

# chemistry

## in new zealand

CONFERENCE ISSUE



One of the new buildings at the  
University of Waikato

Conference  
Titles

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Chemistry  
in the  
Waikato —  
5 Articles

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DNA  
Structure

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Transport  
of  
Hazardous  
Substances

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Guidelines  
to  
Professional  
Employment



Journal of the New Zealand Institute of Chemistry

VOLUME 41  
NUMBER 2  
JULY 1977

# Double-beam AA-375 & friends - more new AA from Varian

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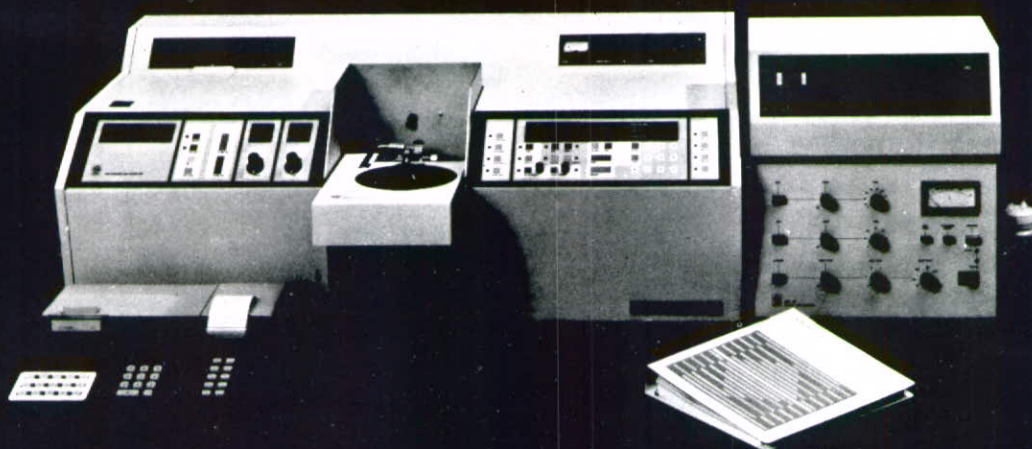
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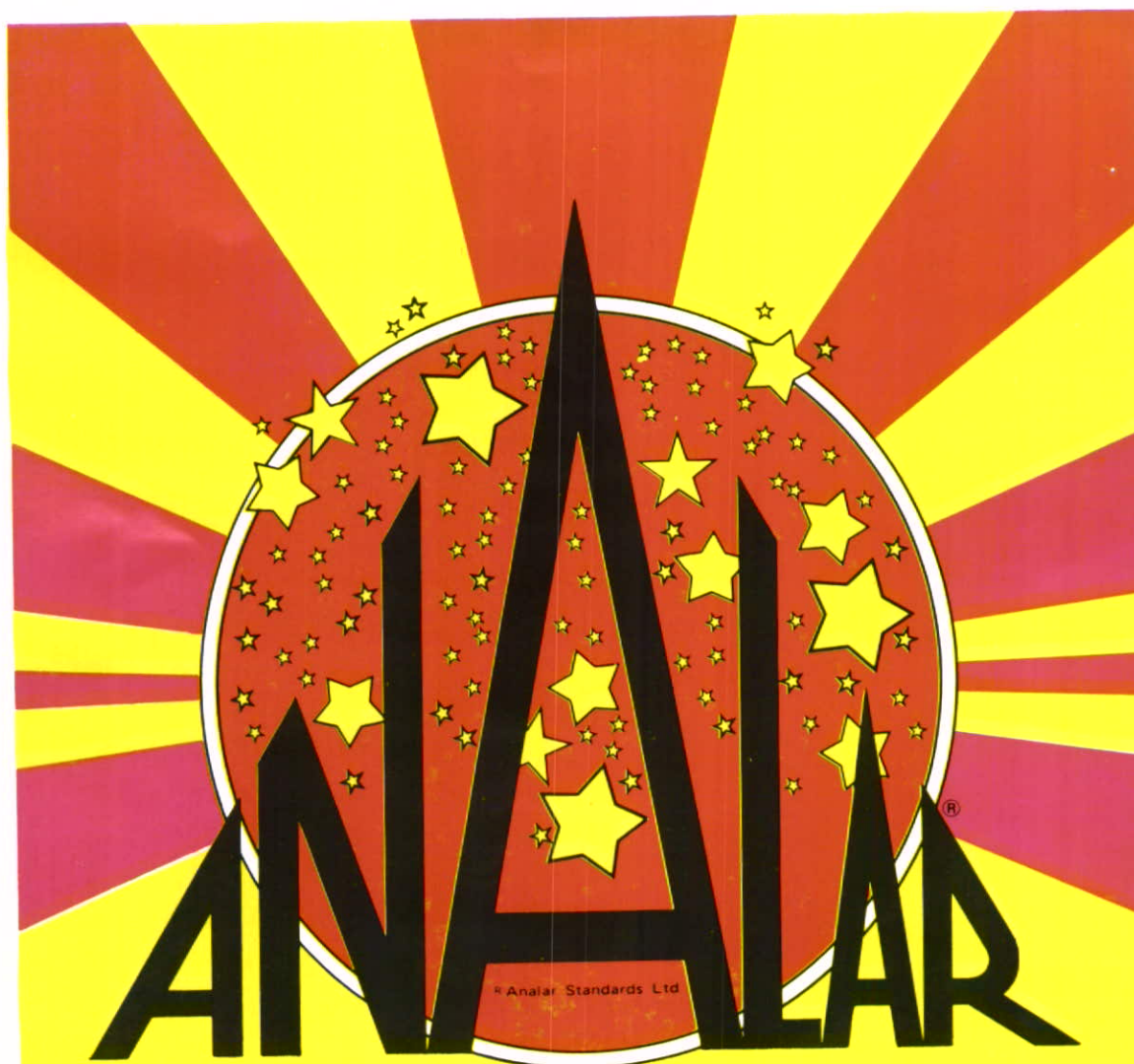
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JULY 1977  
VOLUME 41  
NUMBER 2

# chemistry

## in new zealand

Journal of the New Zealand Institute of Chemistry

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NOVEMBER 1975 1531

### 1977 NZIC CONFERENCE IN HAMILTON

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# THE 1977 N.Z.I.C. CONFERENCE AT WAIKATO

With at least 120 research papers plus the student paper competition, 10 general lectures, 17 Trade Exhibitors and three other groups meeting in conjunction, the 1977 Conference offers a rich feast for the participants. The Conference itself starts on the afternoon of Monday, August 22nd and finishes with the Conference Dinner on Thursday evening. A Chemistry Teachers' refresher course runs from Monday to Wednesday, the N.Z. Association of Clinical Biochemists meets on Monday and Tuesday, while the Trace Elements and Health Symposium runs from Wednesday to Friday. A number of lectures are being shared and the programmes tailored to allow various sessions to be held jointly. Participants in the Conference, or in any of these separate groups, will be able to meet socially and attend lectures of interest in the total programme by registering appropriately.

Further details of the Conference lecturers and specialist programmes are given elsewhere in this issue. The Conference theme of "Chemistry and the Future" is covered by a number of lectures including energy, education and research, industrial and social development, science and the law, and scientific policy making. The Presidential Address will lead off and the Institute A.G.M. has been placed at the end of the programme, so that members will have the chance to take action, if they so desire, on any questions which are raised.

Members will find that there has been considerable building activity on the Waikato campus recently. As a result, the committee has been able to arrange an extremely compact distribution of lecture theatres, display area, catering and accommodation. The longest walk is about 8 minutes from the Halls to the Common Room Club which will be the social centre of the Conference — and it is downhill on the way back!

The Social programme includes a visit to Anderson's Theatre Restaurant — an increasingly popular Hamilton attraction — or a trip to Cooks Winery where the winemaking processes may be observed, and the products appreciated. The committee has chosen to have a relatively inexpensive smorgasbord dinner in the hope that most members will stay on and make this the Grand Finale of the Conference.

All that is needed now is you! The committee looks forward to welcoming a large number of members to the Waikato and to the 1977 Conference.

K.M. Mackay,  
Chairman, Organising Committee

# N.Z.I.C. CONFERENCE 1977 GUEST LECTURES AND SYMPOSIA

## Chemistry Plenary Lecture

"Interstellar molecules and the origin of life" — Professor R. D. Brown.

## Biochemistry Plenary Lecture

"Histones and histone gene expression" — Dr J.R.E. Wells.

Trace Elements Plenary Lecture — Professor L. Smythe.

## Chemical Education Plenary Lecture

Chemistry: the future scenario in teaching and research — Professor R. Mason.

J.W. Lyttleton Memorial Lecture — Professor G.B. Petersen.

Easterfield Address — Dr K. McKenzie.

## Symposia and Special Lectures

Chemistry, Energy and the Future

Chemistry and the future — Professor J.F. Duncan  
Energy scenarios for New Zealand — Dr G.S. Harris  
Science and the Law — Mr P.A. Black, Dr C.L. Davey  
Scientific Policy Making — Mr L.A. Cameron

## BIOGRAPHIES

**PROFESSOR R.D. BROWN** is chairman of the Chemistry Department at Monash University. After graduating B.Sc. and M.Sc. from Melbourne University and Ph.D. from London University he held lecturing positions at London University (University College) and Melbourne University before being appointed Professor of Chemistry at Monash in 1959. He was awarded the Masson (1948), Rennie (1951) and Smith (1959) Medals of the Royal Chemical Institute, the David Syme Prize for research by the University of Melbourne (1959) and the Edgeworth-David Medal of the Royal Society of New South Wales (1961). In 1963-64 he was President of the Victorian Branch of the R.A.C.I.

In 1965 he was elected a Fellow of the Australian Academy of Science and has been a member of the Council of the Academy and Vice-President of Physical Science. He has now been elected Secretary of Physical Sciences (Academy of Science). He is a member of the National Committee for Chemistry and Chairman of the Sub-Committee on Chemical Education. He is also Chairman of the Committee on Science Policy. He is the Australian representative on the IUPAC Committee on Teaching of Chemistry. He is a member of UNESCO's Australian National Advisory Committee's specialist Committee for Natural Sciences.

His current research interests cover theoretical chemistry, spectroscopy, galactochemistry and life in space.

**Dr J.R.E. WELLS.** After completing a Ph.D. in plant biochemistry in 1963 at the Waite Agricultural Research Institute in South Australia, Julian Wells spent 2 years as a Postdoctoral Fellow with Dr Roy

Markham at the Virus Research Unit, Cambridge. In 1965 he returned to Australia on a Queen Elizabeth II Fellowship, and was appointed to the Adelaide Biochemistry Department in 1966. His chief area of interest is in the control of expression of eukaryotic genes, which has involved an extensive study of chromatin from the chicken red cells. In 1972-73 he spent a year in Dr Bill Rutter's department in San Francisco studying mRNA isolation techniques and reverse transcriptase technology. Since then he has characterised chicken globin mRNA and isolated the mRNA for the erythroid cell-specific histone H5. Current efforts are aimed at determining the relationship of H5 genes to the other five histone genes in the chicken genome and ultimately, the basis for the unique expression of H5 genes in red cells.

**PROFESSOR RONALD MASON, F.R.S.** began his academic career at the University of Wales, where he graduated in physics. Following a training in crystallography at London, he became a Research Associate of the British Empire Cancer Campaign (1953-61), engaged in X-ray analysis of carcinogenic hydrocarbons. This work led to an interest in organometallic chemistry, and, after two years as a Lecturer in Chemistry at Imperial College, London, he was appointed to the Chair of Inorganic Chemistry at Sheffield. In 1971 he moved to his present position, as a Professor of Chemistry at the University of Sussex.

Professor Mason is best known for his extensive work on the structural chemistry of inorganic and organometallic compounds. However, he has also done important work on the use of low-energy electron diffraction in the study of small molecules adsorbed on surfaces, as well as making valuable contributions to magnetochemistry, bonding theory and intermolecular forces. Professor Mason's distinguished research activities over a wide range of chemistry have been recognised by the award of the Corday-Morgan Medal (1965), the Tilden Lecturship (1971) and the Chemical Society Award for Structural Chemistry (1973). He was elected to a Fellowship of the Royal Society in 1975.

Professor Mason has been prominent in the formulation of scientific policy at the highest levels in the U.K. He served as Chairman of the S.R.C. Chemistry Committee from 1969 to 1972, and in recent years he has been a member of the Chief Scientist's Requirements Board at the Department of Industry. He has long been keenly interested in chemical education at all levels; his involvement in this area has ranged from membership of the Joint Matriculation Board and the development of school curricula to the organisation of NATO Summer Schools in Theoretical Inorganic Chemistry.

Professor Mason has held a number of visiting fellowships overseas, and is presently visiting New Zealand as an Erskine Fellow at the University of Canterbury.

**PROFESSOR G.B. PETERSEN** graduated B.Sc. in chemistry and biochemistry in 1953 and M.Sc. in chemistry in 1956 from the University of Otago. From 1956-59 he was a student in the biochemistry department of Oxford University from which he graduated D.Phil. in 1959.

In 1959, Dr Petersen joined the staff of the D.S.I.R.

Plant Chemistry Division at Palmerston North. He returned to Oxford in 1962 and was for two years Departmental Demonstrator in the Department of Biochemistry. In 1964 he returned to the Plant Chemistry Division and worked in Palmerston North until 1968 when he took up his present appointment of Professor of Biochemistry at the University of Otago.

Professor Petersen has been chairman of both the Manawatu and Otago branches of the N.Z.I.C. He was a member of the board of the New Zealand Dairy Research Institute from 1969-73, and has been a member of the National Committee for Biochemistry since 1972 and is a member of the two-man Medical Research Council Advisory Committee on Genetic Regulation which has recently made specific recommendations for the control of genetic engineering in New Zealand. His research interests are in the broad area of nucleic acid structure and function, particularly the determination of nucleotide sequences in deoxyribonucleic acid.

**PROFESSOR J.F. DUNCAN**, M.A., D.Sc., D.Phil., M.Sc., B.Sc., was born and educated in Liverpool. He was on the staff of the Atomic Energy Research Establishment, Harwell, until 1952 and then took up a position in the Chemistry Department, University of Melbourne where he was reader in radiochemistry. In 1962 he was appointed Professor of Theoretical and Inorganic Chemistry at Victoria University. He became Head of the Chemistry Department in 1969. Professor Duncan has been a member of various bodies including National Development Committee, N.Z. National Commission for UNESCO, N.Z. Inventions Development Authority and more recently was appointed Chairman of the Commission for the Future.

**Dr G.S. HARRIS** has been Executive Officer of the New Zealand Energy Research and Development Committee since 1974. This committee has a broad policy of funding research and development contracts to meet the growing energy demand and to make New Zealand more self-sufficient in meeting that demand.

After obtaining a M.E. from Auckland in 1959 Dr Harris was an engineer with the Ministry of Works and Development until 1962. He then became a Lecturer in Civil Engineering at the University of New South Wales from 1962 to 1970 being awarded a Ph.D. in 1968. From 1970 to 1974 he was Associate Director, Sinclair Knight and Partners, Consulting Engineers, Sydney.

**Mr P.A. BLACK**, LL.M., is the editor of the New Zealand Law Journal.

**Dr C.L. DAVEY**, M.Sc. (N.Z.), Ph.D. (Cantab.), F.N.Z.I.C., became a member of the New Zealand Institute of Chemistry in 1963, and has held various administrative positions at both branch and national level. He was President of the Institute in 1975. He is Director of the Meat Industry Research Institute.

**Mr L.A. CAMERON**, C.B.E., F.C.A., is chairman of the National Research Advisory Council. He is responsible for advising Government on policy-making, programme setting and financing in the field of scientific research undertaken in Government Departments and Research Associations. The N.R.A.C. has a

parallel role to the University Grants Committee, with which it works in close liaison. Together these organisations have a major influence on the direction and pace of scientific research and development in New Zealand.

## TITLES OF SPECIALIST PAPERS

Papers accepted for the Specialist Sessions as at June 6th are listed under the appropriate headings but they may not be in these same categories in the final programme.

The author giving the paper, where known, is denoted by an asterisk (\*).

### ANALYTICAL AND ENVIRONMENTAL

- PESTICIDE EXCHANGE BETWEEN AIR AND WATER. *D.J. Spedding\** and *R.M. Slater*.
- KINETIC STUDIES OF HYDROGEN SULPHIDE ABSORPTION. *M.R. Vujcich\** and *D. J. Spedding*.
- RADON: ITS DETECTION AND CHEMISTRY IN THE ATMOSPHERE. *K.M. Matthews\**.
- SCANNING ELECTRON MICROSCOPE STUDIES OF MILK PROTEIN DEPOSITION ONTO SOLID SURFACES. *T.J. Nisbet\**, *C.K. Beltz* and *A.G. Langdon*.
- SPECTROSCOPIC STUDIES ON THE STRUCTURE OF HUMIC SUBSTANCES. *M.A. Wilson*.
- QUANTITATIVE ANALYSIS OF THE HYDRATED IRON (III) ION BY ELECTRON SPIN RESONANCE. *W.G. Bryson*, *D. P. Hubbard* (deceased), *B.M. Peake* and *J. Simpson*.
- AN ATOMIC ABSORPTION SYSTEM FOR THE ROUTINE LABORATORY. *P.A. Bennett* and *J.B. Sanders\**.
- THE MEASUREMENT OF TEMPERATURES IN NITROUS OXIDE-ACETYLENE AND NITROUS OXIDE-HYDROGEN FLAMES AND THE RELATIONSHIPS OF THESE TEMPERATURES TO OXIDANT/FUEL RATIOS. *M.D. Lowe\** and *M.M. Sutton*.
- THE HEAVY METAL CONTENT OF SOIL IRRIGATED WITH SEWAGE EFFLUENT. *B.F. Quin* and *J.K. Syers*.
- ROUTINE AUTOMATED ANALYSIS WITH THE CARBON ROD ATOMIZER. *K. G. Brodie* and *J.B. Sanders\**.
- THE AUTOMATED FLUORIMETRIC MEASUREMENT OF NANOGRAM AMOUNTS OF Se BY SOLVENT EXTRACTION USING AN IMPROVED PHASE SEPARATION. *J.H. Watkinson\** and *M.W. Brown*.
- ANALYTICAL METHODS FOR MEDIUM CHAIN LENGTH FATTY ACIDS IN ANIMAL LIPIDS. *C. B. Johnson*.
- PERFORMANCE OF GLASS CAPILLARY COLUMNS. *S.P. Cram*, *F.J. Yang*, *A.C. Brown* and *J.B. Sanders\**.
- A NEW GLASS CAPILLARY GAS CHROMATOGRAPH. *S.P. Cram*, *R.N. McCoy*, *R.L. Howe*, and *J.B. Sanders\**.
- THE ANALYSIS OF SPORIDESMIN BY GAS CHROMATOGRAPHY. *C.A. Pyle\**, *J.W. Ronaldson*, *P.T. Holland* and *E. Payne*.
- A ROUTINE METHOD FOR ANALYSING THE NATURAL SUGARS FROM WOOD OR PULP HYDROLYSATES BY GLC OF ALDITOL ACETATES. *V. Harwood\** and *P. Cobham*.
- THE FORENSIC SCIENTIST'S OBSERVATIONS. *D.F. Nelson*.
- THE APPROACH OF THE WORKING FORENSIC SCIENTIST. *R. Shanahan*.

### APPLIED AND INDUSTRIAL

#### Research papers

- CONSTITUENTS OF MUTTON ODOUR. *L.N. Nixon*, *E.J. Birch*, *C.B. Johnson* and *E. Wong*.
- THE ROLES OF THE APPLIED RESEARCH OFFICE — UNIVERSITY OF AUCKLAND. *J.G. Fletcher*.
- ENERGY RECOVERY FROM SULPHURIC ACID MANUFACTURE. *A.G. Williamson* and *R.T.C. Herman*.

PROCESS CHEMISTRY OF CARBON DIOXIDE REMOVAL WITH POTASSIUM CARBONATE WASH SOLUTIONS. *J.S. Hungerford and J. Child.*

## BIOCHEMISTRY

### Review papers

CONTROL OF LIPID METABOLISM. *J.C. Hawke.*  
GLYCOGEN — A CAUTIONARY TALE. *R. Geddes.*  
MITOCHONDRIA IN THE MAMMALIAN SPERMATOZOON. *I. Forrester.*  
GENETIC ENGINEERING IN NEW ZEALAND. *W.D. Sutton.*  
MUSCLE FUNCTION AND MEAT QUALITY. *C.L. Davey.*

### Research papers

THE ACTION OF DISULFIRAM ON ALDEHYDE DEHYDROGENASE. *T.M. Kitson.*  
MOLECULAR ABNORMALITY & DISEASE: HAEMOGLOBIN HEATHROW. *S.O. Brennan\*, C.C. Winterbourn, J. Hamer, R.W. Carrell.*  
INVESTIGATION OF CALCIUM BINDING SITES ON THE MILK FAT GLOBULE MEMBRANE. *D.J. Stannard and Ann Scotter.*  
THE OCCURENCE AND DISTRIBUTION OF SOME ISOPRENOID LIPID DERIVATIVES IN OVINE RUMEN LIQUOR. *D.R. Body.*  
ELECTRON TRANSPORT IN AN EXTREME THERMOPHILE. *C.W. Hickey\* and R.M. Daniel.*  
THE DISSOCIATION OF MAMMALIAN CATIONIC ANTIBACTERIAL PROTEINS. *Margret Eschenbruch\* and P.C. Molan.*  
ANHYDROBIOSIS IN LICHENS. *D.A. Cowan, T.G.A. Green and A.T. Wilson.*  
THE USE OF HIGH PRESSURE LIQUID CHROMATOGRAPHY FOR THE RAPID ANALYSIS AND PURIFICATION OF PEPTIDES AND PROTEINS. *C.A. Bishop\*, R.L. Prestidge, D.R.K. Harding, W.S. Hancock and M.T.W. Hearn.*  
SOME METABOLIC ALTERATIONS OF THE HOST LIVER IN TUMOUR-BEARING MICE. *J.E. McLean, C. Boberg, M.R. Grigor and M.P. Thompson\*.*  
GLUTAMATE SYNTHASE FROM NITROGEN-FIXING LUPIN NODULES. *M.J. Boland.*  
GERM TUBE INDUCTION IN *CANDIDA ALBICANS*. *M.G. Shepherd\*, Y.Y. Chiew and P.A. Sullivan.*  
AFFINITY CHROMATOGRAPHY OF ARABINO GALACTANS. *I.G. Andrew\* and B.A. Stone.*  
O-METHYL HEXOSES AND O-METHYL-6-DEOXYHEXOSES FROM THE EXTRACELLULAR POLYSACCHARIDES OF SLOW-GROWING RHIZOBIA. *L.D. Kennedy.*  
AFFINITY CHROMATOGRAPHY OF THE GLUTATHIONE S-TRANSFERASES. *A.G. Clark.*  
PHOSPHOFRUCTOKINASE IN A MOUSE PREPUTIAL GLAND TUMOUR. *A. Geursen\* and M.R. Grigor.*  
THE TRANSIENT AND STEADY-STATE PHASES OF THE REACTIONS CATALYSED BY ETHANOLAMINE AMMONIOLYASE. *K.N. Joblin\*, A.W. Johnson, M.F. Lappert, O.C. Wallis, M.R. Hollaway and H.A. White.*  
SYMBIOTIC NITROGEN FIXATION — THE INVOLVEMENT OF ASPARTATE AMINOTRANSFERASES IN AMMONIA ASSIMILATION IN LUPIN NODULES. *P.H.S. Reynolds\* and K.J.F. Farnden.*  
PHOSPHATIDYLCHOLINE — A POSSIBLE SOURCE OF DIACYLGLYCEROL FOR TRIACYLGLYCEROL SYNTHESIS IN OIL SEEDS. *C.R. Slack\* P.G. Roughan and N. Balasingham.*  
STIMULATION OF MONOGALACTOSYLDIGLYCERIDE BIOSYNTHESIS IN ISOLATED CHLOROPLASTS BY GLYCEROL-3-PHOSPHATE AND UDP-GALACTOSE. *J.W.A. McKee\* and J.C. Hawke.*  
THE EFFECT OF GASEOUS SULPHUR DIOXIDE UPON PLANT PIGMENT BIOSYNTHESIS. *R.G. Wallace and D.J. Spedding.*  
ROLE OF MESSENGER RNA 5' TERMINAL 'CAP' IN THE FORMATION OF AN 80S INITIATION COMPLEX *IN VITRO*. *J.D. Brooker and A. Marcus.*

