methodologies, detailed fatty acid analyses of the total lipids, phospholipids, triglycerides, free fatty acids, sterol esters and glycolipids were achieved for the first time. This work remains unsurpassed in the field of lipid analyses. Over 60 fatty acid components, including substantial amounts of iso, anteiso, n-odd numbered, linoleic and linolenic acids, as well as phytanic acid and its metabolites were reported (L., 1974, 9, 825; J.S.F.A., 1975, 26, 961).

Roy's last papers in the area of lamb fats culminated in the most accurate and detailed analyses of the subcutaneous fats from several important breeds of sheep ever published. The mean values (N.Z.J.S., 1976, 19, 413, 1978, 21, 85). epitomised the salient features of the work of the Fats Research Division by quantifying the levels of the fatty acids that had been added by the work of that Division. The cessation of publication of N.Z.J.S., where these papers appeared, is a great loss to a young country trying to build up a science tradition.

His final research paper dealt with the occurrence of C13 to C31 branched-chain fatty acids in sheep faeces and of C12 to C34 n-saturated datty acids in both faeces and rye grass (J.S.F.A., 1978, 29, 107).

Conclusions

Roy Hansen's career is especially fascinating as a study in the development of a skilled research worker. Most successful scientists are first trained by means of a PhD research project supervised by an experience investigator. Roy learnt about research by working on a project while investigating relevant literature. By this process his research capabilities increased with experience to a remarkable degree. In addition, he received very able assistance from his technicians, including Miss June Cooke (Fats Research Laboratory) and Miss Z. (Sophie) Czochanska (Applied Biochemistry Division).

In 1955 Roy was awarded the Institute's ICI Prize. This success was remarkable considering the fact that he had worked on fats research for such a bried period. It was encouraging for the Fats Research Laboratory, whose staff ceiling rarely exceeded 17, to have three such medals awarded.

Roy is remembered especially for his modesty; it was with great difficulty that he was persuaded to put in his research publications for a DSc. In recognition of the significant contribution (resultining in 85 prefereed publications) that Roy's research made to our knowledge of the composition of agriculturally and industrially important fats and oils, he was awarded a DSc degree by Victoria University of Wellington in 1973.

Roy's friendship was greatly valued as was his honesty and loyalty. He did not tolerate any situation that was not dealt with in a straight forward manner and was always prepared to stand by his principles. F.B.S., as his former Director, is grateful for his enthusiasm, his magnificent contrinution to fats research and invaluable assistance in the administration of the Fats Research Division.

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Abbreviations

A.J.S. = Australian Journal of Science, B.B.A. = Biochimica et Biophysica Acta, B.J. = Biochemical Journal, C.&I. = Chemistry and Industry, D.S.A. = Dairy Science Abstracts, E.J.E.A. = The Empire Journal of Experimental Agriculture, J.C. = Journal of Chromatography, J.D.R. = Journal of Dairy Research, J.N.Z.I.C. = Journal of the New Zealand Institute of Chemistry, J.S.F.A. = Journal of the Science of Food and Agriculture, L. = Lipids, N. =Nature (London), N.Z.J.A.R. = New Zealand Journal of Agricultural Research, N.Z.J.S. = New Zealand Journal of Science, N.Z.S.R. = New Zealand Science Review, P.VIIth I.C.N. = Proceedings of the VIIth International Congress ofNutrition, Hamburg, P.XIVth I.D.C.R. = Proceedings of the XIVth International Dairy Congress, Rome, T. = Tappi.

CROWN RESEARCH INSTITUTE IN CHEMISTRY

The Science Policy and Public Affairs Committee of the Institute have prepared and sent a submission to the Task Force to Establish Crown Research Institutes. This submission is reproduced in full below for the interest of members.

SUBMISSION TO TASK FORCE TO ESTABLISH CROWN RESEARCH INSTITUTES

SUMMARY

THE NEW ZEALAND INSTITUTE OF CHEMISTRY RECOMMENDS ESTABLISHMENT OF A CROWN RESEARCH INSTITUTE IN THE DISCIPLINE OF CHEMISTRY, WITH A BOARD OF DIRECTORS REPRESENTING EFFECTIVE BALANCE OF SCIENTIFIC, TECHNICAL AND MANAGEMENT SKILLS AND EXPERIENCE AND HAVING AT THEIR DISCRETION ADEQUATE LEVELS OF FUNDING FOR UNCOMMITTED OUTPUT.

Such a Research Institute is envisaged to be structured in a form similar to DSIR's current Chemistry Division - either in its own discipline or incorporated in a larger centre for physical sciences, including for example, Physics, Engineering, Industrial Technology.

Grounds for this submission are attached.

The New Zealand Institute of Chemistry would be pleased to provide any further support for its submission, as the Task Force may require and to provide representatives to assist in the Workshops proposed for March 1991.

Walter Freitag

Convenor

SCENCE POLICY & PUBLIC AFFAIRS COMMITTEE

A CROWN RESEARCH INSTITUTE IN THE DISCIPLINE OF CHEMISTRY IS PROPOSED ON THE GROUNDS THAT:-

1. Chemistry underlies most other sciences and technologies, making direct contributions to most scientific 'outputs'.

2. Continued fragmentation (into output-oriented units) has been shown to detract from New Zealand's total available pool of expertise in Chemistry and cannot be in the nation's best interests. A Crown Research Institute in Chemistry would reverse the process of fragmentation

3. A Centre for Chemistry will restore - and develop the necessary breadth and depth of expertise to meet New Zealand's needs, offering also corresponding career prospects to encourage and retain the country's investment in education and training

4. A single centre can operate more efficiently than several scattered units, in terms of:
   - capital equipment
   - operation and administration
   - rationalisation of resources
   - generation of ideas

5. A Chemistry Centre can be structured to readily and efficiently support all relevant specialist units within its overall organisation and so develop productive, synergistic interaction

6. A Crown Research Institute in Chemistry should be structured also to provide direct, effective links with Chemistry Departments in the Universities, Polytechnics, other related Crown Institutes, Departments - as well as private sector organisations and overseas organisations.The centre will thus serve as a prime resource for the discipline of Chemistry, to efficiently meet New Zealand's diverse needs.

THE SUCCESSFUL OPERATION OF THE PROPOSED CROWN RESEARCH INSTITUTE IN CHEMISTRY WILL RELY PRINCIPALLY ON THE EFFECTIVE BALANCE OF SKILLS AND EXPERTISE OF ITS BOARD OF DIRECTORS - REPRESENTING THE FIELDS OF FINANCE, COMMERCE, GENERAL MANAGEMENT, AS WELL AS THOSE IN THE RELEVANT SCIENCES AND TECHNOLOGIES:

The need for competent scientific and technical knowledge and experience on the Board of Directors has been strikingly demonstrated over the years, by the success of enterprises in the world's wealthiest economies (eg Japan, Germany) who place high priority on retaining the necessary balances of expertise on their Boards of Directors - in striking contrasts to the disastrous collapses of enterprises deficient in this respect.

It is therefore proposed that constitution of the Crown Institute provides specifically for appropriate levels and proportions of all relevant fields of experience on the Board of Directors.

THE INSTITUTE'S BOARD OF DIRECTORS SHOULD BE GIVEN DISCRETION OVER REASONABLE LEVELS OF ON-GOING FUNDING FOR NON-COMMITTED OUTPUTS:-

Such funding is seen essential to ensure reasonable reliability of on-going operations and certainty of outputs - in particular, to maintain realistic balance between projects aimed to specific short-term gains and those necessary to achieve the nation's longer-term needs and welfare.

Need is also seen for specific provision for funding necessary items of major capital equipment - distinct from operating revenue.

WORK FINISHES ON CONSTRUCTION OF HUGE OXYGEN PLANT

The oxygen plant is being built for FERNZ Corporation, which has entered a contract to supply the oxygen to NZFP for pulp and paper de-lignification.

