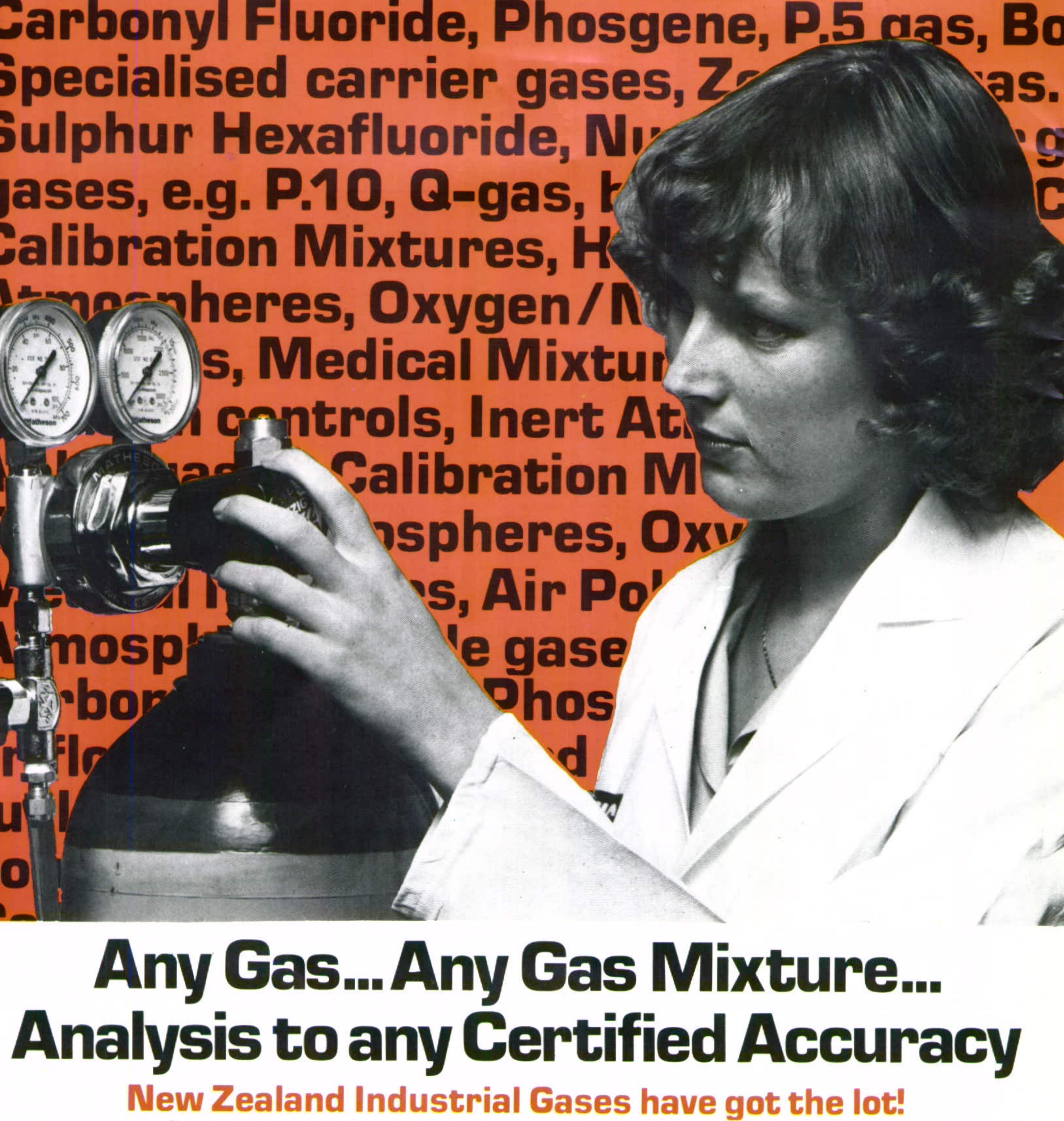
February 1980 Vol. 44 No. 1

Chemistry in new zealand

Official Journal of the New Zealand Institute of
Chemistry, P.O. Box 1926, Christchurch.

INSIDE: POLLUTION — THE BATTLE CONTINUES



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Apparatus for Karl Fischer water determinations

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General

Nowadays, Karl Fischer's iodometric titration is generally used for determining the water content of solid, liquid or gaseous substances.

The titrating reagent consists of iodine, sulphur dioxide, pyridine and methyl alcohol, and reaction may be expressed in highly simplified form as follows

$$I_2 + SO_2 + 2\,H_2O \xrightarrow{C_5H_5N,\ CH_3OH} 2\,HI + H_2SO_4$$

Electrical end-point determination («dead-stop» [biamperometric] method) gives incomparably more accurate and reliable results than the visual end-point indication originally used (coloured indicators, sometimes in already coloured solutions), and has largely contributed to the almost universal degree of popularity enjoyed by the Karl Fischer method today. It is now used all over the world as a standard method for water determination, and has been adopted as such in international standards and the national standards of many countries (c.f. American ASTM Standards, German DIN Standards, the European Pharmacopeia, and the national pharmacopeiae of several countries [Switzerland, Germany, etc.] etc.).

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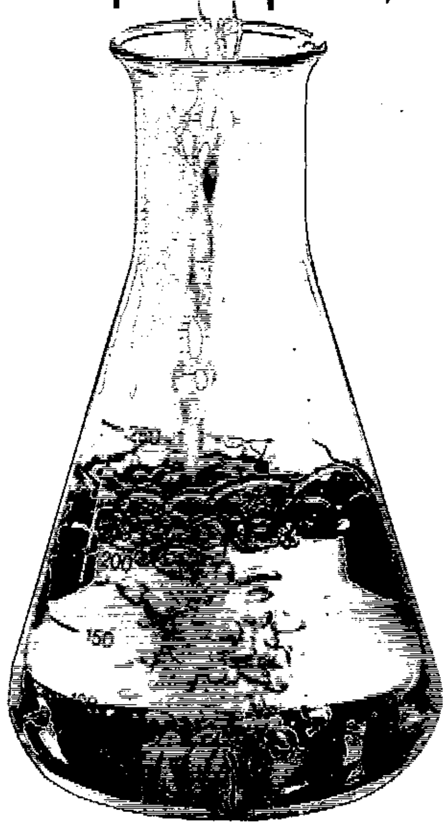

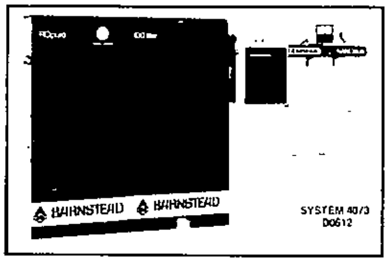
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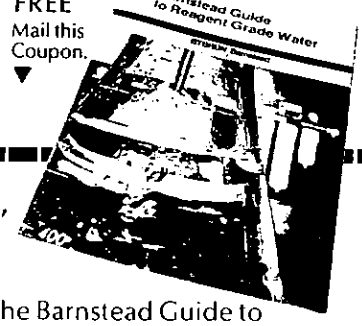
Barnstead Guide to Reagent Grade Water

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February 1980,
Vol. 44 No. 1

ISSN 0110-5566

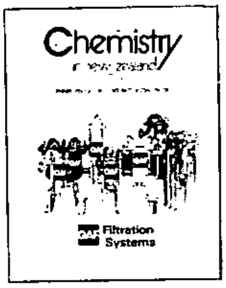
Published on behalf of the New Zealand Institute of Chemistry (Inc.), P.O. Box 1926, Christchurch.

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

A New Zealand registered publication

CONTENTS

Cover: The savings in time, labour and software replacement costs achievable with Gaflo pressure vessel filtration systems have been quickly recognised by many industries. Reporting improvements in cost effectiveness of up to 70%, major users include chemical, pharmaceutical, paint and resin manufacturers all sharing a common aim of removing contaminants to ensure quality of finished product.



STOP PRESS

The seminar on solar UV radiation, sponsored by the Meteorological Service and CIBA-Geigy NZ Ltd, will now be held in Wellington on March 26-27.

KEEP IN TOUCH!

If you're changing your address or your job PLEASE LET US KNOW — in advance, if possible — to ensure your uninterrupted receipt of "Chemistry in New Zealand". Simply complete the coupon below and mail to:

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IMPORTANT ANNOUNCEMENT

At its November 1979 meeting the Institute Council reluctantly decided to raise the subscriptions for the year April 1, 1980 to March 31, 1981. This is the first subscription increase since 1976.

Fellows/Members	$27.00	reducible to $25.00 if paid before Aug 31
Associates	20.00	reducible to 18.00 if paid before Aug 31
Graduate/Technician	10.00	reducible to 8.00 if paid before Aug 31
Local	12.00	reducible to 10.00 if paid before Aug 31

The Council reviewed the statements of income and expenditure over recent years and discussed likely expenditure in the coming year. Over recent years a surplus of income over expenditure of approximately $2 per head has been maintained and it was felt that this policy should be continued. In addition to these subscriptions, subscribers will be asked to pay additional local Branch subscriptions. Efforts are being made to contain costs and yet give service at a reasonably active level. More actively generates more cost, and so it follows that the Institute is only as active as the resources (financial and human) allow.

At the same meeting Council decided to increase the annual Branch grants to $250.

In our next issue....

Despite NZ's industrial development, our nation's economy still relies greatly on agriculture. Our April issue will examine the role of Agricultural Chemicals and their impact.

MEMBERSHIP OF THE NEW ZEALAND INSTITUTE OF CHEMISTRY

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

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

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Guest Editorial

Bright Future For Chemists

Recent announcements in the energy field herald interesting and, in fact, exciting times for members of the Institute.

The increasing production of liquid petroleum gas and compressed natural gas, the manufacture of methanol and its conversion to transport fuel and the possible production of ethanol or biogas by fermentation must provide sufficient scope to tax the expertise and inventiveness of chemists, chemical engineers and biochemists. In the past, apart from a few exceptions, our chemical industry has been relatively small and this boost to our industry will be particularly important for NZ. Unfortunately not everyone will see this development as a progressive step. Many look at the massive industrial complexes overseas belching forth fumes and the news media highlight every accident which occurs. Is it any wonder that many citizens consider it would be a retrograde step to allow our resources to be developed if this is to be the result? But if we are not to slide further into the list of underdeveloped countries we must progress. There can be no standing still; either we stop our procrastination and get on with the job of developing our potential resources or we must be prepared to accept a lowering of our living standards. And this of course would mean stagnation in the scientific field and possible loss of our better scientists.

I am well aware that in many countries pollution is almost synonomous with industry but it is in this area of pollution control and pollution monitoring that we as chemists can play an important role. It is up to us to ensure that reasonable standards are set, that plants are designed to meet these standards, and that these standards are maintained. Gone are the days when any unwanted industrial byproduct is blown into the air or poured down the nearest natural water course. With new industries we can set new standards and I think most will agree that this policy has been very successfully implemented at our aluminium smelter. Let us ensure that this approach is used in our new industries.

The spate of industrial chemical accidents overseas in recent years and particularly in the past few months highlights the fact that with industry comes a potential for accidents. No matter what rules and regulations we have, no matter now careful we are, accidents can happen. Through a careful policy of education we can reduce the number of accidents and we can minimise the resultant effect of accidents but we cannot say there will never be an accident. Again we, as chemists, are in a position of responsibility — we must ensure that the community is protected. Of course, our industry will always be comparatively small when compared with the industrial nations and the potential for accidents will be minor. I am sure the accident rate will be trivial when compared with the death toll on our roads.

The future for the chemist in NZ looks very bright. Let us get behind these developments and give them the benefit of our resourcefulness but let us ensure that we are successful in the eyes of the public as well as in our own.

Arthur Campbell
President, NZIC.

Comment

1979 — The Year That Was

A year ago, I awaited with keen interest — and, to be honest, a certain amount of trepidation — the first issue of "Chemistry in New Zealand" to be published under the Tricom banner. Its production had been fraught with a number of unusual problems and, like our readers, I was keenly interested in the result — and, more importantly, its reception.

Today, 12 months later, the problems continue to present themselves for solution — a common fact of life in any publishing operation — but the journal's reception and acceptance has been all that we, as publishers, could have wished.

Despite the layman's perennial language hurdle — a year ago I could have imagined "enzyme ornithine carbamoyltransferase" being the description of one of those less pleasant human ailments whose cure appears regularly on our TV screens — I believe I'm beginning to gain a glimmer of understanding of the chemist's vocabulary. In any case, I can always rely on Stan Brooker for an erudite explanation!

In more serious vein, I believe (and I hope you will, too) that significant progress has been achieved.

In 1980, further advancement is planned, including the preparation of what I hope will be a significant contribution to the NZIC's Golden Jubilee — a special commemorative issue to be published as the February, 1981, edition.

Thank you for your continuing support.

Peter Reaves
Managing Editor

What's Happening

Chemical Processes In NZ, produced by the Auckland Branch goes further afield; enquiries have now been received from Paris. Copies are still available from the NZIC Auckland Branch, Box 5139, Wellesley St, Auckland at $11 plus $1 for postage and packing. There is a discount of $1 to NZIC members. Our advice is: Get in quickly before all the copies go abroad!

Visitors 1980: Prof. Emanuel Vogel, Institute of Organic Chemistry, University of Cologne, will be in N.Z. March 9-22, starting in Auckland and finishing in Dunedin. Contact local Branch Secretaries for further information.

Dr B. F. G. Johnson, University of Cambridge, will be attending the COMO Conference in NZ, and will be an official NZIC visitor for 1980.

1981 Jubilee Celebrations. There will be a special issue of "Chemistry In New Zealand" in February, 1981 to commemorate the 50th Anniversary of the Institute's establishment in February 1931. Order your copy in advance to avoid disappointment! Branches should consult with **Jim Ellis,** First Vice-President, (Head Office, DSIR, Wellington), who is full of reactions with explosive violence that they can use to make the celebrations effective in their areas.

November Council Briefs

Conference 1982 will be in Dunedin.

Membership — Comment is invited on a **Student** grade of member.

Publications — A new edition of "Careers in Chemistry" is in the pipeline.

The "History of Chemistry in NZ" to be published in 1981 as part of the Golden Jubilee Celebrations will now come out as a series of small booklets. A film is also to be produced on the impact of chemistry on agriculture in NZ. Branches are to be asked to form Golden Jubilee Committees to promote local events as part of the celebrations.

New Journal: A new journal entitled "Environmental Technology Letters" began publication in January. It will be a monthly publication for the rapid communication of papers in the field of applied environmental studies, including sanitary and environmental engineering, atmospheric and water chemistry, air and water pollution control and associated technologies. Accepted contributions will be published within 2 months. Further information regarding paper format or subscription rates is available from **Dr F. Wilson,** Civil Engineering Department, University of Canterbury, Private Bag, Christchurch 1.

Corrosion Conference: The Australasian Corrosion Association has been invited to present a paper entitled "Atmospheric Corrosion Testing in Australasia" at a conference on Atmospheric Corrosion organised by the USA Electrochemical Society, at Hollywood, Florida, October 5-10, 1980.

Fourteen countries have been invited to contribute papers describing their corrosion environments and test locations, and papers will include accounts of unusual atmospheres such as geothermal regions, high rainfall tropics and sub-Antartica. The papers are to be printed as a monograph to be published by the Electrochemical Society (John Wiley & Sons) in 1981.

Dr D. J. Spedding, Chemistry Department, University of Auckland, (Private Bag, Auckland) has been appointed as the NZ co-ordinator for collection and collation of data relevant to this country's contribution to the Australasian joint paper. Any NZ scientists interested in contributing information should write directly to Dr Spedding.

Electrochemistry Conference: A past Editor of "Chemistry in New Zealand", **Hugh Parton,** will present a paper on Solution Electrochemistry to the 5th Australian Electrochemistry Conference, to be held at the University of Western Australia, Perth, August 18-22. He is one of 20 speakers so far listed.

Organised by the Electrochemistry Division, RACI, and sponsored by the Australian Academy of Science, the conference theme "Progress with Electrochemistry" is intended to emphasise modern developments in electrochemical science and technology with particular emphasis on energy conversion and storage, mineral chemistry and extractive metallurgy, electrochemical engineering, industrial electrolysis, metal conservation, solution electrochemistry and electroanalytical chemistry.

A feature of the meeting will be the second award of the Bloom-Gutmann Prize for young authors. Candidates, who must be aged 30 or less on December 31, 1980, will be judged on the content and delivery of their papers presented at the Conference. The prize is valued at $100.

Nominations must be in writing and include the name, address and date of birth of the candidate, the title of the paper and an abstract of 200-300 words. In the case of joint authorship of a paper, the nomination must be accompanied by a statement of the extent of each author's contribution.

The result will be announced during the Conference and published in "Chemistry in Australia". The winning paper will be included in the published Conference proceedings. The Electrochemistry Division reserves the right to withhold an award if there is no contribution of sufficient standard.

Nominations should reach the Conference Secretary, **Associate Prof I. M. Ritchie,** Department of Physical and Inorganic Chemistry, University of Western Australia, Nedlands, W.A., 6009, by March 31, 1980.

Industrial Chemistry Prize: Applications or nominations for this prize, which recognises meritorious achievement in the field of industrial chemistry and which is sponsored by ICI Tasman Vaccine Ltd, are now being invited.

Valued at $200 and restricted to financial members of the NZIC of any membership grade, it can be awarded to an individual or shared between 2 or more members.

Applications should include a written statement of the industrial chemistry activities or achievements of the candidate, and their significance in terms of improved technology, new products, or other benefits to industry or the community. Supporting documents and publications may be submitted with the application and will be held to be confidential to the assessors. If possible the value of the work should be attested by an accompanying statement from the manager, or directors, or head of the organisation. There is no limit on the period of time over which the work was carried out.

Applications for the prize may be made by individual members, or nominations may be made by Branch Committees or by corporate members of the Institute.

Two or three assessors will be appointed by the NZIC Council to consider the applications and make recommendations. The final decision on the award will be made by the Council. Council reserves the right to make no award in the absence of a suitable candidate.

Applications or nominations must be submitted to the Administrative Secretary, NZIC, Box 1926, Christchurch, before April 30.

The prize is being serviced by the NZIC's Industrial Chemistry Specialist Group.

Recent recipients of the prize have been **Dr R. Garland,** NZ Pharmaceuticals Ltd., Palmerston North (1978) and **M. B. Rands,** AFFCO Ltd., Auckland (1979).

Chemical Education Centre: A proposal to establish an international centre for chemical education advanced a stage further late last year when planning meeting was held in Spain. Likely location for such a centre is thought to be Jugoslavia.

Reporting this development to the November Council meeting, **Dr G. R. Burns,** NZIC representative to the National Commission for UNESCO, noted it was one of 3 international activities during the year worth mentioning. The others were an inaugural meeting to form a Federation of Asian Chemical Societies, held in Bangkok, and an international conference on chemical education in Dublin, which he attended. Its theme was "The teaching of chemistry — interaction between secondary and tertiary levels." Dr Burns and **Terry Hitchings,** one of the plenary lecturers, are preparing a report for publication in "Chemistry in New Zealand".

Conference News

Organisation of the 1980 NZIC Conference, to be held at Massey University, Palmerston North, on August 18-22 is progressing well under the chairmanship of **Dr Roger D. Reeves.** The Conference will be a joint meeting with the NZ Biochemical Society. Presentation of research papers (30 mins. for each) in the specialist sessions will start on the afternoon of Monday, August 18, with the formal opening of the following day. Symposia in the areas of chemical instrumentation, chemical ecology and the biochemistry and physiology of plants are being organised. There will also be an opportunity for poster presentations. A number of interesting overseas speakers, including some who will be attending the Australian Spectroscopy Conference gave been invited to present plenary lectures. Circulars containing further information will be sent to members of the Institute early this year. In the meantime enquiries should be sent to **Dr M. J. Hardman,** Dept. of Chemistry, Biochemistry and Biophysics, Massey University, P.B., Palmerston North.

The Committee is as follows: Chairman, Dr Reeves, Massey; Secretary, Dr Hardman, Massey; Treasurer, C. R. Southward, DRI: Programme, Dr E. W. Ainscough, Massey; Social, Dr P. F. Reay, Applied Biochemistry, DSIR; Dr C. B. Johnson, DSIR: Printing/Publications, Dr G. G. Midwinter, Massey; Trade Display, V. J. Chettleburgh, Asst. Registrar (Equipment) Massey; NZ Biochemical Society representative, Dr M. J. Boland, DSIR.

The Conference will be officially opened on the morning of Tuesday, August 19 and will conclude about noon on Friday, August 22.

Rather than attempting to build the Conference around a single theme, the Committee has chosen to give special emphasis to three rather diverse themes on the three full days of the Conference, with a visiting overseas speaker to deliver a plenary lecture on each theme. The themes and speakers will be Plant Biochemistry **(Prof. E.E. Conn,** Department of Biochemistry and Biophysics, University of California, Davis), Chemical Ecology **(Dr J. Edgar,** Division of Animal Health, CSIRO, Melbourne), and Chemical Instrumentation **(Dr L. de Galan,** Technical University, Delft, Netherlands).

In addition there will be the traditional specialist sessions incorporating review lectures, current research papers and student papers. Time has been set aside for the AGM's of the NZIC, NZBS and specialist groups.

Social functions will include a buffet dinner, a theatre evening and the conference dinner. There will also be ample opportunity for socialising of a more informal nature.

Chromatography Seminars: Next month, Warburton Franki Ltd., NZ representatives of the Perkin-Elmer Corporation, will hold a series of seminars in Auckland, Wellington and Christchurch on the theme of "Expanding the world of analytical chemistry."

Guest speaker at each event will be **Dr G Blackman,** Victorian College of Pharmacy, Australia, supported at the Auckland meeting by **Max Amos,** managing director, and **Tim Vine,** chromatography specialist, Perkin-Elmer.

Meeting dates are: Auckland, March 3-4 (Auckland University Club): Wellington, March 6-7; Christchurch, March 11-12. All seminars are timed to begin at 9 a.m. and finish at 5 p.m. Venues of the southern meetings are to be advised.

One day of each seminar will be devoted to gas chromatography, the other to liquid chromatogarphy. Lunch will be provided and no charge will be made. However, the organisers ask intending participants to advise Warburton Franki at their respective offices as soon as possible.

The seminars will discuss the latest developments in micro-computer technology and its use in relation to present equipment.

Emphasis in the gas chromatography seminar will be on sample preparation and injection, clinical applications, drug analysis and headspace techniques. Data processing for GC will be discussed and demonstrated.

The liquid chromatography sessions will cover basic principles and practice and method development. Lectures will be given on clinical applications, gel permeation chromatography and fluorescence detectors with demonstrations.

Conference: The 12th Australian Spectroscopy Conference will be held at the University of NSW, Sydney, August 25-29, 1980. Held biennially, the conference aims to bring together scientists and technologists whose interests range from basic chemical and physical research to industrial, biological and environmental problems. Within this wide area, it is planned that the conference will concentrate on four major themes, as follows:

The Role of Spectroscopy in

- Studying the structure of molecules and materials.
- Biological, environmental and industrial processes
- Exploring fundamental physical and chemical phenomena
- Developing experimental techniques and instrumentation

These themes will be pursued by means of plenary lecturers, contributed papers and an exhibition of commercially available instruments.

A number of prominent overseas scientists have already accepted invitations to attend and deliver plenary lectures at the Conference. In particular, the Frew Lecture will be presented by **Prof. Boris P. Stoicheff,** Toronto University, Canada.

The conference is beding organised by a local committee, chaired by **Prof. R.M. Golding,** Pro-Vice-Chancellor, University of NSW. Enquiries should be addressed to: Associate **Prof. B.J. Orr,** Organising Secretary, 12th Australian Spectroscopy Conference, School of Chemistry, University of NSW, Box 1 Kensington, NSW, Australia 2033.

Problem: Pictured is **Godfrey Husheer,**the alchemist of Napier, in a modest pose with his assistant, **Barry Streeter,** before some of the all-glass apparatus in which he distils hydrochloric and nitric acids, at the premises of his company, Scientific Services, Onekawa, Napier. Godfrey feels somewhat isolated, but he is a regular attender at NZIC conferences. His problem is that he has been making HCl by heating together sulphuric acid and salt in 200-l. glass flasks heated with coal gas for years without any problem, but since the Napier supply changed over to naphtha gas, which has the same calorific value, he has lost 3 flasks in a row. Can someone tell him why?