EFFECT OF THE Na/K ATPase ON THE RATE OF SODIUM-POTASSIUM EXCHANGE IN KIDNEY CORTEX SLICES. *Philippa Wiggins.*

EFFECT ON THE Na/K ATPase ON THE RATE OF SODIUM-POTASSIUM EXCHANGE IN MOUSE DIAPHRAGMS. *Philippa Wiggins and Alice Knappstein\*.*

AMINO ACID UPTAKE IN MOUSE TUMOUR CELLS. *Philippa Wiggins and C.P. Main\*.*

SWELLING OF RAT LIVER AND BEEF HEART MITOCHONDRIA IN HYPERTONIC MEDIA. *V.A. Knight.*

A STUDY OF THE DISSOCIATION OF  $\beta$ -CASEIN FROM THE BOVINE CASEIN MICELLE. *L.K. Creamer\*, Gillian P. Berry and O.E. Mills.*

CONTROL OF FATTY ACID SYNTHESIS IN ISOLATED, INTACT CHLOROPLASTS. *P.G. Roughan\*, C.R. Slack and R. Holland.*

SECRETION OF  $\beta$ -N-ACETYLGLUCOSAMINIDASE BY NORMAL AND CYSTIC FIBROSIS FIBROBLASTS. *P. Wilcox.*

BIOCHEMICAL ASPECTS OF THE BACTERICIDAL ACTION OF HUMAN SERUM COMPLEMENT. *G.K. Scott.*

EVIDENCE FOR THE PRESENCE OF ISOENZYMES FOR AROMATIC AMINO ACID AMINOTRANSFERASES. *Y.C. Chia\* and G.J. Lees.*

DIURNAL RHYTHM AND TURNOVER OF TRYPTOPHAN HYDROXYLASE IN THE PINEAL GLAND OF THE RAT. *B.R. Sitaram\* and G.J. Lees.*

THE EFFECTS OF NEUROLEPTIC DRUGS ON THE DEVELOPMENT OF TRYPTOPHAN HYDROXYLASE IN THE CHICKEN BRAIN. *I.S. McLennan and G.J. Lees\*.*

THE PRODUCTION OF 7-KETO DEHYDROEPIANDROSTERONE BY HUMAN MAMMARY TISSUES *IN VITRO*. *R.A.F. Couch and S.J.M. Skinner.*

CELL-FREE SYNTHESIS OF CASEIN. *A.A. Hobbs\* and M.G. Smith.*

SEPARATION OF  $^{125}$ I-LABELLED PARATHYROID HORMONE FROM UNLABELLED HORMONE. *D.L. Christie\* and P.M. Barling.*

THE INTERACTION OF HORMONES AND OXIDATIVE ENZYMES IN THE INDUCTION OF ROOTS IN RHODODENDRON CUTTINGS. *T.W. Foong and M.F. Barnes\*.*

CHANGES IN THE ACTIVITY OF RIBOSOMES IN *ARTEMIA SALINA* DURING DEVELOPMENT. *D. Williamson\* and W.P. Tate.*

A TECHNIQUE FOR STUDYING ANHYDROBIOSIS. *M. Vickers and A.T. Wilson.*

THE STRUCTURE OF L-LACTATE OXIDASE FROM *MYCOBACTERIUM SMEGMATIS*. *P.A. Sullivan, C.Y. Soon, W.J. Schreurs, J.F. Cutfield and M.G. Shepherd.*

ANDROGEN BIOSYNTHESIS IN THE IMMATURE AND MATURE BULL TESTIS. *Heather Terry\*, J.J. Bass and A.J. Peterson.*

A DETERMINATION OF THE COMPONENTS OF CLOVER JUICE AND BOVINE SECRETIONS THAT ARE INVOLVED IN THE STABILISATION OF FOAMS IN BLOAT. *G.R. Mikkelsen and P.C. Molan\*.*

INTERRUPTED GERMINATION IN *SINAPSIS ALBA* SEEDS. *J. Dunbar\* and A.T. Wilson.*

GLYCEROLIPID SYNTHESIS IN DOGFISH (*SQUALIS ACANTHIAS*) LIVER. *R. Quinton\*, Mary P. Thompson and M.R. Grigor.*

COMPOSITION OF SURFACE WAX IN *CHIONOCHLOA* (GRAMINEAE). *H.E. Connor, M.G. Cowlshaw and R. Bickerstaffe.*

A NEW CHYLOMICRON REMNANT? *A.G. Bosanquet\*, R. Fraser and R. Bickerstaffe.*

BIOSYNTHESIS OF PINUS RADIATA STOMATAL LIPIDS IN RELATION TO DISEASE RESISTANCE. *R.A. Franich\*, L.G. Wells and P.T. Holland.*

CHAIN ELONGATION OF FATTY ACIDS IN LACTATING MAMMARY TISSUE. *D.J. Stannard, Ann Scotter and D.B. Jay.*

FUNCTIONAL ASSOCIATION OF THE PYRIMIDINE BIOSYNTHETIC ENZYMES IN YEAST. *C.H. Sissons.*

## CHEMICAL EDUCATION

- EDUCATION AND POLYMER SCIENCE; THE AUSTRALASIAN SITUATION. *N.R. Edmonds.*
- THE TEACHING OF UNIVERSITY EXTRAMURALLY. *S.V. Rumball\** and *G.N. Malcolm.*
- CHEMICAL PROCESSES IN NEW ZEALAND. *J.E. Packer.*
- COMPUTERS AND CHEMISTRY TEACHING. *R.G.A.R. MacLagan.*
- MARK MANIPULATION. *W.S. Peddie.*

## CRYSTALLOGRAPHY

- THE X-RAY 72 SYSTEM OF PROGRAMMES IN PRACTICE. *G.J. Gainsford.*
- LOCATING AND ORIENTING MOLECULES IN ASYMMETRIC UNITS. *P.P. Williams.*
- THE USE OF A SCANNING MICRODENSITOMETER FOR MEASURING X-RAY DIFFRACTION DATA. *B.F. Anderson\**, *E.N. Baker* and *S.V. Rumball.*
- COMPUTER SEARCHING OF THE CAMBRIDGE CRYSTALLOGRAPHIC DATA FILES. *B.R. Penfold.*
- DEVELOPING AND REFINING 100 ATOM MODELS UNDER DIFFICULTIES. *G.B. Jameson* and *W.T. Robinson.*
- CRYSTALLOGRAPHIC COMPUTING DEVELOPMENTS AT CANTERBURY. *W.T. Robinson* and *Theresa J. McLennan.*
- A CRYSTAL PACKING ANALYSIS OF MALEIC HYDRAZIDE. *D. Hall\** and *Christine E.L. Hedford.*
- IN SEARCH OF A COPPER DI-OXYGEN SPECIES. *K.J. Oliver\** and *T.N. Waters.*
- THE STRUCTURE OF A MOLYBDENUM (IV) SUGAR COMPLEX,  $\text{NH}_4\text{Mo}_2\text{O}_8(\text{C}_5\text{H}_7\text{O}_5)$ . *C.E.F. Rickard*, *G.E. Taylor\** and *J.M. Waters.*

## INORGANIC

- REACTIONS OF BIS(TRIPHENYLPHOSPHINE)IMINIUM PENTACARBONYLMANGANATE(-I). *D.N. Duffy\** and *B.K. Nicholson.*
- STUDIES ON GERMANIUM-METAL CARBONYL SYSTEMS. *R.F. Gerlach\** and *K.M. Mackay.*
- HIGH TEMPERATURE REACTIONS OF ILMENITE. *A.J. Eastafield* and *A.T. Morcom\*.*
- PARAMAGNETIC SPECIES ARISING FROM PHOTOLYSIS OF MANGANESE CARBONYL. *B.K. Nicholson.*
- PHOSPHINOAMINOPYRIDINE COMPLEXES OF GROUP 6 METAL CARBONYLS AND BROMOPENTACARBONYLMANGANESE (I). *E.W. Ainscough*, *A.M. Brodie\** and *S.T. Wong.*
- AQUEOUS SOLUTION EQUILIBRIA OF FIVE-CO-ORDINATE NICKEL(II), COPPER(II) AND ZINC(II) TRIAZAMACROCYCLIC COMPLEXES. *R.W. Renfrew\** and *D.C. Weatherburn.*
- KINETICS OF THE ACID DECOMPOSITION OF FIVE AND SIX CO-ORDINATE TRIAZAMACROCYCLIC METAL COMPLEXES. *P.G. Graham\** and *D.C. Weatherburn.*
- THIOCARBONYL COMPLEXES OF OSMIUM. *T.J. Collins\** and *W.R. Roper.*
- INTERLIGAND REACTIONS BETWEEN HYDRIDE AND THIOCARBONYL IN COMPLEXES OF OSMIUM AND IRIIDIUM. *T.J. Collins*, *W.R. Roper\** and *K.G. Town.*
- PREPARATION AND STRUCTURE OF A CHROMIUM CARBONYL DERIVATIVE OF PODOCARPIC ACID. *P.A. Fowler*, *B.H. Robinson* and *J. Simpson.*
- THE REACTIVITY OF IRON CARBONYLS IN THE. *P.A. Dawson*, *B.M. Peake*, *B.H. Robinson* and *J. Simpson.*
- THE PREPARATION AND VIBRATIONAL SPECTRA OF SOME METAL THIOLATE COMPLEXES. *G.A. Bowmaker\** and *L.C. Tan.*
- COPPER(III) COMPLEXES OF SUBSTITUTED 1,2-DIAMINES IN AQUEOUS SOLUTION. *P.J. Morris\** and *G.D. Beresford.*
- THE DEVELOPING ORGANOMETALLIC CHEMISTRY OF SURFACES. *R. Mason* (Sussex).
- TRANSITION METAL CARBONYL DERIVATIVES OF THE POLYGERMANES. *F.S. Wong\** and *K.M. Mackay.*

TRIFLUOROPHOSPHINE-SUBSTITUTED METAL CARBONYLS AND THEIR GERMANE DERIVATIVES. *Judy Christie\** and *K.M. Mackay.*

## MASS SPECTROMETRY

(Group meeting to be held after session)

- EXPERIENCE OF ASSEMBLING A MASS-SPECTROMETRY DATA SYSTEM USING A NOVA 3 MINICOMPUTER. *H. Young*, *S. Tucker* and *N. Galbraith.*
- MASS-SPECTRA CHARACTERISATION AND OCCURRENCE OF METHYLATED CYCLITOLS IN VARIOUS PLANT EXTRACTS. *J.A. Zabkiewicz*, *A.M. Cranswick* and *R.T. Gallagher.*
- MASS-SPECTRAL AND CHROMATOGRAPHIC STUDIES ON THE CUTICLE WAX OF *PINUS RADIATA* NEEDLES. *P.T. Holland* and *R.A. Frannich.*
- USE OF POROUS POLYMER TRAPS FOR THE STUDY OF THE HIGHLY VOLATILE COMPONENTS OF MUTTON VOLATILES. *E.J. Birch* and *L.N. Nixon.*
- ISOTOPE EFFECTS ON SOLUTE - WATER INTERACTIONS. *M.K. Stewart.*

## ORGANIC

### Review papers

- FREE RADICAL SUBSTITUTION REACTIONS OF AROMATIC AND POLYHALOGENOAROMATIC COMPOUNDS. *G.H. Williams* (London).
- SOME PATHWAYS LEADING TO ELECTROPHILIC SUBSTITUTION. *P.B. de la Mare.*

### Research papers

- THE LIPID COMPOSITION OF SOME PRIMITIVE GREEN PLANTS AS A GUIDE TO THEIR EVOLUTIONARY STATUS. *Z. Czochanska*, *K.R. Markham*, *L.J. Porter\** and *J.W. Wallace.*
- THE DEHYDROCHLORINATION ROUTE TO NON-LINEAR CYCLOPROPA-ARENES. *M.G. Banwell*, *R. Blattner*, *A.R. Browne*, *J.T. Craig* and *B. Halton\*.*
- APPROACHES TO BIS-CYCLOPROPABENZENES. *M.G. Banwell\** and *B. Halton.*
- THE NITRATION IN ACETIC ACID OF 9-ACETOXY- AND 9-METHOXY-10-PHENYLANTHRACENES. *H.D. Christoffersen*, *M.P. Hartshorn* and *K.E. Richards\*.*
- MECHANISTIC ASPECTS OF THE CONJUGATE ADDITION REACTION OF ORGANOCOPPER REAGENTS. *D.J. Hannah\** and *R.A.J. Smith.*
- STUDIES OF TERTIARY CARBINAMINE DEAMINATION. *P.G.J. Van der Beeke\** and *M.D. Carr.*
- 2'-HYDROXYCHALCONE EPOXIDE: ITS SYNTHESIS AND THE MECHANISM OF ITS CYCLISATION TO 3-HYDROXYFLAVANONE. *K.B. Old\** and *L. Main.*
- THE LOW-FREQUENCY INFRARED SPECTRA OF SOME TRITERPENOID. *Kathlyn J. Ronaldson\** and *A.L. Wilkins.*
- A NEW GROUP OF SECOTRITERPENOID. *E.M. Goh* and *A.L. Wilkins\** and *P.T. Holland.*
- THE SYNTHESIS AND HYDROLYSIS OF METHYL 4,5-DIAMINOPENTANOATE. *G.D. Beresford\** and *P.J. Morris.*
- TETRACYCLIC DITERPENOID BIOSYNTHESIS. *J.W. Blunt*, *G.S. Boyd*, *M.P. Hartshorn*, *H.S. Lee* and *M.H.G. Munro\*.*
- MARINE NATURAL PRODUCTS. *J.W. Blunt*, *M.P. Hartshorn*, *M.H.G. Munro\** and *S.C. Yorke.*

### PHYSICAL - General

- SPIN RELAXATION AND MOLECULAR MOTION IN LIQUID TRISTEARIN. *P.T. Callaghan*, *K.W. Jolley\** and *C.M. Trotter.*
- APPLICATIONS OF SPIN TRAPPING IN ELECTRON SPIN RESONANCE STUDIES OF SOME ORGANOMETALLIC AND ALKYL NEUTRAL RADICALS. *B.M. Peake.*
- REACTIONS OF HYDROGEN ATOMS WITH ALKYL NITRITES. *C.G. Freeman* and *D.R. Hastie.*
- RELAXATION OF VIBRATIONALLY EXCITED HF BY H<sub>2</sub>, HD AND D<sub>2</sub>. *P.R. Poole* and *I.W.M. Smith.*

FLOWING AFTERGLOW STUDIES OF GASEOUS PROTON TRANSFER PROCESSES. *C.G. Freeman, P.W. Harland and M.J. McEwan.*

INTERACTIONS OF PROTEINS AT SOLID-LIQUID INTERFACES. *H. van Enkevort, T.J. Nisbet and A.G. Langdon.*

COLLOID CHEMISTRY OF ALLOPHANE. *D. Taylor.*

SOLID STATE REACTIONS OF FELSPATHOIDS. *L. Moroney and A.G. Langdon.*

INTERACTIONS OF SULPHATE ANIONS WITH HYDROUS OXIDES AND AMORPHOUS ALUMINO SILICATES. *S.S. Rajan.*

THE USE OF SOIL AMINO ACIDS AS A DATING SYSTEM. *A. Limmer.*

#### PHYSICAL — Electrochemistry

RAMAN SPECTROSCOPY AND INTERMEDIATES IN ELECTROCHEMICAL REACTIONS. *A.J. McQuillan.*

THE MECHANISM OF FORMATION OF ANODIC FILMS OF LEAD SULPHIDE. *C.A. Wright.*

PITTING CORROSION AS A CATASTROPHE. *M.L. Daroux.*

ANODIC FILMS OF SILVER SULPHIDE. *V.I. Birss.*

ION HYDRATION ENTHALPIES. *D.W. Smith.*

#### PHYSICAL — Polymer

POLYMER MODIFIED CONCRETE — AN INTRODUCTION. *W.R. Sharman.*

POLYMERS AND STEROID RELEASE. *R.A.S. Welch, A.J. Peterson, H.R. Tervit and A.C. Kennet.*

THE OXYGEN PERMEABILITY OF MEAT PACKAGING. *W.J. Rigg.*

THE ASSOCIATION OF BIOPOLYMERS IN SOLUTION. *G.N. Malcolm, I.D. Watson and J.L. Woodhead.*

THE EFFECT OF SUGARS ON THE GELATINIZATION OF STARCH. *J. Lelievre.*

CONFERENCE REPORT. *J. McKinnon.*

#### PHYSICAL — Thermodynamics

THERMODYNAMICS OF DEUTERIUM EXCHANGE IN WATER-ALCOHOL SYSTEMS. *D.V. Fenby and A. Chand.*

THE UNLIKE-INTERACTION SECOND VIRIAL COEFFICIENT FOR THE SYSTEM BENZENE-CYCLOHEXANE. *P.J. McElroy and T. W. Shannon.*

ENTHALPIES OF MIXING OF VAPOURS. *C.J. Mayhew and A.G. Williamson.*

PARTIAL MOLAR ENTHALPIES OF AMINO ACIDS IN AQUEOUS SOLUTIONS. *R.S. Humphrey, G.R. Hedwig, G.N. Malcolm and I.D. Watson.*

## TRACE ELEMENTS IN HUMAN AND ANIMAL HEALTH IN NEW ZEALAND — A Symposium BIOGRAPHIES

**Professor LLOYD E. SMYTHE**, Foundation Professor of Analytical Chemistry at the University of New South Wales since December 1968, was President of the Royal Australian Chemical Institute in 1970. Prior to his present appointment he was Chief of the Chemistry Division, AAEC Research Establishment, Lucas Heights, N.S.W., to which he had been attached since its earliest days, as a member of the AAEC group working at AERE, Harwell, England. At Lucas Heights, he was responsible for the organisation and development of modern comprehensive analytical chemistry facilities. His diverse research interests have ranged from reaction kinetics and electrochemistry to analytical chemistry, and he has been involved in research into atomic fluorescence spectrochemistry, time-decay fluorimetry, neutron activation analysis. He has a general interest in trace analytical chemistry applied to geochemistry and biology; and has published a large number of papers on analysis of trace elements in environmental materials.

**Professor LARS T. FRIBERG** was born in Sweden and gained the degrees of M.D. and Dr of Med. Sci. from the Karolinska Institute. He has served as Head of the Department of Environmental Hygiene at the Swedish National Institute of Public Health and in 1967 was Visiting Professor at the University of Cincinnati. He was appointed to his present position as Professor and Chairman of the Department of Environmental Hygiene at the Karolinska Institute in 1957. He is also Head of Department of Environmental Hygiene of the Swedish Environmental Protection Board, and Medical

Director of the Swedish Motor Vehicle Inspection Company.

Professor Friberg has functioned in various consulting capacities to Swedish Government Departments and the World Health Organisation. He is a member of the World Health Organisation Advisory Panel on Occupational Health and is Chairman of the Subcommittee on the Toxicology of Metals under the Permanent Commission and International Association of Occupational Health. One of his recent activities was to Chair an Evaluation Committee studying the health effects of pollution from large scale use of fossil fuels.

Professor Friberg has published extensively in the field of Environmental Health. Current research interests include health effects of pollution from fossil fuel combustion processes, toxicology of trace elements Cd, As, Sn, Hg; effects on lung physiology of air pollution and epidemiology of chronic diseases using large scale twin registers as a tool.

#### WEDNESDAY, 24th AUGUST

1030—1100

**OPENING SESSION: Chairman — Dr J. Watkinson,** Ruakura Agricultural Research Centre.

Opening Speech by Dr G.W. Butler, Assistant Director-General, Dept. of Scientific & Industrial Research.

1100—1230

**GENERAL ASPECTS OF ENVIRONMENTAL TRANSFER OF TRACE ELEMENTS AND THE RELATION TO HEALTH. Chairman — Dr B. Healy,** Soil Bureau.

Diagnosis of trace element disorders in soils, plants and animals. **M. TURNER.**

Trace element diseases in animals in N.Z. A veterinary diagnostic laboratory viewpoint. **A.J. FRASER and T.C. REID.**

Uptake of Mo by pasture plant species. **G. SHERRELL.**

The forms of elements in the environment with special reference to human and animal health and disease. **L. SMYTHE.**

Metal emissions from fossil fuel power plants and their implications for health. **L. FRIBERG.**

1400—1530

**METABOLISM AND EFFECTS OF TRACE ELEMENTS, SPECIFIC PROBLEMS.** Chairman — Dr T. Kjellstrom, Dept. of Community Health, University of Auckland.

Trace element metabolism in total parenteral nutrition. J. McKENZIE.

Disturbed copper and zinc metabolism during total parenteral nutrition in man. R.G. KAY.

A pharmacokinetic model of gold disposition in the rat. R.W. MASON.

The role of iron in infection. A.M. BRODIE, I.K. PLOWMAN and S.V. RUMBALL.

Trace elements in human milk. C. BURTON and I.K. GRAY.

Trace elements in infant nutrition. K.N.P. MICKLESON.

1600—1730

**SELENIUM AND HEALTH IN NEW ZEALAND.** Chairman — Associate-Professor M. Robinson, Dept. of Nutrition, University of Otago.

Se in human health and disease. C. THOMPSON.

Se in animal health and disease. K.R. MILLAR.

Influence of soil Se on the Se level in human blood in New Zealand. J.H. WATKINSON.

Se and glutathione peroxidase status of New Zealand subjects. H.H. REA, R.L. McKENZIE, C.P. THOMSON and M.F. ROBINSON.

Vit.E, Se, Fe and Vit.A content of livers from sudden infant death syndrome cases and control children and inter-relationships and possible significance. D.F.L. MONEY.

Human medication with selenium. F. HICKEY.

#### THURSDAY, 25th AUGUST

1030—1130

**TOXIC METALS AND THEIR IMPLICATIONS FOR HUMAN HEALTH.** Chairman — Dr T. Kjellstrom, Dept. of Community Health, University of Auckland.

Main Speaker: Professor Lars Friberg, Karolinska Institute, Sweden.

1130—1230

**PRACTICALITIES OF ANALYSIS.** Chairman — Associate-Professor J. Aggett, Dept. of Chemistry, University of Auckland.

Discussion between the floor and a panel with experienced analysts.

1400—1500

**SOME PITFALLS AND SUCCESSES OF STUDIES ON THE DISTRIBUTION AND EFFECTS OF LEAD IN HUMANS AND ANIMALS.** Chairman — Associate-Professor J. Aggett.

Main Speaker: Professor Lloyd Smythe, University of New South Wales, Sydney.

1530—1730

**TOXICITY OF TRACE ELEMENTS IN THE GENERAL ENVIRONMENT OF NEW ZEALAND.** Chairman — Dr W.I. Glass, Dept. of Community Health, University of Auckland.

Pb in the N.Z. environment. J. FERGUSSON.

Lead and other trace elements in human hair. R.D. REEVES.

Heavy metals in printed matter. E.T.J. BATHURST.

A Survey of particulate lead levels in urban air. B.W.L. GRAHAM.

Monitoring workers in a lead smelter. Progress in the solution to a difficult problem. J. PYBUS, W.I. GLASS and B.R. GOLLOP.

As in the Waikato River. J. AGGETT.