Air Separation Ltd, a New Zealand company which represents in Australasia Air Sep Corp, of Buffalo, NY, a giant in the world of PSA oxygen supply plants, earlier this year won the $4 million contract from international competition.

The plant for Kinleith is the largest pressure swing oxygen (PSA) plant in the world. Its day to day operations can be monitored by on-line computer directly from Air Sep Corp's head office in Buffalo, New York. This computer link will monitor all the plant's key operations, allowing its sophisticated functioning to be carefully checked. If necessary, engineers in New Zealand can make adjustments to the plant as its functions are being checked by experienced engineers in New York.

Fernz Corporation's development manager, chemicals, Mr Rob Moon said his company is placing the Air Separation Ltd plant at the chemical complex adjacent to the Kinleith mill site and will supply oxygen for the de-lignification bleaching of pulp, an environmentally clean process producing no waste products.

The PSA method of oxygen generation, which has been proven and accepted over a 20 year period as an efficient and economical method of oxygen production for certain applications, is to be used in the new complex. Pulp and paper plants have been identified as a key target market for this type of plant.

The PSA system generates oxygen by passing air through a molecular sieve of synthetic zeolite, which lasts idefinitely. It uses two molecular sieve beds alternately. Air is passed through one adsorbent bed at high pressure. The sieve adsorbs nitrogen, allowing the oxygen to pass through as product gas.

Before the bed becomes saturated with nitrogen, the inlet air is switched to the second bed. The second bed is now regenerated by desorbing nitrogen through depressurization and is then purged back to the atmosphere.

The pure oxygen is then passed to a separate holding tank (called the surge tank). The complete cycle is then repeated. The zeolite is completely regenerative, and under normal operating conditions will last indefinitely.

Although most of the components for the Kinleith plant will come from overseas, much of the labour and the equipment incldng the pressure vessels, will be sourced from New Zealand.

DOPING CONTROL OF ANABOLIC STEROIDS

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Anabolic steroids are analogs of testosterone, the male sex hormone. Testosterone has both androgenic, or masculinizing, and anabolic, or muscle-building, effects. Efforts to modify the testosterone molecule to minimize the androgenic effects led to the synthesis of anabolic steroids. However, it is not possible to eliminate the androgenic properties of the molecule.

Anabolic steroids are extensively metabolized, and in most cases it is the metabolites in the urine that are being monitored in dope testing. Hence it is important to have an understanding of the major metabolic pathways of the different anabolic steroids. Many of these metabolites are conjugates as glucuronides and sulfates; consequently, any comprehensive steroid screening procedure would include a hydrolysis step, usually by enzymes. Analysis is by gas chromatorgraphy-mass spectrometry. Human urine contains many endogenous steroids, including androgens, progestogens, and corticosteroids, some of them in significant amounts. For this reason, a gas chromatogram obtained with universal detection is very complex, and it is difficult to identify anabolic steroids in the full-scan mode. The selected ion monitoring mode is used instead.

The anabolic steroids that most dope testing laboratories currently test for are listed in Table 1. This list is constantly being revised to include newly investigated compounds.

Table 1. List of anabolic steroids detectable in urine.

Bolasterone	Boldenone
Clostebol	Ethylestrenol
Drostanolone	Furazabol
Fluoxymesterone	Metandienone
Mesterolone	Methandriol
Metenolone	Nandrolone
Methyltestosterone	Oxandrolone
Norethandralone	Oxymetholone
Oxymesterone	Testosterone
Stanozolol	
Dehydrochloromethyltestosterone	

Anabolic steroids are banned for two reasons - the first being that they are performance-enhancing drugs, thus atheletes using them have an added advantage, and this constitutes unfair competition; the second being that they have harmful side effects and are injurious to the health of the atheletes.

Whether anabolic steroids are performance-enhancing has been a controversial subject for some years. The scientific literature does not unambiguously support the notion that they are performance enhancing. On the other hand, there is no uncertainty on their adverse effects.

These include masculinizing effects on females, suppression of gonadal functions in males, and premature closure of the epiphyses in adolescents. Other problems include acne, aggression, mood swing, insomnia, changes in cardiac and liver enzymes levels in the blood, as well as blood cholesterol level. Long-term effects are yet to be delineated.

Over the years, the positive rate detected by doping laboratories is low - about 2%. If only anabolic steroids are considered, the rate is even lower. It was known all along that drug use in sports, especially steroids use, had been more prevalent than this. The anomaly was due to the fact that for many years dope testing was only conducted in competition, so atheletes who abused drugs in training would not have been detected. Steroids are generally used in training to help the athlete recover sooner between training sessions, and to train harder and longer. If the athlete finishes his cycle of drug use well ahead of competition, then his body has enough time to clear the drug, and he would test negative. To overcome this problem, testing should also be performed out-of-competition, such that the athlete is given short or no notice. This is an expensive undertaking, but is an effective deterrent of steroids abuse. Many sports organizations now have out-of-competition testing programs in place.

Another proposed means for detection of anabolics abuse is the so called endogenous steroids profiling. It is alleged that the urinary excretion of endogenous androgens in steroid abusers is suppressed compared to non-abusers. The argument is based on the fact that the secretion of testosterone in the testes is controlled by a negative feedback mechanism on the hypothalamo-pituitary-testicular axis. Presence of exogenous steroids in the blood stream will suppress the release of both gonadotropin releasing hormone and LH, which will in turn affect negatively the biosynthesis of testosterone in the testes.

In a presentation to the 2nd International Athletic Foundation Symposium, Monte Carlo, June 1989, Professor Donike compared the urinary levels of several androgens of power athletes and cyclists. Power athletes were assumed to be steroid users, while the cyclists were deemed not likely to use steroids for performance enhancement. Donike analyzed androsterone (AN), etiocholanolone (ET), testosterone, and epitestosterone concentrations, and AN/ET ratio were lower in the power athletes. Based on these observations, he proposed two parameters to monitor long-term use of anabolic steroids. The first is the urinary concentrations of endogenous steroids. The second parameter is the AN/ET ratio, which is independent of the specific gravity of the urine sample. Some of his data is reproduced in Table 2. Considering the spread of the data, the results from the power athletes are not different from those of the cyclists. Perhaps it is an over-simplification of the situation in attempting to delineate gonadal suppression by examining the urinary levels of androgens. The majority of testosterone is synthesized in the testes, together with a small amount of androstenedione. The adrenal cortex is the site of production of dehydroepiandrosterone, its sulfate conjugate, androstenedione and a small amount of testosterone. Androstenedione and dehydroepiandrosterone are metabolized in the liver into testosterone. All of these are excreted in the urine as androsterone and etiocholanolone. Metabolism of androgens is indeed a very complex phenomenon. In dope testing, the tester has the benefit of examining only one random urine sample, and it may very well be impossible to prove gonadal suppression through some urinary parameters.

Perhaps the most controversial aspect of steroid testing is the

Table 2. Concentrations and ratio of endogenous steroids

	Cyclists (N = 254)		Power Athletes (N = 197)	
	mean	S.D.	mean	S.D.
Androsterone	2165.6	1484.9	974.9	1014.4
Etiocholanolone	2079.7	1398.8	1591.3	1183.3
AN/ET	1.44	1.02	0.63	0.46
Testosterone	41.8	30.7	24.8	22.9
Epitestosterone	35.7	23.6	18.4	17.5

Concentrations in ng/mL

detection of testosterone abuse. As the laboratory cannot differentiate between exogenous and endogenous testosterone, the ratio of testosterone to epitiestosterone (T/E) is used as the criterion to detect abuse of this hormone. A ratio of greater than 6 constitutes violation. The 6 value is an arbitrary administrative cut-off, and has no theoretical basis. Not much is known about epitestosterone, which is not active physiologically, but there is no interconversion between epitestosterone and testosterone. As the excretion rate of testosterone is similar to that of its epimer, the T/E ratio is about 1, and a ratio of 6 is considered a safe margin to define testosterone abuse. However, it is now generally recognized that there are some men who have a genetically high T/E ratio. This discovery poses a dilemma to sports authorities - how can one distinguish between a testosterone abuser and a genetic outlier? Historical data would be useful. If someone has a normal ratio all along, a sudden rise above 6 is highly suspicious. Those with a high ratio and a high testosterone concentration are also suspect. The gray area is when the ratio is between 6 & 10, and the testosterone concentration is not high. One characteristic that can be used to differentiate genetic outliers from steroid users is that athletes abusing anabolic steroids including testosterone could be in a hypogonadtrophic hypogonadal state, as explained earlier where the secretion of gonadotropins in the pituitary is suppressed. This state can last as long as 16 weeks after the cessation of drug use. Symptoms include testicular atrophy and low sperm count. Some biochemical parameters might also be altered, such as the decrease in blood level of LH.