Organic Meeting: The RACI's Organic Division will hold its 6th National Organic Meeting in Melbourne in August. Details are available from **Prof. D. Cameron,** Dept. of Organic Chemistry, University of Melbourne, Parkville, Victoria 3052.

Confrontation Eased: Both the Americans and Russians claim priority for a new man-made element 104 and have claimed the right to name it. However the IUPAC Commission on Inorganic Nomenclature, in a Solomon-like judgment, has proposed a systematic name Unnilquadium (Un =1, nil =0, quad =4). However this solution may have its disadvantages; if we ever get to element 999, it will have the name Ennennennium. With such a lovely sounding epithet, a very short life would be expected!

BRANCH NEWS

Manawatu

The final (November) meeting for 1979 took the form of an afternoon visit to NZ Pharmaceuticals Ltd., at Linton near Palmerston North. **Dr Richard Garland** organised the tour of the factory and laboratory by the large group from the research laboratories, high schools and the University. This company is well known for its export of cholic and deoxycholic acids that it extracts from animal gall.

On February 19 a visit is planned to the Dairy Research Institute. **Dr Peter Robertson** will conduct a tour of the Institute's research laboratories and butter and cheese making Pilot Plant.

Towards the middle of this year an Energy Symposium will be organised, with the main emphasis on the production of synthetic petroleum.

Industrial

NZ Pharmaceuticals Ltd is now putting in new plant to expand its product range into bile salts and peptone products for culture media use. **Dr Richard Garland** has moved from being Chief Chemist to Technical Manager.

The Branch Committee is as follows:
Chairman: S. White
Secretary: M. W. Pritchard
Treasurer: Dr J. Shaw
Council Delegate: Dr L. Creamer
Branch Editor/1980
Conference Committee Co-ordinator: Dr C. Johnson
Taranaki Representative: Dr O. K. Sewell
Hawkes Bay Representative: E. C. Fletcher
Committee: M. A. Gerritsen, Drs G. Lane, V. Crow, D. A. D. Parry, R. S. Humphrey.

Wellington

A well-attended visit to NZ Breweries in Wellington completed the Branch programme for the year. Members and their wives were escorted around the plant after listening to a short talk on the principles of brewing. The refreshments provided afterwards "capped off" a most enjoyable occasion.

The 1979-80 Branch committee is:

Chairman and Council Delegate:	Dr. B. Halton
Secretary:	Dr. D.M. Bibby
Treasurer:	Ms. C. Caradus
Branch Editor:	Dr. H.J. Percival
Committee:	Drs J.P.B. Featherstone, G. Leary, G. Lyon, N. Milestone, S.I. Smedley, Messrs P. Best, J. Butchers, D. Howell, D. Rands

Otago

The Branch committee for the ensuing year is:
Chairman: Dr D. A. Forss
Secretary: Dr Barry Peake
Treasurer: Dr L. Phelan
Council Delegate: Dr P. Grant
Past President: Dr M. Shepherd
Branch Editor: S. G. Gray
Members: Drs D. Fenby, L. Melton, J. Weatherall, D. Brasch, Mr J. S. Billcliffe.

University News

Victoria

Recent visitors to the Chemistry Department who also provided seminars, have included **Dr David Bibby** (Chemistry Division, DSIR), **Dr John Martin** (Texas A and M University, USA) a former PhD student, and **Dr John Blunt** (Canterbury University).

Dr Jim Johnston has been promoted to Senior Lecturer and **Dr Peter Tyler** has left for postdoctoral work at Montreal University, Canada.

The Wellington Branch prizes for Chemistry have been awarded to **Miss Anne Stanley-Hunt** and **Mr John Thompson** (Joint award - 3rd year prize), and **Mr David Jacobson** (1st year prize). The second year prize has yet to be announced.

Otago

Chemistry Dept: Prof. T. Jacobs and **R. L. Scott** (UCLA) and **Drs W. Petri** and **L. N. Mander** (ANU) have been recent visitors. **Dr J. Sivaprasade** (Delhi University) has taken up an Otago University post-doctoral fellowship with **Dr P. K. Grant.**

Pharmacology Dept: Dr Richard Laverty has been appointed to the Chair of Pharmacology from May, 1980. He succeeds **Prof. F. N. Fastier,** who graduated in chemistry from Otago and joined the Dept. of Medicine in 1954 as a research assistant to **Sir Horace Smirk**. From 1961-1964 he was a Best Fellow at Cambridge. He joined the Dept. of Pharmacology as a senior lecturer in 1968 and was appointed Associate Prof. in 1974. Prof. Fastier joined the NZIC in 1965 and was elected a Fellow in 1977.

Prof. Laverty has published numerous papers dealing with the effects of drugs on the cardiovascular system and the central nervous system. He has been particularly interested in the function of catecholamines and in correlating their disposition with behaviour.

Dr Wayne Temple has completed his first year in the department, where he is employed as a scientific officer by the Otago Hospital Board. He is responsible for compiling a file for the National Hazardous Chemicals Information Centre. More than 4000 chemical substances are now listed with information on chemistry, handling, toxicity and treatment.

Dr Rosemary Beresford has been appointed editor, NZ Pharmaceutical Journal, from January. She will continue her work as scientific officer in the department.

Biochemistry Dept: Prof. Peterson has received grants from the Medical Research Committee of the Golden Kiwi Lottery Fund for a PDP-II computer and a grant from the Medical Research Council for a 5-year programme. Total value is over $200,000.

Pharmacy Department: Dr. R.H. McKeown has returned from a year's study leave. He was with **Prof. W.B. Whalley, L. Saunders** and **J.W. Fairbairn,** School of Pharmacy, University of London, for 7 months and then with **Regents Prof. T. Higuchi** and **Prof. L. Lindenbaum** and **H.J. Rytting** at the Pharmaceutical Chemistry Laboratories, University of Kansas, Lawrence, for 4 months.

International Chemical Society Under Study

Meeting in Washington DC late last year, the world's chemical society presidents set up a committee to study the possibility of forming an international chemical society. The committee's formation was described as the highlight of the 7th International Meeting of Chemical Society Presidents.

The formation decision was not reached without much discussion. Among those who questioned the need for a formal international chemical society was NZIC president, **Arthur Campbell.**

Nevertheless, he pointed out areas in which chemical societies can help developing countries. These include education at all levels, opportunities for continuing education, invitations to participate in symposia and workshops, aid in establishing appropriate industries and collective centres for instrumentation and research.

An essential factor in all these aid programmes, he said, is that developed countries help developing ones help themselves to raise their standard of living. "No one expects a handout nor wants a handout," he commented. "There is a genuine desire to earn a living."

Since chemical societies don't have sufficient financial resources for substantial aid-giving, he suggested working with the major funding bodies to make their contributions even more effective. "We can, surely, act as a catalyst to ensure that the best possible value is gained from their funding."

(This report extracted from "Chemical & Engineering News".)

New Branch Chairmen

Auckland

Ian Scoltock joined industry as a cadet at 17 and took on part time study which eventuated in Graduate of the Royal Institute of Chemistry being obtained at Kingston Polytechnic, Surrey. While studying for GRIC he was employed at Beechams UK in their toiletries R and D laboratories in London.

He moved to NZ in 1974 and joined the Meat Industry Research Institute in Hamilton. Wishing to return to industry he found his studies at Meat Research useful for his current position as laboratory supervisor at Abels Ltd,processors of fats and oils.

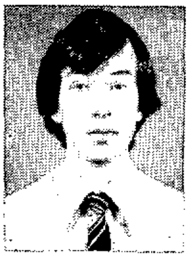
Ian is on the Council of the Auckland Astronomical Society based at the One Tree Hill Observatory and, when family commitments permit, likes to go "bush" for a weekend's tramping.

Manawatu

Stan White received his secondary education at West Christchurch High School (now Hagley College) and attended Canterbury College (now University of Canterbury) graduating BSc. in 1947. In 1948 he joined the technical staff of Davis Gelatine (NZ) Ltd at Woolston, Christchurch as Chemist in Charge of the Agar Department (a war-time initiated industry). Over a period of 13 years he contributed to the continuance of this small but significant export industry. During this period he gained the Diploma (now Certificate) in Industrial Administration.

Following 3 years as a science teacher at Christchurch Technical College and Linwood High School, Stan "migrated" north in 1964 to the Borthwicks Freezing Works at Feilding (near Palmerston North) as Works Chemist. He contributed to the development of a waste treatment system which moved the company from a position of impending litigation in the 60's to the receipt of the NZBC's "I care" Ecology Award in the 70's. Stan has many industrial interests, in particular the application of the work of the NZ Leather and Shoe Research Association and the Meat Industry Research Institute (NZ) to a works situation. He has supervised a number of student projects in conjunction with Massey University Biotechnology Department.

For about 30 years Stan has been an active branch member at Canterbury and Manawatu, has been a corporate member for 25 years, and has twice served on the Manawatu Branch committee. He was recently appointed regional liaison member for the Industrial Specialist Group. Other organisations in which he is a member include the NZ Institute of Food Science and Technology, the Manawatu Branch of the Royal Society, Manawatu Statistics Group and the NZ Organisation for Quality Assurance. Stan's "spare time" interests include swimming, church choir music, "old time" piano and pipe organ playing and dancing.


Scoltock


White


Halton


Swallow


Forss

Wellington

Brian Halton was born in Lancashire, England, and completed his secondary education at St. Joseph's Academy, Blackheath, London. He received his B.Sc. (Hons) in chemistry at Southampton University and Ph.D. in organic chemistry from the same institution in 1966. After a year of postdoctoral research at the University of Florida, he was appointed to the faculty as Assistant Professor. Brian left Florida to take up a lectureship in chemistry at Victoria University and began teaching in NZ at the beginning of the 1969 academic year. He now holds the position of Reader in the Chemistry Department. In 1972 he spent 6 months as Visiting Lecturer at the University of NSW and was on study leave with **Prof. Bryce-Smith** t the University of Reading during 1975.

Dr. Halton has authored and co-authored over 40 scientific papers, has been a contributor to the Specialist Periodical Report 'Alicyclic Chemistry' of the Chemical Society, and has co-authored a text on Organic Photochemistry with **Dr. Jim Coxon** of Canterbury University. His research interests lie in the sphere of unnatural products with particular emphasis on the chemistry of highly strained organic molecules. As a result of his search for a "cyclohexatriene" he was awarded the NZ Association of Scientists Research Medal in 1974.

He is a Fellow of the Institute and has been a member of the Wellington Branch Committee for the past 3 years, 2 of which were spent as Branch Editor and Council Delegate. He was also a contributor to the working party on Possible Contributions of the Institute to Society.

Apart from his teaching and research activities, Brian has developed an active interest in safety matters. He convenes the University's Laboratory Safety Committee and is the editor of the Victoria University Safety Handbook.

Canterbury

William Swallow graduated MSc from Canterbury University in 1969, worked for a year in the protein laboratory at Christchurch Hospital and then returned to University to complete a PhD in 1972. Since gaining his PhD he has worked in the Christchurch branch laboratory, Chemistry Division, DSIR, where he is presently a leader of the forensic and toxicology section.

Current chemical interests include analysis and identification of polycyclic aromatic hydrocarbons, the chemistry of tutin and related compounds, and the stability of reducing chemicals in blood.

Outside interests, besides his family, include bridge, cricket and gardening.

Otago

Dr David A. Forss has spent most of his professional life identifying chemicals responsible for food flavours. In 1967 he became Director of Flavour Research, International Flavours and Fragrances, New Jersey, USA, where he remained for 6 years.

Earlier he spent 20 years on flavour research at CSIRO Division on Dairy Research, interrupted by a year at the Dairy Science Dept., Pennsylvania State University, and a year at the US Army Natick Laboratories in Massachusetts.

He is presently involved with the analytical chemistry of animal nutrition at Invermay Research Centre, Mosgiel. He is a keen tennis player and runner.

Litre Honoured: We wonder how many of our readers know that the name of the unit of volume is derived from that of Frenchman **Claude Emile Jean-Baptiste Litre,** who lived from 1716 — 1788. In ;his early life he followed the family tradition of making glass wine bottles but at 35 independent means allowed him to devote himself to the manufacture of accurate cylinders of clear glass, including the invention and naming of the burette. He produced cylinders which did not vary by more than 1 part/1000 over their whole length. In 1765 he visited London to receive a specially struck gold medal from the Royal Society, and in return he presented the Society with a set of graduated vessels (which were subsequently broken by **Sir Humphery Davy** when he tried to make nitrogen trichloride in them.)

Litre's scientific work started with the production of a bottle of standard volume for wine, which simplified the taxation of it. This standard was fairly close to the standard litre, which the French adopted in Napoleonic times, and was officially recognised last year as an SI unit on the 200th anniversary of Litre's death. Another interesting fact of his career was that he was a great friend of the Swedish astronomer **Celsius** whose name has been given to the standard system of temperature units.

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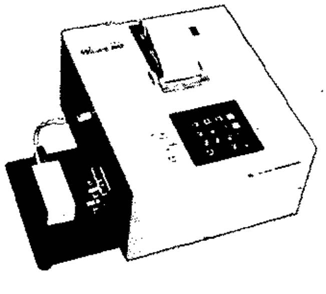

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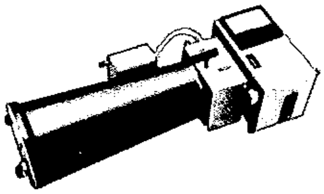

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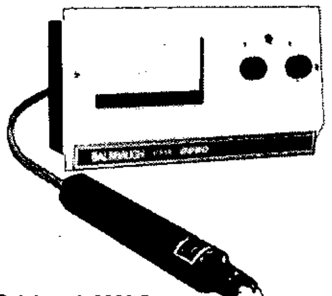

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Trends In Water And Wastewater Treatment

F. Wilson

This paper is intended to present a personal view of what the author feels to be some of the more important problems, innovations and ideas in the field of water and wastewater engineering.

Water Treatment

The connection between the water and wastewater engineering disciplines is illustrated in the efforts of a wit who has written above the toilets in the Oxford (UK) Union "please flush twice London needs the water". This interconnection is recently causing perhaps the biggest headache in the US water industry as it ponders the problems caused by the presence of halogenated organics in water supplies and their implications as carcinogens[1]. This situation had (prior to its recent upstaging by the petroleum fuels crisis) created a market, in Los Angeles, for "pure" water at 75c/gallon.

Paradoxically a contributory factor in the creation of this problem has been the stringency of the US effluent standards. Both the USA and NZ have adopted bacterial standards for effluent discharges. This has led to the use of chlorination as a tertiary (final) treatment process which in turn has tended to increase the incidence of haloforms in the receiving water. Chlorination is also used in the treatment of water supplies; however the humic acids which are thought to be precursors of the haloforms[2] usually exist in much greater concentrations in the wastewater effluent and are subjected to heavier chlorine doses. Multiple reuse of river waters is more common in USA compared with NZ and hence the problem is more urgent in the former country. However, this problem may become important here. As an example, the Auckland Regional Authority is looking at the Waikato river as a possible water supply source, the water to be drawn downstream of the Hamilton sewage works which chlorinates the effluent prior to discharge.

In USA removal of the contaminants has been proposed by the Environmental Protection Agency, initially for water supply undertakings serving more than 75,000 persons[3]. The method proposed uses filters of granular activated charcoal (GAC) with the intention of achieving less than 0.1 mg/L of total trihalomethanes in the water supply. The capital cost of this work, assuming moderate extension of the scheme, has been estimated as more than $US 5.4 billion with an additional annual revenue requirement of $1.2 billion[4].

Since the seemingly beneficial use of chlorination has, at least in part, proved to be a mixed blessing, the suggestion is now being made that the use of GAC will cause problems by encouraging bacterial growth on the filter media, thus increasing the concentration of endotoxins and pathogenic bacteria in the treated water.

Dr. Francis Wilson is Senior Lecturer in Civil Engineering at the University of Canterbury. Prior to this he lectured in Civil Engineering at Strathclyde University (UK). His speciality is Public Health Engineering and he is the author of several papers and two books on this subject. He holds a degree in Chemistry from Liverpool University (UK).

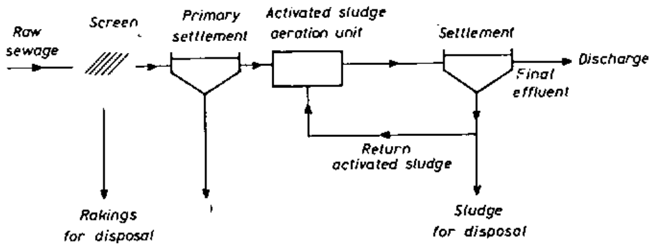

Fig. 1. : The activated sludge process.

In addition, the regeneration of the GAC may, according to the National Water Advisory Council[2], give rise to toxic chlorinated dibenzofurans.

Wastewater Treatment

Conventional wastewater treatment processes have tended to utilise one of three methods[5].

1. Oxidation ponds in which (usually) a lower anaerobic sludge layer digests and an upper aerobic liquid layer supports both algal oxygen production and bacterial oxygen utilisation.
2. Percolating filters consisting of non-biodegradable media (e.g. stone or coke) on which grows a fixed, complex, microbiological film which is sprayed with the aerobic wastewater. The filters are preceded and followed by settlement tanks; the primary settlement tank prevents blocking of the voids whilst the secondary tank removes film sloughed off the filter.
3. The activated sludge process (Fig. 1) in which influent wastewater is mixed with a recycled, free floating, 'activated' (or biological) sludge and the process kept aerobic by surface air entrainment or air spargers. A settlement (decanting) stage follows and the concentrated sludge is returned to the inlet. With time sludge builds up and the excess must be wasted.

Oxidation ponds are popular (provided land is readily available) since they rely largely upon wind and sunlight energy inputs. Interest is now increasing in two variations of this process. The first variation uses a heavily loaded completely anaerobic pond for treatment of warm, high strength wastes and acts somewhat like a septic tank. The second uses a high rate, low retention time pond which is effectively an intensive algal producing reactor.

The percolating filter process has been upgraded in recent years, the stone media, which often has a porosity of 0.4 and (specific) surface area of 40-50 m^2/m^3 being replaced by modern plastic modules of porosity 0.98 and surface area of 85 m^2/m^3. An unusually large example of this type of installation is in operation at the Bromley sewage works in Christchurch where two "Flocor" (ICI trade name) towers have replaced the previously overloaded stone media.

An interesting variation of the biological filter is the rotating disc. Fig. 2 shows the principle of this process which has in recent years become very popular. A rotating shaft carries a large number (100-200) of thin

Treatment Trends (Cont)

(5-10 mm) lightweight (plastic or expanded metal) discs up to 3m diameter which are rotated at 1-2 rpm in order to alternately contact the fixed microbiological film with wastewater then with air. Although this process has been used in Germany for very large (more than 100,000 population) systems, it is more likely to be encountered in Australasia as a small scale unit treating the waste from 20-300 persons. Under these circumstances the units are preceded by an Imhoff type tank, incorporating both settlement and separate sludge digestion and followed by a secondary settlement tank. Their quiet, low energy and low maintenance characteristics are somewhat offset by their high initial cost[5].

The activated sludge process is, despite its technologically impressive title, little more than a condensed, high rate version of the self purifying action which takes place in rivers and lakes. Despite the success with which this process has been adapted to wastewater treatment over the last half century, general kinetic theory development is hampered by both the wide variations in sludge floc behaviour and in substrate (or input) types. Traditionally, the wastewater scientist has borrowed theories of substrate utilisation and sludge growth rates from the biochemist. However, although the Monod equation of bacterial growth is useful as a descriptive guide to the process, the estimations of kinetic constants to be used in the kinetic relationships show unusably wide variations[6]. This field however promises to attract considerable research effort in the next few years, building on the basic studies now being pursued, largely in USA.

The sludge itself is an extremely complex material consisting of 70-80% organics, much of which appears, under the electron microscope, to be non-bacterial or extracellular floc. The role of adsorption of pollutants in achieving a purified effluent is known to be significant and processes such as 'contact stabilisation' utilise this effect by allowing a short (less than lh) contact or mixing between the sludge and the wastewater. After separation from the effluent, the sludge is aerated for several hours to re-activate prior to again being mixed with fresh wastewater. The complex extra and intracellular enzymatic reactions which occur in the sludge aeration stage require careful control. Simple and effective methods of determining the state of the sludge, such as the use of 2, 3, 5, triphenyl tetrazolium chloride to determine dehydrogenase activity, are growing in importance. The next few years may show an upsurge in standardising and automating such tests. The activated sludge process also can be used in small scale wastewater treatment schemes where it is usually found as an extended aeration unit[5]. These units have been accepted world wide in response to the demand for improved wastewater treatment facilities at camp sites, national parks, holiday villages etc. In this process the aeration unit shown in Fig. 1 is extended to give 30 hours' retention time with the intention of producing highly mineralised non-putrescent excess or waste sludge which may be disposed of without nuisance. One advantage of this process is that it will operate on unsettled domestic sewage which removes many of the difficulties associated with disposal of highly putrescent, bacterially contaminated, unaesthetic primary settlement sludge. The process is easy to install, has low start-up time (if needed) and can be supplied as a factory built package. It is however somewhat more difficult to maintain and has higher running costs than the rotating disc units.

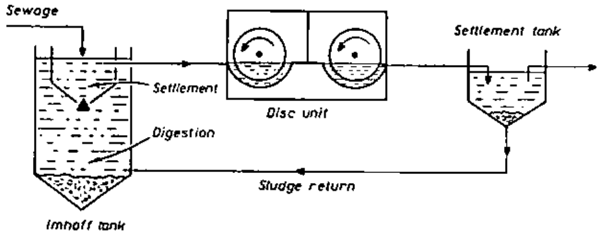

Fig. 2. : The rotating disc process.

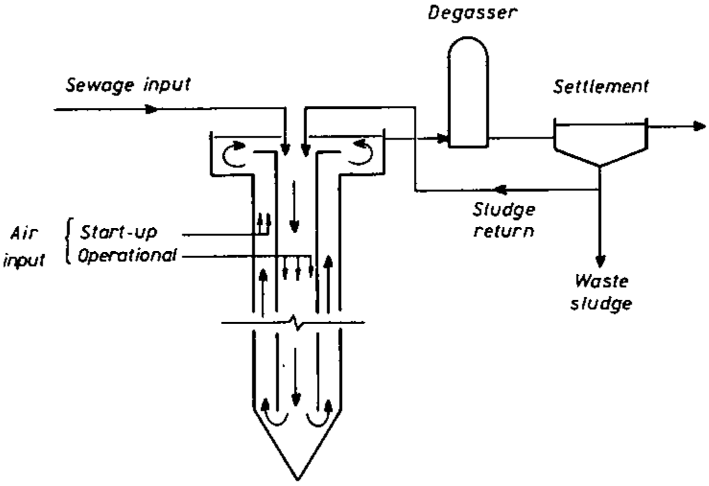

Fig. 3. : I.C.I. 'deep shaft process'[7]. Reproduced by courtesy Imperial Chemical Industries Limited, London.

One unusual use of the activated sludge process that has developed recently as a direct 'spin off' from work on protein culture is the ICI 'deep shaft' process[7]. The process is shown diagrammatically in Fig. 3. Sewage enters the top of a deep (up to 150 m) shaft and air is fed into the downcomer in which the liquid moves at greater velocity (1-2 m/s) than the theoretical rate of air bubble rise. From Henry's law, the efficiency of oxygen transfer increases with depth giving what are claimed to be ideal conditions for bacterial oxidation of the wastewater. The circulation is initially started by feeding air into the riser and the switchover to the downcomer is made after sufficient downward velocity has been imparted to the liquid in the downcomer. The answer to the obvious question 'why does the liquid not stop circlating?' is that the liquor at the surface of the downcomer has a higher density than that below the air input in the downcomer since gas is lost when rising liquid reaches the surface.

Analytical Innovations

Wastewater treatment has often been the meeting place of civil engineers, expert in soils, structures and fluids, and chemists and microbiologists expert in chemical and bacteriological assays. In recent years, leading chemical equipment manufacturers have invested heavily in new analytical methodology requiring little expertise in chemistry and thus being suitable for the engineering profession. Three examples of such innovations are the manometric determination of biochemical oxygen demand, (BOD), the 'suitcase laboratory' and the determination of coliforms by prepackaged, sterile plastic samplers. The Hach manometric BOD apparatus reproduced in Fig. 4 relies upon the principle of bacteriological oxidation of organics in the water giving rise to CO_2 which is absorbed by the alkali in the rubber seal cup. The reduction in volume of the gas phase is interpreted directly on the scale as BOD i.e. the oxygen consumed by bacterial action. Since this apparatus shows the cumulative BOD with incubation time, it can be used to determine the reaction rate constant k_1 in the expression

$$BOD_t = L_0 (1 - 10^{-k_1 t})$$

where BOD_t is the BOD exerted after t days; L_0 is the ultimate BOD (usually accepted as BOD_t at 20 days at 20°C) and k_1 is the reaction rate coefficient based on assumed first order kinetics.