Possible health effects of Hg in food in New Zealand. J. MITCHELL and T. KJELLSTROM.

Mercury in trout of the Central North Island. R.R. BROOKS.

1730—1800

First general meeting of the 'NEW ZEALAND TRACE ELEMENTS AND HEALTH RESEARCH GROUP'.

Decision on future activities of the group.

CLOSURE OF FORMAL SESSIONS.

#### FRIDAY, 26th AUGUST

0900—1030

Time open for workshops on particular topics that need further discussion.

1100—1230

Visit to Ruakura Agricultural Research Centre and discussion of trace element research performed there.



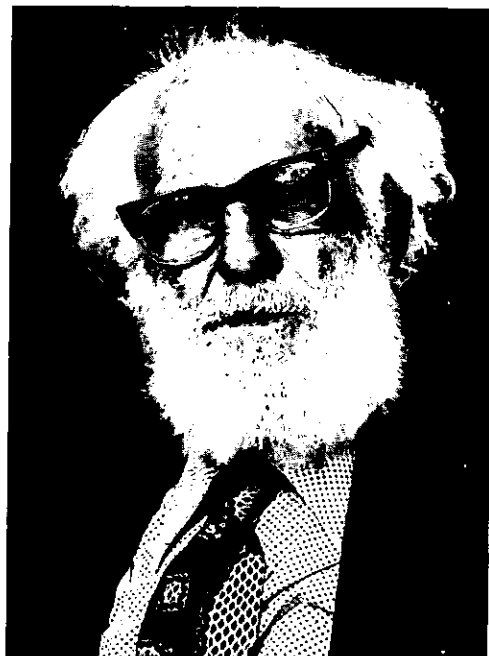
### HONOUR FOR S. H. WILSON

Stuart H. Wilson was awarded the degree of D.Sc. by the University of Manchester on July 8, 1977. Dr Wilson, who retired in 1961 and again in 1967, travelled to Manchester with his wife to receive the degree and will spend some time holidaying in Europe before returning to New Zealand.

Dr Wilson obtained an M.Sc. from Manchester in 1922 with studies in applied electrochemistry. He returned to New Zealand, after spending a year in Germany, and took a teaching position in a technical college in Hastings. After two years he moved to the Dominion Laboratory and in 1958 he transferred to the Institute of Nuclear Sciences, retiring in 1961 as a Principal Scientific Officer. He then worked part-time for a further six years to retire for a second time in 1967.

His principal scientific interests have been in volcanology, hot springs and geothermal research and he has been associated with most geothermal projects undertaken in New Zealand, ranging from analysis of hot spring gases (White Island and Ketekahi, pre-1939) to writing a commentary on the conflict of tourism and geothermal development for a U.N. Conference on the Development of Geothermal Energy.

He was instrumental in the formation of the N.Z. Geothermal Group and edited their newsletter for 10 years.



# CHEMISTRY AND CLIMATE RESEARCH

A. T. WILSON

Chemistry Department, University of Waikato, Hamilton

## INTRODUCTION

At first thought, one might think that Chemistry has little to contribute to climate research. In fact, if one wishes to determine the type of climate occurring before there was direct observation, the record preserved in the chemistry of materials such as stalagmites, lake sediments, ice cores and wood probably become the most important data available. The thermometer was only invented in 1650, and for most areas of the world there are temperature records for only 100 years or less. The problem is how to read out the record.

## THE REASON FOR CLIMATE RESEARCH

One might ask why one wants to have a good long-term climate record.

First, there is a powerful economic reason which has been amply demonstrated during the last year. The drought in Britain during last summer and the cold winter in the North Eastern United States resulted not only in inconvenience but also considerable economic loss. Most of the problems resulted from lack of preparation and inadequate provision of such capital works as water storage and natural gas pipe lines. These capital works are in themselves expensive, and planners need to know just how wet/dry or cold/hot it is likely to become and at what frequency. Even this information would be of considerable economic value. If one could predict the next growing season, this would be of enormous economic value especially to regions of the world which are limited by drought or cold. For example, if the long term climate record trend for central Australia could be predicted, it could be decided whether it would be economically worthwhile to expend resources on developing the desert areas with roads, houses, schools, etc.



*ALEX WILSON graduated M.Sc. from Victoria University in 1950, and obtained his Ph.D. from the University of California, Berkeley, where he worked on the Path of Carbon in Photosynthesis with Melvin Calvin. After studying microbiology with Van Niel at Stanford, he worked as*

*radiotracer chemist with Standard Oil Company of Indiana for two years. He returned to New Zealand in 1957 to work in the Institute of Nuclear Sciences. From 1960-1969 he was on the staff of Victoria University. In 1969, he was appointed Professor of Chemistry and Dean of Science in the newly established School of Science at the University of Waikato.*

Secondly, in order to understand history, it is necessary to have a good record of climate. This is particularly true in a country like New Zealand which has only a short written record. Such questions as, why the Polynesians stopped exploring the South Pacific in the 14th century and why they changed their canoe designs are probably related to the changing climate of this region of the world.

## THE PROBLEM

Plots of temperature vs time, show different phenomena depending on the time scale of the plot. These can be divided into four categories, each probably controlled by a different mechanism: —

- 1. Changes From Year to Year** — As I am sure any reader has experienced, some years are warmer and/or wetter than others. Whether there are a finite number of "types of years" for a given area, and what causes the changes from year to year, is the subject of much debate. Clearly there would be a great advantage in being able to predict the weather during the next growing season.
- 2. Decadal Climate Changes** — Climate changes where the mean temperature may change by perhaps  $0.5^{\circ}\text{C}$  over several decades. For example, the temperature in New Zealand at the turn of this century was  $0.5^{\circ}\text{C}$  colder than in the first half of the early 1970s. This may seem like a small change — but it can have drastic effects on agriculture in that it can dramatically affect the length of the growing season and the frequency of frosts. The fall in England's temperature from the early 1940s to the late 1950s shortened the growing season by two weeks and doubled the number of days with snow lying on the ground.
- 3. Millennial Temperature Changes** — These are changes of perhaps  $1.5^{\circ}\text{C}$  over a period of 1000 years. As is well known, the temperature in Europe in the 12th and 13th century was such that one could grow grapes in England and cereals in Iceland. This warm period even has a name — The Medieval Warm Period. In the middle of the 14th century, the climate changed abruptly and Europe was plunged into a cold period (called the Little Ice Age). Wheat which was previously grown as far north as half-way up Norway was unable to be grown north of Copenhagen. The colony in Greenland became cut off by sea ice. Farms on Dartmoor which were abandoned at the time, have never been re-established, even today. This cold period was a tragedy for people living at the northern limit of the cereal crop. The worst years of the Little Ice Age were probably in the 1690s when the cereal crop in Scotland failed eight times in ten years. England took over Scotland soon after this.

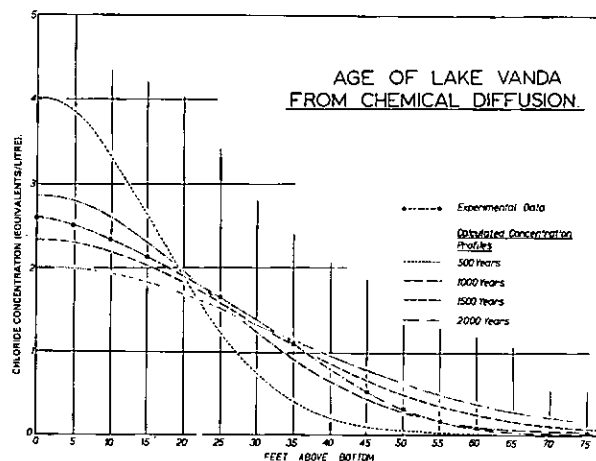
**4. Glacial Periods** — Changes of the order of 5-6°C on a time scale of 100,000 years. These cause rather spectacular changes. During the last ice age which ended only 10,000 years ago, an ice sheet covered North America down to New York and Chicago. Another ice sheet covered most of England, almost to London. The Glacial Periods are so well studied as to have names, *e.g.* the last one was called Wisconsin. In New Zealand, Fiordland was heavily glaciated, *e.g.* Milford Sound was filled with a glacier thousands of feet thick.

During the period since World War I, the world's climate has been reasonably steady. This led the decision makers in governments to assume that climate was essentially constant and so there was little investigation of climate change. However, it has become clear from recent climatically-related disasters such as the drought in Africa, the failure of the Russian wheat crop in the early seventies (which has led to the world's grain reserves decreasing alarmingly since 1970), that we have entered a period of climatic change. Understanding of climate change has become more important as agriculture moves increasingly on to more climatically-marginal land. Another even more alarming threat comes from carbon dioxide. Many scientists believe that the carbon dioxide being released by the ever increasing use of fossil fuels is on the point of changing the world's climate. Paradoxically, we may have to "go Nuclear" as this may be the only way of generating enough energy in the future, without significantly affecting our climate. It can be seen that it will become increasingly important to be able to detect the onset of any influence of carbon dioxide on world climate. Without reasonably long continuous temperature records from certain critical areas, it may be difficult to detect any effect until it is well advanced. These critical areas are often those with only very short records of direct observation.

#### THE CHEMISTRY OF CLIMATE RESEARCH

The climate records preserved in lake sediments, or the width of tree rings are called proxy records. For a number of years we have been working on new ways to read these records which would enable us to obtain additional information. We have also been trying to find new types of records and learning how to read them. Our efforts to date have involved Antarctic Geochemistry. This is because many people believe that events in the Antarctic affect the climate of the Southern Hemisphere and probably the whole earth. We have specialised in studying the Antarctic Lakes, partly because it is a fun place to spend the summer and partly because the salt gradients and sediments contain a great deal of information on the past climate of the Antarctic. To illustrate the sort of information, let us take just one example — Lake Vanda. This is a lake about 5 km long, 1 km wide and 70 m deep covered with 4 m of ice. It is fed from glaciers (*via* the Onyx River), which are in turn fed by local snow precipitation. The amount of precipitation depends on how far it is to the open ocean or, in the Antarctic, the extent of ice cover on the sea. The ice acts as a giant reflector and changes the heat balance of the region. Thus, if we can measure lake levels, we can probably measure heat balance and hence climate

Fig. 1



change. The bottom of Lake Vanda is very saline (80,000 ppm chloride) with a concentration gradient to the top of the lake where the water is fresh.

It is interesting to speculate on the origin of the salt concentration gradient in the lake. The only reasonable explanation seems to be that at some period in the past the climate was such that the Onyx River did not supply appreciable water to Lake Vanda. Under these conditions the Lake-level would have dropped until only a few feet of concentrated calcium chloride remained. When the climate changed, the Onyx would flow during the summer, and fresh water would have flowed up on top of this strongly saline solution. Since that time the calcium chloride has been diffusing upwards. If such a model is assumed, it is possible to calculate when this climatic change occurred.

If it is assumed that Lake Vanda has a flat bottom and vertical sides and that at zero time all the calcium chloride is concentrated in a layer of negligible thickness on the bottom, then the concentration profile at time  $t$  is given by:

$$C = M/(Dt)^{1/2} \cdot \exp(-h^2/4Dt)$$

where  $C$  is the concentration of calcium at distance  $h$  from the bottom after an elapsed time  $t$ ;  $D$  is the diffusion coefficient of calcium chloride (= 0.68 cm<sup>2</sup>/day at 10°C);  $M$  is the total mass of calcium chloride per unit area of lake surface. The calculated profiles for  $t = 500, 1000, 1500$  and  $2000$  years are given in Fig. 1, together with the experimental data. It is clear that the climatic change occurred about 1200 years ago and not 10,000 years ago as had been previously believed.

There are many lakes in Antarctica and we are systematically studying them all. Salt gradients only give the most recent upward movement of the lake. Calcium carbonate and  $\text{CaSO}_4 \cdot \text{H}_2\text{O}$  deposited in the sediment can be dated by  $\text{U}/\text{Th}$  dating (which is also done at Waikato) and the  $^{16}\text{O}/^{18}\text{O}$  ratios in these materials tell the source of the waters that fed the lakes. This is because the isotope ratios of sea water, local glaciers and polar plateau ice are very different. Using such techniques it has been possible to work out the climatic history of the Antarctic during the last 400,000 years [1]. It is interesting to note that this could probably only have been done using chemical techniques.

Polar paleoclimatology is a very specialised type of study. An approach of more general applicability to the rest of the world is to seek a naturally occurring system where material is laid down year by year and see if its isotopic chemistry records climate information. To date, we have looked at the following systems:

**1. Cave formations (speleothems).** We have shown that the  $^{16}\text{O}/^{18}\text{O}$  ratio in the  $\text{CaCO}_3$  of stalagmites records past temperatures which can be measured to perhaps  $0.1^\circ\text{C}$  [2]. This is because the isotopic fractionation between the oxygen in water and the oxygen in  $\text{CO}_3^{2-}$  is temperature dependent. In this way the temperature of New Zealand has been determined for the last 100,000 years. In order to gain some insight into recent climate fluctuations, a high-resolution temperature curve of New Zealand has been determined for the last thousand years. This shows that New Zealand did in fact have the Medieval Warm Period and the Little Ice Age. Spare a thought for the Maoris trying to grow kumara in the southern part of the North Island. Since the climates of New Zealand and Europe are probably independent, this result means that the Medieval Warm Period and Little Ice Age were in fact world-wide phenomena, and not, as has been suggested by others, fluctuations in the Gulf Stream.

**2. Ice in polar ice caps.** We have also shown [3] that the D/H and  $^{16}\text{O}/^{18}\text{O}$  ratios in the Antarctic Ice Sheet provide a 100,000 year old record of the latitudinal temperature gradient and hence violence of the world's winds. This not only gives a measure of the strength of the world's air circulation over the last 100,000 years, but also shows that when it becomes colder the latitudinal temperature gradients increase, *i.e.* it gets colder at higher latitudes than it does at low latitudes. Since the atmosphere is a heat engine, this means that cold periods have more violent weather than warm periods. The stalagmite data show that the world had a very sharp change in latitudinal temperature gradient about AD1350. This sharp change in climate may have important implications in meteorology and history. For example, it may have been the increase in storminess that led the Vikings to abandon their North Atlantic route with the onset of a cold period rather than seek a more southern route. Similarly, the Polynesian migrations in the Pacific started with the onset of a warm period and ended at the onset of the Little Ice Age. It has always been difficult to understand how the Polynesians could have settled New Zealand from Tahiti by the early fourteenth century and then not have gone on to discover Tasmania and Australia. If the Medieval Warm Period had been a period when very violent storms were rare, this would explain how the Polynesians could explore and settle the South Pacific in a few hundred years. If the break in climate in the fourteenth century caused a sharp increase in the frequency of violent storms, the loss of a relatively few skilled navigators could have effectively discouraged further exploration.

**3. Isotope dendroclimatology.** Currently, we are trying to establish this subject. Trees lay down annual layers of wood, which contain cellulose, lignin and other compounds. Each compound contains oxygen, hydrogen and carbon so it can be seen that the possibilities are enormous. Tree rings can be dated to one year by the technique of dendrochronology, and there are tree rings sequences already worked out that go back for many thousands of years. So we have the possibility of obtaining detailed climate — temperature and temperature gradients year by year for many thousands of years. This should enable us to determine what causes the short term fluctuations in our climate and perhaps predict what will happen in the future.

In seeking isotope thermometers among the available isotopes in the various compounds making up wood we have been greatly assisted by a very fortunate New Zealand phenomenon. In the warmer parts of New Zealand, *Pinus radiata* lays down wood all year around. The rings are up to 2 cm wide and one can easily obtain samples of wood which were laid down over a  $10^\circ\text{C}$  temperature range (a range even greater than the Ice Age fluctuations). This provides an excellent experimental system to look for possible isotope thermometers. Already we have been able to show that the D/H ratio in cellulose provides a useful thermometer [4]. We have also shown that the  $^{12}\text{C}/^{13}\text{C}$  ratio in both cellulose and lignin [5] should enable past temperatures to be measured to within  $0.1^\circ\text{C}$ .

### FUTURE PROSPECTS

In the last year we have been collecting samples from all the Kauri logs in the swamps in the northern North Island. These we have been dating with our

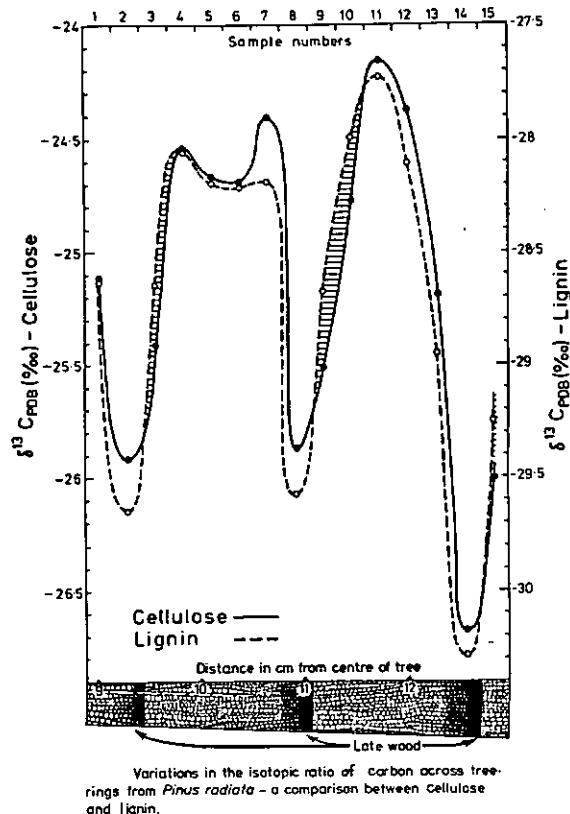


Fig. 2

C-14 dating system. We already have a sequence of wood that goes back for three and a half thousand years. We have a non-continuous sequence that goes back for 38,000 years. This might be compared to the Bristlecone Pine sequence that goes back 8,000 years with little prospect of going beyond the end of the last ice age — 10,000 years. New Zealand may be in the unique position of having an extremely long continuous sequence of wood. Currently, we are measuring the isotope ratios in the cellulose in these wood sequences and have already measured the last thousand years. It seems that the data will be complementary to the stalagmite data. The data from trees gives a very accurate time axis and that from the stalagmite an accurate temperature axis. We are already probably in the position where the temperature over the last thousand years is better known for New Zealand than anywhere else in the world. The prospects for

the further use of chemical techniques in climate research are very exciting indeed.

### ACKNOWLEDGEMENTS

The work reviewed in this paper is obviously that of many people over a number of years. In particular, the author wishes to acknowledge the work of two colleagues, Chris Hendy and Martin Grinsted, and to thank the University Grants Committee for providing our Mass Spectrometer.

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## BIOCHEMISTRY AT THE UNIVERSITY OF WAIKATO

P. C. MOLAN and R. M. DANIEL  
School of Science, University of Waikato

The School of Science at the University of Waikato offered its first courses in 1970. In 1973 a course in biochemistry was run for the first time, at second-year level. In 1974 an additional course, at third-year level was offered, and in 1975, with a second lecturer appointed, teaching was extended to M.Sc. students. The courses are taken mainly by students majoring in Chemistry or Biological Sciences. The content of the undergraduate courses has been selected in close co-operation with the Departments of Chemistry and Biological Sciences to avoid duplication of the material which at other Universities would be taught within a Biochemistry department and is at Waikato taught within various Biology and Chemistry courses. By choosing an appropriate combination of these (*e.g.* Microbiology, Plant Physiology, Animal Physiology, Analytical Chemistry, Radiochemistry) together with the Biochemistry courses, students emerge with a broadly based grounding in biochemistry, and the arrangement seems popular with students. They do not graduate in Biochemistry but in either Chemistry or Biology.

The administration of biochemistry teaching at Waikato is unique within the School of Science. Although it is not a department in the University, Biochemistry is separately funded. The two lecturers in Biochemistry are members of both the Department of Chemistry and the Department of Biological Sciences. These arrangements have been very successful, and have resulted in close collaboration with these departments in teaching and research in biochemistry. The arrangement is particularly appropriate given the School of Science's commitment to interdisciplinary teaching and research.

In research, biochemistry has had the advantage not only of an inter-subject administrative arrangement but also the proximity of several research institutes with biochemical interests, including Ruakura Agricultural Research Centre, the Meat Industry Research Institute, the National Dairy Laboratory, and the N.Z. Dairy Board's Artificial Breeding Centre. This has made possible collaborative research on a wide range of topics, including antibacterial peptides in semen, wine biochemistry, bloat, and microbial oxidative metabolism.

# CHEMISTRY AND THE SCHOOL OF SCIENCE AT THE UNIVERSITY OF WAIKATO

M. D. CARR

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## THE BEGINNING

In 1969 the University of Waikato (which at that time comprised Schools of Education, Humanities and Social Sciences) took a decision necessary for the formation of a real University, and inaugurated the School of Science. The foundation staff was appointed mid-1969; its brief to commence teaching in March 1970. The size of this task can be highlighted by noting that at the time of my first visit to the University (August 1969) there was a building site on which the foundations and the framework of the first floor of the first Science Block could be made out. This was where we were intended to teach in seven months time (and where we were teaching in nine months time, after a spell of conducting Laboratory classes in prefabs). The University had no scientific apparatus or chemicals, these had to be ordered, and **delivered** (!) within the same seven month period. Looking back, our optimism was laudable, and our ability to eventually bludge and borrow (thanks again to the Chemistry Department at the University of Auckland) stretched beyond decent limits. I remember talking to 7th formers at Otumoetai College (a group who had been the pioneer class in a new school and who were sceptically aware of the gulf between promise and performance) and being asked whether the laboratories would be equipped in time. My joking answer was to challenge them to name something which was standard equipment which we may have forgotten to order. The next day I was urgently ordering rubber tubing.

## THE DEGREE STRUCTURE

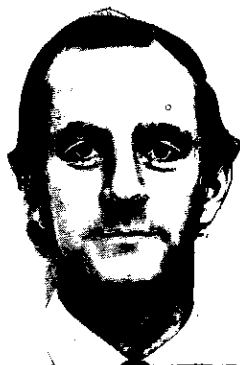
We were aware in designing Course Regulations for the B.Sc. degree of an opportunity to innovate which was given infrequently to University academics in those days. (The pace of change has subsequently quickened!) The Academic Advisory Committee to the University Grants Committee had

recommended at the new University of Waikato "that the student should acquire some expertise in one or more particular subjects. But . . . that he gain a sense of the vital relevance of these subjects to other subjects and of the intimate interdependence of one subject with another. He must be given a context into which to fit his expertise . . ." Other Schools in the University had accepted this challenge, and designed Intermediate years with compulsory Core Courses for all students, an experiment which at the time of our arrival was being re-examined. Science however faced some considerable constraints; we should have lost many potential students had we not offered the traditional Intermediates — Engineering, Medicine, Dentistry, *etc.* This made it impossible to design a degree programme around Core Courses compulsory to all students, and some of us regretted that this was not possible. However one feature of the other Schools which was attractive was the division of study into smaller basic units — their Bachelors degrees comprised 22 courses, the work content of each course being the same whether the course was at first, second or third year level. At a time when other Universities offered 8 unit B.Sc. degrees (with a rigidity and lack of choice which was proving unsufficiently flexible for the wide variety of interests of students) we were enthusiastic converts to a finer division of subjects. We designed a degree in which each subject (Chemistry, Biological Sciences, Physics, Earth Sciences, Mathematics and, for the first two years, Behavioural Sciences) offered two courses at first year level (Part I) and more courses at second year level (Part II) and third year level (Part III). Students would take 2 Part I, at least 3 Part II and at least 3 Part III courses in their major subject, and support these with appropriate courses at Part I, II and III levels in other subjects. The old problem of chemistry students having to take all of Maths II or Physics II was solved; it was possible to take appropriate courses at Part II and Part III in Maths or Physics without having to swallow the whole egg.