An often-asked question is how long the steroid or its metabolites can be found in the urine after the cessation of drug use. Most anabolic steroids are no longer used for therapy; therefore, it would be difficult to get approval from ethics committees to conduct such studies. Information is usually gathered retrospectively through positive dope testing results, and with the cooperation of the athletes. In general, oil based nandrolone injectable lingers the longest in the system. Other injectable steroids could be detected anywhere from a few weeks to a few months after drug use. For oral dosage forms, the clearance time is shorter, and the test is most likely negative after a couple of weeks.

As can be seen, the laboratory faces many challenges in anabolic steroid testing. Much work remains to be done.

DOPING IN SPORT: OLD AND NEW ASPECTS OF A WORRYING PROBLEM

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The use of drugs and medication in sport is in part a reflection of the use of drugs in society. The utilization of drugs for therapeutic or recreational purpose follows similar trends to those in general population. The sportsman, however, may look to drugs for additional ergogenic (psychostimulants), analgesic (narcotics), bradycardiac (beta-blockers) and anabolic (steroids) purposes. Complementary drugs that dilute (diuretics) or mark (probenecid) the excretion of the former are also misused.

The detection of the above cited malpractice after urine analysis has been established for some years (Table II). Extraction procedures involve the isolation of the drugs or their metabolites, sometimes after hydrolysis of conjugates. The combination of gas-liquid (GC) and high performance liquid chromatography (HPLC) allows the necessary detection of the compounds or their derivatives. Final confirmation by GC-mass spectrometry (GC-MS) affords the necessary specificity. New developments in solid-phase extraction and recent efforts to couple HPLC with MS to confirm the presence of doping agents offer new capabilities.

A worrying area of substance misuse appears to be endocrinology. In addition to anabolizing agents the present availability of peptide hormones, sometimes obtained by recombinant DNA technology, is becoming a great concern. Human chorionic gonadotrophin, human growth hormone, adenocorticotrophic hormone and their hypophyseal releasing factors are

TABLE I
LIST OF DOPING CLASSES AND METHODS BANNED BY INTERNATIONAL OLYMPIC COMMITTEE (1990)

I	DOPING CLASSES Stimulants Narcotics Anabolic Steroids Beta-Blockers Diuretics Peptide hormones and analogs
II	DOPING METHODS Blood doping Pharmacological, chemical and physical manipulation
III	CLASSES OF DRUGS SUBJECT TO CERTAIN RESTRICTIONS Alcohol Marijuana Local anaethetics Corticosteroids

TABLE II
ANALYTICAL METHODOLOGY CLASSIFICATION

Screening#	Characteristics
I	Volatile Nitrogen-containing compounds excreted free in the urine (Gas Chromatography GC)
II	Heavy volatile compounds excreted as conjugates with sulphate or glucuronic acid (GC-Mass Spectrometry MS)
III	Stimulants with special chemical structure and properties (High Performance Liquid Chromatography HPLC)
IV	Anabolic Steroids (GC-MS)
V	Diuretics (HPLC and GC-MS)
VI	Beta-blockers (GC_MS)
VII	Hormones and substances detectable with immunological methods

potential targets for misuse. As an alternative to blood doping, Erythropoietin might be used in order to increase oxygen-carrying capacity through stimulation of red-blood cell differentiation. Some issues associated with hormone abuse and problems related to their detection and identification as exogenous agents are itemised in Table III.

Reliability of the whole analytical procedure is guaranteed by following strict Good Laboratory Practice (GLP) regulations (Table IV). However, one aspect as important as the reliability of analysis in the laboratory is the guarantee of the so called "Chain of Custody" which is based on important formal aspects of dope testing (Table V). In this regard some parallelism can be observed between doping control and other fields of toxicology, such as workplace drug testing or forensic toxicology, although some important differences can also be identified (Table VI).

The protocols to assure the origin and the integrity of the samples being collected, the transportation, the analysis and the reporting should always be rigidly followed especially during Olympic Games. In these events the anti-doping programmes are extremely complex to carry out, because of the high number of controls involved, the urgency with which results are needed and the speed with which decisions have to be made. However, previous experience acquired shows that this highly complex operation allows an overall approach (Table VII). By suitable planning, adequate measures are taken to provide valuable information on banned substances to athletes and doctors, reliable procedures are used, results are discussed in depth by experts and every effort is made to reach the correct decisions for the athletes involved.

TABLE III
PEPTIDE HORMONES

Traditional sources:
- Extraction from biological material
- Chemical synthesis

Modern sources:
- Gene technology for some of them

Substances:
- Human chrolonic gonadotrophin HCG
- Corticotropin ACTH
- Somatotrophin HGH
- The corresponding hypothalamic releasing factors
- Erythropoetin EPO

General remark on detection:
- Short plasma half life
- Small quantities in urine-unknown structures
- Cross-reactivity with antibodies
- Difficult to obtain reference material
- Criterior for distinguishing exogenous/endogeous
- Problems for mass spectrometric confirmation

TABLE IV
ANALYTICAL ASPECTS COVERED BY GOOD LABORATORIES PRACTICES

- Organization and personnel
- Quality assurance program
- Laboratory facilities
- Instruments and materials
- Reagents and Reference Substances
- Standard Operating Procedures (SOP's)
- Reporting
- Archiving and storage

TABLE V
IMPORTANT FORMAL ASPECTS IN DOPE TESTING

- Notice to the athlete
- Protocol at the Doping Control Station
- Collection Form
- Transportation Form
- Reception Form
- Opening Form

TABLE VI
DOPE TESTING AND OTHER RELATED FIELDS

Some similarities with:
- Workplace drug testing
- Forensic toxicology
- Emergency toxicology
- Therapeutic drug monitoring

But important differences based on:
- Rapid screening and confirmation
- One biofluid
- Small sample
- Number of classes of drugs
- Detection of parent drug and/ or metabolites
- Techniques used
- High level of expertise
- International credibility

Legal challenge

TABLE VII
SOME CHARACTERISTICS OF ANTIDOPING CONTROL AT THE OLYMPIC GAMES

High number of controls
Urgency of the results

Overall approach allowing:
- Information for athletes and doctors
- Reliable procedures
- In-depth discussion of the results

ANALYTICAL CHEMISTRY BY DISTANCE LEARNING

ATI is developing a distance learning programme for training and updating skills in analytical chemistry. The programme is based on the series of self instructional texts developed by the UK polytechnic system under the name of ACOL (Analytical Chemistry by Open Learning). The series comprises 30 titles covering the a wide variety of topics from fundamentals of analytical chemistry, classical analysis to a range of instrumental techniques. A selection of these topics will be available for study through ATI which has been accredited by ACOL as an approved provider.

Negotiations are in progress between ATI and BTEC (the Business and Technician Education Council) in the UK so that the programme will have recognition in Britain and the European Community as well as in New Zealand. Successful completion of the programme will gain credits at post NZCS level to count towards higher qualifications presently under development at the Institute. In addition the programme will form a substantial part of the requirements for the RSC (Royal Society of Chemistry) Certificate in Applied Chemistry presently being taught at ATI. It is envisaged that ATI will eventually be able to offer this certificate via a distance learning mode.