The determination of BOD_t and k_1 by a method which requires practically no previous chemical knowledge is very attractive to a profession which has often viewed the chemist as an unfortunately necessary evil. In terms of estimating the effects of trade discharges on receiving waters, the evaluation of k_1 is of prime importance.

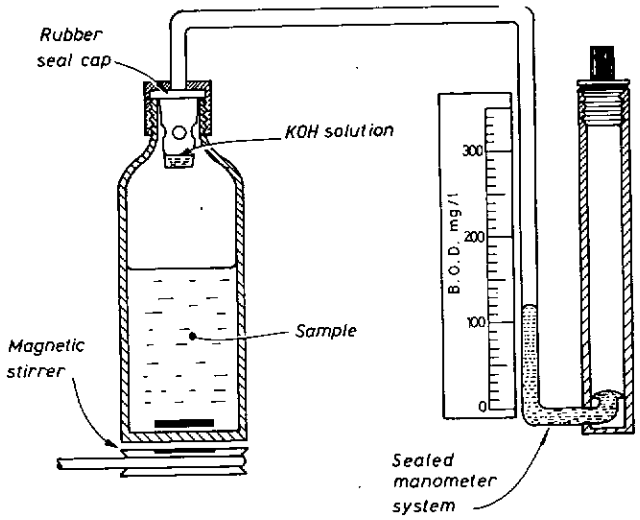

Fig. 4.: Hach B.O.D. apparatus (simplified). Reproduced by courtesy of Selby Wilton, Hach agents.

The laboratory in a suitcase involves simple colorimetric determinations of dissolved oxygen, nitrogen compounds, Fe^{3+}, Cl^- etc. using prepacked sachets of chemicals. It represents a logical extension of the single analysis colorimetric comparators of the 'Lovibond' type. Any reduction in accuracy, in the author's opinion, is more than offset by the ability to obtain, easily and rapidly, a large number of analytical results. This is especially true in wastewater treatment, where rapid fluctuations in composition, of several times the magnitude of the analytical error, are commonplace. Some caution and expertise is of course required to ensure that interference by other ions is minimised.

The necessity of determining total or faecal coliform organisms is an unhappy result of the way NZ water pollution legislation has developed. These tests are particularly difficult because there is no readily available standard against which results may be checked. The author's reservations about the use of these tests in water pollution control arises from the fact that minute specks of faecal matter containing 10^7 faecal coliforms/gm, can result in large inter-sample variations, in field or plant work on domestic wastewaters. The necessity to take multiple samples over short time intervals has led to interest in 'dip stick', samplers such as the Millipore samplers (Fig. 5). On dipping the inner slide into the liquid a set volume is drawn through the membrane filter, trapping the organisms and simultaneously releasing nutrients. Incubation gives rise to colonies which are counted in a conventional manner.

Some misuse of these simple test methods will, perhaps more especially in the case of bacteriological samplers, produce some problems of interpretation. However, the now generally accepted 'Makareth type' dissolved oxygen probes initially suffered from similar drawbacks and lack of calibration. Nowadays, the availability of cheap, robust, combined D.O/temperature probes which can withstand hard handling on board ship or dinghy has greatly eased data collection for fisheries, river authority and lay personnel. It is interesting to note that these probes are now regularly used as in situ monitors in the large European and N. American semi-automated sewage treatment works.

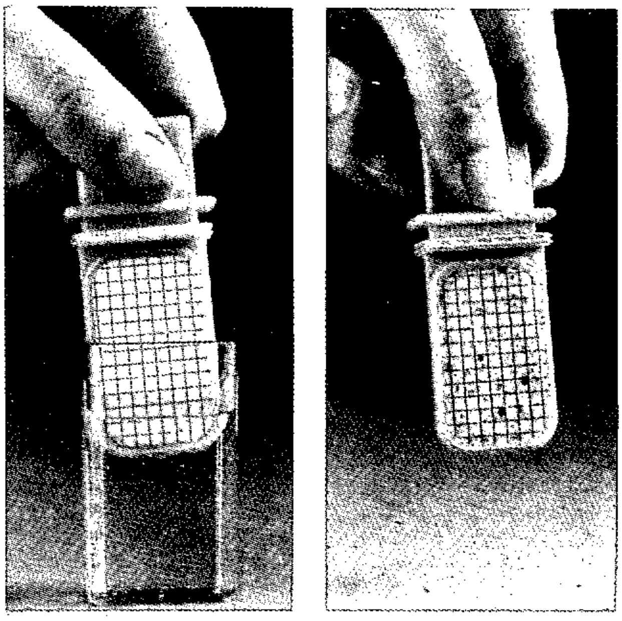

Fig.5. Dipped plate (left) and incubated plate.

Photos courtesy Smith Biolab Ltd.

Comments

In conclusion I feel the prospects for a more intensive application of chemical expertise in water and wastewater engineering has never been brighter. Even the increasing use of analytical equipment which relies little upon formal chemical expertise will, by giving the civil and mechanical engineer more confidence in obtaining and using chemical information, lead to a greater awareness of the part chemistry can play in advancing the science and art of engineering works.

Overseas there has been a growing and real response to the realisation that the wide environment is of such complexity that no group of experts from one particular discipline can hope to understand or predict the full environmental and social impact of their major works. This has led, for example in USA, to the National Environmental Policy Act (1969) which requires an Environmental Impact Report to be prepared for all major works. The drawing together of different disciplines to provide an Environmental Impact Statement is to be applauded.

In NZ the prospects for greater involvement of scientists in decision-making processes concerning major environmental works may be threatened by legislation. At the time of writing, a proposal for an Engineering Practitioners Act is being discussed by the engineering profession. The original draft was so wide ranging in the topics it sought to reserve as the privilege of those with engineering qualifications as to seriously interfere with the present and future employment of water an wastewater engineering scientists.

The Effect Of Lead On The Nervous System Of Children

Tord Kjellstrom

Abstract

Lead toxicity in children has been an ongoing controversy among environmental health scientists for several years. This problem was highlighted in NZ by the visit in January 1979 by Prof. D. Bryce-Smith, who has concluded in a publication that lead is more toxic than had previously been thought.

This paper analyses some of the arguments put forward by Bryce-Smith and the problems in drawing firm conclusions from existing data. It also makes a plea for action to limit children's lead exposure, even if the exact dose-response relationship is not yet known.

Introduction

It has long been known that high lead exposure can cause damage to the brain[1], so-called lead encephalopathy. The symptoms are dullness, restlessness, irritability, headaches, muscular tremor, hallucinations and loss of memory and of ability to concentrate[2]. These acute symptoms may disappear after the lead exposure is eliminated, but it has been estimated that in as many as 25% of children affected, permanent damage occurs[3] leading to e.g. learning difficulties, inability to concentrate, epilepsy or mental retardation. A number of studies have reported that subtle nervous system disturbance or mental effects of various kinds have been associated with lower lead exposures, which did not cause acute encephalopathy. However, studies on the effects have given conflicting results and the whole question has become very controversial.

Factors that tend to obscure the dangers of lead are that industrial users do not want to be without this technically valuable metal and public health authorities all over the world do not want to alarm the general public unnecessarily. One recent review of the problem of mental health effects of lead, which claims that the dangers of lead have been underestimated, is the report "Mental health effects of lead on children" by Prof. D. Bryce-Smith and colleagues[4]. The problems of lead in the environment were widely publicised in conjunction with Prof. Bryce-Smith's participation in the 49th ANZAAS congress in Auckland, 1979[5]. As NZ maintains one of the highest lead concentrations in petrol in industrialised countries and a large number of NZ houses are painted with lead paint, any report that raises suspicions of a greater hazard with lead than we hitherto believed should be studied and evaluated seriously. A delay in preventive action could lead to irreparable damage to the brains of a large number of children.

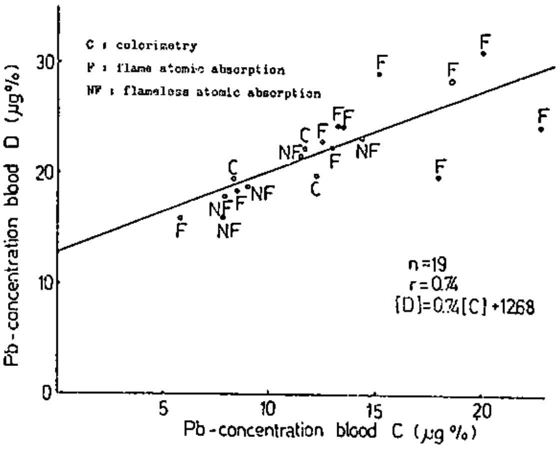

Fig. 1. Correlation between lead concentrations in the dispatched blood samples C and D as measured by 19 laboratories with true intralaboratory coefficient of variation less than 10% for both measurements (from Berlin et alia, ref 7)

Bryce-Smith and colleagues state their case[4] in six so-called propositions. Three of these deal specifically with the mental health effects of lead and they will be discussed here.

Proposition one: "Body lead levels in the range now regarded as 'normal' are significantly associated with pathogenic effects on mental function of children. The manifestations of these effects include disturbance of intelligence, and/or more specific aspects of learning ability, and/or hyperactivity."

Proposition two: The weight of experimental and epidemiological evidence is such as to indicate that the associations in proposition 1 strongly imply a significant cause-and-effect relationship. This conclusion is further supported by numerous reports of behavioural and/or intellectual improvements in children after treatment for lead poisoning.

Proposition three: In addition to the post-natal effects, there is evidence from studies with experimental animals, and some epidemiological evidence for humans, that lead from the mother, or paternal exposure, can harm the foetus at levels which cause no obvious symptoms of poisoning in the mother or neonate; and that such harm to the brain may manifest itself after birth as impaired learning ability in the offspring.

The problem of analysis of lead

Most of the reports on health effects of lead use the concentration of lead in blood as a measure of "internal dose", which means the amount of lead that has been absorbed into the blood and is available to damage internal organs. It is generally agreed[2] that blood lead is a good indicator of internal dose, but the accuracy of the chemical analysis of lead in blood is seldom questioned. Bryce-Smith et al.[4] present a table comparing blood lead levels of different populations with and without health effects of lead. The analysis for each value had been carried out by different laboratories and it is quite possible that large systematic analytical errors could seriously distort this type of comparison.

Treatment Trends (Cont)

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* Suggested further reading if required.

In 1970 one of the first large-scale systematic quality control studies of bloodtlead analysis was carried out in USA[6]. Sixty-six laboratories participated. They received two identical blood samples with approximately 65 μg Pb/100ml blood. Less than half of the laboratories obtained similar results (within 10 μg/100ml) for the two blood samples and the reported values ranged between 0 and 5600 μg/100ml. Even when two outlying results were excluded the range was 30 — 120 μg/100ml.

Another study of 52 laboratories in Europe was carried out in 1973 [7] [8]. Four identical specimens each of one blood and three identical specimens of another blood were distributed to the participants. The identical specimen results were used to calculate the true interlaboratory coefficient of variation for analysis results. These coefficients varied between 1.5 and 129.2% for one blood and between 0.8 and 99.9% for the other blood[8]. The calculated mean results for these two bloods from individual laboratories varied between 2.7 and 49 μg/100ml and 10.3 and 87.3 μg/100ml. Even when the laboratories with large coefficients of variation (more than 10%) for any of the two bloods were excluded the ranges of mean results were 5.8 — 22.3 μg/100ml and 16.0 — 31.3 μg/100ml respectively[7]. There were systematic differences between the laboratories as indicated by the correlation between the results for the two bloods (Fig. 1).

It is thus obvious that results reported from different laboratories in different studies can be at least 2-4 times "too high" or "too low" and such comparisons have to be carried out with great reservations. Only when the same laboratory has analysed blood from the different groups under comparison and when the accuracy of analytical methods has been documented by proper method studies, can comparisons of blood lead in different population groups be carried out with some validity.

Some studies quoted by Bryce-Smith et al.[4] report associations between lead exposure and mental health effects at about 30-50 μg Pb/100ml blood, whereas some other studies do not find such effects. One reason for this discrepancy could be the variation in lead analysis results. It may be that such effects occur at these relatively low blood lead levels and they may occur at even lower levels. Further research is needed to give us more certain data on the "no effect level" for blood lead, and such research should be based on valid analysis quality control studies. This very important problem is not mentioned at all in the report by Bryce-Smith et al[4] [5].

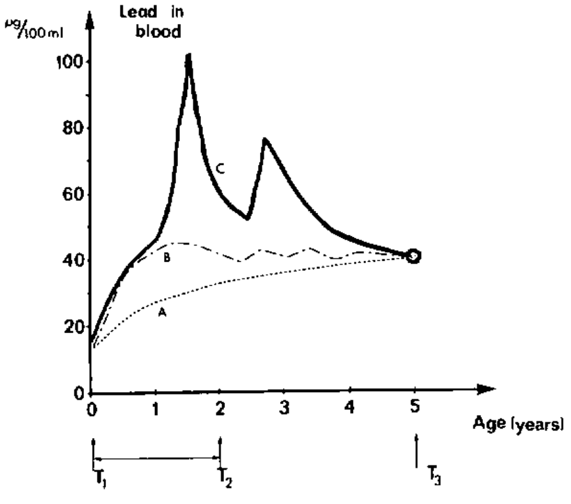

Fig. 2. Hypothetical examples of how the blood level may have varied with time before a measurement of 40 μg/100 ml is made at age 5.

The problem of the timimg of dose estimates

The extent of nervous system damage by lead is likely to be dependent both on level and duration of exposure. The higher the level and the longer the duration of high-level exposure, the greater the damage. The controversial subtle effects such as hyperactivity or learning ability deficit may be most likely to occur if high-level exposure occurs before age 2, when the network of connection between nerve cells develops much faster than later in life[5]. In studies where such health effects are linked to lead dose estimates, it is thus of great importance that the dose estimate indicates both exposure level and duration particularly at very early age.

Blood lead, which is most commonly used to estimate dose is only a point estimate. The half-time of lead in blood is a few weeks[9] so the blood level would not change rapidly from one day to the next, but during the course of months the level may go up or down considerably. Under conditions of relatively constant exposure in different groups of children the mean blood lead levels will be good indicators of the different mean exposure levels. However, for individual children the blood lead at age 5 may be completely unrelated to the lead exposure and dose before age 2.

Hair lead could be a better indicator of long-term exposure, because hair grows very slowly and a 10mm long bundle of hair would integrate the body lead levels during a month[10]; 200mm of hair would thus cover a 2 year exposure period. However, a large proportion of lead in hair has been reported to be absorbed directly from the ambient air[11] and it has not been possible to separate in the analysis lead coming from inside the body into the hair and lead coming from outside. In areas with very low ambient air levels of lead this may not be a problem and hair lead may be a good integrator of blood lead.

Lead in deciduous teeth is another way in which long-term lead dose has been estimated[12]. The lead is slowly accumulated in the teeth over several years. In order to use data on lead in teeth to evaluate the health hazards from certain types of lead exposure it is necessary to know the relationship between lead levels in teeth and the corresponding lead levels in blood, duration of exposure, etc. No quantitative data on these relationships are available yet.

A number of studies on the relationship between lead exposure and nervous system effects (as measured by IQ tests, behaviour rating scales, psychological tests and neurological tests) have been carried out, many of them referred to by Bryce-Smith et al[4]. Some of these studies have concluded that lead exposure caused effects and some have concluded that lead did not cause any. The type of effect studied, the instrument used to measure it and the size and selection of the groups studied may be sufficient reasons for the discrepancies. Another reason may be that most of these studies were cross-sectional, which means that blood leads were measured at the same time as the measurements of effects. The blood lead levels before the study may have been much higher or lower than the levels at the time of the study (Fig. 2).

Two studies [13] [14] used lead in teeth as a dose estimate and both reported deficiencies in psychological scores in the high-lead groups. Only one health effect study[15] used hair lead as a dose estimate. This study concluded that learning deficient children had higher lead levels in hair, but the problem of lead coming from inside the body or from outside was not considered and apart from lead several other trace elements occurred at a higher level in the hair of the learning deficient children.

The problem of establishing cause-effect relationships

As seen from the points mentioned above there are considerable difficulties in accepting existing reports as proof of Bryce-Smith's Proposition 1, which stated that even at "normal" blood lead levels mental health effects may occur. Large-scale prospective follow-up studies with frequent dose measurements (via blood, hair, teeth or urine) and subsequent mental health effect measurements are needed.

Bryce-Smith's Proposition 2 states that numerous reports have seen an improvement of behaviour and intellect in children treated for lead poisoning. Seven reports are referred to but 2 of these deal with the same cases. One of the reports[16] dealt with treatment of children who had had encephalopathy, a serious acute lead intoxication. Two of the reports involved children with mental retardation or epilepsy and comparatively low blood lead levels (less than 50 μg/100ml). The criteria for defining these as lead poisoning were not clear. In one study[17] the assessment of improvement is confused by some hyperactive children receiving other drugs as well as the chelation therapy.

It is true that some animal experiments support the cause-effect relationship mentioned in Proposition 2, but the available data on chelation treatment of hyperactive or mentally retarded children with some increase in blood lead levels are not as conclusive as Proposition 2 implies.

Proposition 3 regarding prenatal lead exposure causing postnatal effects[4] has the best support of the three propositions in the studies referred to. Again, the human dose at which this could happen is not known and further research is needed.

Considering the seriousness of mental health effects possibly caused by environmental lead occurring in a large number of children, public health actions aimed at decreasing the lead exposure of children are justified, even if the clear cut cause-effect relationships have not yet been established. The suspected effects have been summarized by David[18] as in Table I.

Table 1: Suspected signs of subtle lead effects on the brains of children (from David, ref. 18)

Trait	Type of environment	
	Low Lead	High Lead
Conduct	Well-behaved	Badly behaved
Cognitive functioning	Bright	Dull
Motor activity	Normal	Very active or very inactive
Attention span	Long	Short

The dose-effect and dose-response relationships

In order to set criteria for the maximum lead doses that should be accepted in order to achieve prevention of lead effects it is necessary to know the dose-effect and the dose-response relationships. The dose-effect relationship expresses the increasing severity or the changing character of the effect when the dose increases.

One effect of lead that occurs at relatively low lead doses is decreased activity of enzymes, such as δ-aminolevulinic acid (ALA)-dehydrogenase, which leads to decreased production of haemoglobin and anemia. Signs of this effect are an increase of the free erythrocyte protoporphyrin (FEP) in blood, and increases of ALA and coproporphyrin (CP) excretion in urine. The dose-effect relationship for all the different kinds of lead effects has been summarized by a World Health Organisation expert group[2] as shown in Table II.

Table 2: No-detected effect levels in terms of Pb-B (μg of lead per 100 ml of blood) (from World Health Organization, ref 2)

No detected effect level	Effect	Population
less than 10	Erythrocyte ALAD inhibition	adults, children
20-25	FEP	chilren
20-30	FEP	adult, female
25-35	FEP	adult, male
30-40	Erythrocyte ATPase inhibition	general
40	ALA excretion in urine	adults, children
40	CP excretion in urine	adults
40	Anaemia	children
40-50	Peripheral neuropathy	adults
50	Anaemia	adults
50-60	Minimal brain dysfunction	children
60-70	Minimal brain dysfunction	adults
60-70	Encephalopathy	children
more than 80	Encephalopathy	adults

Minimal brain dysfunction is a term covering all the behavioural and mental health effects mentioned above. The "no-detected effect level" means the maximum blood lead level at which the listed effect has not been detected in available studies. Depending on the sensitivity of methods to measure the effects as well as the size of the group studied and the accuracy of lead analysis (as discussed above) these no-detected effect levels may have to be adjusted after more studies have been carried out. It is clear from the table that children are considered to be more sensitive to lead effect than adults.

The dose-response relationship expresses the increasing proportion of an exposed group that get a particular effect when the dose increases. This relationship is based on the individual variation in sensitivity to lead. Just as body weight and body height in the general population vary according to a Gaussian (normal) distribution, other biological characters also vary in a similar way. The dose-response relationships when displayed as a graph often resemble a cumulative Gaussian distribution. Examples from the signs of lead effects of haemoglobin formation are given in Fig. 3.

None of the studies of lead and hyperactivity, learning deficit, or other behavioural psychological or neurological abberations can be evaluated from the dose-response aspect. Usually only a "high-lead" and "low-head" group are compared and the averages of different effect variables are compared. In order to assess dose-response relationships the results for each dose-group have to be expressed as e.g. proportions with IQ below 100.

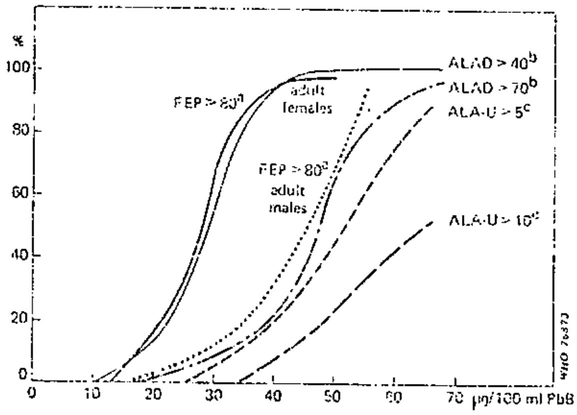

Fig. 3. Dose-response relationships for increased FEP, decreased ALAD or increased ALA in urine (ALA-U) as indicators of lead effects on haemoglobin formations. (from World Health Organization, ref. 2)

Considering the small size of the groups studied so far for mental health effects of lead, it is likely that a relatively high response was necessary to show a difference between "high-lead" and "low-lead" groups. If the necessary response rate was about 30% and the shape of the dose-response curve for these effects is the same as for ALA-U more than 10 (Fig. 3), it is from the figure that a 30% response at 50-60 μg Pb/100 ml blood could correspond to a 10% response of 40 μg/100 ml and some children will be affected at even lower blood lead values.

Thus, it is clear that it is not sufficient to establish a cause-effect relationship. The detailed dose-response relationship has to be known in order to decide on the exposure levels that are "safe". In the concept of safety is included a judgement of what response level is acceptable. Is it acceptable if 30% of children living in a "high-lead" area get subtle mental health effects? Is 10% acceptable? or 1% or 0.1%?

Children's lead exposure in NZ

The answer to the question above may be different in different countries depending on the local exposure situation. If there are only 10 children in the whole country belonging to the "high-lead" group, an expected response of 1% will not be as serious as a 1% response among 10,000 children. Still, the concept of acceptability is very much dependent on one's general attitude to health protection as well as one's perceived benefits of living in a "high-lead" area.

The first study of lead exposure among children in NZ [19] showed that 2.4% of children (age 1-5) admitted to hospital in Christchurch had blood lead levels above 50 μg/100 ml and 10.6% had levels between 30 and 50 μg/100 ml. A study of the total population of preschool children in certain geographic districts of Auckland [20] found no child with more than 50 μg Pb/100 ml blood in a group of 73 children living in "high-lead" areas. Ten children (14%) had levels between 30 and 50 μg/100 ml. In a "low-lead" area none of 25 children had blood lead levels above 30 μg/100 ml.

A continued study of Auckland preschool children (Reeves et al., to be published) so far includes 117 children from "high-lead" areas. Four children (3.4%) had blood lead levels above 50 μg/100 ml and 12 (10.3%) were in the 30-50 μg/100 ml range. The proportions in the 3 studies agree relatively well in spite of differences in selection of groups for study and possible analytical variations. "High-lead" areas were here defined as areas with houses mainly built before 1950 and often with high (more than 2%) levels of lead in the outside paint. Thousands of NZ children are living in this type of area, so if mental health effects of lead do indeed develop, at a blood level of 50μg/100ml, a number of cases of such effects are likely to occur here. We are presently carrying out a quantitative calculation of the possible numbers.