We required at least 8 Part I courses in the subjects within the School to ensure a broad base to the degree, and thereafter students could major in one or two subjects, and support these with appropriate higher level courses outside the subject. It was also possible to take up to 5 courses of the 22 required for a B.Sc. outside the School of Science. (This description may have reduced you to the torpor noticeable when I outlined our course structure to the members of the Waihi Rotary Club one memorable evening.)

Looking back after seven years the innovation does not appear startling; many N.Z. Universities

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have divided their units into smaller lumps — the size on occasion being smaller than that at Waikato. The modification of existing units in this way has, however, been more difficult and one important feature of the courses at Waikato (equal work load no matter what the level) has not always been achieved. In my view this is a major advantage of the Waikato system, *e.g.* in timetabling, and in enabling students to combine courses at all levels in their third year of study with some clear appreciation of the work involved.

### **THE CHEMISTRY COURSES**

In our initial planning, with small staff numbers in all subjects, it was possible to design Chemistry courses in full consultation with other subjects. Hence we began with a clear view of the needs of other disciplines and with an honest effort to accommodate these views. The two Part I Chemistry courses contained an introduction to the principles of Chemistry and some Systematic Inorganic Chemistry (71.101) and an introduction to Physical and Organic Chemistry (71.102). Well-prepared first-year students by-passed 71.101 and went straight to our second year Analytical Methods and Instrumental Techniques course (71.204). This was a good scheme as these students were keen to learn more about the instrumentation and applications of chemistry and this course, designed primarily as a service course for majors in other subjects, was an ideal substitute. At Part II and Part III we had separate courses in Organic, Physical and Inorganic Chemistry and at Part III also a Spectroscopy course and a Radiochemistry course; the Spectroscopy course being regarded as a pre-requisite for Honours Chemistry. This structure has stood a considerable test of time, being basically unaltered since we began teaching.

We had, from the beginning, a number of D.Phil. students (without their assistance laboratory demonstrating would have been impossible) and now have a large number of postgraduate students. In the School there are 116 M.Sc. students and 40 D.Phil. students. Chemistry contributes 24 M.Sc. and 15 D.Phil. students to these numbers. This is not, however, the place to consider postgraduate work further as that is the basis of another article.

### **THE CURRENT SITUATION**

The growth in students from about 100 to 600; and in staff from about 10 to 50 has meant inevitable changes in emphasis and direction. It is no longer realistic to think of staff members as belonging to the School of Science, and of departments as being merely administrative conveniences, which was a much-promoted vision in the early years. Departments with a capital D now surely exist, and the School of Science looks much more like the Faculty than was ever intended. Some of the early camaraderie in which equipment and ideas were shared has noticeably abated.

With the increase in staff has come an increase in the number of specialists wanting to mount new courses appropriate to and supportive of their interests. Very persuasive arguments can always be advanced in favour of new developments, but a disadvantage which can result is specialisation by students as early as in their second year — when they may be able to complete their enrolment by taking courses in only one subject. The inaugural appointees to the School of Science view with some alarm this movement away from a general B.Sc. degree towards a more specialised degree. A further problem comes when attempting to introduce Interdisciplinary courses into a curriculum which already contains a number of specialised courses. When material appropriate to an Interdisciplinary course is already part of courses in several different subjects the barrier to combining these several pieces is often too high for further progress. There is, however, an excellent History of Science course which has overcome these problems.

### **CONCLUSION**

I am well aware that this review has skimmed over the surface of a complex subject. The description of where we are, and any worries about where we are going are personal and may not reflect my colleagues' views. To end on a positive note there is still something here which the Advisory Committee would recognise, a closer binding of subjects and a high proportion of graduates with degrees constructed within a recognisable context. The face of today reveals the bone structure of yesterday if regarded closely (and with affection).

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### **NZIC A.G.M. 1977**

**The Annual General Meeting of the New Zealand Institute of Chemistry will be held on the afternoon of August 25 at the University of Waikato in Hamilton.**

# THE CONTRIBUTION OF BIOCHEMISTRY AT THE MEAT INDUSTRY RESEARCH INSTITUTE TO MEAT SCIENCE AND MUSCLE BIOLOGY

R. H. LOCKER

Meat Industry Research Institute, Hamilton

## HISTORICAL

The Meat Research Institute was founded on its Biochemistry Section. As was normal in the early 1950s in New Zealand, graduates in chemistry were taken and remodelled somewhat to fit the biochemical bias of agriculture-related research. In 1950 the newly appointed Director of the Meat Section of Dominion Laboratory, N.H. Law, recruited two graduates in organic chemistry, B.B. Marsh and R.H. Locker. The original staff of the section, as well as J.C. Scaife (1954) and C.L. Davey (1957), all had the good fortune to spend a period at the Low Temperature Research Station in Cambridge. This latter institution enjoyed the unusual status of a D.S.I.R. enclave on the University campus, and successfully maintained a foot in both the academic and the applied world of food preservation. Its New Zealand guests were able to carry on this tradition, under some difficulty, on returning to Wellington.

B.B. Marsh was appointed while working for a Ph.D. in Cambridge, after a season on the whaling ship, "Balaena". Observations on whale meat led to his thesis study with Kenneth Bailey on the relaxing factor of rabbit muscle. This pioneer work gave the first clues to the possibility that a calcium binding agent was involved in the contraction — relaxation cycle. On his return to Wellington, Marsh continued this work, seeking to isolate a chemical factor. It fell to others to recognise that the elusive factor was an organelle, the sarcoplasmic reticulum, rather than a substance. However, his work set the course for a major advance in muscle biology — the regulation of contraction and relaxation by the calcium pump of the sarcoplasmic reticulum.

R.H. Locker, who also worked with Bailey on end-groups (or their absence) in muscle proteins, on his return applied these methods to the question of whether proteolysis is involved in the aging of meat. The answer was negative, but a by-product of this study proved to have far greater significance. A wide

range of contraction states was noted in various muscles, and this led to a paper relating tenderness to state of contraction, a factor which, rather curiously, had been overlooked.

The Defence Scientific Corps provided the next group of recruits. P.M. Nottingham, who had worked at Torry Research Station, Aberdeen, returned to New Zealand in 1952. After working for two years on connective tissue he moved into the microbiological field and still serves the Institute as chief microbiologist. J.C. Scaife joined the Section in 1954 and left for Canada in 1956. C.L. Davey returned to Wellington in 1957 after thesis work with J.R. Bendall on nucleotide metabolism in post-mortem muscle. He has remained with the Institute to make a distinguished contribution to meat science, and became its second Director in July 1977.

In 1955 the Meat Section became a full-blown research association, the Meat Industry Research Institute, and shifted from Sydney Street to Gracefield with the Dominion Laboratory in 1957. An immediate start was made on planning new laboratories, and in 1960 the shift to Hamilton was made. The new Institute building was officially opened on 4th March, 1961.

## APPLIED STUDIES

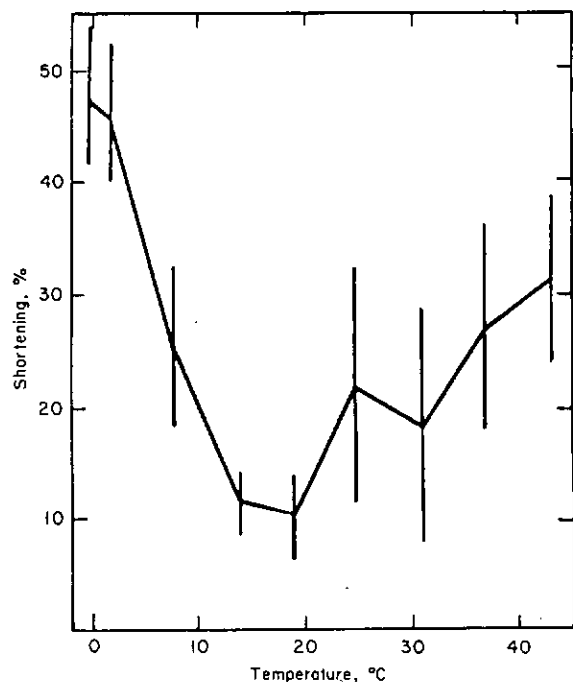
### Meat Toughness

The first task presented to the Biochemistry Section in its new premises determined its course for the next decade. This was an investigation of complaints from the U.K. that New Zealand frozen lamb was often tough. Such heresy was not believed, but a scientific basis for denial was felt to be needed. A large-scale experiment was set up under the direction of B.B. Marsh, with all resources involved. It soon became evident that the complaints were entirely justified and that the freezing method was the culprit. Old-fashioned hanging overnight, followed by freezing in the slow brine freezer, always gave a tender product, while the newer blast-freezers produced any state from tender to very tough.

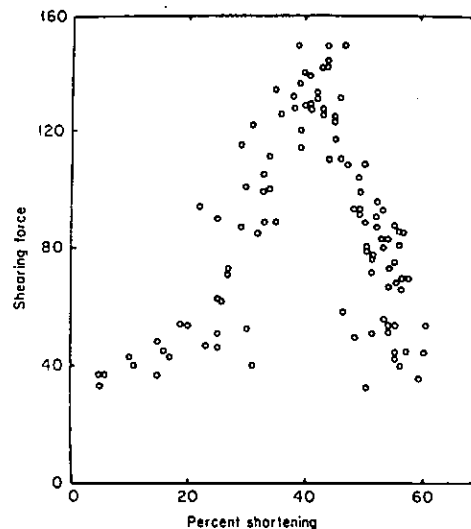
It soon became clear that two adverse effects were at work. About this time, quite fortuitously, Locker had noted that exposing pre-rigor beef muscle at 2°C produced a strong contraction. This "cold shortening", taken together with his earlier observation that contraction induced toughness, suggested an obvious explanation for the serious toughening in freshly-killed lamb exposed to blast-freezing conditions. It was soon confirmed that chilling (without freezing) under blast freezer conditions induced marked toughening. A second effect, "thaw shortening", already known, was found

*RON LOCKER was a student of L.H. Briggs at Auckland. On graduating Ph.D. in organic chemistry in 1950, he joined the embryonic Meat Section of Dominion Laboratory. After conversion to biochemistry at Otago and Cambridge, he has continued research on muscle structural proteins and meat tenderness.*





The relationship between final state of contraction in excised beef muscle, and holding temperature. Contraction is maximal at 0°C and minimal at 14-19°C.



The relationship between toughness (measured as shear force on cooked meat) and degree of cold-induced shortening. Toughening maximal at 40% shortening.

by Marsh to be operative in blast freezing of lamb. This effect causes powerful contraction when a muscle which has been frozen pre-rigor is thawed quickly. Both cold shortening and thaw shortening were found to be additive in frozen lamb, although the contribution of thaw shortening could be avoided by slow thawing of carcasses or joints before cooking. Marsh refined the toughening-shortening relationship and found maximal toughness near 40% shortening, with a decline to near unshortened values at 60%. From a great deal of work by Marsh and others, no practical alternative emerged other than holding carcasses until rigor was near completion ("conditioning") before exposure to low temperatures. The "Conditioning and Ageing Specification for New Zealand Lamb" was drawn up, defining precise conditions for holding lambs in air-conditioned rooms to ensure that this was the case. Davey showed that beef, although slower to cool, also suffered from toughening in even a moderately efficient chiller, and a beef specification resulted\*.

Holding carcasses in air-conditioned rooms is relatively costly and has remained unwelcome to the industry and much of the recent work of the section has been directed to alternatives. Davey found a promising alternative in freezing lambs in altered posture (pelvic suspension), where a more natural balance of tension in opposing muscles minimizes cold shortening. An American visitor, G.R. Schmidt, showed the possibility of "hot-cutting" beef and allowing it to enter rigor at 15°C, when shortening is minimal. Subsequently, Locker showed that hot-cutting of lamb or mutton to primal cuts could also overcome toughening problems with a great reduction in demands on refrigerated space.

\* In 1971 Marsh left the Institute to become Professor of Meat and Animal Science at Wisconsin.

### Electrical Stimulation

The most important break-through came in 1970, when W.A. Carse showed that electrical stimulation of dressed lamb carcasses markedly accelerated onset of rigor mortis. (Earlier British observations and an American patent had never been utilised.) The potential of this method was not fully grasped at first, as pelvic suspension was favoured. However, the problem of marketing the cuts with a different shape arose and attention came back to electrical stimulation. B.B. Chrystall showed that higher voltages and earlier stimulation (on the bleeding rail) could produce rigor even more rapidly. Brief, high voltage AC pulses, at a frequency (15 Hz) just sufficient to cause tetanus if applied for only 45 seconds! produce carcasses which may go safely to the blast freezer at one and a half hours *post mortem*, without fear of cold or thaw shortening. It has also been found that Carse's approach — stimulation after dressing is also quite workable (90 sec. stimulation), allowing freezing to commence at 2 hours *post mortem*.

It has only recently been realised that thaw shortening is unlikely to be a problem in exported lamb, since Davey has shown that enzymic breakdown of ATP (the energy source) continues quite steadily at normal frozen store temperatures reducing the ATP concentration to such a low level within 12 months that the risk of thaw shortening has passed.

Recent experiments on electrical stimulation of beef indicate that considerable benefits are possible, both in avoiding damage during chilling, and in allowing ageing to begin sooner. Davey has shown that beef may be chilled at 40 minutes *post mortem*, boned at 5 hours *post mortem* and then aged for 3 days at 10°C to produce high quality steak.

### Present Situation

Taken together, the above-mentioned results amount to the development of a new branch of meat science — the relationship between muscular contraction, meat tenderness and cold. It has greatly influenced the course of meat research in other centres around the world and finally found



*Lambs on the bleeding rail at Whakatu, being electrically stimulated by 3 600 V pulses applied between the leg shackles and electrodes rubbing against the neck.*

recognition in new international standards for meat handling. It cannot be said to have created an equal impact on the New Zealand meat industry. Although the cause of the problem was known by 1962, up to the present, the results have been applied only to lambs going to the North American market (about 6%), while there has been no change in the quality of lambs shipped to Britain, the source of the original complaint, or developing markets, some of which are quite sophisticated in their tastes. It is possible that there may have been some improvement in beef, but the chilling specification is optional and it is not known to what extent it is being observed. There does now seem to be a real possibility that all our lamb, mutton and beef may be upgraded by installation of electrical stimulators as standard equipment on all processing chains before too many years have passed. Currently 30,000 lambs are being stimulated each day, and most companies are planning electrical stimulation of beef on the basis of a recently developed specification.

#### **Studies at the molecular level**

While this industry-orientated work has been in progress a variety of other work has also been going

on in the section, aimed at a better understanding of meat rather than practical application. This work is too diverse to describe fully here.

Davey continued work on the mechanism of cold shortening and showed that the phenomenon occurs at a fibre level, but not with myofibrils, and is related to calcium concentration, a strong indication that the sarcoplasmic reticulum is involved. More recent studies by others of isolated sarcoplasmic reticulum have confirmed this. Marsh's recent work in Wisconsin indicates that the prime cause of shortening is an efflux of calcium from anaerobic mitochondria. At ordinary temperatures the calcium pump of the reticulum can cope with this, but not in the cold.

Davey has taken a continuing interest in the mechanism of ageing. He showed that the tenderising effect of ageing is progressively reduced as meat contracts, and at the point of maximal toughness (40%) it does not age at all. He also observed the disappearance of the Z-line during ageing and postulated this as the site of weakening in the myofibril. The rate of ageing was found to be maximal at 60°C, emphasizing the importance of accelerated ageing during a slow cook, as in roasting. Finally, he was the first to observe that ageing involved an attack on the "gap filaments" of the myofibril, causing their disintegration during cooking. This was the first unequivocal evidence of the importance of these filaments to meat tenderness (see below).

Locker studied the aerobic outer layers of muscle in which the Pasteur effect suppresses glycolysis, and showed that such fibres could survive for periods of up to a month, conserving their glycogen and living on lactic acid diffusing from inner anaerobic fibres. He also showed that in beef or lamb carcasses, stored 5 days in a chiller, this aerobic survival leads to pH values well above the "ultimate" pH. This finding, together with the high pH of fatty surfaces, indicates that the surface of a carcass is not the low pH medium for growth of micro-organisms that it has been assumed to be.

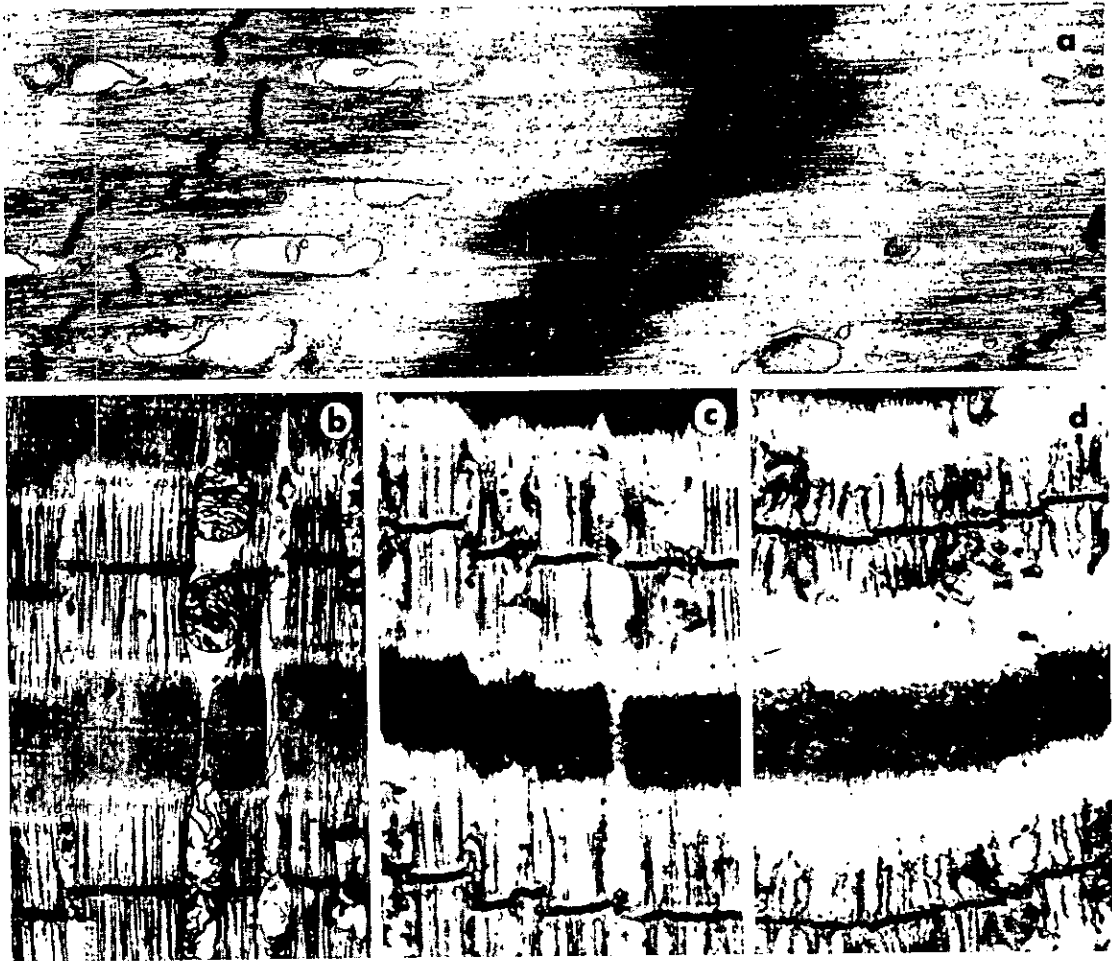
The mechanism of accelerated glycolysis continuing after discontinuation of electrical stimulation has received some attention. C.E. Devine has shown swelling and damage to mitochondria and has suggested that the release of calcium from these organelles stimulates ATP breakdown.

#### **Blood Splash**

The imposition of "humane killing" by the E.E.C. has led to trials of electrical stunning. A serious drawback to this method is "blood splash". It has been shown by Devine and Leet that again we have a contraction problem. Intense localised contractions of muscle fibres, resulting from the intense stimulus to the brain, tear adjoining blood vessels, leading to haemorrhage. The highly erratic occurrence of this phenomenon is a puzzle at present and is under investigation by Devine.

#### **FUNDAMENTAL STUDIES ON THE STRUCTURE OF MUSCLE**

There has been a continuing interest in muscle structural proteins and more recently in their organisation within myofilaments. In 1963, Locker, simultaneously with some American workers, found



(a) Grossly stretched sarcomeres (7.4  $\mu$ ) in a beef muscle fibre, showing separation of the myosin filaments of the dark central A-band and the actin filaments of the I-bands (grey), with a sparser assay of "gap filaments" spanning the gap between.

(b) Raw beef muscle allowed to go into rigor while stretched to two times excised length. "Aged" muscle has a similar appearance when raw. (c) Sample (b) cooked. Both A- and I-bands have shrunk leaving well defined "gap filaments" spanning the

gap. (d) "Aged" muscle cooked. Here gap filaments have disappeared, suggesting that the tenderization obtained by aging is due to their disintegration on cooking, leaving no continuity of structure across the "gap".

the low molecular weight sub-units in the myosin molecule. Using acetylation of the protein to dissociate the sub-units, he was the first to separate the three light components of rabbit muscle and determine their molecular weights. He also showed that the sub-units resided in the heads of the molecule and varied between animals and between types of muscle. Originally dismissed as impurities because they did not fit current myosin models, these sub-units are now accepted as part of the myosin heads and essential to their biological function (that is, to the ATP-ase activity and actin-combining ability of myosin). The way in which the low molecular weight units exert this effect still remains a mystery.

Over recent years Davey has been studying the organisation of myosin molecules within the natural thick filament, and within "synthetic" thick filaments formed by reducing the ionic strength of myosin solutions, mainly by electron microscopy using negative staining techniques. Synthetic filaments vary in length and width, but show a more regular distribution of heads. The bare zone seen at the centre of the natural filaments is lacking. He has also shown formation of paracrystalline arrays during dialysis of actomyosin solutions. Synthetic thick filaments form in ordered parallel arrays with actin filaments. Refinement of the negative staining

technique has revealed a wealth of fine substructure in thick filaments, especially in the "bare zone", where 5-6 aligned rods have been seen.

From a study of very highly stretched single beef fibres, Locker has recently rekindled interest in the "gap filaments" of the sarcomere, known since 1963, but neglected. These filaments, which form a third set, additional to myosin and actin filaments, are shown to great advantage in beef fibres stretched to 4-5 times. Electron microscopy of such fibres, before and after selective extraction, has led to a model for the connections of the gap filaments. This proposes that each gap filament begins as a "core" to a thick filament, emerging at one end only to pass between the actin filaments and through the Z-line, into the next sarcomere, there to terminate as core to another thick filament. The gap filaments thus appear to form an elastic component centred on the Z-line. Attention is currently being focussed on the protein of the gap filaments, which is extracted in 6M urea-borate, after prior extraction of the other proteins of washed myofibrils with MKI-borate.

This academic work has suddenly assumed practical significance as evidence begins to point to the gap filaments as the strength-limiting component of the cooked myofibril. Davey's observation that gap filaments survive cooking in stretched muscle, but not if the muscle has been previously

aged, showed graphically their possible significance to tenderness. Locker found that in heavily cooked stretched muscle, where overlap of actin-myosin filaments did not occur and collagen had been destroyed, most of the strength of the muscle remained, and the gap filaments, which survived, were the point of breakage. He also showed that in unstretched muscle, actin filaments disintegrate leaving only gap filaments in the I-band.

Collagen, once held to be the major cause of toughness, has been somewhat neglected in recent years as attention became focussed on the relationship between muscular contraction and meat tenderness. However, muscle is a dual system of collagen fibres (mainly perimysial) and of muscle fibres. Any satisfactory theory of meat tenderness must take account of both components.