There are no formal entry qualifications but the material will be taught to a post-NZCS level (although the open learning texts facilitate a slightly lower entry point).

Experience of working in analytical chemistry is expected.

The topics covered are particularly suitable for graduates in any area of science who need training in particular topics, or for those returning to analytical chemistry after a career break who need to update their skills.

If you would like further information on these courses, or to register as a participant, please contact: Bruce Fraser, Faculty of Science and Engineering, ATI, Private Bag, Auckland. Ph (09) 773-570, Fax (09) 357-0760

THE STATUS OF ATOMIC ABSORPTION SPECTROMETRY FOR TRACE ELEMENT ANALYSIS

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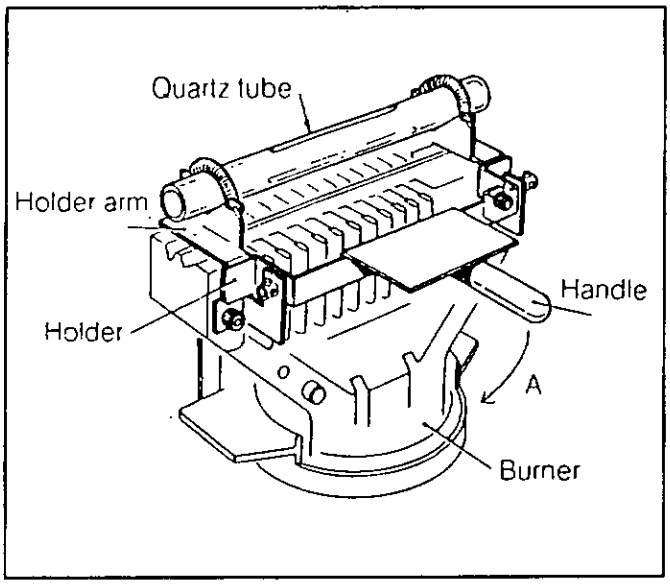
Atomic absorption spectrometry (AAS) is currently the most widely used technique for elemental analysis at the trace level. The determination of lead in blood, aluminium in water and mercury in fish invariably involves the application of AAS in one form or another.

As in most analytical techniques, the advent of the microprocessor has had a profound effect on AAS instrumentation. The number of manual controls on an atomic absorption spectrometer has decreased steadily and most parameters are now set via the instrument's computer keyboard. Self-optimisation routines are available with a number of instruments. When a lamp is inserted, the spectrometer recognises its identity and sets appropriate conditions such as the lamp current, spectrometer wavelength and slit width. Optimisation of the flame conditions can also be performed automatically without operator intervention.

The provision of improved nebuliser/burner systems and the almost universal use of automatic gas flow controls have enhanced the appeal and reliability of AAS in routine trace metal analysis. There are, of course, some limitations and disadvantages of the technique and a number of procedures have been developed to overcome (a) the poor sensitivity encountered for some elements and (b) the effects of matrix interferences, which may cause errors in analysis.

SLOTTED TUBE ATOM RETARDER - (STAR)

The use of a slotted quartz tube to increase the sensitivity of flam AAS was first described by Watling. Philips Scientific were the first supplier to introduce this. With this procedure, a quartz tube is positioned in the flame such that the HCl beam passes along the tube (Figure 1). Two slots cut in the quartz tube allow the passage of the flame gases into the tube with the effect that the residence time of the analyte atoms in the HCl beams is increased. The corresponding improvement in sensitivity ranges from a factor of 2 to 5 for the more volatile elements (e.g. Ag, As, Au, Bi, Cd, Cu, Hg, Zn) (Table 1). The procedure has been used recently to determine the concentration of Cu and Zn in serum and urine in conjunction with a micro sampling procedure.



ELECTROTHERMAL ATOMIC ABSORPTION SPECTROSCOPY - (ET-AAS)

Recent advances in electrothermal AAS have concerned the development of instrumentation or procedures which minimise the influence of matrix species on the measurement of the AAS signal.

There are basically two approaches (chemical modification and high temperature atomisation) to chemical interference control in electrothermal atomic spectrometry.

CHEMICAL MODIFICATION

This involves the addition of a reagent to the standard and sample solutions to either assist the removal of the matrix at normal char/ash temperatures or prevent loss of the analyte at elevated char/ash temperatures. Some of the more commonly applied modifiers are NH_4NO_3, $NH_4H_2PO_4$, $Mg(NO_3)_2$ and Ni.

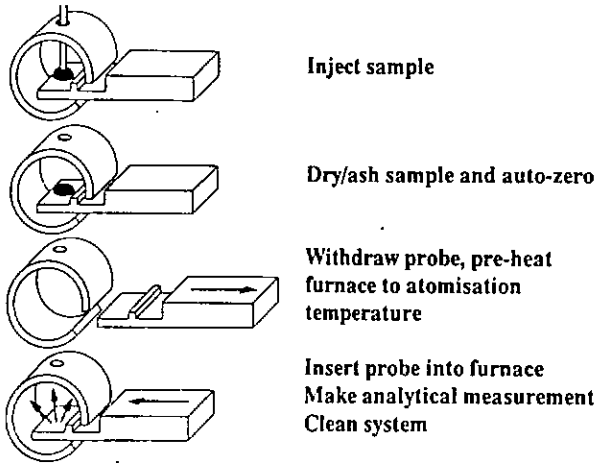
TABLE 1
Comparision of Conventional Versus STAR-FAAS Sensitivities

Element	Flame Type	Conventional FAAS (ug mL^{-1})	STAR-FAAS (ug mL^{-1})	Improvement Factor
Pb	Air-C_2H_2	0.1	0.03	x 3.3
Cd	Air-C_2H_2	0.014	0.004	x 3.5
As	Ar-H_2	0.3	0.06	x 5.0
Se	Ar-H_2	0.26	0.08	x 3.2
Cu	Air-C_2H_2	0.04	0.015	x 2.7
Zn	Air-C_2H_2	0.01	0.004	x 2.5
Sn	Air-H_2	0.35	0.1	x 3.5
Tl	Air-C_2H_2	0.28	0.1	x 2.8
Ag	Air-C_2H_2	0.03	0.01	x 3.0
Au	Air-C_2H_2	0.12	0.05	x 2.4
Hg	Air-C_2H_2	2.7	0.85	x 3.2
Pt	Air-C_2H_2	1.2	0.9	x 1.3
Bi	Air-C_2H_2	0.28	0.08	x 3.5
Sb	Air-C_2H_2	0.36	0.12	x 3.0
Te	Air-C_2H_2	0.2	0.08	x 2.5

Recently there has been considerable interest in the use of palladium as a general modifier for electrothermal AAS. The palladium is added in the form of nitrate or chloride salt, but during the char stage, the Pd^{2+} ions are reduced to palladium metal and it is thought that some form of amalgam is formed with the analyte element. The use of palladium can increase the maximum char/ash temperature to 1000-1300 deg C for elements such as As, Bi, In, Pb, Sb, Sc, Sn, Te and T1, which would normally be vaporised at temperatures 300-500 deg C lower. Although palladium has been used in conjunction with other modifiers there is sufficient information to suggest that the addition of H_2 to the furnace purge gas to ensure reduction of Pd^{2+} to Pd^0, is the only requirement for widespread use of this modifier.

HIGH TEMPERATURE ATOMISATION

Chemical interferences can occur in electrothermal AAS if a volatile analyte species is vaporised into a relatively cool furnace environment along with an excess concentration of, for example, matrix halide salts. In the presence of a halide matrix, volatile analyte molecules may be vaporised before the furnace gas has reached a temperature capable of producing analyte atoms and they are therefore lost. Also, the high excess concentration of halide species produced by the sample matrix may inhibit the dissociation of analyte molecules or react with the atoms once produced. Whatever mechanism dominates, the occurrence of vapour-phase interferences reduces the efficiency of atom formation so a lower absorption signal is measured compared to atomisation of the analyte in a halide-free specimen. Many attempts have been made to improve the atomisation of volatile elements by vaporising the sample into an environment at a higher temperature than would be experienced by the analyte under normal conditions. The most widely used approach is the platform atomisation method. A small slab of pyrolytic graphite is positioned inside the atomiser tube and the sample droplet is placed on to the platform rather than the tube wall. During the atomisation stage, the platform heats at a much lower rate than the rest of the tube so that when vaporisation occurs, the analyte and matrix components are volatilised into a gas at a higher temperature than would have been experienced by the analyte with wall atomisation. When used in combination with chemical modifications, interferences can be removed at matrix levels 10^3 - 10^4 times higher than can be tolerated with conventional wall atomisation.