The more severe cases of lead poisoning would be hospitalised for treatment. The official Health Department statistics (Table 3) show that thenumbers and the incidence rates have not changed much over the years. These cases would of course be the "tip of the iceberg", being the most severe cases who are properly diagnosed as lead poisoned. Some of them may, on the other hand, be asymptomatic cases with high blood lead, only admitted for treatment.

Table 3

Number of cases aged less than 5 years, discharged from or dying in NZ hospitals with a diagnosis of "toxic effects of lead and its compounds (including fumes)".

Data compiled from Health Statistics Report, Hospital and Selected Morbidity Data, Department of Health, Wellington (one report for each year).

Years	Cases	0-5	years	Average population (male & female)	Annual Incidence rate/100,000
	Male	Female	Total		
1950-1959	38	32	70	261,000	2.68
1960-1969	48	32	80	292,000	2.74
1970, 1972-1974	22	18	40	302,000	3.31

For each child admitted to hospital there will be a large number with other minor effects who are not hospitalised. One would hope that prevention programmes will achieve a cut in the hospitalised numbers, while further probes into lead exposures, effects and dose-response relationships are continued.

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Leaded Petrol Affects Children

Lead in petrol plays a highly significant part in boosting the level of lead in children's blood, concludes research sponsored by the US Housing and Urban Development Department (HUD). In what is thought to be the most extensive study of its kind, a team led by **Dr Irwin Billick**, director of HUD's Environmental Hazards Research Division, found a "striking" correlation between body burdens of lead in New York children and the peaks and troughs of leaded petrol sales.

In addition to these cyclic rises and falls in body burdens of lead, a 7-year decline in the sales of leaded petrol was reflected dramatically in reduced lead levels among 178,533 New York children of all ages, ethnic groups and city areas studied. The findings, which persuaded the US Department of Energy to abandon its call for a halt to the phased reduction of lead in petrol, challenge the view that petrol additives are only a minor contributor to the body burdens of lead in urban children.

AIR QUALITY IN AUCKLAND

A Review Of The Work Of The Auckland Air Pollution Research Committee

Bruce W.L. Graham and Norman G. Thom

In the middle of the 1950's the residents of Auckland were plunged into the environmental age when they discovered an unfortunate fact about one of their harbours — it sometimes produced an extremely unpleasant odour. Not only did it smell badly but whatever was in the odour also appeared to cause the paint on the outside of homes to discolour in a process which reversed itself once the odour disappeared.

The harbour was the Manukau. The phenomenon was an interesting one, environmentally — a localised water pollution problem in the upper reaches of the harbour at certain times of the year converted itself into an air pollution problem which made itself felt over a considerable part of the Auckland area. This type of situation can still occur in today's enlightened times. In solving one pollution problem (e.g. excessive dust emissions) we may create an equally obnoxious problem in some other part of the total environment (e.g. sludge disposal, excessive noise from control equipment, etc.)

Whatever the philosophical and technical thinking of the time Aucklanders were certain of one thing — something needed to be done about the air pollution in their area, and the matter became the subject of a Commission of Inquiry and two reports [1,2,3].

Bruce Graham (left) is the Chemist in the Health Department's Environmental Laboratory. He graduated M.Sc. from Auckland University in 1970 and moved to the University of Waikato to do a Ph.D. in organometallic chemistry, which he completed in 1973. After a year's post-doc in England he took up a position with Chemistry Division, DSIR, Wellington, working on aspects of natural gas utilisation. In 1977 he took up his present position where, as well as investigating various aspects of air pollution, he is actively involved with work in the fields of industrial hygiene and chemical hazards in general.

Norman Thom was educated at the Auckland Technical Institute and the University of Auckland before qualifying for NZIC Membership by examination. He was Technical Officer for the Auckland Air Pollution Research Committee from 1960 to 1965, Regional Chemical Inspector then Regional Air Pollution Control Officer with the Department of Health from 1966 to 1978 and is now Regional Scientist in charge of the National Acoustics Centre and Environmental Laboratories in Auckland. Mr Thom has performed several assignments as an air pollution consultant to the World Health Organisation.

The first paper delivered at the first General Meeting of the Society of Chemical Industry in June 1881 was by E. K. Muspratt on "Noxious Gases Legislation". In it Muspratt records that John Evelyn wrote to Charles II in 1661, predicting that coal smoke would be the doom of London. 'This is that pernicious smoke that sullyes all her glory, superinducing a sooty crust or furr upon all that it lights, spoiling the moveables, tarnishing the plate guildings and furniture, and corroding the very iron bars and hardest stones with those piercing and acrimonious spirits which accompany its sulphure and executing more in one year than to the pure air of the country it could affect in some hundreds.'

The formation and work of the Auckland Air Pollution Research Committee has been reviewed elsewhere[4], but briefly it was established in 1959 to coordinate the activities of a variety of Government Departments, Local Authorities and other interested groups, in tackling the Auckland "fumes" problem. It remained in existence for 20 years, being disbanded in 1979, and in this time extended its area of interest well beyond the original "fumes" problem.

We feel that this is an appropriate time to review some of the work of the Committee and at the same time describe aspects of the present air pollution scene in Auckland.

Formation And Work Of The Committee

The formation and organisation of the Committee has been described in detail by Sparrow et.al.[4] It was funded by a per capita levy collected through local authorities in the greater Auckland area and must be acclaimed for its anti-inflationary zeal. In 1959 its initial levy of 3d per head of population gave an income of L4,000 stg. In 1977 its income from local authority contributions was less than $4000.

The original work of the Committee consisted of the establishment of three areas of study: measurement of air quality, assessment of water quality around the Manukau Harbour, and a programme of meteorological observations related to identifying conditions of greatest air pollution potential. The first area of study has extended considerably beyond the original "fumes" context and is the main subject of this paper.

The air quality measurements were rapidly extended to areas beyond the Manukau, initially for reference data but subsequently as studies in their own right. It soon became obvious that air pollution from motor vehicles, the larger industries and various city-wide activities (e.g. rubbish disposal) needed to be studied in depth and these were gradually given attention. Major developments, such as power station proposals, came under consideration and significant inputs were also made into the development of legislation and standards.

Sulphur Pollution

The original reason for the Committee's existence evaporated rather rapidly. Industrial wastes had been discharged into the Manukau Harbour for up to 50 years prior to the fumes problem but up to that time the affected population and the frequency of complaints had both been sufficiently small to not cause significant public attention. Rapid expansion of both housing and industry in the mid-1950's precipitated the problem however and it was forcibly placed in the public eye (or, in this case, in the public nose).

The problem and its solution were both reasonably straightforward and have been reported elsewhere.[5] Basically the discharge of various tradewastes (especially meatworks effluents and the like) into the shallow tidal areas of the upper harbour was placing an excessive oxygen demand on the aquatic ecosystem. At certain times of the year (primarily autumn when reasonably warm conditions coincided with increased meatworks activity) the pollutant loading on the mudflats became so great that anaerobic conditions were established and the resulting H_2S (and methane) was released into the atmosphere. Autumn is also the time of the year when meteorological conditions are the least conducive to good gas dispersal.

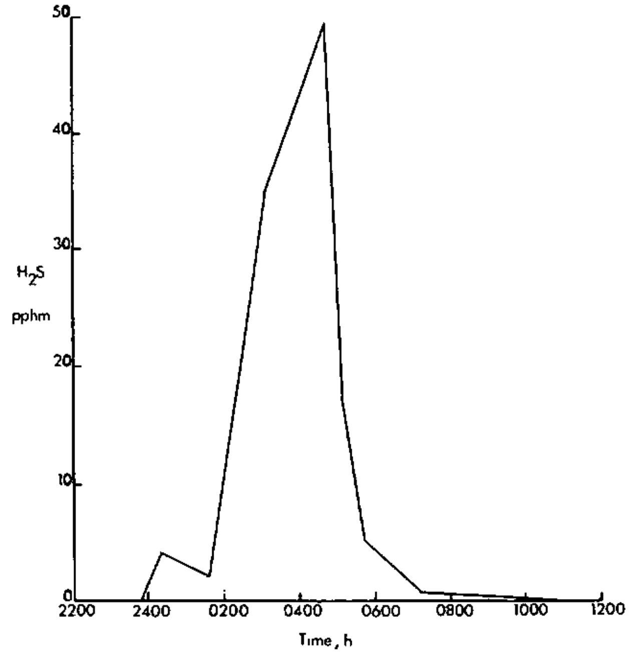

Fig. 1 Typical Fumes Incident

(Auckland, circa 1960)

Fig. 1 shows the results of monitoring for H_2S, using a lead acetate paper technique, during a typical fumes attack. Subsequent investigations into this technique lead us to believe that these results may be significantly lower than the true values.

Fortunately relief was at hand as in 1961 tradewastes were progressively diverted to the new treatment plant at Mangere and the improvement in both water and air quality was dramatic. In its 1962 Annual Report the committee was able to note an almost total absence of H_2S in the air of the region and the complete cessation of "fumes attacks" and paint blackening that had been occurring in the nearby suburbs.

When monitoring first began in the Auckland area lead candles, which are indicative of sulphonation, were adopted as suitable indicators of overall sulphur pollution. Fig. 2 shows the results from a number of typical sites. The early work at Westfield reflects the response of the candles to the relatively high levels of H_2S, while the monitors at the other sites shown gave an early indication that sulphur dioxide was not a problem pollutant in the Auckland area. Subsequently more detailed investigations have confirmed the general trends indicated in the figure.

Motor Vehicle Pollution

The Committee began to turn its attention elsewhere and the motor vehicle soon came under scrutiny. Levels of smoke recorded in Broadway, Newmarket, in 1962 were the highest recorded at any of the monitoring sites in Auckland (with the exception of a site at Mechanics Bay, adjacent to the main railway yards) and this was attributed to the high traffic density in the area; especially the large number of heavy vehicles using that particular route. A detailed study of the area was carried out in 1965, including measurements of smoke, carbon monoxide, oxides of nitrogen, aldehydes, and lead, and these were detailed in the 1965 Annual Report of the Committee, and are also discussed more fully elsewhere.[6]

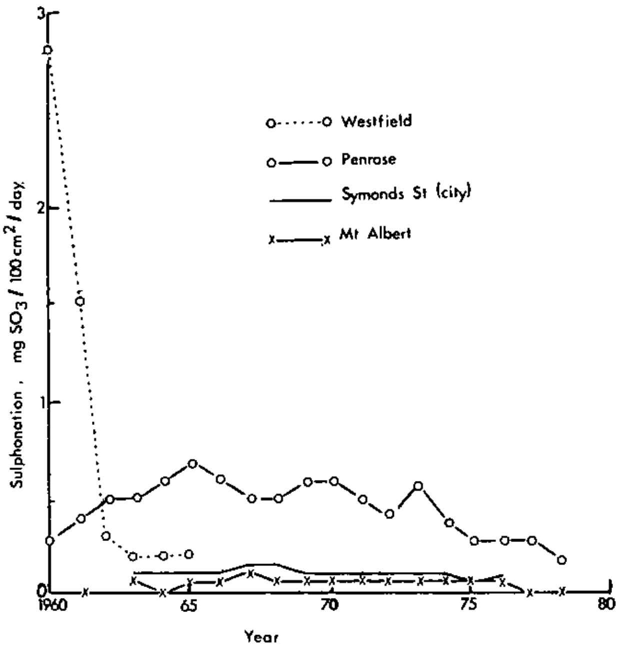

Fig. 2 Sulphur Pollution — Auckland

(annual averages)

Since this early work excessive smoke emissions from diesel-powered vehicles have been reasonably reduced by a better appreciation of maintenance and operation requirements on the one hand and the strengthening of legislation on the other. In recent years monitoring has been concentrated on carbon monoxide and lead in areas of traffic congestion, and overall levels of oxides of nitrogen.

Carbon monoxide emissions from motor vehicles in this country appear to be excessive and various studies of emissions at idle have indicated that about two-thirds of all cars may be out of tune.[7] It has been proposed that a tuning requirement be introduced into the normal Warrant of Fitness test, and this would go a long way towards alleviating the excessive build-up of carbon monoxide that can occur in congested city streets.

Regular and adequate engine tuning and improved vehicle flow from the application of traffic engineering principles can also be helpful in reducing air pollution from motor vehicles. This is illustrated in part by the results of carbon monoxide monitoring carried out in Queen Street during the mall trial in May 1979, where the complete removal of traffic was quite effective in causing a considerable reduction in CO levels. Fig. 3 shows the CO levels recorded at a site within the mall area on two days with similar meteorological conditions; one during the week prior to the mall trial, and the other during the trial.

Lead pollution from the petrol used in motor vehicles may be becoming significant in Auckland, although our own and other studies indicate that dust containing lead produced from the weathering of old houses may be even more significant. More detailed investigations

Air Quality (Cont)

are currently underway and the results from these will form the basis of various reports at a later date.

Photochemical Smog

While nitrogen dioxide is an air pollutant in its own right it is also a major precursor for the formation of photochemical smog, which is a significant problem in many overseas cities such as Los Angeles, Tokyo and Sydney. Oxides of nitrogen are produced from high-temperature combustion processes and these react with the other major precursor, hydrocarbons (produced from incomplete combustion of fuels, evaporation losses from hydrocarbon storage and handling facilities, chemical processes and vegetation sources). The reactions are initiated by sunlight and proceed through a complex variety of free-radical processes to form photochemical smog. This is a mixture of oxidised and nitrated species (including ozone and peroxyacylnitrates, PAN) which can cause visibility deterioration, vegetation damage to sensitive species and health effects such as eye and lung irritation.

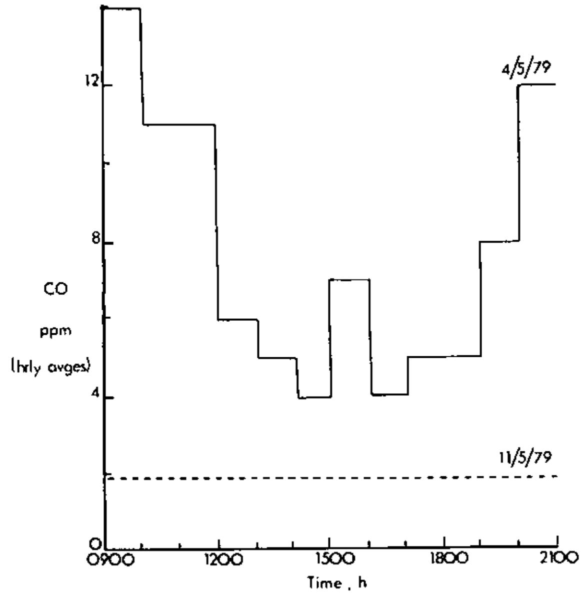

Fig. 3 Carbon Monoxide, Queen St, Auckland
(Before and during mall trial)

"Oxidant" monitoring (i.e. the monitoring of ozone and other species capable of oxidising neutral KI solution) has been carried out in Auckland for many years and while it is now quite clear that such oxidants are produced over the city on a small number of days (10-20) during the summer, levels so far recorded are generally low in comparison with international guidelines.[8] Fig. 4 shows a typical set of results from a previous report[9] with elevated levels (above background) recorded during the day, as a polluted "air parcel" moves over the city. A significant amount of effort continues to be put into monitoring photochemical smog and its precursors so that any deterioration of the present situation can be recognised and preventative steps taken.

Fuel Usage, Rubbish Disposal And Smoke Levels

From the earliest days of the Committee's work there was an awareness that significant visible pollution was being produced throughout the Auckland area due to smoke from domestic and industrial fuel burning and the incineration and open-burning of rubbish. A number of major studies were commissioned including a survey of patterns of fuel usage in the area and a questionnaire to local authorities aimed at identifying air pollution trouble-spots in each district. Much has been done over the years in controlling many of these sources — notably implementation of the Clean Air Act, training of local authority smoke inspectors, revision of the NZ Standard on Incinerators and the production of various guideline notes on school incinerators, disposal of domestic rubbish, and so on.

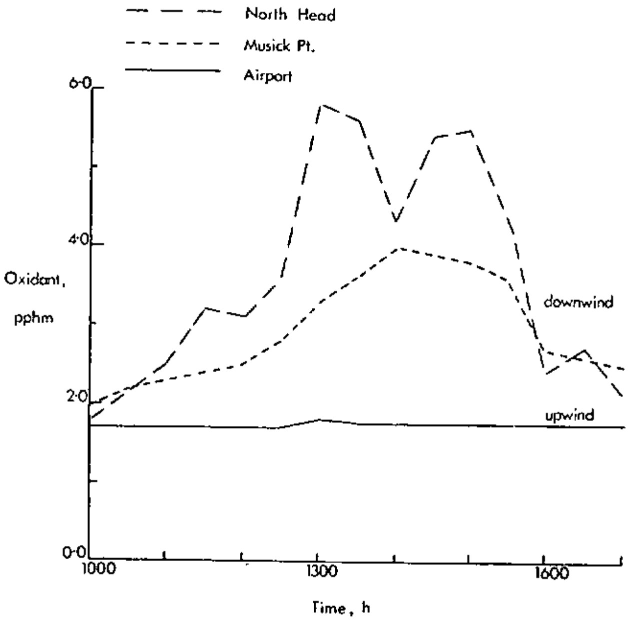

Fig. 4 Oxidants, Auckland City, Jan 26, 1977
(30-minute averages)

Nevertheless smoke pollution can still be significant at certain times of the year throughout the city. Two sets of monitoring results are of interest. Fig. 5 shows a comparison of levels of suspended particulate in the

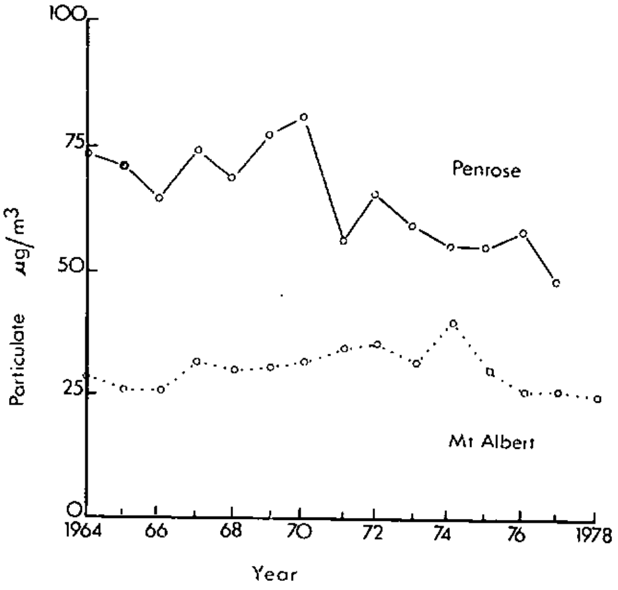

Fig. 5 Suspended Particulate, Auckland
(annual averages)

Chemistry And Physiology Of Dental Caries

J.D.B. Featherstone

Summary

Dental decay, or dental caries, is a multifactorial disease related to the production of organic acids during the metabolism of carbohydrates by oral bacteria. The subsequent diffusion processes and chemical interactions sometimes lead to demineralization (decay) of tooth enamel. This process may be controlled or reversed by alteration of one or more of a complex set of variables and fluoride acts in several beneficial ways both for children and adults. If preventive or reversal (remineralization) meaures are taken soon enough dental caries can be controlled. A chemical model is presented to illustrate the process.

Introduction

Dental caries, or tooth decay, is well known to the majority of our population. New Zealanders have a high rate of tooth loss, with for example over one quarter of the population in the age group 35-44 edentulous[1] (with no natural teeth). Although tooth decay is by no means the only reason, it is a large contributing factor. The purpose of this paper is to describe in outline some aspects of tooth structure, the oral environment, the chemistry of dental caries and how we can influence the process.

Tooth Structure and Composition

Teeth (Fig. 1) consist of an enamel exterior, about 1000 μm (= 1mm) thick overlying dentine and the inner pulp cavity. The main component of enamel and dentine is a calcium phosphate of the 'hydroxyapatite' type (Table 1)[2]. The dentine forms the bulk of the tooth structure and with a protein content of about 20% resists stresses and strains. It is however quite porous and is readily attacked chemically. The enamel is much harder, less porous, has less than one percent organic content (protein and lipid) and forms a protective and physically hard surface, suitable for biting, grinding and tearing. The precise composition varies from person to person and tooth to tooth. The inorganic apatite is present in the form of long needle-like crystals approximately 40 nm (about 1,000th of a hair's breadth) in diameter running from the outer tooth surface to dentine and nearly perpendicular to the surface[3] (Fig. 2). About 100 of these form enamel 'prisms' each 4 μm in diameter, with protein, lipid (about equal amounts of each[4]) and water forming a bonding, but slightly porous, matrix between crystals and prisms. Hydroxyapatite is readily soluble in acid under some conditions. Thus enamel is a physically hard material but one which is susceptible to acid attack and hence dental caries.

Penrose and Mt Albert areas from 1964 to the present time. The results are produced by a gravimetric determination of the concentration of dust in the air. In the Penrose area which is predominantly industrial a considerable reduction in dust levels has occurred. In comparison the results at Mt Albert have not varied significantly over 15 years.

Smoke levels can also be measured by determining the discolouration produced when air is drawn through a filter paper. These results are reported as "smoke units". In 1978 the maximum smoke level recorded in Penrose was 50 units. In Pakuranga, a residential suburb to the east the maximum result was 45 units, recorded during mid-winter. We feel this situation may be symptomatic of the present move towards wood and coal-fired home heating units in response to changing fuel costs, particularly electricity. This situation is being kept under close review.

Conclusion : A Legacy

Much of the work supported by the Committee has not been reported here. In particular a vast amount of information has been produced on microbiological aspects of the Manukau mud flats, water quality in the Manukau Harbour and meteorological information throughout the Auckland area.

As far as air pollution is concerned the Committee set the scene for a large amount of data gathering and in-depth studies. These have contributed greatly to the understanding of air pollution in the region which in turn allows for the development of an appropriate air quality management programme for the area. Furthermore, by assisting with the purchase of monitoring instruments and related equipment, the providing of funds for overseas travel and the purchase of air pollution literature, the Committee has contributed greatly to the establishment of the pool of skilled manpower, equipment and information resources which are now available in the area. Specifically the residual funds of the Committee are now being used to establish a collection of monitoring and testing equipment which will be held and maintained by the Health Department and will be available for use by local authorities in the area in controlling their local air pollution problems.

Acknowledgment

The permission of the Director-General of Health to present this paper is gratefully acknowledged.

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Early Enamel Caries

The early carious lesion is observed clinically as a small 'white spot' on the tooth and this is the precursor of carious cavity and eventual destruction of the tooth substance. Our teeth are covered by a thin film of protein chemically adsorbed from saliva in the mouth[5]; this so-called 'pellicle' is strongly adsorbed to the tooth surface and protects the crystals against acid attack. However, we rapidly build up a layer over this called plaque, which consists primarily of oral bacteria[6], some of which (for example, strepto-coccus mutans) metabolise carbohydrates, e.g. sucrose, from our diet and produce acid by-products such as acetic acid and lactic acid[7]. If these acids can penetrate to the enamel crystal surface at sufficient concentration some of the apatite will dissolve. If this process continues partial subsurface dissolution occurs and a 'white spot', or early carious lesion appears (Fig. 3).

The 'white spot' has an apparently intact, relatively hard surface layer about 40-50 μm thick (hair's breadth), less than 20% demineralized and below it there are one or more subsurface zones up to 70% demineralized. Eventually the loss of material from the subsurface is sufficient for the structure to break down and a cavity forms, pentrates to the dentine and pulp, giving severe discomfort and tissue breakdown.

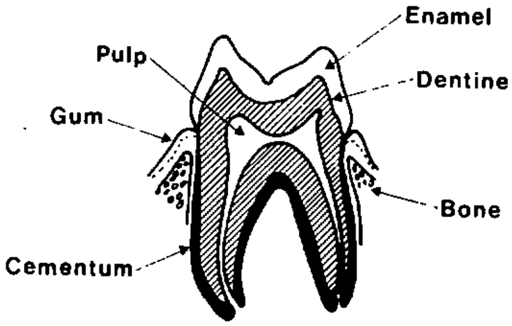

Fig. 1. Schematic drawing of a cross-sectioned molar.