Interest in the contribution of collagen was rekindled by Rowe, who found in 1974 (in Australia) that the crimped perimysial collagen of relaxed muscle, when tensioned by contraction or stretch, is revealed as a well organised net. Independently Locker observed the same net in meat cooked at rest length. In the first case the net was tensioned mechanically, in the second by thermal shrinkage of collagen.

## A THEORY OF TENDERNESS

There is good evidence from the work of Davey and others that there is a close relationship between tensile strength of cooked muscle and shear force, measured in a mechanical tenderometer and widely used as an objective measure of tenderness. In seeking to explain tenderness it is therefore reasonable to assess the tensile strength of muscle filaments.

Locker has recently studied the extensibility and tensile strength of muscle cooked to varying degrees, and muscle in which either the myofibrillar or the collagenous components had been selectively destroyed by alkali or by long cooking respectively. This work, taken together with the gap filament studies and the collagen net concept, make possible a theory of meat tenderness which takes into account both myofibril and connective tissue.

There are two quite distinctive responses to loading of muscle, depending on the degree of cooking. The discontinuity in behaviour coincides with the two-stage development of toughness in cooking, observed by Davey. This is related to stepwise denaturation of proteins.

Raw meat in rigor, or meat lightly cooked (to 60°C) is difficult to stretch, due to actin-myosin links, but suddenly yields at a certain load due to failure of actin and gap filaments near the Z-line. The collagen net is not tensioned at this point and takes up none of the stress. The muscle now extends readily without further loading, tensioning the net of inelastic native collagen fibres until they impose a limit to stretch at twice excised length. It requires great force to break these and it is the first "yield point" which the tenderometer "sees".

Well cooked meat (70°C or above) extends more readily. The actin filaments have disintegrated, destroying rigor links, but the gap filaments remain strong. The collagen has been heat denatured and has become elastic, while the net it forms has been

pre-tensioned by thermal shrinkage. The gap filaments of the myofibril and the collagen of the connective tissue now stretch in unison under the load, each contributing significantly to strength. At a much higher load than the "yield" of lightly cooked muscle, the two components fail. Ageing reduces the contribution of the gap filaments, and long cooking the contribution of collagen.

The inability of meat shortened by 40% to tenderize on ageing may now be explained. The pushing of adjacent A-bands together at this degree of contraction gives rise to a continuum of fused thick filaments on cooking, eliminating the gap filaments as a weakened link.

In conclusion, the biochemistry section of MIRINZ has managed to make contributions both to muscle biology and meat science, and by relating muscular contraction to meat tenderness has built some new bridges between the two sciences. On the basic side, it is currently contributing to an understanding of the organisation of the filaments which make up the contractile machinery. On the applied side, it has shown that the dynamic properties of living muscle, which persist after the death of the animal, may cause it to respond to the processing environment in a way which profoundly modifies the final state of the material. It has provided an overdue warning that freshly killed meat is not an inert material to be treated as the processor wishes; nor is it to be thought of as just a bacterial medium in which growth should be inhibited by the full power of modern refrigeration, turned on as early as possible. If the warning is ignored in the pre-rigor period, nothing which the processor can do subsequently will restore the quality which the consumer values most — its tenderness. Best of all, the section has produced what industry always expects — a cheap and simple solution which does not hold up the production line.

Over the short history of the Institute there has been a happy (and lucky) interplay between adding to knowledge and usefulness, in the work of its biochemists.

## ACKNOWLEDGEMENTS

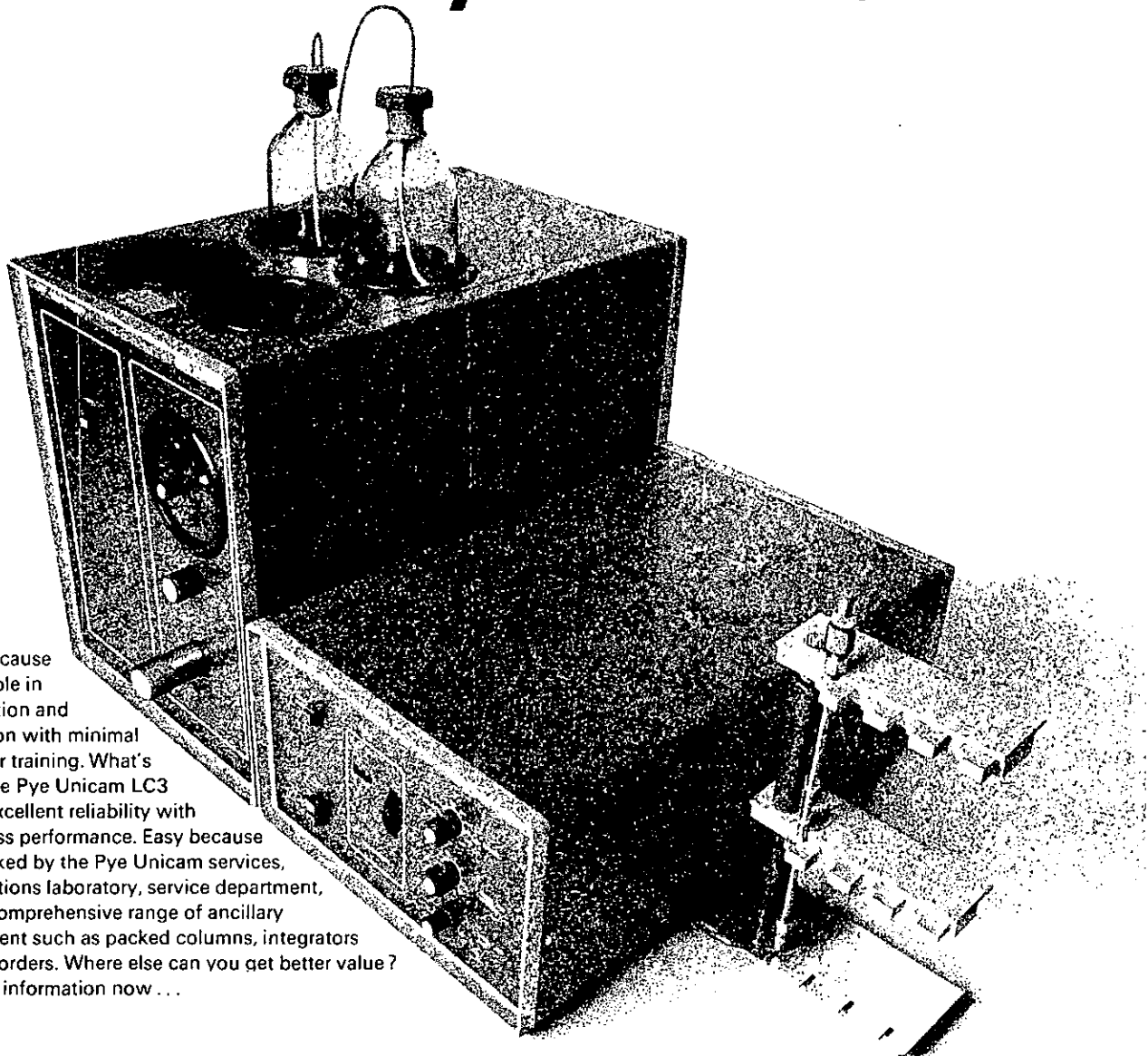
The research described would not have been possible without the skill and energy of its technical staff: C.J. Hagyard, K.V. Gilbert, N.G. Leet, A.E. Graafhuis, G.J. Daines and A.E. Niederer. The contribution of W.A. Carse deserves special mention for initiating the electrical stimulation experiments, which opened the way for the most important technical advance yet towards better eating quality.

The work has also depended on the co-operation of other sections: taste panel services, microbiology and increasingly, the electron microscope.

## PRINCIPAL REFERENCES TO MIRINZ BIOCHEMICAL WORK

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# THE IMPACT OF CHEMISTRY ON THE WAIKATO

N. T. CLARE

P.O. Box 11023, Hillcrest, Hamilton

As a district "The Waikato" is not well defined, but presumably it originally denoted the valley and drainage area of the Waikato River, from Lake Taupo to the sea 50km from Auckland. For the purposes of this paper "The Waikato" is taken as the territory of the Waikato Branch of the Institute, extending the original connotation beyond the present watershed to include the old courses of the river and over the divide to the Bay of Plenty and Rotorua. The main centres within this territory where chemistry is practised are Hamilton, Tokoroa, Rotorua, Kawerau and Taupo; but in the wide fields of agriculture and forestry in particular, the results of chemical research and application influence the whole area. Indeed much of this district would never have remotely approached the present level of productivity without the efforts of the pioneers of New Zealand chemistry nor be able to maintain it without the work of their successors.

## MINING OF GOLD AND SILVER

Probably the earliest chemical activities in the district were carried out on the Thames goldfields. One of the Schools of Mining started by Professor Black to give miners more knowledge for recognising, testing and processing ores was sited at Thames and assays were undertaken there. However the greatest impact came from the introduction of the cyanide process in 1889. Basic studies on this

reaction by Maclaurin and practical adaptation by men trained in the schools of mining led to a standard of cyanide extraction equal to that anywhere in the world. The efficiency of this process with lower grade ores and for retreatment of tailings was largely responsible for the boom during the nineties and early years of this century on the Thames and Waihi fields, when Thames ranked second to Auckland among the towns of the north.

## CHEMISTRY AND AGRICULTURE

The prosperity of the Waikato was built, and still mainly depends on agriculture, particularly dairying. It is no accident that the banner of one Hamilton Rotary Club bears identical twin calves, for 30% of its members are concerned with agricultural production and processing; or that the only sculpture in Hamilton's municipal gardens is Molly McAllister's "Little Bull".

It is therefore not surprising that the greatest impact of chemistry has been through agricultural production. Over the last 50 years much of the central Waikato has emerged from bush, scrub and swamp into dairy cow grazing country with an outstanding record for per hectare production. This would not have been possible without the development of chemical fertilizers, an understanding of the chemistry involved in soil-plant-animal inter-relationships, the application of chemistry and biochemistry to animal disease, and the evolution of processing technology to improve the quality and diversity of dairy products. Parallel improvements have been effected on sheep grazing country, allowing more intensified meat and wool production, and in the processing and preservation of sheep products.

## Fertilizers and Pasture Production

Probably the greatest single factor in the development of pasture grazing in the Waikato has been the use of phosphatic fertilizers. By the time the Waikato was settled after the Maori Wars the production of superphosphate from phosphatic rock, initiated by Lawes in 1842, was well established (manufacture started in New Zealand in the eighties). Use of phosphate was based initially on English trials for hay production omitting the influence of the grazing animal. However the experience of a few advanced farmers, supported and extended later by trials made by the Department of Agriculture soon after it was established in 1892, emphasized that if phosphate was supplied the Waikato soils would grow clover and ryegrass swards capable of supporting much higher annual production, under continuous grazing, than the Yorkshire fog, browntop, and other grasses



*NORMAN CLARE graduated M.Sc.Hons. from V.U.C. in 1934, joined the Chemistry Section of the Department of Agriculture in 1936, transferred to Wallaceville in 1938, and was appointed Section Leader of the Chemistry Section at Ruakura in 1947. During 1965-67 he worked with F.A.O. es-*

*tablishing a biochemistry unit for the Sheep Diseases Project in Turkey. He retired in 1972. Mr Clare's research activities have included facial eczema and other photosensitization diseases, trace elements, plant and animal pigments and analytical methods. His monograph "Photosensitization in Diseases of Domestic Animals" [C.A.B., 1952] is the standard reference on this subject. Elected a Fellow in 1947, he has served on a number of Institute committees, and was secretary of the Laboratory Assistants' Certificate Committee in the 1940s, Chairman, Delegate and Conference Chairman for the Waikato Branch, and Journal Editor 1960-1964.*

originally used. The "Waikato Mixture" (super, bonedust, and guano) was developed for the purpose of maintaining pasture under grazing pressures, but with increase of local manufacture after the Nauru deposits became available superphosphate became generally used in the 1920s.

In more recent times large areas of peat have been brought into production by methods pioneered by chemists and field officers of the Soil Fertility unit of the Department of Agriculture. These have involved control of the water table to allow winter growth without overdrying in summer, alteration of pH with lime, and the provision of phosphate, potash, sulphur, nitrogen and trace elements (copper, selenium and molybdenum) where these are found to be necessary for plant and animal needs.

The present high productivity of Waikato farmlands has thus been achieved through the use of fertilizers to establish permanent clover and ryegrass pasture, and the adjustment of stock management and conservation to the growth patterns of the Waikato climate. The efforts of enterprising farmers, experimental trials and advisory services, research into manufacture and application by fertilizer producers and by the Fertilizer Manufacturers' Research Association, and the development of special pasture strains by the D.S.I.R. have all contributed to this achievement. But fundamental to these developments has been the work of chemists and chemical technicians, not only in the initiation of some of the advances, but in the less obvious fields of manufacture and quality control, analysis of samples from trials, soil testing and diagnosis of fertilizer requirements. This has often required the devising of new methods. Particularly notable are the spectrographic and flame photometry methods developed by E.J. Allen for rapid soil testing services and culminating in his conversion of the flame absorption principle into a practical analytical technique; and, in the trace mineral field, the highly sensitive fluorometric analysis for selenium initiated by Cousins and developed by Watkinson.

Despite all that has been accomplished there are many tasks ahead for chemistry, in the solution of problems of phosphate fixation for example, in new methods of increasing soil fertility, and in the adjustment of fertilizers to suit special purposes as agriculture is diversified. The impact of chemistry on the Waikato in these fields is not likely to lessen, but to become more diverse and sophisticated.

### **Animal Nutrition and Management**

Complementary to the improvement of pasture production has been the exploration of management and nutrition for more efficient conversion of pasture to animal products. Here again chemistry has played a leading part. Many of the projects have required a wide range and immense number of routine analyses of pasture, milk and meat, and some, especially for genetics and breeding problems, are demanding the elaboration of sensitive assays of hormones and other active materials. Techniques have been devised to study the balance between energy intake and production under continuous grazing conditions, a requirement much more

common in New Zealand than in most agricultural countries.

One typical example of such applications of chemistry has been the improvement of forage conservation, especially the production of silage from spring excess growth for use in winter. In the Waikato, Lancaster and colleagues have studied the chemistry of the ensiling process and applied the knowledge obtained to harvesting and ensiling conditions and the use of additives, to produce a more palatable and nutritious silage with less wastage.

### **Mineral Deficiencies in Ruminants**

*Bush Sickness*, a wasting disease of sheep and cattle, was first observed near Tauranga in the 1880s, and was soon reported widely as farming spread on the volcanic shower soils towards the centre of the North Island. Young stock could not be reared, adult animals failed to thrive, and farms were abandoned. From analyses of pasture, blood and organs from 1904 onward Aston concluded that an iron deficiency was the cause — a very reasonable hypothesis in view of knowledge of physiology at the time. In 1910 Aston obtained remarkable responses by dosing with iron salts. Use of iron salts as pellets, licks and drenches became standard practice for dairy stock on the bush sick country in the 1920s and in 1931 good results were obtained with the locally available iron ore, limonite. Limonite treatment spread rapidly until by 1933 the disease was virtually eliminated on some of the worst affected areas. Land values rose sharply, and in the words of C.R. Taylor reporting in 1933: (1) "... the spirit and outlook of the people are vastly changed and in place of despondency is a feeling of unbounded confidence in the future."

However, puzzling features about the disease remained. Different samples of limonite varied widely in effectiveness and the potency of other iron-containing materials was not related closely to their iron content. It seemed therefore that an element other than iron might be involved. Meanwhile workers in Western Australia had found some limonites useful in the closely similar disease "enzootic marasmus". In 1933 Filmer and Underwood sounded the death knell of the original Aston hypothesis of iron deficiency by showing that iron-free extracts of limonite were just as effective against this disease as the parent limonite. In South Australia Marston and co-workers had adopted a different approach to a similar ailment ("coast disease") by systematically trying all likely elements and in 1934 announced that cobalt, as well as copper, was involved in their disease. Following these leads New Zealand chemists found that a deficiency of cobalt, present in small amounts in all the potent iron compounds, was the cause of "bush sickness". (Incidentally this conclusion might have been reached earlier by the New Zealand chemists if they had pursued the comment of a colleague that a colour change in ash from active iron-free concentrates indicated the presence of cobalt!) A further major contribution was the refinement by McNaught of the cobalt determination at lower levels, paving the way for diagnosis of marginal deficiency and closer mapping of the deficient

areas. Subsequent control of the disease has been through the use of cobaltized fertilizers supplying about 5oz of cobalt sulphate per acre.

One of the most interesting aspects of the bush sickness saga is that Aston's pursuit of a false, but at the time reasonable, hypothesis, led to a practical solution of the problem and contributed greatly to its ultimate resolution. If the iron salts and limonite treatment for bush sickness had not been successful years before the role of cobalt was established much of the land brought into agricultural production in the Rotorua and Bay of Plenty districts would have remained unfarmed for a further 10 or 15 years or, like comparable country in the area, have been converted to pine forests in the twenties.

**Copper Deficiency** in sheep and cattle in the Hauraki Plains and on deep peat and peaty loams elsewhere in the Waikato was demonstrated by Cunningham and co-workers in the early 1940s. Some pumice-derived soils around Wairoa and Taumarunui are also copper deficient. On some of these areas there is a simple deficiency, with pasture copper levels below 3ppm. On others there is an imbalance between copper and molybdenum, normally adequate copper levels of around 6ppm proving insufficient in the presence of molybdenum concentrations of 5ppm. The situation is complicated by a series of modifying factors, such as lime and sulphate, and by the fact that over-enthusiastic application of copper, or of molybdenum used to remedy deficiency affecting pasture growth, can lead to toxic effects. An extensive programme of chemical analysis of pasture and livers, associated with topdressing trials on various soil types, was required to delineate and characterize the affected regions. Use of copperized fertilizers is the normal method of control.

**Selenium Deficiency** may cause "White Muscle Disease" in lambs and calves, leading to early death; infertility in ewes; and ill-thrift in both sheep and cattle. Economically the ill-thrift, not always readily diagnosed, is probably the most important. In the Waikato area selenium deficiency is associated mainly with a belt to the east of Taupo and extending north to Tauranga.

### **Facial Eczema**

A long and intensive investigation on "Facial Eczema" has been conducted mainly at Ruakura and is of particular relevance to the Waikato because of the frequent occurrence of the disease in this district. The essential feature of facial eczema is not the photosensitivity which gave rise to the name, but the antecedent liver damage. Once this was established research was focussed on the search for the liver-damaging agent in pasture — a massive task complicated by the irregular and seasonal occurrence, and by difficulties in obtaining toxic pasture and in testing for toxicity. Concentration of toxic fractions led to isolation of substances which, while not themselves toxic, were closely associated with toxicity. The similarity of these materials to some known fungal products revived a theory, based on climatic conditions conducive to the disease, that the toxin was produced by a fungus.

Mycologists from the Soil Bureau collaborated with Ruakura staff and produced a large number of microorganisms from pasture for testing. At this point a casual remark by a farm hand led an alert research officer to collect an unusual dust on the blades of a mower. This contained fungal spores rich in the indicator substances which accompanied toxicity in extracts, and subsequently cultures of this fungus produced facial eczema liver lesions in guinea-pigs and lambs. A year later the liver-damaging agent was isolated from cultures of this fungus (*Phthomyces chartarum*) by Synge and White, and the following year, with the assistance of X-ray crystallography carried out in Australia, its constitution was determined.

Identification of the fungus, characterization of the toxic principle (sporidesmin) and development of sensitive methods of estimating it opened up new fields of study on the nature, course, and control of the disease. Prevention methods based on fungicides have replaced the cumbersome and not always reliable management measures previously required. Other approaches still under investigation include the possibility of inducing immunity and of breeding resistant sheep, using the estimation of biochemical degradation products of sporidesmin as a measure of resistance. Administration of zinc salts during exposure to the toxin has been found to give some protection and if toxicity problems can be overcome this may also provide a control measure. Identification of sub-clinically affected animals through biochemical indicators of mild liver damage promises to assist in deciding whether such animals are worth retaining. Over 20 years ago C.P. McMeekan raised a storm in the Waikato by stating that "farmers must learn to live with facial eczema". There is still little chance that the cause of the disease will be eliminated, but the research progress since then, of which the chemistry has been an essential feature, has taught us much more about how to live with it. In addition to its importance to New Zealand this work has stimulated world-wide interest in the possible role of fungal toxins in other diseases, and in compounds related to sporidesmin; an instance of the impact of a Waikato problem on chemistry.

### **Bloat**

With its intensive dairy production closely tied to the grazing of pastures containing clover, the Waikato annually suffers serious loss in production through bloat. Studies on plant chemistry and rumen physiology by the D.S.I.R. at Palmerston North have shown that clovers contain a protein which produces a stable foam in the rumen, and the possibility of other foaming agents playing a role in the disease is being investigated. Identification of such causative agents offers the possibility of breeding strains relatively free from them. Because cows vary in their susceptibility to bloat there is also the possibility of breeding lines less prone to the disease, especially if intrinsic factors influencing susceptibility can be discovered. Meanwhile the investigations have provided methods of reducing the incidence of bloat through the use of foam-breaking materials such as oils and non-ionic detergents.

## LETTER TO THE EDITOR

The NZFMRA,  
P.O. Box 23-637,  
Hunters Corner.

The Editor,  
NZIC Bulletin.  
Dear Sir,

In Townsville during February I visited the CSIRO laboratory—a multidisciplinary one concerned with the soils, the plants and the animals which grow on them in North Queensland. A common enquiry of all the scientists I met was how long will supplies of phosphate rock for fertiliser last.

Their concern arose from presentations in the media and by the Club of Rome suggesting that phosphate ores are very limited. This is not so.

As New Zealand's agriculture is based on the highest per capita use of phosphate fertiliser in the world, superphosphate being the catalyst for fixation of nitrogen by clovers, the following references to recent publications on phosphate deposits will be of interest to your readers.

1. Emigh, G. D. 1975. Industrial Minerals and Rocks, A.I.M.E., 935-962.
2. Notholt, A. J. G. 1975. Proceedings First Industrial Minerals Congress, 104-120.
3. Anon. 1976. Industrial Minerals, November 17-27, 29-31.

These papers illustrate the world wide distribution of phosphate rock which occurs throughout the geological column. For instance deposits in Queensland currently under development by B H South Limited are Cambrian or over 500 million years old whereas those on Nauru and Christmas Islands, from whence Australasia draws supplies are Miocene, or about 25 million.

Current world consumption of phosphate rock is 100 million tonnes per annum, New Zealand using one million. Relatively little is used in the "third world". Morocco for example exports 15 million tonnes and uses only a hundred thousand or so although it is an agricultural country. Late in 1973 Morocco almost tripled its export price and much of this increase continues.

Yours sincerely,  
J. ROGERS,  
Director.

## NZIC AGM

The Annual General Meeting of the New Zealand Institute of Chemistry is to be held on the afternoon of Thursday, August 25, at the University of Waikato in Hamilton.

## The Royal Society Member Bodies National Committees

Advice has been received that the following persons have been elected to the National Committees for Chemistry, Biochemistry and Biophysics for three-year terms commencing June, 1977.

### CHEMISTRY

Dr T. A. Rafter (acting convenor)  
Professor R. C. Cambie  
Dr A. J. Ellis  
Dr R. J. Furkert  
Professor M. P. Hartshorn  
Dr W. E. Harvey

### BIOCHEMISTRY

Professor M. Smith (acting convenor)  
Dr D. J. W. Burns  
Dr A. R. Cashmore  
Professor G. B. Petersen  
Professor A. G. C. Renwick  
Dr D. E. Wright

### BIOPHYSICS

Dr J. H. Troughton (acting convenor)  
Dr J. H. Buckingham  
Dr J. D. Harvey  
Dr R. J. Offen  
Dr D. A. D. Parry  
Dr A. R. Sherlock

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# BRANCH NEWS

## AUCKLAND

### Branch News:

The "Seventh Form Lecture" for this year was given by Associate-Professor B. R. Davis who spoke on "Birds, Bees and Chemical Control". The lecture was well received by a good attendance of senior secondary school students.