An alternative approach to achieving high temperature vaporisation in electrothermal AAS is the use of probe atomisation. With this procedure, the sample droplet is deposited on to a small graphite strip (Figure 2) rather than directly onto the tube wall or a platform. The probe-head is positioned inside the tube beneath the injection hole so that sample deposition can be achieved using a conventional furnace auto-sampler. The dry and char/ash sequence occurs with the probe-head inside the tube and once this is complete, the probe with the sample on it, is removed from the atomiser and the tube is heated to the required temperature. When the temperature has stabilised, the probe is reintroduced, the probe-head is heated rapidly by tube wall radiation (as is the platform) and the sample is vaporised into the hot furnace gas. A probe atomiser programme for the determination of lead and cadmium is given in Table II. Two principal advantages of the probe, compared to the platform, are (i) improved control of the gas temperature and atoms experience and (ii) rapid heating of the atomisation surface to the colatilisation temperature of the volatile analyte and matrix. Probe atomisation methods have been reported for determination of Cd, Cu, Mn, Ni ad Pb in clinical and environmental samples, without addition of matrix modifiers or the use of standard additions or matrix-matched solutions for standardisation. Philips Scientific developed this technique and Autoprobe atomizaton is a unique feature of the Philips range of graphite furnaces.

TABLE II
Probe Atomiser Programme for the Determination of Lead and Cadmium

Phase	Temperature deg C	Time s	Ramp deg C s^{-1}	Argon Gas Flow
1	200	45	200	On
2 Pb	700	20	200	On
Cd	500	20	200	On
3	2500	3	2000	Off
4	2700	2	2000	On

SOLID SAMPLING IN ELECTROTHERMAL AAS

The ability to analyse solid samples is an often quoted advantage of electrothermal AAS atomic spectrometry. However, it is only since the advent of chemical modification and platform atomisation that accurate and precise analysis of solids has become a practical reality. There are two basic approaches to the direct analysis of solid samples by electrothermal AAS. Particles of the sample can be introduced directly into the atomiser tube, or alternatively a suspension of finely powdered material can be prepared and volumes injected into the tube with the auto-sampler. The latter approach is often called slurry sample introduction and the homogeneity of the dispersion can be maintained by mechanical or ultrasonic mixing, or by use of thixotropic thickening agents. Introduction of the solid sample in the form of a suspension has a number of advantages. It is easier to automate the process in comparison to the use of direct solids insertion. Repeat micro weighings are avoided, a larger portion of the specimen can be selected for repeat analysis and contamination can be minimised. The approach is limited to samples which can be ground to a fine power, e.g. chemicals, rock, freeze-dried foodstuffs and biological tissues. When combined with some of the advances in methodology described above, slurry analysis can improve detection limits by an order of magnitude which may be of importance in the detmination of toxic elements such as Cd and Pb.

CONCLUDING COMMENTS

Atomic absorption spectrometry can now be considered a comparatively mature technique but improvements in instrumentation and methodology continue to enhance its application in many areas of elemental analysis. Although the advocates of plasma-based atomic spectrometry techniques may disagree, it seems likely that AAS will continue to play an important role in chemical analysis for the forseeable future. For many users, the simplicity of flame AAS, the sensitivity of electrothermal AAS and the flexible approach that is possible in many specialist applications will continue to be attractive features of the technique.

CARBON DIOXIDE AS A WORLD "GREENHOUSE" GAS PART TWO
FROM OPTIMISM TO PESSIMISM TO OPTIMISM

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Unlike "Carbon Dioxide as a World "Greenhouse" Gas - A New Approach?" Part 1 [1], the concepts illustrated here are different from those that were presented at the annual Institute of Chemistry Conference) Health and Environment Session), Wellington, New Zealand in August, 1990. Part 1 presented an optimistic picture because it ignored the complication due to the variation of the carbon concentration within the sea. The consequences of this variation is now included in the discussion in the following paper.

INTRODUCTION

In Part 1 [1] there was great emphasis on the ability of the sea (or oceans) to absorb carbon dioxide. That is indeed correct. However, one very important matter which was not part of that previous discussion was the need to consider the degree of mixing within the oceans. In that presentation it was assumed that most of the resistance to transfer between air and the total sea occurs at the air-sea interface. Although this would apply to most liquid-gas processes considered by chemical engineers, it is not true in this instance. The reason is simply one of size; the oceans are so very deep.

Houghton and Woodwell [2] made the following statement - "If current fluxes were reduced by 3 billion tons annually, the atmospheric carbon dioxide level would be stabilized for a few years. The stabilization would not be permanent, however. The rate of accumulation in the oceans is determined by how fast they can absorb carbon dioxide from the atmosphere; this in turn depends on the difference in carbon dioxide concentration between the atmosphere and the ocean. As the flux of the excess carbon is reduced, the difference is also reduced and the ocean becomes less capable of absorbing excess carbon; carbon dioxide emissions would have to be reduced still further to prevent additional atmospheric accumulation." In order to better understand the reason for this statement, Scenario A will be considered. It consists of a mathematical model where a diffusion mechanism is used to describe the movement of carbon from the surface to the deep sea.

Scenario A - Diffusion Model

In the diffusion model [3,4,5 etc] the sea is considered as a series of separate levels with the layer near the surface termed the mixed layer. In this layer any difference in the carbon dioxide with height is considered to be insignificant. However the depth of this layer is relatively small and varies with latitude [3]. The average value used by Watts and Morantine [6] is 60m; the value of Baes et al [3], Emmanual et al [4] and Solomon et al [7] is 75m and the value of Enting is 100m [8]. Hence there is no agreed value but what is agreed is that its value is very much less than the average depth of the sea which is around 4 km [3,6]. In this paper a value of 75m will be used and the carbon content in the mixed surface layer, on that basis, is 630 billion tonnes of carbon [7]. This is less than 2% of the total carbon in the sea of around 36,000 billion tonnes of carbon [1,2].

As a gross simplification the sea will be divided into just these two categories, the mixed surface layer and the deeper non-surface sea. Table 1 gives reconstructed current carbon reservoir values when the sea content is separated into these two categories. If resistance to the mass transfer of carbon dioxide between the air and the mixed surface layer is relatively a very small value when compared to the resistance between the mixed surface layer and the deeper sea, then it would be expected that any percentage increase in atmospheric carbon dioxide would be matched by a similar increase in the carbon dioxide in the mixed surface layer.

Table 1 The Current World's Major Carbon Reservoirs (values in billion tonnes)

(1)	Atmosphere	735	(1.7%)
(2)	World Vegetation and Soils	2060	(4.7%)
(3)	Sea - Mixed Surface Layer	630	(1.4%)
(4)	Sea - Deeper Non-Surface	35370	(80.8%)
(5)	Fossil Fuel Reservoirs	greater than 5000	(11.4%)

If it is assumed that the rate of carbon emissions continued at their current level (2 billion tonnes - deforestation, 5 billion tonnes - burning fossil fuels [1,2] but with no net transfer within the sea beyond the mixed surface layer and assuming the accumulation of carbon in the air and mixed surface layer is in proportion to their original carbon contents, then in about 100 years, the current known fossil fuel reservoir would be exhausted and at the end of that time, hypothetically, the situation would be that given in Table 2. This might be called the "worst case" scenario at current usage. Note that the carbon content in the atmosphere (4505 billion tonnes) is greater than the value of 3735 billion tonnes obtained by Evans in the so-called "constant proportional flow" scenario [1].