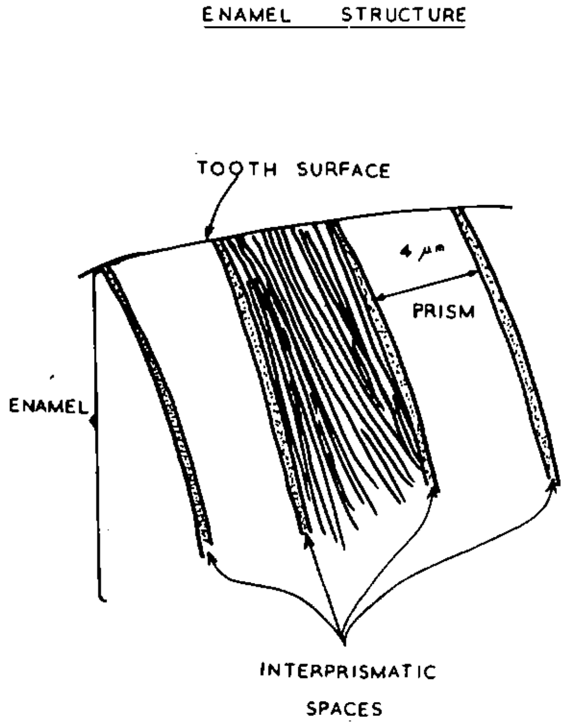

Fig. 2. Schematic diagram of enamel crystal and 'prism' arrangement.

Caries Chemical Model

The following simplified qualitative description summarises the way in which apatite-like enamel is attacked in the process of dental caries [8 9 10 11] (Fig. 4).

(i) Organic acids such as lactic acid (HL) and acetic acid are produced rapidly by plaque bacterial metabolism of carbohydrates during snacks, drinks or meals. With accumulated plaque (e.g. 48 hours) the critical pH (acid concentration) of about 5.0 is reached in one to two minutes after sucrose ingestion. It takes one to two hours to rise again. Fluoride inhibits the acid production process. Tooth-brushing prior to eating reduces the bacterial population and reduces the acid production rate for subsequent sugar ingestion.

(ii) The external enamel surface is largely protected by the adsorbed salivary pellicle and the acid must diffuse between the protein molecules and down into the enamel before any damage is done.

(iii) If acids are produced at high enough concentrations they will diffuse, predominantly in the unionised form (Table 2, ref. 9,10) through the water-filled organic matrix (protein and lipid) of enamel, between crystals and prisms. The diffusion rate is therefore indirectly related to bacteria type and quantity in the plaque, carbohydrate type and quantity ingested, acid type and the pore structure of the matrix.

(iv) As HL diffuses some will dissociate to H^+ (hydrogen ion) and L^- (lactate ion or acetate ion) all of which will attack and dissolve enamel apatite if they can get round and through the adsorbed protein/lipid.

(v) The rate of dissolution of the enamel crystals is

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Dr Featherstone graduated B.Sc. in Chemistry and Mathematics from Victoria University of Wellington in 1964. He spent 9 years in the cosmetic and pharmaceutical industries in NZ and UK before completing an M.Sc. at Manchester University. A Ph.D. as an MRC Training Fellow back in Wellington led on to the present work.

In his spare time Dr. Featherstone is active in boating, tramping, mountaineering, and search and rescue, with interests in drama and music in conjunction with a wife and two children.

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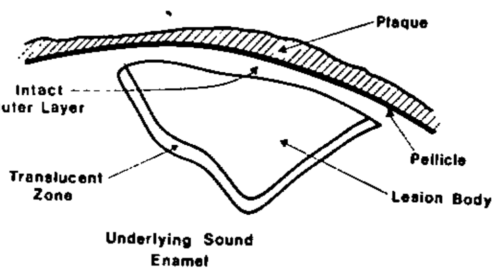

PLAQUE BACTERIA + SUGAR ⟶
ORGANIC ACIDS

Fig. 3. Schematic diagram of a cross-section of an early carious lesion (early tooth decay) of enamel.

related to the inclusions and defects in the crystal lattice, such as carbonate, magnesium, sodium and flouride. Fluoride inclusion in the crystal reduces the susceptibility to acid attack. Thus the effect of various chemical inclusions on the solubility rates of apatite is important in slowing down or speeding up this part of the process. Weak points in the crystal will be dissolved first, leaving less soluble material behind [10 11]. If the acid attack is stopped the crystals may partially regrow in a more resistant form. This is remineralization. This cycling process continues in the outer few µm of our enamel from the time of eruption of the tooth into the mouth, and we form a layer of enamel more resistant to subsequent acid attack. Fluoride enhances this process if it is present in the oral environment at sufficient concentration. This is one of the reasons why fluoridated water is beneficial not only during tooth development but also topically after eruption for both children and adults. Likewise chewing or sucking fluoride tablets daily is beneficial in non-fluoridated areas for both adults and children. Fluoride toothpastes used regularly will also improve the resistance of outer enamel to carious challenge.

(vi) The rate of progression of a carious lesion is also dependent on the rate of outward diffusion of chemical species such as $CaHPO_4$. This will be slowed considerably if these are present in sufficient concentrations in the oral environment i.e. in saliva and plaque. Saliva naturally contains such chemical species and if their action can be enhanced by fluoride then we have a inhibitory or even a remineralizing situation. Thus if we can reverse the diffusion direction shown in Fig. 4 dental caries inhibition and even reversal will occur.

(vii) The 'intact surface' layer is continually rebuilt as specias such as $CaHPO_4$ diffuse out, partially dissociate and recrystallise [8 9]. A 'toll-gate' situation exists and the thickness of this surface layer is dependent on the degree of protection by the pellicle and the chemicals in the oral environment. Subsurface dissolution continues if the acid challenge continues.

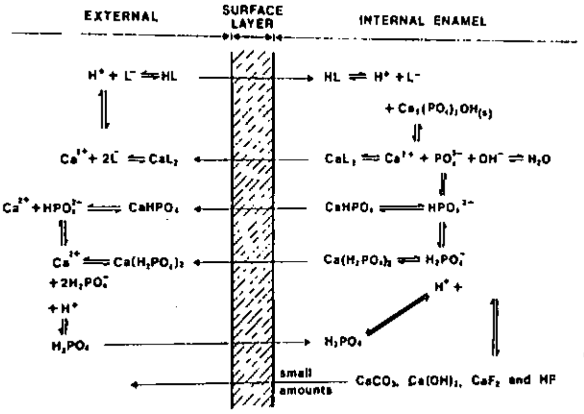

Fig. 4. Diagrammatic representation of simplified chemistry of subsurface emineralization proceeding after the intact surface leyer has been formed.
$Ca_5(PO_4)_3OH_{(s)}$ represents solid enamel-apatite crystals. All other species are aqueous ions or aqueous complexes in solution.

Prevention Of Dental Caries

Dental decay is a multifactorial problem and there is no one factor which we can alter which will prevent decay. There is still some way to go to achieve a full understanding of the process but there are known factors which will aid in the prevention of dental caries and some are listed below.

Reference to Fig. 4 and the discussion of it will assist in understanding the following:

1. Stop or slow down acid production by plaque.
   (a) Maintain plaque at a low level by daily toothbrushing with a mildly abrasive toothpaste, probably before meals.
   (b) Reduce the frequency of sugar intake.
   (c) Substitute xylitol for sucrose in confectionery (xylitol is not metabolised to acids by oral bacteria, but looks and tastes like sucrose).

APPROXIMATE ENAMEL COMPOSITION

APATITE	$Ca_5(PO_4)_3OH$	94%
WATER	H_2O	2-3%
OTHER INORGANIC INCLUSIONS (IN THE APATITE LATTICE)		
Carbonate	CO_3^{2-}	~ 2.5%
Na, Mg, K, Cl, etc		~ 1%
Fluoride	F^-	0.01 - 0.05%
ORGANIC	PROTEIN	< 1%

Table 1. Approximate enamel chemical composition, % w/w. In comparison dentine has approximatly 70% apatite, 20% organic and 5-6% water.

DIFFUSIBLE SPECIES

$CH_3\ CH(OH)COOH$ = HL	Unionised Acids
$CH_3\ COOH$ = HAc	
$Ca\ HPO_{4(aq)}$, $CaL_{2(aq)}$	Metal Complexes
$Ca\ Ac_{2(aq)}$, $Ca\ Tart_{(aq)}$	

RETARDED SPECIES

Ca^{2+}, HPO_4^{2-}, L^- Ac^-, CO_3^{2-}, $Tart^{2-}$	Ions

Table 2. Predominant diffusing species relevant to dental caries. The charged nature of the apatite-like enamel crystals together with the protein/lipid matrix surrounding them retards ion movement making uncharged species important.

GENETIC MANIPULATION

As we go to press we learn that the US National Institute of Health committee, which authorised the guidelines covering recombinant DNA experiments, has agreed to an exemption of all work covering E.coli K12, which accounts for 80-85% of the experiments. — Ed.

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All of us have heard various arguments concerning the topic of recombinant DNA research, but few have the background to appreciate the techniques involved or how these bear upon the controls at present in force. It is the aim of this short article to outline the essentials of the experimental techniques involved and to try to clarify the present position we have reached in the formal control of such techniques.

Experimental Techniques

Deoxyribonucleic acid (DNA) is a complex macromolecular polymer of four different hetrocyclic bases cytosine, adenine, thymine and guanine and the sugar deoxyribose joined together by phosphodiester bonds. The form of DNA found in most organisms consists of two strands of the polymer, running in opposite directions, held together by hydrogen bonding between the heterocyclic bases. The information, commonly known as genes, is stored in the sequential arrangement of the four bases. In order for a cell to synthesise proteins the information contained in the genes is first transcribed into an intermediary, ribonucleic acid (RNA), which is itself translated into a protein sequence.

Recombinant DNA technology involves the chemical synthesis or isolation of one or more genes from an organism, followed by insertion of this DNA into the DNA of a host organism to give the recombined DNA. The recombined DNA must then be in such a form as to allow the host organism to copy the newly formed DNA, that is to clone it.

The development of this technology over the past few years has been dependent upon five main advances:-

(1) The discovery of restriction enzymes, which are enzymes capable of breaking the phosphodiester bonds of DNA only at specific sequences of bases.
(2) The ability to splice together strands of DNA formed by the action of restriction enzymes using ligase enzymes.
(3) The development of vectors for carrying the DNA to be cloned.
(4) The development of techniques used for inserting and identifying recombined DNA reproduced in a host cell.
(5) Our ever growing knowledge of *Escherichia coli (E. coli)* and its genetic characteristics.

The simple outline above of the development of recombined DNA technology now allows us to investigate the present situation more closely.

The most widely used host organism for cloning experiments is a strain of the normally non-pathogenic bacterium *E. coli* K12. This organism contains a single chromosome consisting of a piece of circular, double helical, DNA which contains all the normal cellular genetic information. In addition to this single chromosome *E. coli* often contains extra-chromosomal DNA in a form known as plasmids. These plasmids often carry the genetic information responsible for such things as antibiotic resistance. Plasmids consist of short sequences of DNA closed in a circle and are easily isolated from chromosomal DNA.

Some *E. coli* strains can also be infected with DNA containing viruses known as bacteriophages such as phage lambda. These phages can introduce DNA into a bacterial cell as an extra-chromosomal species, which will be replicated many times and released when the cell dies.

Thus plasmids or phages can act as extremely effective vectors in recombinant DNA experiments; that is as

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Dental Caries (Cont)

(d) Fluoridation of water supply, fluoride toothpaste, toothpaste as a buffer.
(e) Other dietary influences such as cheese after a meal (good buffering action).

2. Stop or slow down enamel crystal dissolution and the outward diffusion of calcium and phosphate.
   (a) Improve initial enamel formation and improve the enamel outer layer in the oral environment — fluoride, balanced diet, plus other trace metals.
   (b) Maintain and improve the pellicle, by good salivary flow and composition, coupled with mild abrasive only.
   (c) Remineralization by calcium, phosphate and fluoride complexes in the oral environment — fluoridated water supply, fluoride toothpaste, calcium carbonate abrasive, fluoride tablets, fluoride mouth rinses, remineralizing mouth rinses, i.e. enhance the natural protective action of saliva.

Acknowledgements

The work which led to the chemical model described here was supported in several ways by the Medical Research Council of NZ.

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carriers of the DNA sequence to be cloned. The main obstacle in recombinant studies is how to introduce the required DNA sequence into the vector. In the case of the use of restriction enzymes a piece of DNA, which contains the required sequence, is treated with the enzyme and is cleaved at a recognition site known as a palindrome. A palindromic sequence is one which contains a two-fold rotational axis such as:

— C A A T T G —
: : : : : :
— G T T A A C —

where C, A, T, G represent heterocyclic bases.

Such treatment usually leads to a segment of DNA which has a cohesive or 'sticky' end, that is a segment in which the terminal of one strand of the double helix is not completely complemented by the other strand:—

— C
:
— G T T A A —

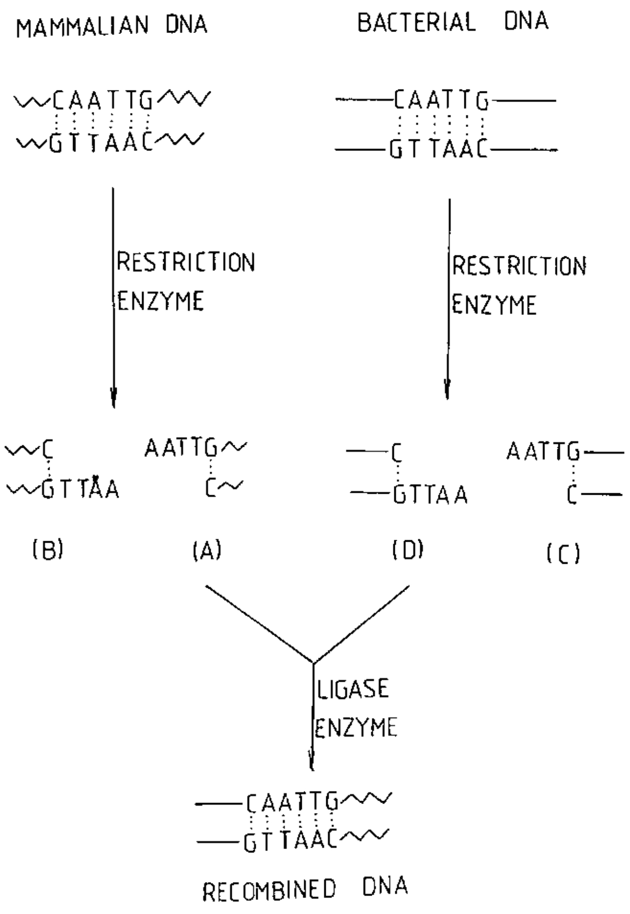
As a consequence of this palindromic cleavage, the treatment of, for example, a human DNA sequence with a particular restriction endonuclease will yield at least one fragment which has a cohesive end, complementary to that produced by treatment of a segment of bacterial DNA with the same enzyme. Using a ligase enzyme it is then possible to join these two fragments together (see Fig. 1.).

The isolation of the original DNA molecule from a cell represents only one of the methods available to investigators. When the amino acid sequence of the required protein to be synthesised is known, it is now possible to predict the equivalent DNA sequence and to synthesise the DNA chemically. It is also possible to prepare DNA, from its associated RNA intermediate, by a process known as reverse transcription. The chemical synthesis and reverse transcription method, however, do not normally produce DNA with the appropriate cohesive ends. In the past it has been necessary to chemically add on these sequences after synthesis. Recently, however, a butt ligase enzyme has been isolated which can be used to join fragments not possessing cohesive ends[1].

We can see now how it is possible to cut and splice the necessary DNA sequence. But this is only part of the problem, as the recombined DNA must be put into a vector in such a form as to allow successful replication and translation into protein.

The use of plasmids and phages as vectors has been mentioned above. Plasmids, when introduced into a bacterium, may be replicated to form as many as a hundred or more copies. The use of plasmids which also confer antibiotic resistance allow the introduction of the recombinant DNA and then the selection of the newly transformed cells, by employing their newly gained antibiotic resistance. Thus we have seen how it is possible to create recombinant DNA and introduce it into a host cell and having done so select for the newly transformed orgaisms. However, the final goal of such studies is the production of protein. Because of the greater complexity of the genetic control exercised in higher organisms, insertion of the appropriate DNA sequence from, for example, a mammalian cell into a bacterium alone will not necessarily lead to protein synthesis. To some extent this problem has been overcome by the 'trick' of introducing the foreign DNA next to a control element of the bacterial chromosome, which seems to 'fool' the bacterium into recognising the newly introduced DNA as part of its own genetic material.

FIG 1



Present Use

One of the recent tours-de-force which exemplifies this technology is the production of somatostatin[2]. Somatostatin is a mammalian hormone which is in part responsible for the control of the secretion of growth hormone, insulin and glucagon. It was originally isolated, using classical biochemical techniques, in yields of only a few milligrams from the brains of half a million sheep.

Using chemical synthetic techniques the corresponding DNA sequence has been produced and introduced into *E. coli* via a plasmid. However, early experiments apparently failed to yield somatostatin, due to degradation of the protein by enzymes within the bacterium. This problem was elegantly circumvented by another experiment, which incorporated the somastostatin DNA at the end of a sequence coding for a bacterial protein. In this case protein synthesis occurred to give somatostatin linked to the end of the native protein. The bacterium recognised the normally synthesised portion of this complex as native and failed to degrade the new molecule. Isolation of the protein followed by simple chemical cleavage yielded somatostatin. Recombinant DNA technology thus made possible the isolation of milligram quantities of the hormone from only 100g of bacteria.

Future Prospects

After consideration of the techniques of recombinant DNA it is now sensible to consider the possible future

Genetic Manipulation (Cont)

of such technology; to look at its promise and possible drawbacks.

Firstly the promise. It seems likely that in the not too far distant future other hormones, enzymes, blood factors and pharmaceuticals will be produced in a similar manner to that used for somatostatin. In fact, researchers in California have already predicted that by 1982 *E. coli* will be used in the mass production of insulin. Other applications of recombinant DNA are foreseen in gene therapy and immunotherapy against viral disorders and perhaps even cancer.

The controversy concerning the use of recombinant DNA centres on speculation as to the possibility of the formation of novel pathogenic species, which might escape containment and wreak havoc on populations which have no natural immunity whatsoever to these species.

Control Measures

As early as 1971 scientists voiced concern as to the possible consequences of recombinant experiments. However, it has been known for many years that 'natural' recombinant events occur between bacteria in the environment. The concern centred on the new possibility of DNA transfer between species. Concerns crystallised in 1973 at a Gordon Conference, when a group of 90 scientists requested the American National Academy of Science to appraise the possible risks[3]. The committee so formed, called for a moratorium on certain types of experiments from 1974 onwards.

An international conference at Asilomar, California, in 1975 agreed that most experiments should proceed and made the significant proposal that biological containment of host-vector systems should be used, in addition to physical containment[4]. The National Institute of Health (NIH) was asked to establish guidelines. Biological containment was proposed in two forms (a) the development of bacteria capable of growth only under very special laboratory conditions and (b) vectors only capable of living in very specific hosts and unable to transfer to other hosts. While the NIH was finalising its guidelines Curtiss, of the University of Alabama, was developing a safe strain of *E. coli.* In March 1976 the Curtis derivative was certified as meeting the NIH requirements of biological containment[5]. The strains require laboratory chemicals, are sensitive to antibiotics and bile salts and are easily destroyed by sunlight. The NIH guidelines of June 1976 explicitly prohibited certain experiments and suggested four levels of physical containment (P1-P4) and three of biological containment (EK1-EK3). These proposals did not, however, quell the arguments which rose to a high pitch in the summer of 1976, when the city of Cambridge, USA, discussed the proposal of Harvard University to build a moderate risk (P3) facility. After prolonged debate city ordinance controls were established which were only slightly more restrictive than those of the NIH.

Recently in USA several Congressional bills have been introduced concerning recombinant DNA, but none have been passed. One of the main reasons for this is the fact that advance in this area of research is so rapid that legislation is difficult to draft. In particular, the main argument that recombinant DNA experiments may produce completely novel organisms has to some extent been quashed. Chang and Cohen, of Stanford University, have recently shown that, although the probability is low, it is possible for fragments of DNA from higher organisms to enter naturally into bacteria and be cloned there[6]. Also it has been shown that higher organisms often contain genes which require different translational mechanisms to those in bacteria, and so recombinant DNA experiments leading to the synthesis of higher organism proteins, will in most cases require higher organism host — vector systems[7].

As in USA, over the same period in UK the Dept. of Health and Social Security set up a working party, which led to the establishment of the Dangerous Pathogens Advisory Group (DPAG). The US request for a moratorium stimulated the Advisory Board for Research Councils to set up its own working party under Lord Ashby. This working party concluded experiments should continue in UK provided appropriate precautions were taken. The precautionary safeguards were devised by another group under Sir R. Williams and by the end of 1976 a National Genetic Manipulations Advisory Group was established.

Although in NZ regulations governing recombinant DNA research direcly affect only about 10 researchers (compared with hundreds in USA and scores in Europe) the pattern of development of controls has followed those outlined above.

In July 1975 the Medical Research Council of NZ (MRC) invited Profs. P.L. Bergquist and G.B. Petersen to form a committee to examine the position in NZ and to make recommendations. An interim report appeared in February 1976. The MRC then directed all MRC grant holders to observe these interim guidelines. After a formal report from the MRC was submitted in March 1977, the DSIR in April of that year established a formal advisory committee. The advisory committee submitted proposals similar to those of the MRC but modified specifically to cover higher plants and their associated micro-organisms. It was in May 1977 that the Minister of Science and Technology directed the DSIR to ensure that all its laboratories conformed to the MRC guidelines and requested that the Ministries of Health, Forestry and Agriculture and Fisheries also adhere to these controls.

In April 1978 a report appeared from a Working Party on Novel Genetic Techniques, established by the Minister of Science and Technology in July 1977. This report recommended that NZ scientists proceed in the field as long as appropriate control measures were observed and the establishment of a National Committee to adjudicate on all proposed experiments. However, it was foreseen that although no legislation need be enacted, private sector concerns should be required to be licensed before undertaking recombinant DNA experiments.

The containment proposals for NZ follow those of the Williams committee in UK, but further stress biocontainment and, as such, are probably more stringent than those in operation in either UK or USA.

Conclusion

Although the recent findings and controls have to a large extent satisfied the sceptics, some very serious areas of concern remain. The NIH, MRC and SRC guidelines are binding only on researchers holding grants from these bodies, although all reasearchers have voluntarily followed them. If no legislation is forthcoming, with the possible massive gains to be made, one wonders just how long it will be before many major pharmaceutical companies establish substantial research projects in recombinant DNA. In fact the General Electric Co., USA, has already been granted patents for a bacterium. Even so perhaps the most ominous 'horror scenario' is the use of such techniques to produce commonly invasive orgaisms containing toxic plasmids, for agressive use by countries not wealth enough to engage in nuclear research. However, with

Development Of Nuclear Power In NZ

B. J. O'Brien

Bernard John O'Brien was born in Hastings in 1926; attended Victoria University in the late 1940s' gained an M.Sc. (1st class Hons) in 1950. Between 1951 and 1958 he was employed on research and development at the Dominion Physical Laboratory in Lower Hutt, where he was engaged in instrument development for geophysics and other research areas, and was responsible for setting up a section engaged in research into biophysics.

In 1959, he joined the recently established Institute of Nuclear Sciences and was engaged on theoretical nuclear research and radioactive hazard evaluation. Between 1962 and 1964, and again for several periods between 1970 and 1974, Dr O'Brien was employed by the UN Scientific Committee on the Effects of Atomic Radiation. He attended the Massachusetts Institute of Technology between 1964 and 1967, completing a Ph.D. degree while working on problems of low-energy nuclear physics. Between 1975 and 1978, Dr O'Brien was on leave from DSIR working for the UN Environmental Programme, and during this period was appointed Acting-Director, Monitoring Assessment and Research Centre, Chelsea College, London. He returned to N.Z. in 1978 to become Director, Institute of Nuclear Sciences.

The Need For Nuclear Power In NZ

In its reports prior to 1976, the Planning Committee on Electric Power in NZ had suggested that this country would need to commission, by the late 1980s, two 600 MW(e) nuclear power generating stations. Several developments had led up to this proposal. Firstly, during the late 1960s and early 1970s electricity demand had been increasing rapidly, due not only to increased domestic usage, but also to a very enhanced demand by the commercial and industrial sector. Between 1970 and 1975 the use of electricity by the latter sector increased by 79%. Another reason for the rapid growth of electricity consumption in NZ was no doubt the low price of electricity to the consumer, particularly when compared with the price of alternative forms of energy. At that time it seemed that nuclear power might be necessary if alternative sources of energy could not be developed in time.