Dr I. Shearer, Member of Parliament for Hamilton East, spoke at a luncheon meeting in June. This was a combined meeting with the Institute of Physics. Dr Shearer's title was "N.Z. Science—Backroom or Shop Window". He dealt with topics such as genetic engineering, the energy debate, death with dignity and the issue of professional secrecy. The meeting was well reported in both daily papers.

Professor P. J. Scott of the Auckland Medical School is to speak on July 5, on the topic "Degenerative Disorders of Arteries". This is to be a combined meeting with the Australasian Corrosion Association.

The Branch has organised a two-day course on July 7 and 8 entitled "The Chemistry Department Revisited". The programme will include lectures, displays, demonstrations and discussion on Biochemistry and Chemistry. It is designed as a refresher course for Graduates to catch up on teaching and research activities in both Departments.

Organisation is well underway for a one-day symposium planned for November 10, entitled "Food Additives—Improvers and Contaminants". Speakers have been arranged for a wide range of topics, but additions could still be made for speakers with a particular interest in this field (contact Dr L. Eyres).

### University of Auckland — Chemistry Department:

The L. H. Briggs Memorial Prize for the best Ph.D. thesis presented during 1976 has been awarded jointly to Dr R. D. Wilson and Dr R. Hill.

Professor G. H. Williams, Head of Chemistry at Bedford College, University of London, is visiting the Department from mid-July.

### Biochemistry Department:

The Faculty of Science has approved a new second-year course in Biochemistry commencing in 1979.

The Department of Health has established the National Hormone Laboratory in the Department of Biochemistry by permission of the University Council. The initial task of the laboratory will be to prepare human growth hormone for diagnostic and therapeutic purposes.

### DSIR:

Dr R. J. Wong has returned from a period working at Chemistry Division, Wellington.

Dr P. E. Nelson is leaving (temporarily) in August on his way to Britain to work for a year at the Home Office Central Research Establishment, Aldermaster. He intends to gain experience there in various aspects of forensic toxicology.

Mr Arthur Gennett was in Sydney from June 5 to 12 at the Mid-Year Council Meeting of the Australasian Corrosion Association.

### ATI:

The Polymer Group of the NZIC, in association with the Auckland Technical Institute, is offering a short course on the theory and application of modern polymers and associated materials entitled "Aspects of Polymer Science". The course is to be held on Wednesday evenings, commencing on 31 August.

### FMRA:

Dr J. Rogers was the guest of B H South Limited in February at their phosphate mining operations at Phosphate Hill and the shipping installation at Townsville during a visit to Australia which included meetings of the Council of the Clean Air Society of Australia and New Zealand in Brisbane and the Council of the Australasian Institute of Mining and Metallurgy in Melbourne.

In May Dr Rogers took part in the Annual Conference of the Australasian Institute of Mining and Metallurgy in Hobart, Launceston and King Island as well as visiting the British Phosphate Commissioners and CSIRO in Melbourne for discussion of research on Christmas Island phosphates.

Mr D. L. Thomas is currently on leave in England where he will visit Fisons, Warren Spring Laboratory and the Universities of Bradford and Loughborough.

A Chemists' Day at Otago, 21-22 June was attended by 16 chemists and technicians from ten of the 12 superphosphate manufacturing works operated by FMRA'S six member companies in New Zealand.

contributed by  
Dr K. R. Bedford.

### WAIKATO:

#### Branch Activities:

The April meeting consisted of a visit, organised by Dr J. Zabkiewicz, to the Forest Research Institute at Rotorua. In the evening, lectures were given to present an overview of chemical research at FRI, covering inorganic chemistry, wood chemistry, and plant biochemistry.

At the May meeting Mr A. Kennett of the Chemistry Division of DSIR, Auckland, spoke on "Hazardous Chemical Transportation".

Professor G. Malcolm was to have presented the Presidential Address to the Branch in June, but this was cancelled owing to his illness. We convey our wishes for a speedy recovery.

#### University of Waikato:

The Science Board of Studies has approved the proposal of the Chemistry Department to present a course in Geochemistry. This course will be offered in 1978. It will be at second-year level.

A Student Chemical Society has been formed. The inaugural meeting was held in early July. This consisted of a social evening preceded by a lecture by Dr D. W. Smith on "Heavy Metal Pollution".

An informal colloquium was held in June on the question "Can New Ways be Found to Increase the Fertility of Soils Deficient in Nutrients of Low Mobility?" The colloquium was organised by Professor A. T. Wilson, who also spoke on "Possible New Fertilizers". Dr J. H. Watkinson and Dr C. Powell, both from Ruakura ARC,

spoke on "The Possible Importance of Soil Structure" and "The Mycorrhiza Approach", respectively.

Approval has been received for a Geochemical Expedition to Antarctica, setting out at the end of November this year.

Dr M. D. Carr has left to spend a year working with Dr D. Banthorpe at University College, London.

Dr C. H. Hendy has returned from study leave spent at the University of Washington. Whilst there he made use of the extensive cold-room facilities in the Quaternary Research Centre to study the phase relationship of salts precipitated from mixtures of strong salt solutions at sub-zero temperatures. He also worked on the measurement of oxygen isotope ratios of carbonates recovered from cores obtained in the Dry Valley Drilling Project in Antarctica.

Dr D. W. Smith has returned from study leave spent working with Dr Peter Day at the Inorganic Chemistry Laboratory of the University of Oxford. This work consisted of theoretical studies on the electronic structure of metal halide complexes. On his way to Britain Dr Smith visited the University of Tasmania, attended the 10th Australian Spectroscopy Conference at Perth, visited the Italian National Research Council in Rome, attended the International Coordination Chemistry Conference at Hamburg, and gave lectures at the University of Marburg, Germany and to the Danish Chemical Society in Copenhagen.

Whilst in Britain he gave research seminars at the Universities of Oxford, Leicester and Sheffield, and on his return visited the University of Cork, Ireland, and York University, Toronto, Boston University, Washington State University, and the University of Victoria, British Columbia.

### MIRINZ:

On 15 July Mr N. H. Law retires from his position of Director of the Meat Industry Research Institute in Hamilton. His successor is to be the current Deputy Director, Dr C. L. Davey. Mr Law, a Fellow of both the New Zealand Institute of Chemistry and the Royal Institute of Chemistry, has been involved in meat research for nearly thirty years. Graduating from Auckland University with 1st class honours in physical chemistry, he went to the U.K. to do post-graduate work at Imperial College, London. In 1943 he was appointed Chief Chemist (Fine Chemicals) with Boots Pure Drug Co.

Then in 1948 he returned to New Zealand and established the Meat Research Section of DSIR at Gracefield. Whilst with DSIR he instituted the New Zealand Defence Science Dehydration Research Program and instituted a program of research for the New Zealand Bacon Curers' Association.

In 1957 Mr Law was appointed Director of MIRINZ. In his time as Director there have been many changes in the meat industry. MIRINZ has contributed much to the industry by its discovery of the relationship between "cold-shortening" and the toughness of muscle, and the consequent introduction of conditioning and ageing of meat and squat-posture hanging of carcasses. The most recent con-

tribution, the process of electrical stimulation of carcasses to accelerate conditioning holds great promise for the production of uniformly tender meat. MIRINZ is involved in research in such fields as biochemistry, engineering, microbiology and pollution. Mr Law has gathered around him a group of highly qualified scientists with an international reputation for their contribution to meat processing technology.

Mr Law has represented MIRINZ and the meat industry on many committees and working parties. He has also served as Chairman of the Waikato Branch of the NZIC.

Dr C. L. Davey has been on the staff of MIRINZ for 20 years. Born in Dannevirke, he attended the University of Otago and graduated with first class honours in chemistry. He worked for 3 years at the Low Temperature Research Station of the University of Cambridge on a Defence Scientific Scholarship to obtain his Ph.D. then joined the staff of MIRINZ.

Dr Davey has played an active part in the research carried out at MIRINZ and has contributed much to the basic understanding of muscle physiology and biochemistry that has led to the development of the processes now used for conditioning carcasses. His research interests lie in the fields of the ultrastructure and biochemistry of myofibrillar proteins, the biochemistry and physiology of rigor mortis, and the relationship between muscle properties and meat quality.

Dr Davey is a fellow of the NZIC and has served as President of the NZIC and Chairman of the Waikato Branch of the NZIC.

contributed by  
Dr P. C. Molan.

## MANAWATU:

### Branch Meeting:

At the May meeting the NZIC President, Professor G. N. Malcolm, gave the presidential address entitled "Micelles and Gels in Polymer Systems".

## Massey University:

Dr M. Chick, Department of Chemistry, Biochemistry and Biophysics has returned from leave spent in the Department of Organic Chemistry, University of Liverpool, where he worked in the area of natural product biosynthesis. Drs W. S. Hancock and I. G. Andrew, Department of Chemistry, Biochemistry and Biophysics, presented papers at the Australian Biochemical Society Conference held recently in Brisbane.

Dr S. V. Rumball, Department of Chemistry, Biochemistry and Biophysics, has received from the Child Health Foundation a grant in aid for the purchase of an X-ray camera for use in structural studies on lactoferrin.

## DSIR:

Dr R. W. Bailey, Applied Biochemistry Division, attended a Workshop on Plant Fibre (Dietary Fibre) and Human Health held recently in Bethesda, Maryland.

## N.Z. Dairy Research Institute:

Dr W. A. McGillivray, director, has been awarded a CBE.

Dr R. C. Lawrence has recently returned from the U.S.A. where he was a guest lecturer at the American Dairy Science Association's Annual Meeting. Dr A. Dennard has recently resigned his position in the Whey Products section.

Miss J. Lattey has recently resigned her position as Librarian and Information Officer at the Institute.

Dr T. F. Fryer has returned from leave spent at the Food Research Institute at Norwich in the United Kingdom.

Dr D. F. Newstead will soon take leave to spend a year at the German Dairy Research Institute at Kiel. He will extend his studies on the effect of heat treatment on the proteins in milk to the ultra-high-temperature region.

contributed by  
Dr G. R. Hedwig.

## WELLINGTON

### Branch News:

**Birthday Honours** — The single Wellington branch member to be honoured was Dr A. T. Johns, Chairman of the University Grants Committee, who was awarded a CBE.

**Branch Meeting** — Members were pleased to welcome our President, Professor G. N. Malcolm, over an informal buffet dinner prior to his address "Micelles and Gels in Polymer Solutions" given at our June meeting.

## Victoria University of Wellington:

Professor R. J. Ferrier was recently elected to Fellowship of the Royal Society of New Zealand. Dr S. I. Smedley left for his first sabbatical leave early in July. He will be working with Professor C. A. Angell at Purdue University. While in the U.S.A., he will attend the 6th International High Pressure Conference and the Gordon Conference. He will return to Wellington late next February via the U.K.

## DSIR — Chemistry Division:

Mr B. E. Jackson who joined Dominion Laboratory in 1947 after working for 13 years in private industry, has now retired from Chemistry Division where he was involved in the analysis and testing of oils.

Dr S. H. Wilson, head of the Geothermal Section at Chemistry Division until 1958, has been awarded a D.Sc. degree from Manchester University. A bulletin entitled 'Geochemistry 77' is being prepared to commemorate Dr Wilson's 80th birthday.

Dr B. Commins, The Water Research Centre, Medmenham, U.K., presented a seminar on "Public Health Aspects of Water Analysis" during his recent visit to the Division. The seminar examined the evidence which has linked water hardness with cardiovascular disease.

## Industry:

In recent months several changes have occurred in the staff of ICI's Development Laboratory at Seaview. Dr Ron Maylor left for a position with A. C. Hatrick, Auckland, Steve Molnar was transferred to Dyestuffs Division, ICI Head Office, and Sheryl Wilkinson left to produce a handsome young male (however, such are the delights of working in industry that she has now returned on a part-time basis). To replace these people Dr Steve Blakestock has joined as a Senior Development Chemist, and Denbigh MacDiarmid and Frank Heiss as Development Chemists.

A. C. Hatrick have just acquired a new Chief Chemist from Caltex, Mr Murray Jarrett.

## CIT:

Dr G. F. Shanks, Senior Tutor in Pharmacology, School of Pharmacy,

and member of the N.Z. Health Department's Drug Assessment Advisory Committee, has returned from leave in the Department of Pathological Biochemistry, Royal Infirmary, University of Glasgow.

contributed by  
Dr C. Freeman.

## CANTERBURY

### Branch News:

The June meeting of the Branch was addressed by Professor A. G. Williamson of the University of Canterbury, Chemical Engineering Department who described various aspects of applied chemistry in Malaysia and Australia which he had observed during recent study leave.

Professor L. F. Phillips has been appointed Chairman of the Organising Committee for the 1978 NZIC Conference in Christchurch.

## University of Canterbury:

Dr D. A. House is at present on short leave during which he will visit Universities in Chile, Brazil and Britain to study aspects of the teaching of coordination chemistry. He will also be the N.Z. representative at the 18th International Conference of Coordination Chemistry in Sao Paulo in August.

Dr J. W. Blunt has recently returned from study leave at the University of Western Ontario, London, Canada where he has been studying aspects of C-13 n.m.r. spectroscopy.

## Christchurch Clinical School:

Dr R. W. Carrell has been appointed to a personal chair in Clinical Biochemistry at the Christchurch Clinical School of the University of Otago.

## Lincoln College:

Dr B. R. Wilkinson has been appointed to a Senior Lectureship in the Department of Wool Science.

## Wool Research Organisation:

Dr P. E. Ingham has recently returned to W.R.O. Lincoln after two years at the I.W.S. Technical Centre, Ilkley, W. Yorks and the University of Bradford where he completed a Ph.D.

contributed by  
Dr B. Halton.

## OTAGO

### Branch News:

The May meeting was addressed by Dr B. T. Commins of the Water Research Centre, Medmenham, U.K., on Environmental Pollution. It was unfortunate that the President's visit in June had to be cancelled for health reasons. We wish Professor Malcolm a steady recovery.

## Otago University — Chemistry Department:

Dr P. M. Warner of the Iowa State University visited the Department and gave a talk on "The Synthesis and Chemistry of Un-natural Products."

## Nutrition:

Dr Barbara E. Guthrie leaves in mid-July to take up a U.S. Public Health Service International Research Fellowship to continue her work on chromium with Dr Walter Mertz in USDA Nutrition Institute, Beltsville, Md. U.S.A. Both she and Dr Marion Robinson will be attending the International Symposium on Trace Element Metabolism in Man and Animals (TEMA-3) in Munich (July 25-29, 1977).

## Salary Scales for Scientists and Technicians

The Government has announced pay increases for its Scientists and Science Technicians. The new rates are effective from 15-5-77. They are set out below for the benefit of industrial members who may seek to compare Government rates when attempting to achieve some degree of parity for their own organisations.

CLASSIFICATION 101 SCIENCE			
Sub class	Rate	+ \$365 c.o.l.	= Gross Salary
101.102	6 090		6 455
	6 399		6 764
	6 613		6 978 A
	6 898		7 263 B
	7 190		7 555
	7 511		7 876 C
	7 831		8 196
	8 151		8 516
	8 472		8 837
101.103	9 113		9 478
	9 755		10 120
101.104	10 423		10 788
	11 118		11 483
	11 814		12 179
	12 044		12 409
101.105	12 507		12 872
	13 042		13 407
	13 575		13 940
	14 084		14 449
	14 453		14 818 D
101.106	14 966		15 331
	15 966		16 321
101.107	17 079		17 444 E
101.108	18 093		18 458
101.109	18 349		18 804 F
101.110	19 556		19 921
101.111	20 197		20 562 G
101.112	21 075		21 440
101.113	22 403		22 768
101.114	23 725		24 090
101.115	25 041		25 406
CLASS 180 SCIENCE TECHNICIANS			
	Rate	+ 7%	Gross Salary
180.102	3 372		3 608 School Cert.
	3 686		3 944 U.E.

	4 100		4 387
	4 513		4 829
	4 905		5 248
	5 289	+ \$365 c.o.l.	5 654
	5 707		6 072
	6 156		6 521
	6 399		6 764
	6 613		6 978
180.103	6 613		6 978 NZCS min.
	6 898		7 263
	7 190		7 555
180.104	7 511		7 876
	7 831		8 196
180.105	8 151		8 516
	8 472		8 837
180.106	9 113		9 478
180.107	9 755		10 120
180.108	10 423		10 788
180.109	11 118		11 483
180.110	11 814		12 179
180.111	12 507		12 872

### Explanatory Notes:

- Promotion in any sub class is by automatic annual increments.
  - Promotion from one sub class to another is by special consideration.
  - Typical recipients:
    - 2nd Class Honours, Division II.
    - 2nd Class Honours, Division I.
    - 1st Class Honours.
    - "Senior Lecturer" bar. The equivalent "Senior Lecturer" would only go above this if he were very good.
    - Section Head responsible for 8-12 persons.
    - Group Leader responsible for several Sections.
    - Senior Appointment such as Government Analyst.
- A, B and C are starting salaries, whilst D-G are final end-of-promotion salaries for the positions indicated. The point D is for the slightly-better-than average scientist without any administrative responsibility.

## IUPAC Notices

### Appendices on Provisional Nomenclature, Symbols, Terminology and Conventions

Eight new appendices have been recently published and are available from the secretariat. It is hoped that chemists will comment on these provisional proposals.

PNA 58: Use of Abbreviations in the Chemical Literature (Interdivisional committee on Nomenclature and Symbols and Commission on Molecular Structure and Spectroscopy).

PNA 59: Proposed Nomenclature for Transport Phenomena in Electrolytic Systems (Commission on Electrochemistry).

PNA 60: Electrode Reaction Orders, Transfer Coefficients and Rate Constants — Amplification of Definitions and Recommendations for Publication of Parameters (Commission on Electrochemistry).

PNA 61: Recommendation for Measurement and Presentation of Biochemical Equilibrium Data (IUPAC-IUB-IUPAB Commission on Biothermodynamics).

PNA 63: Recommended Nomenclature for Liquid-Liquid Distribution (Solvent Extraction): Revised 1975 (Commission on Analytical Nomenclature).

PNA 64: Recommendations for Nomenclature of Thermal Analysis — II: DTA and TG Apparatus and Technique; III: DTA and TG Curves (Commission on Analytical Nomenclature).

PNA 65: Recommendations on the Nomenclature of Sampling in Applied Chemistry (Commission on Analytical Nomenclature).

## A COMPILATION OF CURRENT IUPAC PROJECTS

IUPAC is best known in the international chemical community for its work in standardization of existing and recommendation of new nomenclature in all branches of chemistry. A large number of other IUPAC activities are generally not as widely known. For example, as a direct contribution to enhancing the quality of life IUPAC bodies are currently working on such projects as microbial aspects of water quality; changes during deep fat frying; mycotoxin analytical standards; single cell proteins; chemicals in air with longterm effects; pollution abatement in industry, etc.

These are only some of the approx. 400 projects currently under investigation by the 50 or so Committees within IUPAC. A complete list has been issued in the form of a booklet in May 1977. Although initially intended for organizations and individuals directly connected with IUPAC, copies are available for chemists and institutions interested in IUPAC activities. The compilation gives the title of the project, name of the coordinator and date of its completion or review. A copy of this booklet is available free-of-charge, upon request to

IUPAC Secretariat (Attn: Mr P. D. Gujral),  
Bank Court Chambers,  
2-3 Pound Way,  
Cowley Centre,  
Oxford OX4 3YF,  
United Kingdom.

Stocks are limited so please ensure your copy by requesting one as soon as possible.

## PROCESSING OF AGRICULTURAL PRODUCTS

### Meat Industry

The meat processing industry in New Zealand has a long history of employment of chemists but most of their work was the solution of immediate works problems. Establishment of the Meat Industry Research Institute in Hamilton to serve the whole industry has allowed scope for more basic studies on the nature and properties of muscle and its behaviour during freezing, storage and transport. From this work has emerged a better understanding of the effect of low temperatures on muscle after slaughter. By adjusting the cooling conditions of export carcasses undesirable effects on tenderness have been minimized, allowing New Zealand lamb in particular to compete on markets where it was previously unacceptable.

An important discovery is that electrical stimulation of carcasses immediately after slaughter influences glycolysis and the onset of rigor. If engineering problems, and complications arising from the obligation to introduce electrical stunning, can be overcome this process may become a prominent feature of our meat processing.

### Dairy Industry

With a high proportion of its income derived from dairy produce the Waikato is indebted to the early chemists who established control methods and analysis as a basis of payment. Chemists of the Dairy Division of the Department of Agriculture and of the Dairy Research Institute solved such problems as the deterioration of butter through the catalytic effect of traces of copper, the elimination of undesirable flavours, and "openness" in cheese. In particular the Institute, with research at all stages from the milking process onwards, has provided the dairy manufacturing industry with basic information and with specific techniques during the diversification into production of casein and dried milk products, the introduction of new types of butter and cheese, and the packaging and transport of these materials to export outlets.

### PULP AND PAPER PRODUCTION

Around 1923 there was a great increase in the planting of exotic forest over the area between Rotorua and Taupo, including much land unfarmable at the time because of bush sickness. These forests and later plantings have provided the raw material for the pulp and paper industry which has developed over the last 20 years. This is the largest chemical industry in the country, with a production of over 900,000 tons of newsprint and pulp products, valued at about \$150 million in 1974. Exports in 1974 totalled \$52 million.

Apart from the chemistry involved in the manufacture of these forestry products, chemists are also concerned in the continued growth and maintenance of the forests themselves, and in extending the range of products. The Forest Research Institute at Rotorua conducts research on nutrient and trace element requirements, disease control and timber treatment, and is extending work on natural products from both indigenous and exotic woods. Investigations by the Chemistry Division of the

D.S.I.R. on "tall oil" from the sulphate pulp process resulted in the recovery of products with an export value of over \$500,000.

One result of the siting of the paper-making and logging industries in the forested areas has been the rapid growth of new population centres. Kawerau, a town started in 1953 specifically for the Tasman mill, now has a population of 8,000, and nearby towns have also expanded. The work force includes many Maoris, whose living standards, in material terms at least, have risen considerably; and as they are drawn from the traditional territories of several tribes a multi-tribal community developed, with a life style modified by closer contact with Europeans. Conversely the European population has been influenced by contact with the Maori, with a leavening also of immigrant specialists (2). The population growth of Tokoroa has been even more spectacular — from about 1200 in 1951 to 18,000 in 1975. Other important impacts on the area are the development of road and rail facilities and of the port at Mount Maunganui.

### CHEMISTRY IN OTHER FIELDS

Farms, dairy factories and meat works, timber mills and paper mills, and the many subsidiary trades and industries that service or depend on these, are all consumers of electricity. From above Lake Taupo to near Cambridge extends the main hydro-electric system of the North Island. Chemistry has played comparatively little part in the construction of these stations, although the D.S.I.R. has assisted in the formulation of some special cements for the dams. More significant has been the contribution of chemists in the use of geothermal energy at Wairakei, providing basic information on the large amount of salts carried by geothermal steam and waters, especially in relation to corrosion problems in piping and generating equipment.

Farms, factories and industries, and the population centres that grow about them, accumulate waste products rapidly with consequent dangers of pollution of the environment. The Waikato River itself has changed very greatly since the Institute held its first Conference in Hamilton in 1935, and the condition of Lake Rotorua had deteriorated seriously over the last few years. Chemistry is already involved in efforts to reduce the present pollution and its role in ensuring the safe disposal of wastes must increase in the future.

### CONCLUSION

This article has not attempted to review thoroughly the influence of chemistry on the progress of "The Waikato" but only to refer to some fields in which the work of chemists has had a major effect. Much of the chemistry involved has been the work of individuals and institutions with little direct connection with the Waikato, but conversely, local investigations have been applied throughout New Zealand and beyond.