Table 2 The World's Major Carbon Reservoirs in 1000 Years Time if Current Rate of Flux Continues (billion tonnes) - Scenario A (1) No transfer below mixed layer.

(1)	Atmosphere	4505	(10.3%)
(2)	World Vegetation and Soils (15+45)	60	(0.15%)
(3)	Sea - Mixed Surface Layer	3860	(8.8%)
(4)	Sea - Deeper Non-Surface	35370	(80.75%)

Consider now the situation where the flow of carbon from the mixed surface layer to the deeper non-surface sea was such that a constant proportional flow pattern as indicated by Evans was obtained [1,2]. Such a pattern would generate the values, after 1000 years, as shown in Table 3. Figure 1 gives the required net flux pattern (on an annual basis) to establish the pattern with the assumption that the values do not change significantly with time over the period.

Table 3 The World's Major Carbon Reservoirs in 1000 Years Time if Current Rate of Flux Continues (billion tonnes) - Scenario A (2) Transfer to mixed layer to give a defined constant proportional flow.

(1)	Atmosphere	3735	(8.55%)
(2)	World Vegetation and Soils	60	(0.15%)
(3)	Sea - Mixed Surface Layer	3200	(7.3%)
(4)	Sea - Deeper Non-Surface	36800	(84.0%)

On the basis of the pattern given in Figure 1, what rate of burning of fossil fuels would be just sufficient to maintain the carbon dioxide level at its current level? Figure 2 shows this value would be only 1.43 billion tonnes/year or about 30% of the fossil fuel emissions or 20% of the total carbon emissions. Figure 2 helps explain the recently specified condition that a reduction of greater than 60% in man-made carbon emissions is necessary in order to stabilise the carbon dioxide concentration in air at its present day level [9]. Such a scenario gives a very pessimistic picture compared to that presented in the previous paper (Part 1 [1]), where it was suggested (optimistically) that if the burning of fossil fuels was reduced to 80% of its current value and net deforestation was no longer continued then the carbon dioxide concentration should remain near its present level. Scenario A requires (pessimistically) that the

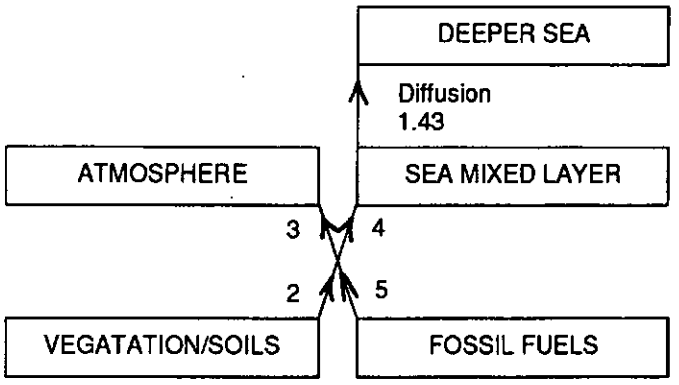

Figure 1 Carbon Reservoir Net Fluxes - Current Values (in billion tonnes/year)

current burning of fossil fuels must be reduced to 30% of its current value and net deforestation no longer continued if there is to be no increase of carbon dioxide in the atmosphere.

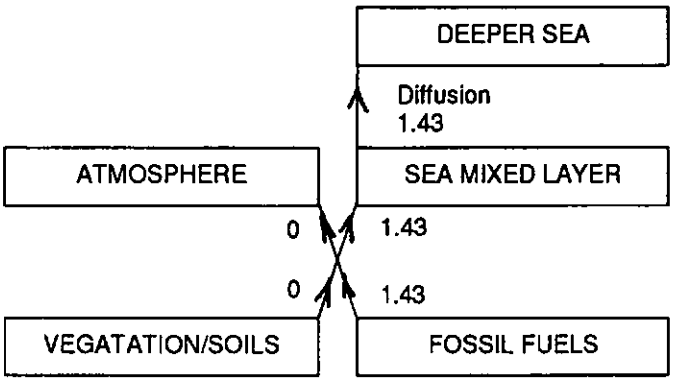

Figure 2 Carbon Reservoir Net Fluxes - Reduced Values for Scenario A (in billion tonnes/year)

Scenario B - Circulation Model

Bjorkstrom [5] was the first to propose an ocean model for the trasfer of carbon which included water downwelling from the cold regions and upwelling from the warm regions. It is now recognised that the parametization of all the vertical ocean movement into a single diffusion coefficient is not realistic and, in fact, diffusion itself is not a major contributor [4]. The term advection is often used to describe this circulatory movement in a vertical direction.

The potential for removing carbon into the deep sea by advection can be seen from the following assumptions and calculations -

(1) Upwelling occurs in 50% of the sea surface (i.e. 50% of 3.6 x 10^{14} m^2 [7]);

(2) The average velocity of upwelling is 4 m/year [6];

(3) The downwelling involves only the mixed surface layer;

(4) The carbon dioxide in the mixed surface layer is proportional to the carbon dioxide currently in the air; and

(5) The carbon dioxide concentration in the upwelling is proportional to the carbon dioxide that was in the air in 1850. This also assumes that for a thousand years or more before 1850 the carbon dioxide concentration in the atmosphere did not change markedly.

Assumptions (1) and (2) give the total flow as 7.2 x $10^{14}$$m^3$/year and since the mixed layer contains 630 billion tonnes of carbon in its volume of 2.7 x $10^{16}$$m^3$ (3.6 x $10^{14}$$m^2$x75m), then from assumption (3), the total carbon flow should be 630 x 7.2/270 = 16.8 billion tonnes of carbon/year. It is estimated that in 1850 the atmospheric carbon dioxide concentration was about 82% of its current value [2], and therefore, on the basis of assumptions (4) and (5), the net flux would be 0.18 x 16.8 = 3.0 billion tonnes of carbon per year.

There is a further consideration to the above proposed net transfer of 3 billion tonnes of carbon per year into the deeper ocean, and that is an implicit requirement for an additional increase in the carbon capacity of the mixed surface layer. This increase should be 0.18 x 630 = 113.4 billion tonnes over one hundred and forty years and would average at slightly less than 1 billion tonnes/year. The current annual increase in atmospheric carbon dioxide is about 0.5%/year [7] so the mixed surface layer should also need to increase by 3 billion tonnes/year giving a total of 6 billion tonnes/year which is greater than the estimated 4 billion tonnes of carbon/year being absorbed by the sea. There are at least two methods which might be used to resolve this discrepancy.

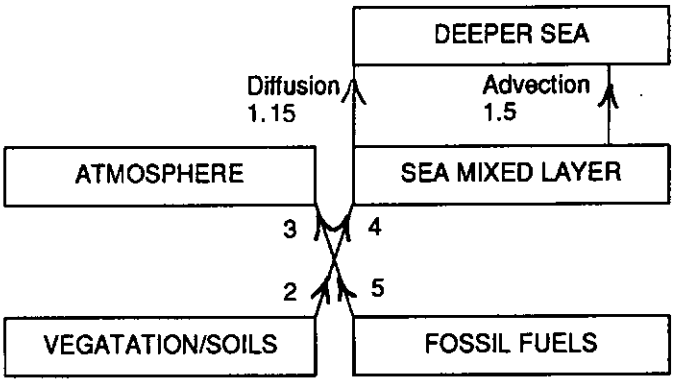

Figure 3 Carbon Reservoir Net Fluxes - Current Values for Scenario B1 (in billion tonnes/year)

The first method relies on the phenomena of phytoplankton which are mainly responsible for a large decrease in the dissolved inorganic carbon content in the mixed surface layer [3,7]. If sea water of typical deep-water composition was brought to the surface and warmed to the surface temperature then there would be a more than three-fold increase in the carbon dioxide vapour pressure [3]. Hence the death of phytoplankton would have a very large effect on the atmospheric carbon dioxide (and of course the sea food chain) content because the sea would then release a large amount of carbon dioxide into the atmosphere until it had reached a value around 1200 ppm (currently around 350 ppm). Assuming that the phytoplankton distribution is the same today as it was in 1850 and that the effect of increasing the carbon dioxide in the atmosphere has been to alter the concentration gradient from the deeper water to the surface, then this proposed triangular-like effect would cause the average concentration in the mixed surface layer to increase by only half of the surface value itself. However this would also halve the increase in the amount of carbon being advected to the depths of the oceans. Hence by halving both the capacitative effect in the surface layer, halving the amount being advected to the deep sea and balancing the remaining carbon flux by diffusion gives the situation depicted in Figure 3 (Scenario B1). Under this scenario the current burning of fossil fuels must be reduced to 53% of its current value and net deforestation no longer continued if there is to be no further increase of carbon dioxide in the atmosphere.