In 1978 the report of the Royal Commission of Inquiry into nuclear power generation in NZ was published. This Commission had held public hearings during the previous two years and considered various possible energy strategies for NZ Between 1975 and 1978 there was also a reduction in the rate of increase in electricity demand. This was caused by several factors, among them a reduction in economic activity with a consequent lower demand by industry as well as a substantial price increase. The changes in demand were such that in 1977 and 1978 revised projections were made by the Planning Committee as to NZ's electricity generating needs during the next decade or two. Thus in 1975 the Planning Committee estimated that the country's needs for electricity in 1989-1990 years would be 53,000 GWh, whereas the prediction made in 1978 was about 34,000 GWh.

In view of these new, revised projections, the Royal Commission stated that "it appears unlikely that NZ will need to commission a nuclear station before the turn of the century". However, the Commission also stated that NZ should maintain an interest in the nuclear field and continue to survey it closely. Presumably this is for contingency reasons, in case the demand at a certain stage increases more rapidly than can be supplied by alternative energy sources.

Whether or not we will need nuclear power during the next 20 years will depend on many factors. These include the extent to which the domestic and industrial demand for energy will be transferred to other sources such as natural gas; how the nation fares economically during the next decade or so, particularly whether or not there is rapid industrial growth in NZ; or alternatively whether we opt for a low-technology economy, with perhaps a considerable flow of population to other countries. Other factors include the extent of our future gas and coal supplies and how much of these will be needed during this period to provide liquid fuels for transport; to what extent generating capacity can be provided from small hydroelectric schemes and how much capacity will be eventually contributed from geothermal energy.

Most of the cost of electricity generated from nuclear energy results from the capital cost of the station, only a small fraction being due to fuel costs; in this it is similar to that generated from hydroelectric power schemes. In the case of nuclear power however, NZ would have to import a greater fraction of the equipment. All these factors need to be continually re-evaluated.

Nuclear Power Developments Worldwide

The expansion of nuclear power industries in developed overseas countries has been very variable, depending to a large extent upon the electricity demand, and whether or not there were reasonable quantities of other sources of energy within those countries. At present USA has the greatest installed capacity for nuclear energy generation, some 52 GW(e). This is expected to reach 170-odd GW(e) by 1988, when plants already under construction come into operation. However, the countries which are most committed to nuclear energy, in terms of their overall generating capacity, are France and Japan, countries which have very small resources of fossil fuels within their own territories. At present France generates some 10% of its electricity from nuclear stations and this is planned to increase to some 35% by mid-1980s. World capacity will be about 150 GW(e) in 1980 and is expected to reach 400 GW(e) by 1990. Most nuclear reactors in operation and under construction are of the light water type; however

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Genetic Manipulation (Cont)

the ready availability of such 'natural' organisms as Clostridium Botulinum this latter prospect, hopefully, seems at least a little incredulous.

As for almost all major advances in science in man's history, recombinant DNA technology holds the prospect of enrichment or possible destruction. The outcome rests squarely on the choices made by society.

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Nuclear Power (Cont)

graphite-moderated reactors are being used in UK and to some extent in USSR and France, while heavy-water-moderated reactors are used in Canada. Fast breeder reactors are under development in several countries, although USA has reduced its effort because of fears of terrorist activity if plutonium becomes readily available. France is pressing on with the construction of a 1.2 GW fast-breeder reactor, planned to generate power in the early 1980s. Although there was confidence 20 years ago that nuclear fusion power would be demonstrated by now, a practical device for generating power has not yet been produced. It is unlikely therefore that nuclear fusion will be an important energy source before the turn of the century.

There has been a continuing debate for a decade or more concerning the safety of nuclear reactors, particularly the light-water-moderated reactor. It is therefore worth describing the recent accident at Three Mile Island since this is the only serious accident involving an electricity generating reactor. Previously there had been major accidents involving new reactors being developed and plutonium-producing reactors. There were the accidents at Windscale, UK, the NRX reactor in Canada, the SL1 at the Idaho reactor testing station and the Enrico Fermi fast-breeding reactor in USA.

We shall here describe the incident that took place at Unit 2 of the Three-Mile Island Nuclear Generating Station in Pennsylvania on March 28 this year. At 4 a.m. a pump in the secondary cooling loop failed. A back-up system was automatically activated, but because 2 valves in the back-up feed-water system had been left closed, against regulations, the back-up system could not work. This caused the pressure and temperature of water in the primary cooling system to rise to such an extent that the reactor was automatically shut down. Pressure continued to rise, due to residual heat being released from decaying fission products, until a relief valve opened, and this then stuck in the open position, causing much water to be lost from the primary cooling circuit. This activated the emergency core-cooling system which then proceeded to pump cold water into the primary circuit. Some time later the emergency cooling pumps were shut off by the operators. During the next 1-2 hrs some radioactivity, initially present in the primary cooling system, was released to the atmosphere; this was mainly composed of noble gases. Between 1-2 hours after the accident started, operators shut off the pumps in the primary coolant circuit, purportedly to prevent cavitation and damage to the pumps! With no forced convection and heat sink available the temperature inside the pressure vessel rose to such an extent that steam was formed and eventually the upper portions of the core were not covered by water. This resulted in damage to the fuel rods, with melting of the zircalloy fuel cladding. The zircalloy reacted with the water to produce hydrogen gas which formed a bubble at the top of the pressure vessel. After considerable delay the gas bubble was drawn off and forced convection resumed and the reactor core was cooled down.

There was considerable reaction from the news media, from anti-nuclear groups as well as from people living within the vicinity of the reactor. President Carter visited the reactor during the time of emergency and later set up a Presidential Commission to investigate this accident. This is expected to report about the end of October. Measured increases in radiation levels surrounding the power station were fairly small and not very long lived. Subsequent measurements made on some 400 persons living nearby indicate that in no cases were any increased levels of radioactivity detected. After the incident the US Nuclear Regulatory Commission closed down 19 similar plants for modifications to the emergency cooling system. Some of these are now starting up again. An investigation into this incident has already been completed by the US Electric Power Research Institute. This has shown that damage to the reactor core did not occur until some 3-4 hrs after the accident began. This indicates that the accident did not really become very serious until operators closed down the primary-coolant pumps between 1 and 2 hrs after the accident was initiated.

The Electric Power Research Institute investigation concluded that the operators at Three-Mile Island did not really know what they were doing after about an hour into the accident. One outcome of this, already voiced by the industry and the Nuclear Regulatory Commission, is that there will be changes to ensure that operators are more carefully selected, better educated and qualified, and that they should receive more training on simulators, particularly related to a variety of possible accident configurations.

Another proposal is to have a safety engineer on duty at all times. From remarks made by persons involved with the Presidential Commission it seems that there will not only be changes made in the organisation and control of nuclear reactor operators, but also there may be major structural changes within the US Nuclear Regulatory Commission itself. The accident will no doubt result in improvements in various hardware equipment as well as better devices to monitor the state of this equipment. However, the major improvements will probably be to the operating and organisational structure concerned with operation and safety, an area that seems to have been somewhat lax in USA. The incident was also watched closely by nuclear experts from many other countries who hoped to gain information that would help them to better organise their own safety procedures.

Ontario Hydro: 8 Years Of Nuclear Power Without Mishap

Peter Reaves

Yesterday some 30% of electricity generated by the Ontario Hydro — the Canadian province's power supplier — was nuclear sourced — just as it has been for the past 8 years.

The Hydro's Pickering nuclear generating station, just east of Toronto, was commissioned in 1971 and has been the subject of continuous emission monitoring since then. All Ontario Hydro reactors are of the Candu type, developed jointly by Atomic Energy of Canada Ltd and the Hydro. (It was a bitter disappointment to both concerns when Argentina opted in October to buy an unproven "story book" reactor system from West Germany at a cost of $C1 billion more than the Candu system; this on top of Japan's earlier rejection of the Canadian reactors in favour of developing its own technology means, as one spokesman commented, "we'll have to try harder in future nuclear marketing.")

Constantly aware of a genarally pugnacious local news media and subjected to regular scrutiny by local environmental "watchdogs" (including a branch of the Sierra Club), the Hydro tries to keep its customers up to date about the Pickering nuclear station through handouts (typical examples are "Nuclear questions and answers" and "The Nuclear story"); originally it adopted a policy of informing local media of every occurrence at Pickering, but found generally the media were interested only in problems, rather than achievements. "Having abandoned that policy, we're now accused of 'covering up'," a Hydro public relations man told me in September, "It's hard to win in those circumstances."

In its 8 years' operation, the Pickering plant has never had a mishap requiring even the activation of the first of its 3 back-up safety systems. As a result of the Three Mile Island accident, Ontario Hydro — which controls the generating power of the (Canadian) Niagara Falls — has been selling power to Metropolitan Edison — and has been accused of profiting from that company's misfortune!

The Hydro buys uranium concentrate from mining companies operating in Ontario and, as is pointed out elsewhere, the fuel cost is much lower — 1lb of uranium costs $C31 (1976/77 figures) and produces an average 280 million

"Electric Vehicles Will Have Place In Future Transport" — Arthur Williamson

Prof. Arthur Williamson, a member of the NZIC's Energy Committee, comments on Dr David Rand's papers published in our October and December 1979 issues.

By chance Dr Rand's papers arrived on my desk for comment simultaneously with another discussion paper on battery electric vehicles prepared by a Government department.

There is no doubt at all that electric vehicles will have a place in the future of road transport. The uncertainties are when and how much.

We have now reached the point where the decisions about immediate measures to alleviate the country's transport fuel problems are about to be taken. We will I hope soon be setting about a vigorous campaign to extend the industrial use of gas, fuel a very much larger proportion of our fleet cars on CNG (and some on LPG) and supply the rest with methanol extended fuel. The time is now ripe to start planning the next phase of the energy campaign which should include a very much more serious consideration of the electric vehicle than has been given in the past.

The "deficiencies" of the electric battery vehicle are its short range, its relatively low top speed, its abysmal acceleration at very low speeds, its relatively long recharge time, its high weight and the high cost of battery replacements. All these deficiencies are ones of comparrison with the highly developed petrol engined vehicles. If one puts a few minor constraints on vehicle requirements some of these deficiencies are no longer evident. If one is only interested in an urban vehicle which will do 50-80 km/day, which never strays more than 40 km from home base, which does not have to climb steep hills, which does not carry heavy payloads and which does not have to exceed the city speed limits then one is left only with the minor inconveniences in the performance of poor acceleration.

The cost of battery replacement must be put in its proper perspective in which the combined costs of battery replacement and running are matched against engine replacement and running costs for a conventional vehicle. In the first case we are looking at 1.4c/km (3.3c/kwh) running costs and 4.8c/km ($1200 and 500 charge cycles); in the second case, at 3.8c/km (petrol @ 40c/l) and 1c/km for engine replacement ($1500/50,000 km). One can argue about the details of the above figures but they do indicate the nature of the economics of the 2 types of vehicle. The battery costs will almost certainly decrease significantly and the fuel costs for the petrol vehicle will certainly increase in the next few years. It would take only a 50% increase in the prices of petrol and electricity and a 25% improvement in the battery life estimated above to turn the 30% advantage of the petrol vehicle to a 30% disadvantage.

Much work has been done of late in the field of electric vehicle control systems and significant improvements have been made. One of the most promising systems derives from the a.c. motor controllers devised by Mr. D.J. Byers, Electrical Engineering Department, Canterbury University. This system allows the use of cheap, easily produced a.c. motors as the driving units albeit at the not inconsiderable expense of some very sophisticated electronics. However it is held that the opportunities for reducing the cost of electronic systems are better than those for reducing the costs of electric motor construction. Be that as it may, I believe it is now time for some serious effort to be put into examining the place of electric vehicles in our future transport pattern with a view to answering questions such as: "Should we encourage the use of electric vehicles?" If so at what rate should they be introduced to the system? How may electric vehicles should we aim to have? What types of vehicles are already available? What types are being developed? When will they be ready? What advances are being made in battery design? When are new designs of battery likely to be available commercially? Should we be encouraging research and development in vehicle design in NZ? Should we be encouraging research and development into battery systems in NZ?

I believe that the answers to these last two questions are "Yes!" and "Yes"! There is already clear evidence that the ideas being developed here in electric vehicle control systems are at least as good as — and possibly better than — those being developed anywhere else in the world. We have thereforesomething which can be of value to all and which might even be of economic value to the country as an export item and which should not be stifled. On the other hand there is no research on storage battery systems that I know of in NZ. This is not too surprising since development in this field can be very expensive. Dr. Rand's papers are a compact summary of the present state of the art in vehicle propulsion batteries. For the moment we appear to be stuck with the lead acid-cells which fall short of the ideal by a factor of about 3 in almost all respects — capacity, power and cost. Much work has gone into examining new chemistries involving systems with higher EMFs and lower equivalent weights. While these are certainly sensible directions to go they all seem to be the product of the electrochemist's approach. In purely chemical terms there are plenty of reactions with Gibbs free energies of about 1 kwh/kg. The problems of converting many of these into an "electrochemical" form are not great but the problems of ensuring that most of the mass of battery is in the form of accessible reagents do appear to be very difficult. It seems to me that there may be some benefit to be had in the storage battery field from a greater attention to surface chemistry.

Quite apart from the technological and scientific benefits which might come from research into electric vehicle design and storage battery design it is of vital importance to the nation to have a nucleus of expertise in any field in which we are likely to be nationally involved. One of the best ways of ensuring that this nucleus exists is to have a group of enthusiastic researchers working in the field. Such a group will automatically keep itself au fait with developments and will produce a pool of people knowledgeable in the field and ready to recognise and take advantage of developments wherever they might originate. For this reason alone it is important to support and encourage research and development in the electric vehicle and storage battery area in the universities and elsewhere in the country.

The cost of such a programme is relatively small. In the energy field most costs can be scaled by comparing them with the cost of oil exploration. Some years ago I heard a figure of 50c quoted as being the cost of discovering one new barrel of oil. Some $50 million was spent in 1978 on oil drilling off our coast. An annual budget equivalent to a mere 20-30 metres of "dry-hole" would probably be more than an active research group on electric vehicles could manage to spend.

BTUs; oil burned at another station to produce the same BTUs cost $C513 (1976/77 figures).

The Hydro conducts regular health checks among Pickering staff; monitoring of residents in the area is the responsibility of provincial government agencies, but the checks have given no cause for concern. The Hydro retains local doctors to advise on public health-related matters.

In early October the West German Federation of Environmental Groups published a detailed dossier on the safety of nuclear power stations which concluded that the accident record of West German atomic power stations was so poor that use of nuclear energy was connected with "intolerable" risks, according to The Guardian newspaper, UK.

The dossier reportedly contained a complete list of confidential accident reports collected by the West German Government between 1965-77. In the last 2 years, said the report, the number of accidents averaged one every third day.

In the face of public concern over nuclear power stations (and bearing in mind, as others have stated, that much of it is based on uninformed or ill-informed opinion of non-scientific commentators) it is interesting to note the audiences (in N.Z. and elsewhere) who have flocked to see the film "The China Syndrome", whose subject is a nuclear power plant accident. As a movie it makes for powerful, popular entertainment — but has done nothing to advance the cause of nuclear power generation. It was released in USA prior to the TMI accident.

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Public Affairs Committee Defines Its Role

Michael Kingsford, convenor of the NZIC's Public Affairs Committee.

When the working party on "Possible Contributions of NZIC to Society" published its report, one recommendation was that Council should establish a "Public Affairs" Committee to be concerned with, among many possibilities, Government policies, safety, the environment, energy and education, and that the committee should have the power to issue statements on behalf of the Council.

The report of the Working Party was accepted in general terms at a special general meeting of the Institute held during ANZAAS Conference at Auckland in January 1979, and Council responded to the recommendation by setting up a committee comprising the President, and the two Vice-Presidents.

In August, 1979, this decision was modified by Council which changed the committee membership to the following:

Dr M. Kingsford (convenor)
Dr J. D. B. Featherstone
Dr A. F. Wilson

The committee is concerned that the Institute is not making the contribution that it might to decisions which affect the whole of NZ society, and seeks to develop a mechanism by which the expertise available within the Institute might be identified and persuaded to contribute to statements made on behalf of the Institute.

In principle the committee also represents a method of speeding up the process of generating such statements so that they may be timely rather than too late for the event.

Clearly any enterprise of this kind is not going to succeed unless it is supported by a substantial proportion of the Institute's membership. This support falls into at least two categories. The first is the provision of expert knowledge and comment when called upon by Council or the Public Affairs Committee, and the second is the identifying of matters on which the Institute might properly comment.

We envisage branch chairmen as playing a crucial role. Any member of the Institute, having identified an area which he considers worthy of comment, should approach his branch chairman to see what might be done. The branch chairman has the choice of three actions. He may decide that he can generate a suitable comment himself, with the aid of the expertise in his branch, he may refer the matter to the Public Affairs Committee, or he may decide that in his judgement, and that of his committee, it is not a matter that the Institute should be concerned with.

In the last case the member concerned may well feel that his branch committee is unenlightened and wish to communicate directly with the Public Affairs Committee. Undoubtedly some matters raised will fall within the terms of reference of committees already appointed by the Council, such as the Energy and Chemical Materials Resources Committee, or the Hazardous Chemicals Committee. In such cases the Public Affairs Committee will naturally expect those other committees to be responsible for preparing statements.

The PAC does not see itself in the business of the wholesale production of statements for public release. It does see itself as a means of co-ordinating the public affairs of the Institute and of provoking response from members to affairs external and internal to the Institute. For this reason, as has been stated, the success of its activities must depend upon the co-operation it can gain from the membership.

Our major role is one of co-ordination, and our main aim is to ensure that, within the limitations of available time, the Institute offers the best available chemical guidance.

Your role is to keep us informed of important developments and to make your skills available when they are needed.

We look forward to a happy association.

Michael Kingsford

Contact addresses of the Public Affairs Committee members are: Dr M. Kingsford, 5 City View Grove, Lower Hutt. Ph: 666-919 (home), 695-908 (bus.); Dr J.D.B. Featherstone, Box 27-007 Wellington. Ph: 897-156, (home), 843-083 (bus.); Dr A.F. Wilson, Box 543 Wellington. Ph: 739-719 (bus.).

People

I. R. C. McDonald, Deputy Director, Chemistry Division, DSIR, and Dominion Analyst, was recently appointed as the Director of this Division to replace **Dr A. J. Ellis** who has become an Assistant Director-General, DSIR.

Mr McDonald was educated at Scots College, Wellington and joined the then Dominion Laboratory in 1942 as a cadet. In 1944 he left to undergo navigator training in the RNZAF and after the war he studied part time at Victoria University of Wellington, completing a B.Sc. in 1947 and a M.Sc. in 1948. Further study followed (1950-1952) at the Forest Products Research Laboratory, Princes Risborough, UK.

Mr McDonald returned to the Dominion Laboratory in 1952 and worked on terpene chemistry (with particular reference to NZ turpentine), the structure of Zeatin, and the rot-proofing of cellulosic materials (from which the orange tarpaulins still used by the NZ Railways were developed). He became interested in the application of instrumental methods (uv, ir, nmr, and glc, etc.) to chemical and structural analysis, and following a period as Group Leader in Chemistry Division (from 1961), was appointed Dominion Analyst in 1971. His recent interests have included the analysis of alcohol in blood and in the breath, carbon monoxide toxicity, and the automation of chemical analysis.

R. R. Biddle has gone from Henderson High School, Auckland to Nuie High School; **Mrs K. G. Roberts** is now a teacher at Edgewater College, Pakuranga, Auckland; **Dr V. L. Crow** from Massey University to Dairy Research; **Dr M. E. Taylor** to be Research Director, Water Quality Research, Water and Soils Division, MWD Wellington; **Dr C. G. Hughes**, Ph.D. (Hull) has been appointed Tutor in Pharmacy at the Central Inst. of Technology, Trentham; **Dr M. T. Hearn** has been promoted to be Senior Research Officer at the Medical School, Dunedin; **A. K. Guthrie** has joined Canterbury Frozen Meat at Belfast; **A. J. McBride** of Knox College, Dunedin has been ordained and has gone to Westshore, Napier; **Dr C. N. Trotman** from the University of East Anglia has been appointed to the Dept. of Microbiology at Otago; **Mrs S. Nellailingam**, B.Sc. (Madras) has been appointed Chemist at the Railway Workshops, Lower Hutt; **Dr R. T. Baker** from the Levin Horticultural Research Centre to the Plant Health Station, Mt Albert, Auckland; **M. G. Banwell** from Victoria University, Wellington to Ohio State; **R. W. Meadows** from NZ Forest Products to Beecham (NZ) Auckland; **Dr G. B. Kitto** is now a full Professor at Clayton Research, Austin, Texas; **P. J. Melling** from Chemistry Department, Victoria University, Wellington to Univ. W. Ontario, London, Canada.

Address wanted: L. A. Jenkins, last heard of at Australian Iron & Steel, Woolongong.

Mr **J. Hudson** has been appointed manager, chemical division, GAF NZ Ltd. He replaces **Mr P. Levshin**, who is returning to Australia.

Readers' Letters

RSNZ Fellowship For Industrial Chemists

A strong plea for consideration of industrial chemists for election as Fellows of the Royal Society of NZ is made by Mr F B Shorland in a letter to the Editor. The fact that the RSNZ has no industrial chemist in its Fellowship savours of irrational behaviour, he says, pointing out that a readership survey conducted by "Chemistry in NZ" shows that 65.7% of its readers are industrially employed.

"It seems unlikely that those in industry could be exclusively lacking in genetic material for Fellowship ability while chemists who are not in industry have their fair share," he comments.

After outlining the method of Fellowship nomination, he notes that in practice the election criteria have been, "withough exception", published work. The possiblility of exceptional administrative ability as a worthy factor is usually settled, he says, by indicating that the person with the best publications record also has administrative ability.

Mr Shortland continues "In the past in NZ we have elected 1 or 2 Fellows for their obviously outstanding influence on science even though such persons have not produced scientific papers except possibly in the context of scientific history and matters impinging on scientific organisation. Overseas it was recognised that influential people, such as Charles II, were appropriate to include in the Royal Society of London which today would seem to desire to include exceptional people and not solely because of their published scientific contributions. One such example would be the inventor of the jet engine.

"In NZ we have the particular difficulty of the industrial chemist who is unlikely, because of company policy, to be able to publish freely; the work may not lend itself to publication or, perhaps for reasons of competition, the development of a new process should not be made known.

"What is needed, therefore, is for the RSNZ to seek from the industrial chemists a high standard of criteria that would parallel that used now for the Fellowship. This could mean, for example, that a candidate with some published work could cite in addition, evidence of the development of industrial processes, the solving of manufacturing problems, the development of patents, the introduction of new products or the better utilisation of resources. These various aspects could be evaluated as with published work. Scientific and industrial promotion should also be a highly desirable attribute.

"I consider therefore that we should make our Fellowship more strictly representative of the scientists that we have as the first requirement.

"The RSNZ president has stated the direction of science is becoming more the concern of 3 bodies — the National Research Advisory Council for government science, the University Grants Committee for university science **and the RSNZ for science outside these areas.** I think it must be agreed that the residue of science outside govenment and university largely must be industrial science. The analysis of the situation surely must mean that the aspect of science about which the RSNZ is most concerned, namely industrial science — largely industrial chemistry — is the part in which it has least capability. It has no industrial chemist Fellows upon whom to draw for advice.

"The exclusion of industrial chemists and of scientifically influential industrialists from the Royal Society may be an infinitely more important issue to us than the question of overseas relationships of our national committees including such matters as the simultaneous representation of Taiwan and mainland China. These are more the questions for the great nations of the world to solve. Our destiny depends on local issues, the greatest of which could well be the proper and respectable role of industry in our scientific framework, without which we cannot generate funds required for the development of our local science.

"It is up to the Institute to press for a solution to the problem of having people in the industrial field recognised as Fellows of the Royal Society of NZ," he concludes.

The Editor

Sir,

I write to protest at the statement that intravenous solutions and ampoules for injection are not pharmaceuticals (Vol.. 43 (6), p. 229). Your columnist's extraordinary view can be refuted by referring to any text book on pharmaceuticals, the Health Department's Code of Good Pharmaceutical Manufacturing Practice, the British Pharmacopoeia, the Concise Oxford Dictionary or the New Ethicals Catalogue.