As an indicator of the magnitude of the impact of chemistry, the work on bush sickness is relevant. In his Aston memorial address (to the Society for Animal Production in 1949) Grimmett said, "On a conservative estimate . . . the results of this one piece of work more than paid for all the expenditure

on agricultural chemical research in New Zealand up to the time of Aston's retirement in 1936." In fact the impact of that work continues. Of the one million acres estimated by Andrews (3) as requiring cobalt to maintain production, about 600,000 acres is within the Waikato as defined for this paper. As most of this land could never have been farmed profitably until bush sickness was conquered its continued productivity may reasonably be credited to research on that disease. It would require a production of only \$26 per acre on this land alone to pay the net expenditure on all agricultural research (\$15.6 million) for the 1972-73 financial year.



## REFERENCES

- 1 Taylor, C.R.: Report to the Empire Marketing Board. Quoted by R.E.R. Grimmett, *Proceedings of the Society for Animal Production*, 1949.
- 2 Metge, A. Joan: "The Human Factor", in "New Zealand's Industrial Potential" Misc. Pub. No. 3, N.Z. Geographical Society, 1960.
- 3 Andrews, E.D.: "Cobalt Deficiency in Sheep and Cattle". Bulletin No. 180, N.Z. Department of Agriculture, 1971.

## STUDENT WINS WORLD DENTAL RESEARCH PRIZE

Professor J. F. Duncan announces that one of his research students, Mr J. D. B. Featherstone, has recently won the Edward Hatton Award for the best student research paper at the 55th Annual Meeting of the International Association for Dental Research (IADR) in Copenhagen.

The Hatton Award is given to young investigators judged best in presenting a paper at the World Meeting. The selection is made on the basis of (i) originality and scientific merit, (ii) accuracy of data, (iii) conclusions and (iv) competence in presenting and discussing the subject. Mr Featherstone's paper entitled 'Diffusion Phenomena during Artificial Caries Lesion Formation', covered some aspects of his research into the chemistry of dental caries. This research has been funded by a Training Fellowship of the Medical Research Council of New Zealand, and was carried out in the Chemistry Department at Victoria University of Wellington in close liaison with the Dental Research Unit of M.R.C. in New Zealand. Attendance at the Copenhagen meeting was made possible by a joint travel award from the Medical Research Council of New Zealand and the Dental Research Foundation of New Zealand.

Mr Featherstone last year also won the Colgate Palmolive Travel Award for a paper entitled 'A Crystallographic Study of Caries-like Subsurface Demineralisation of Enamel', presented at the N.Z. Section meeting of the IADR. This enabled attendance at the Australasian Division IADR Meeting in Melbourne, where his paper 'Surface Layer Phenomena during Artificial Caries Lesion Formation in Human Enamel' won the Colgate Research Prize. Thus, Mr Featherstone's research has now won him three major prizes for the presentation of research papers in Dental Chemistry — the World Edward Hatton Award, the Australasian Colgate Research Prize and the N.Z. Colgate Palmolive Travel Award.

Mr Featherstone is currently completing a Ph.D. and will then take up an appointment in the Pharmacy School, Central Institute of Technology, Heretaunga, where he will continue his research into dental caries with particular emphasis on possible preventive or curative measures, in conjunction with the Chemistry Department, Victoria University of Wellington, and the Dental Research Unit of the M.R.C., Wellington.



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**THE NEW ZEALAND INSTITUTE OF CHEMISTRY (INC.)**

**INCOME AND EXPENDITURE ACCOUNT FOR YEAR ENDED 30TH APRIL, 1977**

1976			1976		
\$	<b>EXPENDITURE:</b>		\$	<b>INCOME</b>	
	<b>Administration Expenses:</b>		17,052	Subscriptions — Annual .. . . .	17,978.91
4,617	Honoraria (Less \$390 charged to Journal) .. . . .	4,875.12		<b>Interest Received:</b>	
2,241	Printing, Stationery, Postages, Tolls etc. . . . .	3,061.18	150	Bank of New Zealand .. . . .	119.88
1,665	Travelling Expenses .. . . .	2,331.85	144	Local Body Stock .. . . .	143.76
900	Branch Expenses Allowances .. . . .	900.00	(294)		263.64
—	Legal Fee — Re Library Deed .. . . .	45.60			
400	Audit Fees .. . . .	635.00			
252	Conference Costs Paid by Institute .. . . .	127.50			
77	Donations — S.A.N.Z. .. . . .	77.00			
—	— Auckland Institute Museum .. . . .	115.00			
150	— Water Pollution Research .. . . .	—			
(227)	— Cost of Submission — Industrial Relations Bill .. . . .	192.00			
19	Interest — Bank of New Zealand .. . . .	50.00			
7	Depreciation — (Per Attached Schedule) .. . . .	2.64			
10	Royal Society of N.Z. Fee .. . . .	43.00			
		40.00			
(10,338)		-----			
		12,303.89			
	<b>PUBLICATIONS:</b>				
7,394	Cost of Journal — (Including \$390 Honoraria) .. . . .	6,505.43			
717	"An Invitation" .. . . .	—			
—	Environment and Industry .. . . .	73.10			
153	Monographs .. . . .	76.20			
54	Sundry Publications .. . . .	—			
(8,318)		-----			
		6,654.73			
2,341	Less Revenue from Advertising and Journal Subscriptions .. . . .	3,464.93			
347	Education in Chemistry .. . . .	280.03			
—	Sundry Publications .. . . .	57.73			
(2,688)		-----			
		3,802.69			
(5,630)		-----			
		2,852.04			
1,378	Excess of Income over Expenditure .. . . .	3,086.62			
====		-----			
\$17,346		\$18,242.55	\$17,346		\$18,242.55
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**THE NEW ZEALAND INSTITUTE OF CHEMISTRY (INC.)**

**BALANCE SHEET AS AT 30TH APRIL, 1977**

<table border="0" style="width:100%;"> <tr> <td>1976</td> <td></td> <td></td> <td></td> </tr> <tr> <td>\$</td> <td><b>CURRENT LIABILITIES:</b></td> <td></td> <td></td> </tr> <tr> <td>548</td> <td>Sundry Creditors . . . . .</td> <td>759.59</td> <td></td> </tr> <tr> <td>—</td> <td>Subscriptions in advance . . . . .</td> <td>217.50</td> <td></td> </tr> <tr> <td>(548)</td> <td><b>TOTAL CURRENT LIABILITIES:</b></td> <td></td> <td>977.09</td> </tr> <tr> <td></td> <td><b>SPECIAL FUNDS:</b></td> <td></td> <td></td> </tr> <tr> <td>140</td> <td>Education Fund (School Bulletin) . . . . .</td> <td>140.00</td> <td></td> </tr> <tr> <td>382</td> <td>Overseas and Visitors Travelling Fund . . . . .</td> <td>521.65</td> <td></td> </tr> <tr> <td>635</td> <td>Easterfield Fund . . . . .</td> <td>634.86</td> <td></td> </tr> <tr> <td>(1,157)</td> <td><b>TOTAL SPECIAL FUNDS:</b></td> <td></td> <td>1,296.51</td> </tr> <tr> <td></td> <td><b>TRUST FUNDS:</b></td> <td></td> <td></td> </tr> <tr> <td>2,601</td> <td>Balance 30 April 1976 . . . . .</td> <td>2,604.47</td> <td></td> </tr> <tr> <td>3</td> <td>Plus Interest Credited . . . . .</td> <td>3.39</td> <td></td> </tr> <tr> <td>(2,604)</td> <td></td> <td></td> <td>2,607.86</td> </tr> <tr> <td></td> <td><b>ACCUMULATED FUNDS:</b></td> <td></td> <td></td> </tr> <tr> <td>2,952</td> <td>Balance 30 April 1976 . . . . .</td> <td>4,329.55</td> <td></td> </tr> <tr> <td>1,378</td> <td>Excess of Income over Expenditure for year . . . . .</td> <td>3,086.62</td> <td></td> </tr> <tr> <td>(4,330)</td> <td><b>BALANCE 30 APRIL 1977</b></td> <td></td> <td>7,416.17</td> </tr> <tr> <td>---</td> <td></td> <td>---</td> <td>---</td> </tr> <tr> <td>\$8,639</td> <td></td> <td>\$12,297.63</td> <td></td> </tr> <tr> <td>===</td> <td></td> <td>===</td> <td>===</td> </tr> </table>	1976				\$	<b>CURRENT LIABILITIES:</b>			548	Sundry Creditors . . . . .	759.59		—	Subscriptions in advance . . . . .	217.50		(548)	<b>TOTAL CURRENT LIABILITIES:</b>		977.09		<b>SPECIAL FUNDS:</b>			140	Education Fund (School Bulletin) . . . . .	140.00		382	Overseas and Visitors Travelling Fund . . . . .	521.65		635	Easterfield Fund . . . . .	634.86		(1,157)	<b>TOTAL SPECIAL FUNDS:</b>		1,296.51		<b>TRUST FUNDS:</b>			2,601	Balance 30 April 1976 . . . . .	2,604.47		3	Plus Interest Credited . . . . .	3.39		(2,604)			2,607.86		<b>ACCUMULATED FUNDS:</b>			2,952	Balance 30 April 1976 . . . . .	4,329.55		1,378	Excess of Income over Expenditure for year . . . . .	3,086.62		(4,330)	<b>BALANCE 30 APRIL 1977</b>		7,416.17	---		---	---	\$8,639		\$12,297.63		===		===	===	<table border="0" style="width:100%;"> <tr> <td>1976</td> <td></td> <td></td> <td></td> </tr> <tr> <td>\$</td> <td><b>CURRENT ASSETS:</b></td> <td></td> <td></td> </tr> <tr> <td>91</td> <td>Cash on Hand . . . . .</td> <td>36.11</td> <td></td> </tr> <tr> <td>2,663</td> <td>Bank of New Zealand . . . . .</td> <td>4,786.35</td> <td></td> </tr> <tr> <td>—</td> <td>National Airways Corporation — Deposit Account . . . . .</td> <td>669.00</td> <td></td> </tr> <tr> <td>2,300</td> <td>Subscription in Arrears . . . . .</td> <td>3,113.33</td> <td></td> </tr> <tr> <td>—</td> <td>Prepayments — A.C.C. Levy . . . . .</td> <td>12.18</td> <td></td> </tr> <tr> <td>751</td> <td>Sundry Debtors . . . . .</td> <td>910.80</td> <td></td> </tr> <tr> <td>200</td> <td>Publications on Hand . . . . .</td> <td>—</td> <td></td> </tr> <tr> <td>(16,005)</td> <td><b>TOTAL CURRENT ASSETS:</b></td> <td></td> <td>9,527.77</td> </tr> <tr> <td></td> <td><b>TRUST FUND INVESTMENTS:</b> (At Cost)</td> <td></td> <td></td> </tr> <tr> <td>104</td> <td>Post Office Savings Bank . . . . .</td> <td>107.86</td> <td></td> </tr> <tr> <td>1,000</td> <td>Nth. 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**STATEMENT OF ACCOUNTING POLICIES:**

**General Accounting Principles:**

The general accounting principles appropriate for measurement and reporting of profit under the historical cost method are used by the Institute.

**Particular Accounting Principles:**

- (1) Depreciation has been charged using the straight-line method based on the economic life of the assets.
  - Office Equipment and Typewriter (5 Years)
  - Addressograph Plates (Written Off)
- (2) Membership Subscriptions in Arrears — Subscriptions in arrears over 1 year have been written off.

**NEW ZEALAND INSTITUTE OF CHEMISTRY (INC.)**

**DEPRECIATION SCHEDULE FOR YEAR ENDED 30TH APRIL, 1977**

<b>Office Equipment:</b>	
(1/5) of \$28 — (5 Years) . . . . .	6.00
<b>Typewriter:</b>	
(1/5) of \$175 — (5 Years) . . . . .	35.00
<b>Addressograph Plates:</b>	
Book Value Written Off . . . . .	2.00
	<u>43.00</u>
	===

We have audited the books of the New Zealand Institute of Chemistry (Inc.) for the year ended 30th April 1977, and have received all the information and explanations we have required. In our opinion, according to the best of our information and the explanations given to us as shown by the books of account, the Balance Sheet, Income and Expenditure Account and Trust Fund Account are properly drawn up so as to give a true and fair view of the state of the Institute's affairs as at 30th April, 1977.

SHANAHAN AND WINDER

Chartered Accountants

M. P. Winder

# TRANSPORT OF HAZARDOUS SUBSTANCES

The Standing Advisory Committee on the Transport of Hazardous Substances which was set up by the Ministers of Internal Affairs and Transport in 1975 to review the requirements governing the transport of hazardous substances has now reported and made a number of recommendations. These are set out below and are followed by a commentary by the Auckland branch sub-committee on Hazardous Chemicals.

## RECOMMENDATIONS

1. Government agreement should be sought for the expansion of responsibility for control of the containment of hazardous substances. In particular the road transport division of the Ministry of Transport should develop detailed container design specifications for the transport of hazardous substances by road. Amendments to the relevant legislation will be necessary to enable codes of practice relating to the road transport of hazardous substances to be issued and enforced.
2. A technical standing committee, consisting of a group of experts (including industrial representation where appropriate) should be established to co-ordinate activity and control concerning design of intermodal containers for hazardous materials; such containers being those not restricted to any one mode of transport. It is considered that the Standards Association of New Zealand (SANZ) with its close links with the relevant industrial experts is the most appropriate body to undertake this work and it is recommended that SANZ be invited to do so. It is important that this proceed apace with the development of container design requirements for the road transport of hazardous substances.
3. All organisations filling drums or similar metal receptacles with hazardous substances should be held responsible for ensuring that the drum, its liner (where fitted) or its protective coatings are in good condition and will safely contain the contents for transport and/or storage. In addition if any substance should be spilled around the top of the drum during filling, set procedures should be established by the company to ensure that the spillage is removed promptly so that damage to the drum or persons handling the drum cannot occur under any circumstances.
4. The contents of all freight containers should be correctly contained and identified. Where internal containment is provided in the form of drums, boxes, packages or bottles then each such item must also be correctly contained and identified. Where these items can be further subdivided then each successive subdivisible group must also be correctly packaged for transport purposes so that as loads are subdivided for distribution, correct and safe containment is maintained.
5. Where large bulk consignments of hazardous substances are to be transported, consideration should be given wherever possible to using rail or sea transport in preference to road to reduce the risk of public exposure.
6. On the advice of the relevant departments, all substances enclosed in containers for transport should be recorded in a central registry as hazardous substances or exempted from the need for registration.
7. The registrar of hazardous substances should maintain a fully cross-referenced register of hazardous substances indexed under all their various common, trivial, trade and chemical names and where available, their UN identification numbers.
8. Interested organisations and libraries should have access to the register.
9. The register should be cognisant of all relevant legislation relating to all aspects of hazardous substances and should provide an authoritative advisory service in appropriate liaison with the administering departments and other interested organisations.
10. The exteriors of all containers of hazardous substances should be marked with the approved IMCO/IATA hazard warning label or labels. The dimensions and characteristics of the labels should be defined in the various pieces of legislation concerned, or by the registrar until such time as this is done. Specifications for the labels could be prepared by the Standards Association of New Zealand.
11. Approaches should be made (a) to IATA to use classification numbers on its dangerous goods labels in line with IMCO practice and (b) to IMCO to change its label wordings of "inflammable" and "oxidising agent" to "flammable" and "oxidiser" respectively. Regardless of whether such changes are accepted by IMCO, the word "flammable" is recommended for use on those labels manufactured in New Zealand.
12. Additional forms of labelling the exteriors of containers should be acceptable provided they do not conflict with or detract from the required IMCO/IATA hazard warning labels and are not of the diamond shape characteristic of those labels.
13. Industry education programmes should be established by all organisations involved in the

transport of hazardous substances to instruct their workforces on all aspects of the handling of hazardous goods. Programmes should include advice along the lines set out in the three appendices to this report, *i.e.* secure loading, segregation of incompatible hazardous substances, packaging, documentation, labelling and emergency procedures.

14. All hazardous substances being transported should be accompanied by transport documents appropriately identifying the goods; this identification being either trade names, or common names in English usage, or chemical names, or a UN number, or any combination of these, all of which having been recorded by the registrar. It is further recommended that hazardous substances transport documents should be identifiable by distinctive colour banding or coding, and that they should be readily available on demand at any stage in the carriages of the goods to which the documentation relates.
15. All transport documents should preferably be accompanied by an emergency action code recommended by or acceptable to the Fire Service Commission or other appropriate authority.
16. All transport documents should include a declaration that the goods have been securely packed and labelled as prescribed in relevant legislation.
17. It is recommended that it be made an offence for transport operators to carry goods in the absence of required documentation and labelling, or when loads entail mixing of items which are more dangerous in proximity than when carried separately.
18. The safety procedure list given in Appendix II should be available as a durable stick-on sheet or as a paint stencil for permanent application within the cabs of transport vehicles.
19. All police or fire service districts which have not already established Hazardous Substances Technical Liaison Committees should do so.
20. Subject to reasonable discretion with regard to regular systems, all proceedings relating to mishaps with hazardous substances should be controlled by the existing emergency services advised by the local Hazardous Substances Technical Liaison Committee as outlined in Appendix III.
22. There should be statutory authority to enable substances salvaged from an accident and no longer wanted by the consignee to be given away to industries willing to use them in an acceptable manner.
23. Where there is no immediate threat to human requiring urgent and massive sluicing with water, spilled hazardous substances should be disposed of by recycling into industry wherever possible, or by controlled incineration where appropriate. If neither course is possible and dumping is the only resort, this should be in accordance with the principles laid down in

the 3rd chapter (Toxic Waste Disposal) of the Board of Health Manual on Solid Waste Disposal in New Zealand. Dumping at sea should be in accordance with the Marine Pollution Act 1974.

24. Investigations and negotiations should be conducted in association with industry with a view to providing recycling facilities in both the North and South Islands for the appropriate use of hazardous materials.
24. At least one appropriately designed furnace should be commissioned or constructed in each of the North and South Islands for controlled high temperature incineration of waste organic materials.
26. High security storage areas should be commissioned by local authorities for temporary storage of salvaged hazardous substances pending decisions on modes of disposal. Such areas need not be set aside solely for this purpose since this will be infrequent. It should be binding upon local authorities or groups of local authorities to ensure that such premises are available for priority usage of the kind envisaged.

#### **THE AUCKLAND BRANCH SUB-COMMITTEE ON HAZARDOUS CHEMICALS WISHES TO MAKE THE FOLLOWING COMMENTS.**

- (i) One of the greatest obstacles to the uniform and efficient control of the transport of hazardous substances to and in New Zealand is the fact that the following nine statutes are of prime relevance in regulating such transport and they are administered by the Departments of Health and Internal Affairs and the Ministry of Transport.

1. The Shipping and Seamen Act 1952
2. The Shipping (Dangerous Goods) Rules 1953.
3. The Civil Aviation Regulations 1953.
4. The Traffic Regulations 1956.
5. The Explosives Act 1957 and Explosives Regulation 1959.
6. The Dangerous Goods Act 1974 and Dangerous Goods Regulations.
7. The Agricultural Chemicals Regulations 1968.
8. The Poisons Act 1960 and Poisons Regulations 1964.
9. The Transport of Radioactive Materials Regulations 1973

It is unfortunate that the committee has not been able to recommend a means of incorporating these requirements into a smaller number of statutes.

- (ii) The committee recommended the use of IMCO/IATA hazard warning labels. (These abbreviations stand for the Intergovernmental Maritime Consultative Organisation and the International Air Transport Association.) It is disappointing that the compulsory use of a system of action labels has not been recommended. Several such systems are available and though none is fully developed or universal several are sufficiently comprehensive to give

on-the-spot guidance to emergency services dealing with a spill or other accident.

- (iii) The committee recommended that transport documents should bear the trade name, or the common name in English usage, or the chemical name or the UN number of the goods. Although the committee did not recommend it, there is also a need for such information on the packages themselves. Documentation is an unreliable means of identification as it may be illegible (due to a variety of reasons such as poor handwriting, poor carbon copy, etc) or separated from the goods.
- (iv) The Standing Advisory Committee should be urged to give further consideration to marking packages with Action Code Labels and with names which are registered in the proposed Registry of Hazardous Substances. The Institute should seek to ensure that the Registry is set up under the guidance of chemists and that its information is available on a 24-hour basis by toll-free telephone call. The Registry's telephone number should be on all IMCO/IATA and hazard warning labels.
- (v) Labels need to be durable yet easily removed when the need has passed. But the Standing

Advisory Committee has made no recommendation about responsibility for their removal.

- (vi) The suggestion that SANZ accept responsibility for container design and label specifications is excellent provided this overloaded organisation is given the means to complete the tasks expeditiously.
- (vii) Although it is recommended that areas be set aside for the temporary storage of salvaged hazardous substances the suggestion that they might not be used exclusively for this purpose almost certainly means that they would not be immediately available when needed in an emergency.
- (viii) General: The Standing Advisory Committee in their twenty-six recommendations have made a substantial contribution to the safer transport of hazardous substances. Nevertheless through their Institute chemists should continue to keep a close watch on progress in this area, and should ensure that their views are known to those in authority.

**Auckland Branch Sub-committee: R. Hopgood  
A. Kennett  
P. Tse**



## LETTER TO THE EDITOR

Bairds Road,  
OTARA.

Dear Sir,

I would like to comment on G. J. Dougherty's paper on "A New Approach to Testing For 'Doping' in Race Horses", appearing in Volume 41 Number 1 of your Journal.

The economy to be realised in dispensing with the expensive techniques used to identify the individual drugs involved is the major advantage of the concept suggested.

Controlled tests with all the drugs likely to be used in this field would elicit a range of responses, and there would be no need to identify the drug if the animal under test gave a response which indicated that it had been influenced by a drug. A response which was the same as that elicited by a drug but due to other causes such as illness, food upsets or lack of training, need not be differentiated, as it is unlikely that an animal so affected would reach the winners' circle.

It can be assumed that basically only winners would be tested, although unexpected losers would have to be considered. However, the observers would be quite capable of indicating any animal which should be tested.

The author does not elaborate on this, I feel deliberate, non-qualifying of his term 'observers', when he contrasts these with 'qualified scientists'. These observers would require no training and would need no financial recompense. Their feeling that justice had been done would suffice for them. Race-track patrons consist mainly of observers and, like observers anywhere, wish their fellows to know that they are observers (they might consider a

qualification), and greatly desire that their observations be generally known. Because individual communication with other observers is impossible in the split second that the observation is made, a universally accepted technique has been evolved over the ages, and this is to voice the observation to the gods; and to know that all true observers will do the same. And the gods in their turn will influence observers who might otherwise keep their observations private for use on a rainy day, to observe vocally as well. And, of course, slack or non-observers can return to the sunshine of the gods by joining in this chorus to the deities.

All that would be required is a tonal meter in the concourse to record the quality of the observations. Tampering with the system could be avoided by using a number of meters carried in the clothing of peripatetic recorders, and an average quickly calculated. The animal drawn to the attention of Olympus would then be put to the test in the approved manner.

The author suggests that all racehorses would need to be trained for the test, but this perhaps would defeat the object of the exercise. However, if further research indicated some preliminary training to be needed, it would not be necessary to train every racehorse. Horses are generally quadrupedal, but it is well known that the majority of racehorses are tripodal. This stable configuration is noted by the author, and is responsible for the inability of these animals to proceed to the temporary instability of a horse at full gallop. This tripodal type never succeeds to the winning circle and can be discounted.

I do agree that this new concept warrants further investigation.