A second possible explanation is demonstrated by considering the latitudinal variation in the carbon dioxide transfer from air to sea. In the tropics, sea water loses carbon to the atmosphere because of the higher water temperature and therefore higher sea water carbon dioxide vapour pressure in that region [10]. If equilibrium existed in 1850, then at that time the amount of carbon transfer in the tropics must have been balanced by the absorption occurring in the colder regions. Today there is no longer a balance and carbon builds up in the sea. Suppose currently the balance point occurs after 2/3 of the transfer area has been in action. Then changes in the carbon concentration level with time might be considered to affect mainly the remaining 1/3 of the mixed surface layer. Also once again the process may be mainly triangular or lop-sided in character with the 0.5%/year increase occurring at the point of advection but with little effect at the balance point. Then a flux value of 0.5 billion tonnes/year (i.e. 0.5 x 3 x 1/3) might be sufficient to meet the carbon capacity requirements of the mixed surface layer and for the remaining 3.5 billion tonnes/year to be the amount removed to deep water. The fact that the latter value is greater than the 3 billion tonnes/year calculated earlier can be explained by the previous value being based on the average surface mixed layer concentration rather than higher value at the point of advection. Figure 4 denotes this proposal (Scenario B2).

There is a means of checking whether such a proposal is reasonable. Consider the mixing in the sea to consist of simple plug flow. Then in an idealised model (average depth 4 km), a period of 2000 years at the designated rate of 4 m/year over 50% of the area would be required to reach 100% mixing. The addition of 2000 x 3.5 = 7000 billion tonnes to the existing total carbon in the sea of 36,000 billion tonnes (see Table 1) would give a value of 43,00 billion tonnes and from Table 2 in the previous paper [1], this value would correspond to an atmospheric equilibrium value of 720 ppm which is very slightly lower than the current value. Since in Scenario B the difference between the equilibrium value and the actual value is expected to be small, the result of this check is an indication that Scenario B2 is credible.

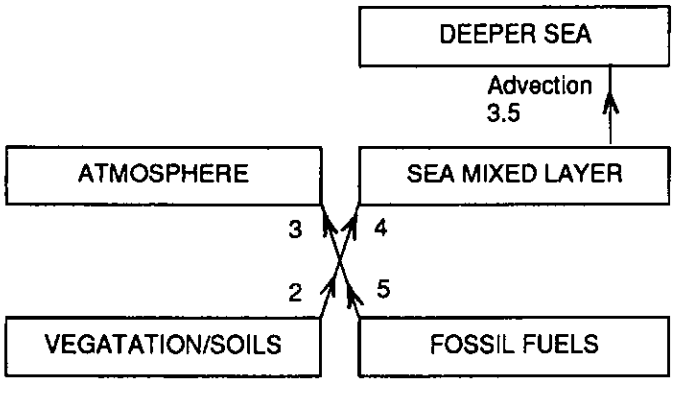

Figure 4 Carbon Reservoir Net Fluxes - Current Values for Scenario B2 (in billion tonnes/year)

Discussion

It is difficult to make meaningful incremental carbon concentration measurements in the sea [10]. Also there is no available information on the variation of carbon concentrations in the sea for as long ago as say 1850. Without such information it is difficult to check any of the mathematical models that have been devised. The potential difference scenario presented in the previous paper [1] should be valid if it was applied to the interaction between the atmosphere and the mixed surface layer. However there is no information on the concentration of carbon in the mixed surface layer in 1850 and hence there is no data base on which to build such a model.

Crude models have been presented here to give an indication of what in fact might be happening. There is still a long way to go in modelling and the current models do not account for all the carbon dioxide being evolved. It is not certain whether this is due to the quality of the models or because there are carbon sinks which are not being included in the models [3,4,10]. Knowledge on the circulation of the ocean is growing rapidly through the use of many tracers. It is perhaps ironic that radioactive tritium produced by atmospheric nuclear testing and chlorofluorocarbons are important as transient tracers. However the information acquired to date has not been sufficient to provide an adequate picture for the needs of the more sophisticated models [3]. The difficulties are not surprising when the complexity of the problem is considered - with the occurrence of evaporation, organic and inorganic interactions, temperature changes, seasonal changes, buffering, detritus fallout, mixing etc.

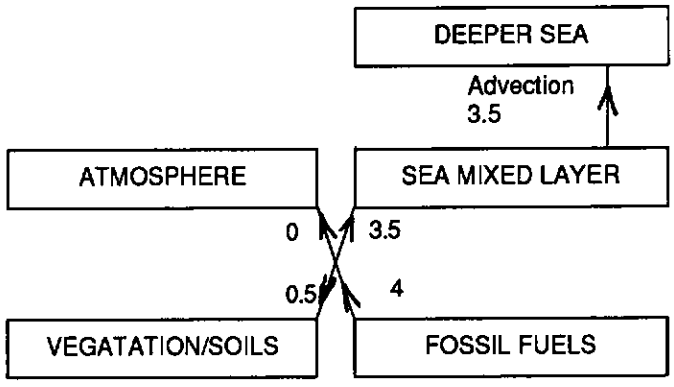

Figure 5 Carbon Reservoir Net Fluxes - Reduced Values with Reforestation for Scenario B2 (in billion tonnes/year)

From the crude models presented here, a pessimistic view would be that the man-made carbon dioxide evolution rate would need to be lowered to 20% of its current level (i.e. 1.5 billion tonnes/year of carbon (Scenario A) = 30% of fossil fuel combustion) for the carbon dioxide level in the atmosphere to stabilise. The optimistic view would be that the man-made carbon dioxide evolution rate would need to be lowered to 50% of its current level (i.e. 3.5 billion tonnes/year of carbon (Scenario B2) = 70% of fossil fuel combustion). If the movement of carbon from the mixed surface to the deeper ocean is mainly governed by diffusion-like behaviour with the carbon flux being driven by a concentration gradient then the former will apply. If the movement of carbon from the mixed surface to the deeper ocean is mainly governed by circulation-like behaviour with the carbon flux depending on the rate of deep-water formation and the concentration increment for carbon in the mixed surface layer, then the latter will hold.

To date the possibility of reforestation has not been included in these considerations. A net rate of reforestation which absorbs 0.5 billion tonnes/year (i.e. about a quarter of the current rate of deforestation) would seem a very reasonable aim. Marland [211] looked at reforestation rates that were ten-times this level. By combining such a reforestation rate with the most optimistic scenario above (see Figure 5) would give the 80% of current rate of fossil fuel combustion that was proposed as a viable strategy in Part 1 [1]. On the basis of the evidence presented here, such a strategy would be the minimum amount of reduction that might be justifiable.

Part 1 [1] also looked at the possibility of absorbing carbon dioxide directly into the sea. Such a policy would only be viable if the sea water was in a down-welling location as discussed by Marchetti [12] and others [13]. Marland [11] believes that "none of the proposals offered to date are sufficiently attractive to seriously contemplate implementation." Possible approaches to the "greenhouse effect" as outlined in Part 1 [1] are not new. What is new is that political action because of the "greenhouse' effect is now about to be taken or is likely to be taken in the near future. As a result of this action there should be an entirely new attitude towards the availability and use of fossil fuel energy resources.