I refuse to speculate on the motives of your columnist.

M. Kingsford
Leader, Pharmaceutical Section,
Chemistry Division, DSIR, Lower Hutt.

The Editor,

Sir,

I enjoyed reading the article on "Catalytic Processes in Production of Liquid Fuels from Synthesis Gas" by M. S. Wainwright and W. Marsden (Chemistry in New Zealand, Oct. 1979). However, the quotation at the end of the article was taken slightly out of context, and perhaps I could take this opportunity to put the record straight.

With respect to the operation of the Mobil process, I believe that this will eventually be carried out in a fluidised bed reactor. However, at the moment, the fixed bed process has been successfully operated in a pilot plant, while the fluidised bed reactor has yet to be operated on this scale. From the properties of the reaction and those of the catalyst, I regard this as being only a matter of time although — as would be expected for any new reaction taken to a fluidised bed pilot plant — I would anticipate some teething troubles.

I regret that I have no knowledge of the progress of the Mobil fluidised bed pilot plant in New Jersey, but I know that the in-house technology is such that any problems whould be rapidly solved. For the present, I believe that the choice of the fixed bed reactor is the only practicable alternative. For the future, the properties of the reaction are such that it is to be hoped that a fluidised bed reactor will be available.

Prof. David L. Trimm
School of Chemical Technology,
University of NSW.

The Editor.

Sir,

The problems of an "energy crisis" — or in reality of a petroleum shortage with its rapidly escalating costs — have struck NZ. Alternative forms of fuel for cars are being actively investigated. These include compressed and liquified petroleum gas (CPG and LPG), synthetic petroleum, methanol and ethanol.

In the short term CPG and LPG are being actively promoted for use in commercial, Government and local body car fleets and eventually in private cars. When one considers the consequences of this trend, the only comment can be "Heaven forbid".

Is our technology advanced enough for the widespread use of CPG and LPG in private cars? LPG is too dangerous to fuel passenger ships. Is safety in the use of these fuels being overshadowed by economic considerations?

I am not aware of any accidents involving cars using these fuels and would not wish to be near such an event, especially if a fuel line is broken or a cylinder ruptured. Has this type of accident been thoroughly researched and the necessary safety features included in conversion kits? More horrific would be a tanker explosion, similar to that which occurred at Los Alfaques in Spain a few months ago. We can now say such an accident could happen in NZ, as recently a truck carrying 8 tonnes of LPG rolled over on SH 3 at Mahoenui. The driver in this accident was very lucky to survive as, according to newpaper reports, it took fireman 3 hrs to free him from the crushed cab of the truck and a gas leak developed. The consequences of this type of accident happening in a city area, say New Plymouth, must be carefully considered. Luckily, gas fires and explosions are rare events here and overseas.

Another problem is that of shortage of these products at disposal points (cf. service stations for petrol) throughout NZ. The possibility of accidents here, both to car drivers and station operators, must be considered as these facilities will be developed in built-up areas. A recent meat workers' complaint against the positioning of a LPG tank 180 metres from a dining room at the

Books Reviewed

STRUCTURE DETERMINATION BY X-RAY CRYSTALLOGRAPHY

M.F.C Ladd & R.A. Palmer, Plenum Press, New York, 1977, Pp 393.

Price $35.40

Published in 1977 this book aims to introduce crystallography to final-year undergraduate and first-year graduate students. The early chapters deal with symmetry, preliminary crystal examination by optical and photographic methods and space group determination. Later chapters cover methods of structure solution which include the Patterson function, heavy atom method, isomorphous replacement and direct methods. Mathematical detail has been kept to a minimum. Numerous examples have been included in the text to illustrate the concepts discussed. The final chapter presents details of the structural analysis process for two different molecules, the first a bromine containing organic compound, the second a relatively small "all light atom" molecule.

Each chapter ends with a bibliography for suggested further reading together with a number of problems, solutions to these being given in an appendix. Common methods of X-ray examination and data collection receive scant mention. Thus four-circle diffractometry is relegated to two paragraphs in the appendix and the precession method receives even less attention.

The book is concisely written, has numerous illustrations and is well produced. It is, however, less comprehensive than some of the volumes to which it refers in its bibliographies and at $35.40 is an expensive addition to a student's crystallographic library.

J.M. Waters

Mass Spectrometry in Drug Metabolism. Edited by A. Frigerio and E.L. Chisalberti, Plenum Press, New York-London, 1977, 532 + xii pp., $51.00.

This book is a selection of papers presented at an International Symposium on Mass Spectrometry in Drug Metabolism held at the "Mario Negri" Institute for Pharmacological Research in June, 1976. Most of the research recorded here, both in original papers and in invited reviews, deals with the identification and quantitative analysis of drugs and their metabolites. For this purpose, review papers cover recent developments in mass spectral and related instrumentation.

The papers are divided into six sections: Identification of Drugs and Drug Metabolites (9 papers), Quantitation of Drugs and Drug Metabolites (8 papers), Intermediates in the Metabolism of Drugs (2 papers), Stable Isotope Labelling (2 papers), Developments in Methodology (4 papers), and Drug Abuse (7 papers). Identifications of drugs and some of their metabolites are described in the opening papers. The drugs include feprazone, iopronic acid, isopropylbiphenyl, trithiozine, 9-hydroxy-19,20-bis-nor-prostanoic acid, sodium dipropylacetate, 3-(p-tolyloxy)-1,2-propanediol and 3-phenoxy-1,2-propanediol, difenpriamide, pyrazofurin, Org GC 94 and digoxin. Metabolites produced by the protozoa *Trichomonas vaginalis* (orginally suspected of producing the cancer-inducing compound dimethylnitrosamine) and by schizophrenic and depressive patients are described. A natural source, in this case propolis (or bee's glue), of potential drugs is discussed.

Developments in analytical instrumentation include single and multiple ion monitoring mass spectrometry (now known as mass fragmentography), chemical ionization and field desorption mass spectrometry and the role of computers in analytical gas chromatograph-mass spectrometer combinations. Some of these systems were used to detect the presence of drugs in the enviroment and by hospital departments involved with emergency toxicology. Illicit drugs considered include the cannabinoids, heroin (impurities found therein) and five commonly used anabolic steroids. The book concludes with a list of participants in the Symposium and an index (subject).

Congratulations to the editors and publishers for the rapid accumulation of the papers and publication of this book. No one could complain that the work described here is dated as many of references include papers published in 1976. The book is well presented with clear printing and diagrams and it is reasonably priced for its size. This book should be on the library shelf of any organisation interested in the application of mass spectrometry to bichemical problems. Unfortunately, because of its limited scope, I do not believe many people would wish to purchase a personal copy. A cheaper edition in paper-back may have made it more attractive for the home library.

As there was a selection in the papers recorded in this book a full list of papers that were presented at the Symposium would have been more useful than the list of participants. A record of the discussion at the Symposium of the individual papers would also be valuable.

Does this book fulfil a need other than the publication pf the papers which could have been done in a primary journal? A wide area of research is covered here, from "leisurely" laboratory investigations of drug metabolites to the "instant" answers required for cases involving illicit drugs and drug overdoses, as well as the use and limitations of the instrumental methods of analysis. Most people who read this book will not be interested in the individual drugs under investigation or their mass spectra. They will wish to evaluate the methodology used for the analyses of the various types of compounds and the overall results. At best, this concentration of papers covering a specific area of mass spectral analysis should stimulate the imagination of the reader to investigate further topics of interest that are discussed in this book.

C.B. Johnson

The Nonclassical Ion Problem

Herbert C. Brown
with comments by
Paul von R. Schleyer
Plenum Press, New York, 1977 pp301.
$US29.95

H.C. Brown has discovered that the nonclassical ion theory does not seem to be among the beautiful theories that can be slain by ugly facts. The book is ostensibly about a rather specialised area of organic chemistry. Its wider implications are the popular acceptance of theories backed by too little "hard" fact, the selection of experimental results to favour established theories and the emotional reaction to those who challenge such theories.

The problem referred to in the title is whether certain carbonium ions exist as static classical ions represented by a single Lewis structure, rapidly equilibrating pairs of such ions, or non-classical ions which cannot be represented by single Lewis structure. In non-classical ions a carbon or hydrogen atom bridges two electron deficient centres (the sigma bridge).

Nonclassical ions are usually written with dashes instead of solid lines between the three or more atoms involved in the

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Borthwicks-CWS Longburn plant indicates union feeling on this matter. Problems (union) with the transport of LPG to South Island ports should also be mentioned.

In my opinion the conversion of hydrocarbon gases to liquid products, either methanol or synthetic petroleum (via methanol or a reforming process) is preferred over the direct use of these gases. This recommendation is purely from a safety, rather than an economic,point of view. Energy expenditure in the conversion process and maximum power output from the final fuel product would need to be considered. This would be a major consideration also for the proposed conversion of carbohydrate products to fuel ethanol.

The export of LPG from the Maui field, as recently suggested, may in the short term provide urgently-required overseas funds, but would be a waste of a valuable resource that should be used in NZ. The possibility of a viable petroleum industry, other than for fuel or urea production, appears to be rapidly disappearing.

C. B. Johnson
Palmerston North

bridge. Brown quotes symposium speakers as favouring non-classical structures because "they are fashionable", and "because it looks so nice". Others might add because "they take up less space to write."

In the book Brown summarises and examines critically the experimental evidence for and against nonclassical ions. Most of the arguments are about the "best" examples 2-norbornyl and cyclopropylcarbinyl. Brown concludes that the huge majority of cations in organic reactions have classical structures.

The style of the book is polemical. However, at the end of each chapter Paul von R. Schleyer comments on Brown's case and offers counter arguments.

Brown writes clear direct prose and the book is rather easier to read than most of the papers published in this field. The book deserves to be widely read, particularly by those who teach and research in physical — organic chemistry.

W.P. Judd

Agricultural and Food Chemistry: Past, Present, Future.

Edited by R. Teranishi. AVI Publishing Co. Inc., Westport, Connecticut, 1978. PP. 458. Price $36.00. ISBN 0-87055-231-7.

The book is a compilation of the papers delivered at the Agricultural and Food Chemistry sessions of the American Chemical Society's Centennial Meeting, New York City in April 1976. The impressions of 44 experts are gathered as to the great developments in production, processing, and utilisation (which includes nutrition and safety) in the last 100 years.

The text of the book is divided into 39 chapters and these are grouped into 6 sections. The first section weighs heavily on the historical side, detailing the highlights of US agricultural and food chemistry over the last 100 years. It is an interesting area but undoubtedly has more application to readers within USA. The second section covers plant production with a review of 100 years of plant breeding, using disease and insect resistance in crops and plant breeding contributions to food production in developing countries. Animal production is the title of the third section reviewing the partnership of cattle and chemistry, dairy cattle production, a century of chemicals in the poultry industry, and progress in pig, sheep and goat production. Each chapter admirably covers changes over the last 100 years and brings the reader to the present state of play with some pointers to the future.

The fourth section, and one occupying more than one third of the book's contents, is titled "Challenges of food processing and flavour: past, present, and future". The reviewer particularly enjoyed reading this section and it does have greatest relevance to readers of this journal. It begins by reiterating the fact that all foods are chemicals and proceeds into chapters on:- food ingredient challenges; food product and process development; energy and food processing; food additives and their regulation; plant protein foods; food preservation; food acceptance; natural food colorants; isolation and identification of food flavours; meat flavour research; flavour chemistry of tea, cocoa and coffee; flavour chemistry of fruits and vegetables. All of these chapters afford excellent reviews in each field and are strenghtened by useful bibliography.

Section five deals briefly with nutrition describing the newer knowledge of animal nutrition, food additives and nutrition and, of course, fibre, the in-nutrient of this decade (although terminology still poses problems). The section closes with a chapter on the expanding role of nutrition in clinical medicine, including a brief coverage of diet-associated diseases.

The sixth and final section is 'Food safety', an area of paramount concern to all of us. The concern of the food industry with food safety is covered, contrasting the safety of our modern food supply with that of yesteryear. A centennial look at food regulation in USA is taken followed by the broad subject, protection against biological and chemical hazards in our food supply. The GRAS list ('Generally Regarded As Safe') of food additives is evaluated in the final chapter and concludes with a list of the members of the Select Committee on GRAS Substances.

The book is recommended to all those engaged in research and development in the field of food sciences. It is only with a knowledge of our past successes and failures that we can plan for the future with any measure of confidence. This publication affords us the opportunity to reflect on the last 100 years of agricultural and food chemistry.

Norman Lodge

Biosynthetic Products for Cancer Chemotherapy Volume I

by George R. Pettit (Arizona State University, Tempe). Plenum Press, New York, 1977.
xii + 215 pp. US $23.40

This book begins with a short overall view of the nature of cancer and its probable causes, with particular reference to chemical carcinogenesis. Methods of treatment are reviewed, and the advantagaes and disadvantages of the main treatment modalities (surgery, radiotherapy, immunotherapy and chemotherapy) are noted.

Table I provides an excellent summary of most of the current clinically — used cancer chemotherapeutic agents, listing usual dosages, toxicity, major uses and structural formulae.

Chapter 2 is a very readable account of the search for cancer chemotherapeutic agents from natural sources. In particular, the early history of the US National Cancer Institute (NCI) and its cancer chemotherapy programme is traced from the founding of the Cancer Chemotherapy National Service Centre in 1953 to the present. The author notes the current move away from the traditional animal tumour models such as the L-1210 and P-388 leukaemias in favour of solid tumour models of lower growth fraction (eg the Lewis lung carcinoma and the B-16 malignant melanoma) as screening systems.

This brings one to the author's main thesis, that although upwards of 100,000 extracts of plant and microbiological origin have been screened by NCI to date, this total represents but a tiny fraction of the known species, and that an expanded effort along these lines is justified.

The remaining chapters (3-10) detail what has been achieved in the detection and isolation of antitumour agents from various natural sources, from the lower plants and fungi, through the higher plants, the marine invertebrates, and concluding with products from the marine vertebrates and higher animals. Much of the work in the latter three areas comes from the author's laboratory and the whole review, which constitutes the bulk of the book, is well-written, well-referenced and authoritative. Ample structural formulae are provided, as is an adequate index. Together with the companion Volume II, which is a tabular summary of all the naturally-occurring antitumour and cytotoxic compounds described in the literature (to early 1976), this book provides a comprehensives introduction to 'biosynthetic products for cancer chemotherapy' from the point of view of an organic chemist. However, Volume I stands very well by itself as a well-written and above all, enthusiastic, introduction to experimental cancer chemotherapy for chemists outside the field. Those working in the area, while they may not agree fully with the author's main thesis, will find this enthusiasm refreshing.

W.A. Denny

LIQUID PHASE OXIDATION OF HYDROCARBONS

N.M. Emanuel, E.T. Denisov, Z.K. Maizus, PLENUM PRESS. New York 1967.

Although this book is over 10 years old it arrived mysteriously in the hands of the Journal's Editor and, considering the current energy crisis and the need for knowledge of synthetic routes to organics, it was considered relevant, at least, to review the book.

Much research on oxidation and catalysis has been carried out in the Soviet Universities and Research Instutions and this book would complement two others in the field namely, "The Gas Phase Oxidation of Hydrocarbons" and "The Inhibition of Fat Oxidation Processes".

The study of hydrocarbon oxidation reactions is of great interest academically and it has obvious economic applications. This book is the result of many years' study by the authors and includes a vast amount of

The Sceptical Chemist

The Public Affairs Committee considers that one of its functions is to provide for stimulus inside the Institute. To aid this, it proposes a new column for "Chemistry in New Zealand" which will be published under the pseudonymn "The Sceptical Chemist". Many members may have controversial views which they are unwilling to publish with their own names attached to them. The new column offers them an opportunity to make available to the membership views of this kind in an anonymous fashion.

Of course, it is necessary for somebody to co-ordinate and solicit contributions to the column and for the present this task will be undertaken by Dr M. Kingsford (5 City View Grove, Lower Hutt). Please send him any contributions and mark them "Sceptical Chemist" so that they may readily be identified. Some contributions have already been solicited by word of mouth, and one is included in this issue's column.

Those members who were at the 1979 annual general meeting will recall a debate on the remit from the Wellington Branch that interviews for membership be made optional at the discretion of the interviewing panel. It seemed to me a simple enough proposition, and yet it was surprising that some members present had difficulty in grasping what it was all about. The Chairman, with his usual tact, declared that the Council would take no notice of the remit regardless of whether the meeting recommended it or not, and by this single act succeeded in polarizing the meeting into two camps, one pro and one anti-university. In discussion with some of those who spoke in the ensuing, at times acrimonious, debate, it was horrifying to find that many had voted in terms of the personalities involved, rather than because of the worth of the arguments. However the most remarkable feature of this rather sorry affair was that during discussion the Chairman declared that it was entirely optional whether interviewing panels took the interviewing procedures seriously or not, and that they might care to conduct some interviews for a minute or two over a pint of beer in a local pub. Doubtless some of those present, like myself, had difficulty in understanding precisely where the difference lay between this approach and the approach proposed by the Wellington Branch. It all seemed a lot of fuss over nothing.

This is one of the contributions that have already been received. If you have something that you want to complain about, or something that irritates you about the attitudes or habits of members of the Institute, why not consider contributing it to the column? The Public Affairs Committee reserves the right to refuse unsuitable contributions, so please don't send in anything that is libellous or irresponsible. Do send in points of view which deserve a hearing, particularly those that have not received the attention they deserve.

We look forward to your contributions.

Books (Con't)

experimental data, methods, analytical techniques and theoretical treatments of data.

The book proceeds logically through a discussion of free radical formation, peroxide production and the kinetics of chain reactions. There is a section on experimental apparatus and methods which is well presented but could have been much more detailed to be of practical assistance to the researcher. The chapter on analytical methods is brief and it is apparent from the section on GLC that the book is out of date as far as this technique is concerned. A full mathematical treatment of the kinetics is given which this reviewer found tedious but would be of immense use to a researcher in the field. Following a reasonable amount of theoretical discussion the book deals with the oxidation of individual classes of compounds, the production of commercially important intermediates, the effects of ionizing radiation, catalysis by metal ions and the inhibition of oxidation processes.

My only criticism of the book is the lack of alphabetical index but apart from that I would thoroughly recommend the book for anyone working in the industrial field and for those in the Universities.

L. Eyres

BREAKTHROUGH IN BARK EXTRACT DEVELOPMENT

A major breakthrough in the development of an adhesive extract from the bark of the radiata pine tree has been made by NZ Forest Products Ltd. It is thought that company technology leads the world in this particular field.

Bark extract, used as a bonding agent for particleboard and plywood, has superior water resistant properties to cost competitive materials currently in use and has the added advantage of being processed from what is essentially a waste material.

Urea formaldehyde, melamine and phenol formaldehyde, the resins which are now used, are to a large extent imported so the new development will be a saver of overseas funds. It is also believed the product has excellent export potential.

Extract from the radiata pine bark is produced in the first instance as a liquid resin which is then spray-dried into powder form, making for much easier freighting and satisfactory storage life.

There are important potential uses for the bark residue after processing. The extracted bark is fine, friable, sterile, free of weed seeds and is non-toxic to plants. This gives it exciting possibilities in horticultural circles as a replacement for peat moss (supplies of which are constantly diminishing) for use as a potting mix or mulching material.

Surplus extracted bark may be used beneficially as a boiler fuel.

Serious research on the project began in 1971 and initial results were encouraging enough to warrant the building of a major pilot plant at Kinleith which began testing operations some 4 years later.

The development has now reached the stage where its commercial viability has been proved to the satisfaction of the company, which has given the go-ahead for the building of a processing plant at Kinleith. It is expected that full scale production of the bark extract will begin by 1980.

OBITUARY

Edmond Francis Hubbard died in Wellington in October after a long illness. He was a former Chief Chemist at the Railway Workshops, Lower Hutt, where he had spent most of his working life, having been transferred there from the Clerical Division in 1929. He was elected a Fellow of the Institute in 1962, and took a keen interest in the Wellington Branch. After retirement in 1970, he worked for some time for the Consumer Institute. He was also a Fellow of the Chemical Society and a member of the Association of Scientists. We extend our sympathy to his wife.

The Art Of Reference Writing

'C Lector'

Have you ever had to write a reference for someone? Have you been amazed in the past at some of the unlikely successes and the surprising failures? In looking at references relevant to students hoping to go on to Higher Education some of the reasons become clear.

It was part way through last academic year that light slowly dawned. I was getting used to the fact that very few people like to say outright 'Don't have this person at any price'. There are more sympathetic ways of doing it, for example:

> *'I find it difficult to write that I consider a degree course is beyond him, since I have a good deal sympathy with him as a individual and with him in his painful struggle to achieve something'.*

That sort of positive approach is probably favoured by many referees. When I first read:

> *'I do not feel able to strongly support her application to read for a degree in a British University. . .'*

I classified it in the same way at first, until I realised that it went on:

> *'. . . and find it difficult to know how she would compare with American students at a similar level. . .'*

So far as I could see the student was not American, had not been in the US, and so far we have not been taken over by the Americans. I labelled it 'Diversionary' and it suddenly struck me that Stephen Potter had probably written a book 'Refereemanship' which everyone else was using and I had never read. As there is no such book in print I have hastily composed the following guide for others in my position.

Don't

Never say 'Don't have him'. You must leave the recipient with the feeling that if he admits this student he is showing bad judgement and acting against the student's interest. Try the direct approach:

> *'I admire his ambition but on balance I would have recommended against this application in the interest of the candidate himself'.*

Alternatively, you may use the indirect approach:

> *'He seems unable to appreciate his limited ability'.*

For variation try the throwaway approach:

> *'It is possible that he has the intellectual potential for study of degree standard . . . it is difficult to feel . . . that he could actually undertake a degree course with reasonable hopes of success'.*

When in doubt about the institution receiving the reference and/or the student, sit firmly on the fence:

> *'. . . he is not completely incapable and in view of all these circumstances although I hesitate to recommend him strongly I am reluctant to dismiss him out-of-hand'.*

The obscure approach puts the reader on his mettle:

> *'I am certain that you will get far poorer candidates for a place'.*

When appropriate just be patently honest and straightforward:

> *'It was really, I think, a question of finding the best I could say about someone I did not really know all that well. . .*

Stupidity

When you are asked directly about intellectual qualities you must never say 'this person is stupid'. Think what would happen if it ever leaked out. In this case it is important to be positive about something that might easily be confused with intellect:

> *'She is capable of working extremely hard and if this alone were the criterion of success she would have no difficulty in following a subtained course of higher level study'.*

Or assume that what is not obvious is most important:

> *'Superficiality in written work hides a bascially intelligent, astute and perceptive capability. . .'*

Be careful not to overdo it. That reference orginally went on:

> *'His essays still tend to be scrappy and lack the required substantiation, depth and endeavour in geology and geography'.*

This is an example not to be followed since the superficiality seems to have been substantiated.

You could imply that the lowest standards are really the best:

> *'. . . he has the intellectual ability to obtain at least a Grade D or E pass in each subject'.*

If you feel inspired just try eloquence:

> *'He always promises more than he performs, yet still does not seem to come to grips with reality and, clutching at straws of promise, almost seems blind to his true situation.'*

I guarantee that the reader will notice something out of the ordinary and therefore give the application more consideration than usual.

Attitude

Some reference to basic attitudes should be made. This gives great scope for condemning the otherwise good student and promoting the poor student. For instance, make it quite clear that the application is likely to produce a crop of high blood pressure problems if admitted. This is easily done by writing:

> *'An infuriating boy who has quite good basic ability but who resists manfully every attempt to make him work effectively'.*

Give the impression that you are sympathetic and have tried your best, but to no avail:

> *'He listens quietly, nods his head and responds by doing precisely nothing'.*

Or alternatively:

> *'He has not always found it easy to accept advice or other opinions once he has made a decision'.*

Convey the sense of a balanced judgement enlivened by a touch of homour:

> *'This man has impressed me by his notable lack of effort throughout the year'.*

Individuality

Most people like to feel they appreciate individuals. Always attempt to make the character of a candidate you are pushing seem interesting. This can be done in a number of ways.

> *Intrigue the reader; make him wonder: 'His enthusiasm in this field is substantiated by frequent voluntary use of biology laboratories for private experimental work'.*

Suggest that the student is worthwhile as a person:

> *'She is attractive, self-sufficient and pleasant to deal with. She is worth encouraging.'*

Make the reader feel a cad to discard such a good type:

> *'He is eminently trustworthy, loyal, cooperative and a first-class citizen'.*

Invent something that means little but which seems to say something such as:

> *'I like him for his truly rural disposition'.*

Always attempt to be positive. Find something that might be important in college life such as:

> *'He is an expert snooker player'.*

Finale

To win hands down, go in for complete and utter selfconfidence. I think you could do no better than the following:

> *'Previous exam performance — good*

Rapid Change To "Pharmacist" Unlikely

The Pharmaceutical Society of NZ is, according to its secretary/registrar **John Ferguson,** doing all it can to encouragepharmacists to use the words "pharmacist" and "pharmacy" instead of "chemist" when describing themselves or their places of business. However, it considers any rapid change unlikely.

Mr Ferguson states this in a letter to NZIC General Secretary **Gavin Fletcher,** responding to the concern expressed at the 1979 Conference, when a motion urging pharmacists to use that term for themselves was carried and passed on to the PSNZ.

The text of Mr Ferguson's letter is as follows:

"The Council of the Society does all that it can to encourage pharmacists to use the words "Pharmacist" and "pharmacy" instead of "chemist" when describing themselves or their places of business. There are signs of change in that very few new companies which are to conduct pharmacy businesses are nowadays registered with the word "chemist" in the title but it has to be said that there is a very long history of the use of the word "chemist" by pharmacists both in this country and in others where the early pharmacists came from Britain. There is a natural reluctance to give up the use of a title which is protected under the provisions of the Pharmacy Act 1970 where it is made clear that the only persons who may use the word "chemist" in connection with the sale of goods by retail, are those who are registered as pharmacists and those who are entitled to use the word "chemist" by virtue of holding a degree, diploma or other qualification.

"Over the years, the description "chemist and druggist" changed to "chemist" and "pharmaceutical chemist" and as you will know, many pharmacists qualified by taking a Pharmaceutical Chemist Diploma.

"There is not likely to be any rapid change although the Society will continue to do what it can to encourage the use of the words "pharmacist" and "pharmacy". We have been successful in one move in that in future, the Yellow Pages telephone directories will no longer list pharmacies under the heading "Chemists and Druggists". That heading will still appear in the index but the entry will read "Chemists and Druggists — Retail see Pharmacies".

"I should mention that the organisation which represents the proprietors of pharmacies — The Chemists' Guild — is understandably reluctant to stop using in advertising a word which is well known by members of the public as a description of both a set of premises and the qualified person who can be found at those premises. The Pharmaceutical Society is encouraging the Guild to substitute the word "pharmacist" in cooperative advertising which relates to professional services."

Present exam performance — very good
Promise for future — excellent
Character — good
Interests — normal
Health — good and sound
Suitability — very suitable'

I hope this brief introduction has shown you the importance of being a good referee for, believe it or not, these quotations are all from one year. I hope you will remember to play the game so that this year is better than last.

With acknowledgement to "Chemistry in Britain".

'C Lector' is the pen name of a higher education lecturer responsible for considering applications for courses leading to science degrees.

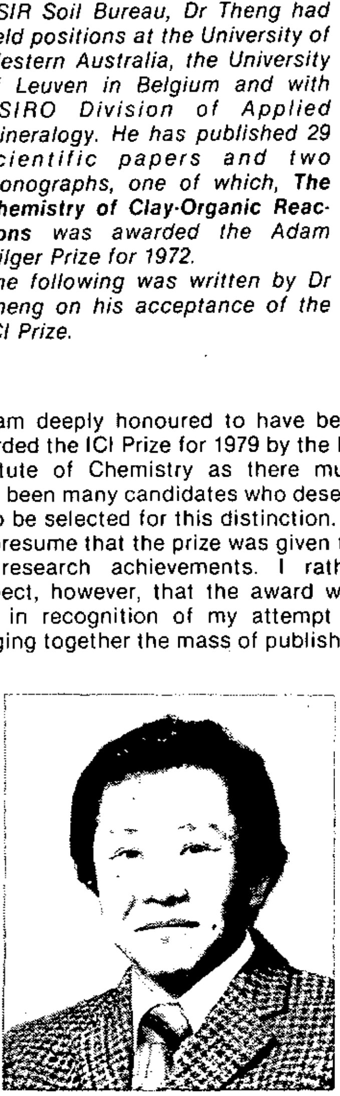
ICI Prizewinner

***Dr B. K. G. Theng,** Soil Bureau, DSIR, Lower Hutt, has been awarded the ICI Prize for 1979 for his work on clay-organic interactions. Educated initially in Indonesia then later at the University of Adelaide he graduated B.Ag.Sc. with first class honours in 1961 and Ph.D. in 1965. Prior to his appointment as Scientist with DSIR Soil Bureau, Dr Theng had held positions at the University of Western Australia, the University of Leuven in Belgium and with CSIRO Division of Applied Mineralogy. He has published 29 scientific papers and two monographs, one of which, **The Chemistry of Clay-Organic Reactions** was awarded the Adam Hilger Prize for 1972.*

The following was written by Dr Theng on his acceptance of the ICI Prize.

I am deeply honoured to have been awarded the ICI Prize for 1979 by the NZ Institute of Chemistry as there must have been many candidates who deserved to be selected for this distinction.

I presume that the prize was given for my research achievements. I rather suspect, however, that the award was also in recognition of my attempt at bringing together the mass of published data in the form of two monographs. This is gratifying on both counts as the study of clay-organic reactions does not belong to the "mainstream" of chemical research and the writing of books is, in some quarters, regarded more as a hobby than a research activity.



In this context I should like to thank my mentors for kindling my interest in the subject, the many colleagues for imparting ideas and an underlying philosophy, and the heads of the various departments and institutions for providing an environment conducive to doing research in the wide sense of that word.

It is perhaps surprising that so much literature has accumulated since the early 1940s when clay-organic systems began to be systematically studied, following the general acceptance of the crystallinity, and the elucidation of the main groups, of clay minerals. The great interest in these systems and the stimulus for research are undoubtedly provided by the importance of the clay-organic interaction in agriculture and industry. Such processes as the biostability of humus in soil, soil aggregation and structure, the clarification of wine and edible oils, the formulation of paints, greases, and cosmetics, the manufacture of certain papers, and the reinforcement of plastics, to name just a few examples, all involve some kind of clay-organic interaction. More recently, this interaction has become the focus of research in the genesis and maturation of petroleum and in the extraction of petroleum precursors from tar sands and related deposits.

Much is now known about the way simple organic molecules are adsorbed and align themselves at the clay surface. Much progress is being made in understanding the adsorption and conformation behaviour of organic polymers. The availability and application of modern instrumental techniques to the study of clay-organic reactions will find out the existing gaps in our knowledge leading to an even greater explosion of information.

The wide ranging practical applications of the clay-organic interaction will, I am sure, attract the attention of an increasing number of scientists of diverse backgrounds and training. I am pleased if I have been able to contribute, in some small way, towards this end.

Company Turns Animal Byproducts Into $1 Million Export Earner

A young company processing animal by-products has broken the $1 million export sales mark in 3 years and earned itself a Trade Promotion Council export award.

The company, NZ Pharmaceuticals Ltd, has been producing cholic and deoxycholic acids from sheep and cattle gall at its Linton factory near Palmerston North. These acids are used to produce drugs which alleviate arthritis and digestive problems.

The company's beginning dates back to 1969 when the freezing industry, encouraged by the Agriculture Production Council, investigated the possible use of waste animal by-products.

The survey showed cholic and deoxycholic acids from animal gall to have the best prospects.

At that stage Tasman Vaccine Laboratory (now ICI Tasman Ltd) expressed an interest in the project and the then managing director, **Mr Lewis Fitch**, initiated research in collaboration with the Biotechnology Department of Massey University.

Although the company was formally established in 1971 it took 3 years' research and development to perfect the complex chemical processes involved before the company was ready for production.

Dr Richard Garland, the chief chemist, awarded the NZIC Industrial Chemistry prize for his work on the processes, says the early development work required many hours in the laboratory searching for the right process.

"Although there was much literature around about the general topic, there were many claims which couldn't be reproduced in the laboratory. What made our task more difficult was that we were mixing sheep gall with higher quality cattle gall which meant we had to devise a process that could handle the high level of impurities.

"After many experiments we found the right process which gave us a high yield of high quality bile acids. Later, an American bile producer told us their process could never handle the high proportion of sheep gall that we used."

Once the process had been proven in the laboratory a pilot plant was set up at Massey University to perfect large scale operation.

A full-scale production plant was then built to the company's specifications on a 6 hectare block of land at Linton, 16 km south of Palmerston North.

At the same time, the company started looking for an overseas buyer of cholic and deoxycholic acid and in 1974 it signed a 2 year contract with a French pharmaceutical company for the factory's entire output.

Mr Brian Service, NZ Pharmaceuticals manager, says the pilot plant proved vital during the negotiations with the French.

"No amount of laboratory sample or letters would convince them we were really serious. It wasn't until they had seen the plant and plunged their hands into a barrel of the product that they would negotiate."

Mr Service says the directors showed great faith in the company's future when they went ahead with the building of the factory in October 1973, 6 months before the production was sold.

The raw material for the process, bile, is collected from the bladders of slaughtered sheep and cattle at freezing works. There it is concentrated into a dark tarry substance called gall.

Large numbers of sheep and cattle are needed to collect even small amounts of gall — 1000 cattle yield about 33kg of gall and 1000 sheep about 7½kg.

To supplement its local supply the company occasionally imports gall from Australia.

At the Linton factory, the gall is melted and amino acids (building blocks of proteins) are separated from the bile acids. This leaves the crude biles acids (the body's natural detergents) to be separated and refined several times into cholic and deoxycholic acids. In all the process takes about 3 weeks.

The fine white powdery deoxycholic acid is used to produce cortico-steroid drugs which alleviate arthritis. Cholic acid derivatives are used in alleviating digestive problems.

Because the substances are so valuable, all waste and filtrate liquids are returned to the refining process.

"People don't realise how valuable these materials are. It takes a million sheep to produce only ½ tonne of pure bile acids. If we didn't return all the wastes for reprocessing we couldn't stay in business." Mr Service says.

The company processes about 150 tonnes of animal gall a year and produces about 40 tonnes of cholic and deoxycholic acids. In the past year the company has expanded its range to five other products derived from the two basic acids.

There is great emphasis on quality control and all stages of the refining process are monitored to ensure maximum purity of the product.

Development and testing are carried out by a 5 strong team using a small laboratory at Massey University. Test results ensure quality remains consistent.

Dr Garland says because the world market for its present goods is so small the company has been forced to diversify. Investigations are underway into the possible production of heparin, a substance which prolongs the clotting time of blood.

"Development of new international products like heparin is very difficult for us compared with overseas companies which have better facilities and greater finance. But we take pride in the fact that we have 3 of our 20 staff permanently engaged in research and development."

In 1975, the first year of production, the company earned $525,000. The next year earnings reached $825,000 and in 1977, $1.14 million. Total export earnings for the current financial year are expected to be about $1.25 million. The average export earnings per staff member is a remarkable $62,500.

"We export our total production," Brian Services says. "It's not an easy task competing with European and American producers in their domestic markets with high transport costs and import duties, and the fact that the total gall production of the NZ meat industry isn't really large enough for genuine economics of scale."

"Our main advantage is that we have a young, enthusiastic and innovative team which has grown up with the company and has a deep commitment to its success."

Another testament to the company's success was its receipt of high priority status from the Department of Trade and Industry. This award is made to companies which demonstrate a significant contribution to the country's balance of payments.

The latest signs of the company's growth are the new research laboratories and offices at its Linton site.

After 440 hours work on the computer, two scientists at California State University have worked out that the largest prime number is 221701 — 1.

. . .

The metric system is catching on judging by a sign at a country petrol station:-

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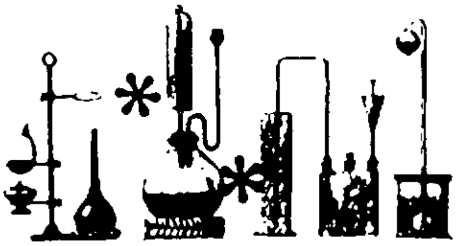

New Products, Services

HOMOGENISERS

The need to make the best use of fuels has led to the use of equipment for adding up to about 25% water to fuel oils in order to promote cleaner burning and improve efficiency. A British company, Ultrasonics Ltd., manufactures a range of homogenisers which have proved suitable for the rapid low cost production of micron sized water in fuel oil emulsions.

If a burner produces atomised droplets, about 50 micron diameter, of an emulsion of oil containing 2-10 micron droplets of water, each atomised drop will contain several water droplets. As the oil burns, the water is heated rapidly and vaporises explosively, resulting in a secondary atomisation effect, and improved atomisation always leads to more efficient combustion, says the company.

An ultrasonic homogeniser can normally be expected to carry out the task of dispersing water in fuel oil faster, to a higher standard and at a lower cost than other competitive machines.

An ultrasonic homogeniser consists of an electric motor driving a special pump, and an homogenising head. Process material is fed by pump pressure into the homogenising head, where it is forced through a specially formed orifice on to and across a blade. It is the velocity of the stream of liquid itself which is responsible for high frequency vibrations being set up in the liquid, so producing cavitation, which causes most of the effects on the process material.

C038 For further details, use Reader Service Card

OZONE CALIBRATION SYSTEM

A brochure is available describing the operation and research advantages offered by the new CSI Photocal 3000 Ozone Calibration System.

This CSI Photocal 3000 was specifically designed to meet EPA requirements. The system consists of an ozone generator and a UV photometer interfaced to a microprocessor. It qualifies as a calibration standard for both manual and remote monitoring of ozone analysers.

A powerful onboard Z-80 microprocessor provides reliable automated programme sequencing, self-diagnosis, compensation for changing temperature and pressure, and data collection, analysis and display. The CSI Photocal 3000 satisfies the requirements of both a primary standard and a portable transfer standard.

Additional information and a copy of the brochure are available through Advanced Electronics Ltd.

C039 For further details, use Reader Service Card.

WATER SAMPLER

Suitable for sampling in the open or in sewer systems, a portable, battery-driven sampling unit is now available through Selby-Wilton Scientific Ltd.,

The Aquasampler HCV26 is designed to withstand the rigours of outdoor work in any kind of weather or to operate under very unfavourable conditions in sewers.

It has a rainproof PVC housing with carrying handle and is fitted with a peristaltic pump which delivers the water sample to a collecting bottle. The pump is situated at one end of the housing behind a transparent cover. It has a horizontal rotor fitted with 8 mm i.d. tubing, which is led out through the sides of the housing, and a detachable tube-bed. The pump is controlled by an electronic unit, situated behind a transparent cover at the other end of the housing.

The control panel consists of a frequency control and a digital switch clock. The frequency control consists of a continuously variable setting for the pumping frequency, corresponding to an output of 0.3 to 2l/h. By means of a switch the pump yield can be doubled while an additional switch enables the pump to be run continuously with maximum output. On top of the housing is a socket for connection of external frequency control devices.

The digital switch clock contains a digital watch with 4 figures showing hours and minutes, and two 4 digit counters for preselection of start and stop within 100 hours from the set-up. A built-in switch makes it possible to work in cycles consisting of work alternating with periods of rest.

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INFORMATION FOR BIO-RAD

New materials, equipment and techniques for chromatography, electrophoresis, cell culture and HPLC are introduced in the 30th issue of Bio-Radiations, just published by Bio-Rad Laboratories, represented in NZ by Selby-Wilton Scientific Ltd. Concise, well illustrated articles include application data, useful references and "how to" information. For convenience, necessary instruments and accessories can be ordered directly from the information provided in Bio-Radiations. In the current issue: A new analytical electrofucussing system that adds considerably to the power and versatility of this protein separations technique. ...Five ways to take advantage of hydroxylapatite chromatography for separating and concentrating proteins ... The Bio-Rad products exhibited at FASEB — including beaded micorocarriers for concentrated cell culture ... And, for HPLC, a new 250mm reverse phase column which offers 20,000 plates/meter for under $200 (US price) and inexpensive, convenient prefilled columns for HPLC sample cleanup, with tips on which columns to use for removing the various contaminants that can clog HPLC columns or distort results. There's also a unique column for carbohydrate analysis, and a number of articles on other related separations techniques,
including isoelectric focussing. A free copy of Bio-Radiations 30 is available on request.

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H-P Distributorship To Northrop

Northrop Instruments & Systems Ltd has been named exclusive distributor in NZ for Hewlett-Packard analytical and medical products and distributor for distance measuring instruments and calculators. The distributorship was held previously by Medical Supplies NZ Ltd, now a division of NZ Farmers Fertiliser Co Ltd. Northrop is a specialist importer of electronic instrumentation. "Our appointment reflects the changing marketing conditions", said general manager **Murray Cole.** "Our company recognises the new market environment; within which electronic instruments are sold. We place our reputation on the line with our service support and in our application of electronics to analytical, medical and distance measuring.

"Many of the medical-oriented products are critical to patient care: in coronary care, neo-natal and intensive care", said Mr Cole. "Hewlett-Packard products are used in X-ray, accident and emergency and respiratory departments. Other applications are in criminal forensic analysis, and scientific and industrial research. We will further establish the reputation of our principals in the NZ market."

Northrop's head office is in Wellington, with branches in Auckland and Christchuirch. From these centres, full servicing will be effected.

Commenting on the appointment, **Mr J W Squires,** general manager, Hewlett-Packard (NZ) Ltd., said Northrop's would be able to deal directly with the factories for technical information and "will have the advantage of using our computer-based communications and order processing systems."

DETECTING OIL SLICKS BY SATELLITE

A technique has been developed in UK for transforming infrared pictures obtained from space satellites into colour maps that may be used to identify, measure and follow the movement of oil slicks at sea. In overall charge of the research is Dr Duncan Telfer, Lancaster University, seen here with a part of the equipment used in the new technique.

Oil slicks on water raise the temperature in the affected area by about 1 °C and this small increase can be detected by the sensitive infrared measuring devices on board the orbiting satellites. The temperature differences registered by the instruments are recorded as data and are normally transformed on the ground into maps with shades of grey representing different temperatures. The system devised transforms these shades of grey into 8 'false' colours. The operator then scans the infrared satellite picture, enlarges a given area, and any one degree rise in temperature will show up as an outstanding colour difference.

The University is searching for known oil slicks to see how effective their technique is in practice. It is also using a land based rig in which sensors pick up infrared radiation from 2 tanks — one containing water and the other water and oil.

In addition to watching oil slicks the technique can also be used to map land uses, detect forest fires and measure the warm water effluent from power stations. It may also find a use in medical research where the false colour imagery could prove helpful to doctors using X-rays and ultrasonic images which normally appear in shades of grey.

There was a smash and grab raid on a jeweller's shop in this city. When the police arrived, all they found was a man leaning against a telegraph pole 30 yards away. They said, "What do you know about this?" and he said, "Nothing." And they said, "It's only just happened. You must have seen it. Hop in the car and we'll go down to the the station." And after 20 minutes' grilling, he said, "All right, I'll tell you. But it's so extraordinary that you won't believe it."

"Never mind that, get on with it," said the police.

And the man said, "I was standing there like you saw me when a large square van stopped outside the jeweller's shop and the man beside the driver got out, went round to the back, wound a handle and lowered the back to form a ramp — and an elephant got out.

"The elephant went over to the shop, smashed the window with its trunk and handed the trays of diamond rings to the driver's offsider who put them into the van. When the window was empty, the elephant got back into the van, the offsider wound up the ramp and the truck drove away."

And the police said, "We don't believe you." And the man said, "I told you you wouldn't."

And the police said, "What sort of an elephant was it?" And the man said, "I dunno, just an ordinary elephant." And the police said, "You must have noticed something; was it an African or an Indian elephant?" and the man said, "I dunno. What's the difference?"

And the police said, "African elephants have large ears that stick out sideways and Indian ones have small ears that lie flat." And the man said, "I couldn't see its ears, it had a stocking over its head."

— From the Leighton Memorial Award address by Sir Henry Somerset, CBE, to the Royal Australian Institute of Chemistry.

FUND OF FUTILE FACTS DEPARTMENT

Only 9 months after the first public demand for it, the British Standard Institute has produced a standard for skateboards.

. . .

During the terrible cholera epidemic of 1832, a popular prophylactic in Dublin was Irish whiskey, used as an enema.

. . .

In Britian only 1 housewife in 6 serves more pudding than she did 3 years ago.

. . .

What are biological bulldozers? See Science, 203, 458 (2/2/79)

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Solution to December Puzzle

1 F	U	2 T	U	3 R	E	■	4 O	5 C	T	6 A	N	7 E
A	■	E	■	E	■	8 H	■	O	■	L	■	N
9 C	A	N	T	F	L	Y	■	10 C	Y	C	L	E
T	■	E	■	I	■	D	■	O	■	O	■	R
11 O	F	T	E	N	■	12 R	O	A	D	H	O	G
R	■	■	■	E	■	O	■	■	■	O	■	Y
■	13 P	14 R	E	D	I	C	T	15 A	B	L	Y	■
16 A	■	E	■	■	■	A	■	I	■	■	■	17 M
18 F	I	S	C	19 H	E	R	■	20 R	I	21 F	L	E
F	■	T	■	A	■	B	■	B	■	L	■	T
22 O	F	O	I	L	■	23 O	I	L	R	I	C	H
R	■	R	■	Y	■	N	■	U	■	E	■	Y
24 D	I	E	S	E	L	■	25 P	E	T	R	O	L

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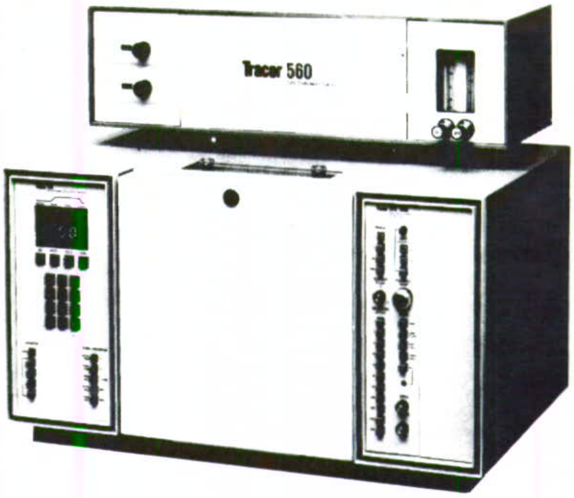

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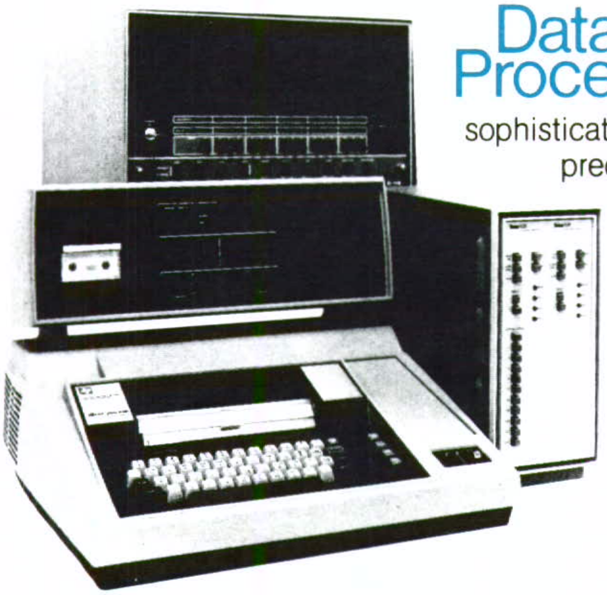

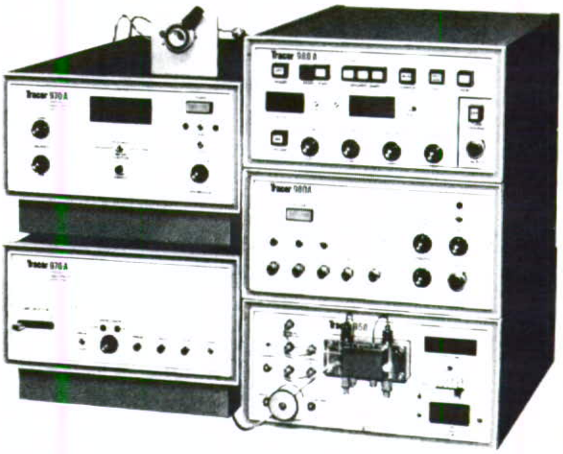

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