Conclusions

(1) If the accumulation of carbon dioxide in the atmosphere is to cease, then man-made carbon dioxide emissions (i.e. from fossil fuels and deforestation) will need to be reduced from its current value of 7 billion tonnes of carbon/year to below 4 billion tonnes/year.

(2) The extent of the required reduction below 4 billion tonnes of carbon/year is less certain. Optimistically it may be only 0.5 billion tonnes of carbon/year (i.e. to 3.5 billion tonnes/year). Pessimistically it may be as much as 2.5 billion tonnes of carbon/year (i.e. to 1.5 billion tonnes/year).

(3) If the circulation of the oceans is the major means of moving the carbon from the mixed surface layer to the deep ocean then the optimistic value sould be nearest to reality. It is hoped that future research into ocean circulatory patterns combined with better modelling of the atmosphere-ocean interaction will resolve this matter.

(4) There is a fossil fuel usage rate which will not cause a further significant increase in the "greenhouse" effect. The problem is to determine that rate and then satisfactorily provide a strategy which will produce world compliance.

(5) Optimistically, with net reforestation, it should be necessary to only reduce the fossil fuel combustion rate to a level of 4 billion tonnes of carbon/year and still not cause an increase in the concentration of atmospheric carbon dioxide.

(6) WHAT A GREAT AND MIGHTY CARBON RESERVOIR ARE OUR OCEANS!

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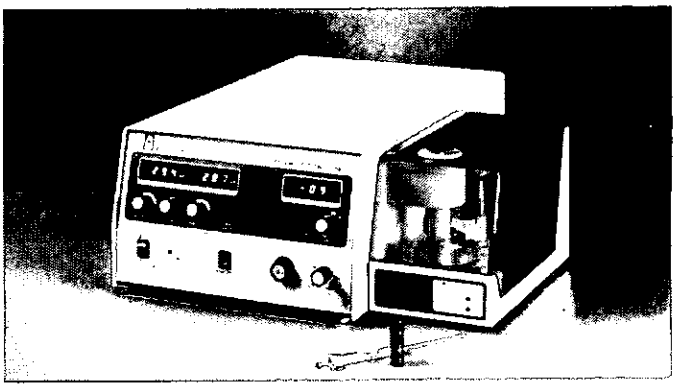
PRODUCT NEWS



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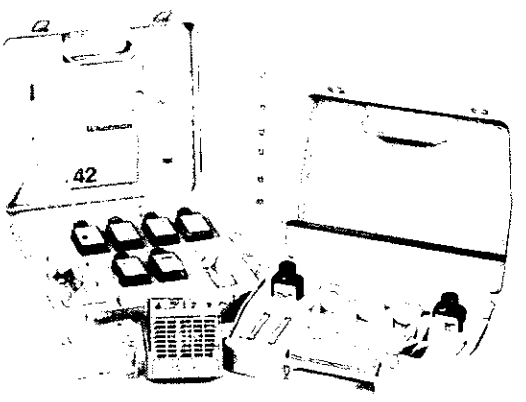

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The AT20 is the only mass produced, fully electronic analytical balance on the market with 2ug resolution and a weighing range of 22g. In design and operation it corresponds to the other At models and In addition has a flexible inner micro draft shield which plays an important role in ensuring rapid and stable weighing results.

The AT20 is used in all cases where comparatively heavy tare vessels are employed and extremely exacting demands are made on the readability. Appropriate applications are found, for instance, in CHN analysis with absorption tubes (tare weight of the tubes > 10g), in liquid chromatography, where the samples are weighed directly into the vessel with a tare weight of around 10g, in ecological analysis with soil samples of a few 100 mg in platinum boats of up to 9g tare weight, or in microtitration in which samples of a few mg up to 2 g are weighed into 2.5 and 10ml volumetric flasks with a tare weight up to 10g.

Operation of the METTLER AT20 is identical to that of the other balances of the AT series. The weighing result is shown directly on the clear LCD. The automatic draft shield simplifies, and at the same time accelerates the weighing-in. This reduces the number of operating steps from the usual nine to just five and increases both the weighing rate and the quality of the weighings.

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Fiske Associates have recently released the latest addition to their family of freezing point osmometers for the determination of osmolality. The new model 2400 is a completely automatic osmometer able to accomodate between one and twenty four samples. It features stat and batch capabilities for a 15 ul sample size, microprocessor - controlled calibration and a dry refrigeration bath.

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COOLED INCUBATORS

Sanyo has introduced a series of cooled incubators, MIR 152/252/552. Incorporating a 8-bit microcomputer, these incubators, with a wide temperature range of -10 to 50 degC, control the heater and compressor within a precise +/-0.2 deg and +/-1 deg range respectively.

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Because SANYO Cooled Incubators are microcomputer controlled, optimim automatic operation is possible, resulting in a high energy savings. The incubators have an automatic setting temperature alarm and an independant over temperature protection device which protects experimentation materials in the rare event that a temperature abnormality does occur. Remote controlled alarm contact is provided for monitoring alarm from a remote location.

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HPLC CARBAMATE SYSTEM FOR AUTOMATED DETECTION OF PESTICIDE RESIDUES

System exceeds detection requirements for EPA method 531.1

A fully automated, PC-based HPLC systems for detection of N-methylcarbamate pesticides, some of the most widely used agricultural insecticides, was displayed by Varian Associates, inc, at the 1990 Pittsburgh Conference.

The complete hardware/software system has been developed specifically for busy, production-oriented environmental and food quality laboratories where productivity and sample throughput are critical. It automatically performs and documents the analyses detailed in EPA Method 531.1.

Over the next several years, the EPA is expected to require that Method 531.1 be performed more regularly in determining the presence of carbamate residues,such as Aldicarb, in food and water. This analysis is especially important in rural agricultural areas and other places where water supply and soil can be affected by carbamate runoff.

Since carbamates are somewhat polar as well as thermally unstable, analysis by more traditional and more sensitive gas chromatographic methods commonly used for pesticides is difficult, as samples are often destroyed. Consequently, the EPA has established Method 531.1, and HPLC routine using fluorescent detection for enhanced sensitivity as the method of choice for carbamate analysis.

By including its Fluorichrom II Fluorescence Detector for high sensitivity, Varian's new Carbamate System is designed to handle analysis of the ten carbamates of highest environmental concern as listed in EPA Method 531.1.

The system combines the latest in HPPC instrumentation with one of the most respected names in post column reaction systems (PCRS), the Pickering PCRS. The combination of Varian's LC Star system, with its single point control of pump, autosampler, and data system and the Pickerng PCRS gives environmental laboratories a carbamate system that can run many samples in unattended operation and document findings automatically.

Varian's LC Star System includes the PC-based Star Workstation with Mircosoft Windows software and a range of intelligent, standalone pump and autosampler modules.

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THE UNIVERSITY OF AUCKLAND

Review of the Department of Chemistry

Late in 1990, the University of Auckland initiated a review process for three Departments including the Department of Chemistry.

The terms of reference are:-

(a) to examine the activities of the Department of Chemistry in meeting its commitments to the academic study of Chemistry, to the University and to the community at large;

(b) to examine the structure, composition and level of the undergraduate programme and graduate programmes in Chemistry and to evaluate these in comparison with programmes in other institutions in New Zealand and overseas;

(c) to examine the quality of teaching and research in Chemistry;

(d) to examine the appropriateness of the present organizational structures and availability of resources in Chemistry at the University of Auckland.

The Review Committee, chaired by Professor Roy Sharp, welcomes sumbissions from organisations or individuals who have had professional contact with the Department.

Submissions should be forwarded no later than 1 June 1991 to
Mr Richard Bolley, Senior Administrative Assistant, Academic Registry, University of Auckland, Private Bag, Auckland, Telephone 737-999; Fax 732-878
to whom any enquiries may also be directed.

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