H. J. McCOACH

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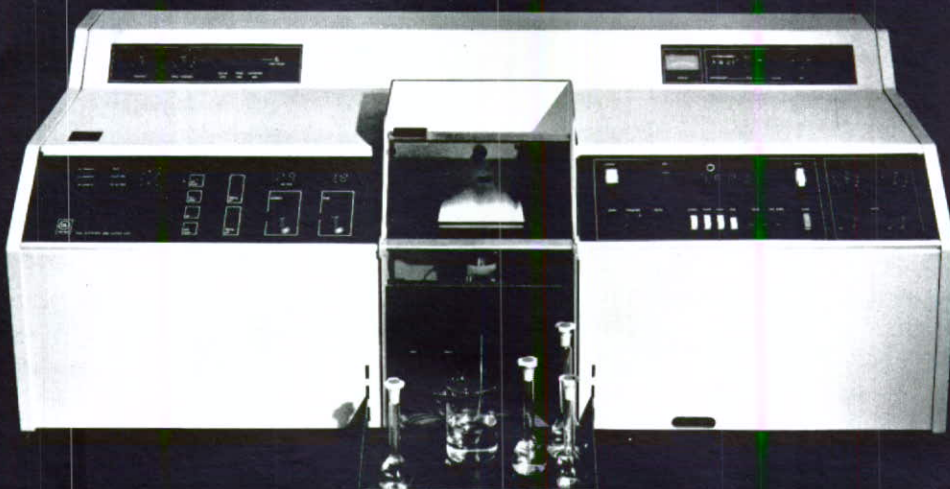
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# WILTONS



# GUIDELINES TO PROFESSIONAL EMPLOYMENT

Council has been giving serious consideration to the welfare of its members in the matter of standards for professional employment. It has recognised that this is a matter of concern for employers as well as employees, and that both of these groups are included within the membership of the Institute.

A Council working party has made several attempts to draw up an acceptable set of guidelines which are more than a list of specific minimum standards. In the course of this work their attention was drawn to a document entitled "*Guidelines to Professional Employment for Scientists and Engineers*" which had been developed through the co-operative efforts of the major engineering societies in the U.S.A. working through an ad hoc group called the Inter-Society Committee on Professional Guidelines. The guidelines as they appear below are based on those published in the journal TAPPI, July 1974, vol. 57, No. 7. They have been modified by the undersigned only where different New Zealand conditions made some change necessary. We have been assured by the Executive Director of TAPPI that formal permission to use the Guidelines is not required.

Council has expressed very great interest in these Guidelines, and has decided to publish them in the Journal in order to seek comment from members. A formal proposal to endorse these guidelines, possibly modified as a result of comment by members, will be made to Council at the earliest opportunity.

Would members please consider these Guidelines as a matter of urgency, and submit their comments to the General Secretary. Brief letters expressing approval or disapproval in general terms will be just as helpful as those containing more detailed comment.

A.F. WILSON (Auckland Branch)  
G.N. MALCOLM (President)

## FOREWORD

This publication is a guide to mutually satisfying relationships between professional employees and their employers. In this document, professional employees are defined as engineers and scientists. These guidelines cover factors peculiar to professional employment and omit many generally accepted precepts of personal relations which are common to all classifications of employees.

These guidelines are applicable to professional employment in all fields and in all areas of practice (including both nonsupervisory and supervisory positions).

It must be stressed in the implementation of these guidelines that they represent desirable general goals rather than a set of specific minimum standards. Wide variations in circumstances and individual organisational practices make it inappropriate to judge any given employer on the basis of any single employment policy or fringe benefit. Rather, attention should be devoted to evaluating the entire employment "package", including such intangibles as opportunity for future advancement or participation in profits, location, local cost of living, and other factors which may be important to professional employees.

Observance of the spirit of these guidelines will minimise personnel problems, reduce misunderstandings, and generate greater mutual respect. It is anticipated that they will be of use to employers in evaluating their own practices,

to professional employees in evaluating both their own responsibilities and those of their employers, and to new graduates and other employment seekers in obtaining a better picture of prospective employers.

## OBJECTIVES

To meet the goal of achieving mutually satisfying relationships it is necessary for professional employees and employers to establish a climate conducive to the proper discharge of mutual responsibilities and obligations. Essential and prerequisite to establishing such a climate are:

1. Mutual loyalty, co-operation, fair treatment, ethical practices, and respect are the basis for a sound relationship between the professional and his employer.
2. The professional employee must be loyal to the employer's objectives and contribute his creativity to those goals.
3. The responsibility of the professional employee to safeguard the public interest must be recognised and shared by the professional employee and employer alike.
4. The professional growth of the employee is his prime responsibility, but the employer under-

takes to provide the proper climate to foster that growth.

5. Factors of age, race, religion, political affiliation, or sex should not enter into the employee/employer relationship.

Effective use of these guidelines is accomplished when the employer provides each present and prospective professional employee with a written statement of policies and practices relating to each of the items covered. Adherence to these guidelines by employers and professional employees will provide an environment of mutual trust and confidence. Local conditions may result in honest differences in interpretation of, and in deviation from, the details of these guidelines. Such differences should be resolved by discussions leading to understanding which meets the spirit of the guidelines.

## 1 RECRUITMENT

Employment should be based solely on professional competence and ability to adequately perform assigned responsibilities, with employee qualifications and employment opportunities represented in a factual and forthright manner. The employer's offer of employment and the employee's acceptance should be in writing, including a clear understanding with regard to relocation assistance; past, present and future confidentiality and patent obligations; salary; expected duration of employment; and other relevant employment conditions and benefits.

### Professional Employee

1. The professional employee (applicant) should attend interviews and accept reimbursement only for those job opportunities in which he has a sincere interest. The applicant should prorate costs for multiple interviews during a given trip on a rational basis. The guiding principle should be that the applicant receives neither more nor less than the cost of the total trip.
2. The applicant should carefully evaluate past, present, and future confidentiality obligations in regard to trade secrets and proprietary information connected with the potential employment. He should not seek or accept employment on the basis of using or divulging any trade secrets or proprietary information.
3. Having accepted an offer of employment, the applicant is morally obligated to honour his commitment unless formally released after giving adequate notice of intent.
4. The applicant should not use the funds or time of his current employer for the purpose of seeking new employment unless approved by the current employer.

### Employer

1. The policy of the employer regarding payment of expenses incurred by the applicant in attending the interview must be made clear prior to the arranged interview.
2. The applicant should have an interview with his prospective supervisor in order to under-

stand clearly the technical and business nature of the job opportunity. This prospective supervisor should ethically be responsible for all representations regarding the conditions of employment.

3. Applications for positions should be confidential. The expressed consent of the applicant should be obtained prior to communicating with a current employer.
4. Agreements among employers or between employer and professional employee which limit the opportunity of professional employees to seek other employment or establish an independent enterprise are contrary to the spirit of these guidelines.
5. Having accepted an applicant, an employer who finds it necessary to rescind an offer of employment should make adequate reparation for any injury suffered.

## 2 TERMS OF EMPLOYMENT

Terms of employment should be in writing, in accordance with the applicable laws, and consistent with generally accepted ethical professional practices.

### Professional Employee

1. The professional employee should be loyal to his employer. He should accept only those assignments for which he is qualified; should diligently, competently and honestly complete his assignments; and he should contribute creative, resourceful ideas to his employer while making a positive contribution toward establishing a stimulating work atmosphere and maintaining a safe working environment.
2. The professional employee should have due regard for the safety, life, and health of the public and fellow employees in all work for which he is responsible. Where the technical adequacy of a process or product is involved, he should protect the public and his employer by withholding approval of plans that do not meet accepted professional standards and by presenting clearly the consequences to be expected if his professional judgement is not followed.
3. The professional employee should be responsible for the full and proper utilisation of his time in the interest of his employer and the proper care of the employer's facilities.
4. The professional employee should avoid any conflict of interest with his employer, and should immediately disclose any real or potential problem which may develop in this area. He should not engage in any other professional employment without his employer's permission.
5. The professional employee should not divulge technical proprietary information while he is employed. Furthermore, he should not divulge or use this information for any agreed-upon period after employment is terminated.
6. The professional employee should only sign or seal plans or specifications prepared by himself or others under his supervision, or plans or

specifications that he has reviewed and checked to his personal satisfaction.

7. The professional employee should not accept payments or gifts of any significant value, directly or indirectly, from parties dealing with his client or employer.

#### **Employer**

1. The employer should inform professional employees of the organisation's objectives, policies, and programmes on a continuing basis.
2. The professional employee should receive a salary in keeping with his professional contribution which reflects his abilities, professional status, responsibility, the value of his education and experience, and the potential value of the work he will be expected to perform. The salary should be commensurate with the salaries of other employees, both professional and nonprofessional. Sound indirect compensation programmes should be provided. The most important are retirement plans, life insurance, sick leave and paid holidays.
3. The employer should establish a salary policy, taking into account published salary surveys, and provide equitable compensation for each employee commensurate with his position and performance. The salary structure should be reviewed at least annually to keep the assigned dollar values adjusted to the current economy.
4. Each individual position should be properly classified as to its level in the overall salary structure. The evaluation of each position should consider such factors as the skill required for acceptable performance, the original thinking required for solving the problems involved, and the accountability for any action and its consequences.
5. Economic advancement should be based upon a carefully designed performance review plan. Provisions should be made for accelerated promotions and extra compensation for special accomplishments. At least annually, performance evaluations and salary review should be conducted for the individual professional employee by his supervisor. Performance evaluations should include discussion on how well he has performed his work and what he can do to improve. The professional employee should be clearly informed if his performance is considered unsatisfactory. All promotions in salary and responsibility should be on an individual merit basis.
6. For the professional employee whose aptitude and interests are technical rather than supervisory, equivalent means of advancement and recognition should be provided.
7. It is inappropriate for a professional employee to use a time clock to record arrival and departure, particularly since situations may arise which require unusual effort on his part. However, if the work demanded of a professional employee regularly exceeds the

normal working hours for extended periods, the employer should compensate him for this continuing extra effort according to a clearly stated policy.

8. The professional employee should be included in an adequate pension plan which provides for early vesting of rights in safe-guarded pension funds. Vesting should be so scheduled that it does not seriously affect either the employer's or the professional employee's decision as to continued employment. As a goal, eligibility for participation should not exceed one year after employment, maximum full vesting time should be five years, and the minimum pension upon reaching retirement should be no less than 50 per cent of the average best five year's salary (based on a 40-year working career with a single employer). If a pension plan is not provided, or the benefits are less than outlined above, other compensation should be increased proportionately.
9. The employer should provide office, support staff, and physical facilities which promote the maximum personal efficiency of the professional employee.
10. Duties, levels of responsibility, and the relationship of positions within the organisation hierarchy should be clearly defined and should be accurately reflected in position titles.
11. The employer should not require the professional employee to accept responsibility for work not done under his supervision.
12. The employer should provide formal assurance through organisational policy that it will defend any suits or claims against individual professional employees employed by the organisation in connection with their authorised professional activities on behalf of the employer.
13. Unless required by law there should be no employer policy which requires a scientist to join a union of workers as a condition of continued employment.
14. It is the employer's responsibility to clearly define proprietary information.

### **3 PROFESSIONAL DEVELOPMENT**

The employee and the employer share responsibility for professional development of the employee — the employee to establish the goals and take the initiative to reach them, and the employer to provide the environment and attitude which is conducive to professional growth.

#### **Professional Employee**

1. Each professional employee is responsible for maintaining his technical competence and developing himself through a programme of continuing education.
2. The professional employee should belong to and participate in the activities of appropriate professional societies in order to expand his knowledge and experience. Such participation should include the preparation of professional and technical papers for publication and

presentation.

3. The professional employee should achieve appropriate registration and/or certification as soon as he is eligible.
4. The professional employee should recognise his responsibility to serve the public by participating in civic and political activities of a technical and non-technical nature. Such participation, however, should be undertaken solely as a responsibility of the individual without interfering with the timely execution of his work and without involving the employer.

#### **Employer**

1. The employer, as a matter of policy, should provide an atmosphere which promotes professional development. This will include, among other programmes, encouraging and supporting membership and attendance at professional society meetings and at formal courses of study which will enable the employee to maintain his technical competence.
2. The employer should consider compensated leaves of absence for professional study as a means of enabling the employee to improve his competence and knowledge in a technical field.
3. Consistent with employer objectives, the employee should be given every opportunity to publish his work promptly in the technical literature and to present his findings at technical society meetings.
4. It is in the best interest of the employer to encourage continuing education to broaden the qualifications of employees through self-improvement, in-house programmes, formal education systems in the institutions of higher learning, and meetings and seminars on appropriate subjects.
5. The employer should encourage and assist professional employees to achieve registration and/or certification in their respective fields.

#### **4 TERMINATION AND TRANSFER**

Adequate notice of termination of employment should be given by the employee or employer as appropriate.

##### **Professional Employee**

1. If the professional employee decides to term-

inate his employment, he should assist the employer in maintaining a continuity of function, and he should provide at least one month's notice. When termination is initiated by the employee, no severance pay is due.

##### **Employer**

1. Where it is necessary for employment to be terminated for reasons other than misconduct or unsatisfactory performance, compensation should be provided by the employer in consideration of responsibilities and length of service. As a desirable goal, redundant employees should receive the maximum redundancy payment possible under the current wage adjustment regulations (one week's pay for each year of service up to 20 years). In the event that the employer elects notice in place of severance compensation then he should allow the employee reasonable time and facilities to seek new employment.
2. Employers should make every effort to relocate terminated professional employees either within their own organisations or elsewhere. Consideration should be given to continuing major employee protection plans for some period following termination, and to their full reinstatement in the event of subsequent re-employment.
3. If a professional employee is involuntarily terminated on the basis of early retirement, the employer should consider an equitable provision for an adequate income for the period remaining until the employee receives his pension at his normal retirement age.
4. In a personal interview, the employer should inform the employee of the specific reasons for his termination.
5. The employer should provide an adequate transfer-time notice, with due consideration to the extent of personal matters which the professional employee must settle before moving. All normal costs of the transfer should be paid by the employer including moving expenses, real estate fees, travel expenses to the new location to search for housing, and reasonable living expenses for the family until permanent housing is found. Unusual moving expense reimbursement should be settled in a discussion between the employee and employer.

#### **ACKNOWLEDGEMENT**

This document has been prepared for the New Zealand Institute of Chemistry, and is based on a similar document prepared in the U.S.A. by an ad hoc group called the Inter-Society Committee on Professional Guidelines. This committee was set up under the auspices of the Engineers Joint Council and the National Society for Professional Engineers. The American document has been published in a number of professional society journals, including the journal TAPPI, July 1974, vol. 57, No. 7.

# AN ALTERNATIVE MODEL FOR THE STRUCTURE OF DNA

G. A. RODLEY

Department of Chemistry, University of Canterbury, Christchurch

## INTRODUCTION

A new model has recently been proposed for the structure of DNA [18, 22]. This differs significantly in appearance from the Watson-Crick model [25], as indicated in Figure 1. Although initially described as a "possible conformation for double stranded polynucleotides" [18], this model has now been presented as an alternative to the double helix in a detailed paper [7] which summarises work carried out at the University of Canterbury over the past two years. Nonetheless the apparently "proven" status of the double helix model is frankly acknowledged.

Two recent results strongly indicate the correctness of the double helix model for DNA. The fine details of a dinucleotide fragment as determined by X-ray analysis [21] show the structural units arranged in just the manner predicted by the Watson-Crick model [25]. In addition, the structure of transfer RNA [16] shows that the regions which are double stranded have the right-handed helical arrangement. Many other studies of DNA have been successfully interpreted in terms of the double helix model. For example, results from studies of the superhelicity (additional twisting) of covalently closed circular DNA may be explained quantitatively in terms of the specific degree of unwinding that



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*His work on the structure of DNA, which arose from "extra-mural" studies, is being carried out in collaboration with Professor R.H.T. Bates and Mr C. H. Rowe of the Electrical Engineering Department, Dr J.P. Day (who was a Visiting Lecturer in Chemistry at Canterbury in 1976) and several research students.*

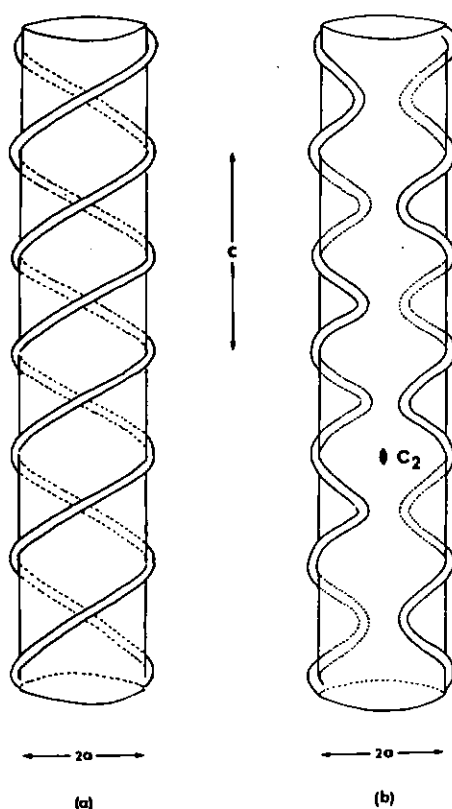


Figure 1. Idealised drawings of (a) an elementary Watson-Crick model and (b) an elementary side-by-side (SBS) structure.

- $c$  = axial length of the repeat unit
- $a$  = approximate radius of the phosphate strands
- $C$  = two-fold (dyad) axis (perpendicular to paper)
- $2$  (from reference 18)

occurs when certain planar molecules are sandwiched (intercalated) between neighbouring base pairs [24]. Primarily, however, confidence in the double helix model is based on the success found in fitting it to a wide range of X-ray data obtained from the various forms of DNA and related duplexes [1-4]. It therefore seems highly improbable that DNA might have a different basic structure. What possible reasons are there for not accepting the double helix model? One is the current uncertainty about the exact form of double stranded DNA in chromosomes; another is the apparent advantages the

alternative model has in certain areas [6, 7, 11, 18-20].

The outstanding problem so far as the double helix is concerned is its highly intertwined character. At an early stage this was recognised as being a difficulty but over the intervening years concern about the "unwinding" problem diminished, mainly owing to the discovery and identification of cutting and splicing enzymes. More recently, as indicated, it has been the question of how DNA can bend and fold (as it does in a highly compacted manner) in chromosomes that has led to a reappraisal of the Watson-Crick model. In order to overcome the difficulties posed by its rigid rod-like character, Crick and Klug [10] have suggested that the double helix kinks every twenty base pairs for DNA in chromosomes. Kinking involves partial unwinding, a stretching out of the double helix with consequent loss in base stacking and bending about the kink position. This is a drastic structural change and there are no real indications as to how it might come about.

One can argue that the X-ray studies of duplexes, although very extensive and impressive [1-4], do not constitute "proof" of the double helix model; primarily because of the limited range and relatively poor quality of the data available for any single form. Questions have been raised in the past about the reliability of the X-ray studies [12]. However, now that X-ray results for all the available forms have been satisfactorily interpreted in terms of a basic double helix, it is all the more difficult to suggest that an alternative model might exist and that it should be examined. Nonetheless, if there is any doubt at all about the double helix model every effort should be made to keep the assessment of existing data as open as possible because of the dependence of many studies on an accurate understanding of DNA structure. Uncertainties about X-ray studies are highlighted by the fact that the two models have significant structural similarities. As described below, almost half of the repeating unit of the side-by-side (SBS) model is itself in the form of a regular right-handed double

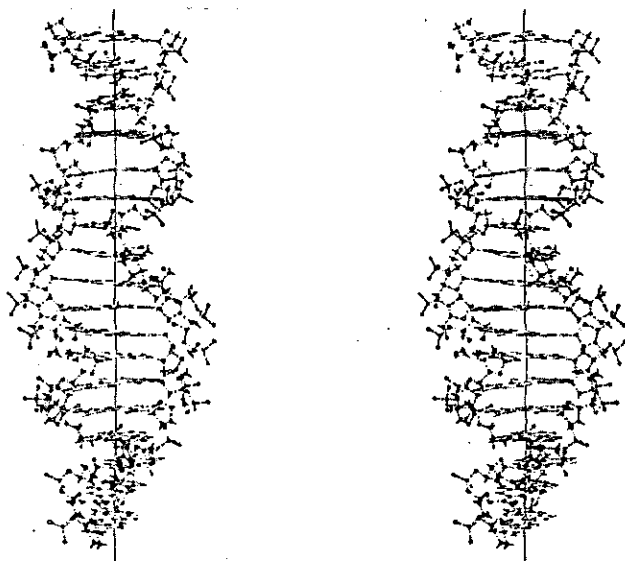


Figure 2. Stereo view of the SBS model viewed from the narrow groove side (reference 18)

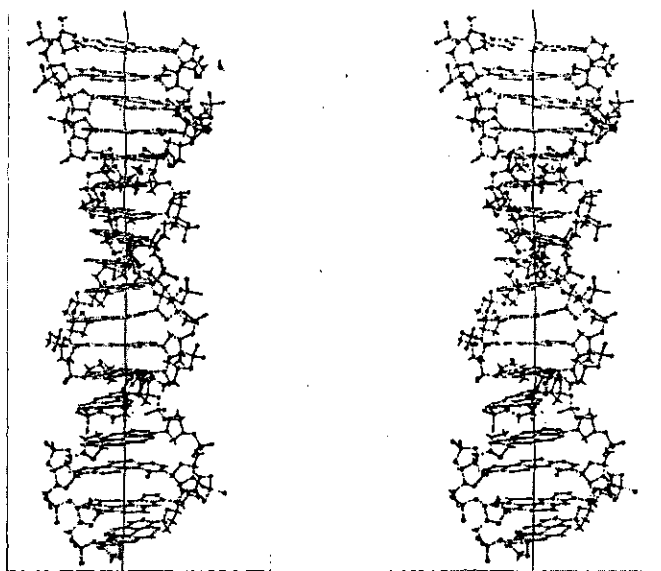


Figure 3. Stereo view of the SBS model viewed at a position  $90^\circ$  from Figure 2 (from reference 18)

helix. Thus it might not be possible to readily discriminate between them on the basis of X-ray analysis alone.

In an area as broad as DNA structure it is obviously difficult to consider over a short period of time all of the ramifications of proposing a new model. Also the stereochemical viability of the model has not been firmly established and difficulties have been encountered in interpreting certain results in terms of an SBS model. In this article an outline only of the details of the model and some applications of it will be given. Full details have been presented elsewhere [18] and comparisons of the model with the double helix are contained in two other publications [7, 19].

## DETAILS OF THE ALTERNATIVE MODEL

The alternative structure, referred to as the SBS model [18], is most simply described as an alternating arrangement of left- and right-handed double helical sections that are five base pairs long. (Figures 1-14). The accepted Watson-Crick base pairing scheme is used and the only significant change from a double helix is the stereochemistry of the sugar-phosphate backbone. In a double helix only one configuration (referred to as *gauche-gauche*) is employed whereas in the SBS structure alternative arrangements (*trans-gauche* and *gauche-trans*) are also used. In double helix models all the sugars have the same pucker conformation. For the SBS model different sugar conformations are used. Figure 1 shows the overall difference between the sugar-phosphate backbone structures of the two models; the double helix backbone has a smoothly helical form while the SBS one is sinusoidal. This arises from bending of the backbone that is necessary in order to change the sense of the helical twist every five base pairs. It is this bending of the backbone which is considered to be the most unsatisfactory feature of the model. However, the conformations used are no different in detail from ones which have been observed in other structures including that of transfer RNA [14, 16]. While bending of the backbone and the use of left-handed sections is almost certainly energetically less favourable than

using the right-handed arrangement alone, the SBS structure appears to facilitate better stacking of the base pairs on top of each other. Maximisation of base stacking is a key feature of the structure of transfer RNA [16].

Although considered to be another problem when the model was first formulated, the long range right-handed twist (apparent from a close study of Figures 2 and 3) is now recognised as a crucial property of the SBS model. Electron micrographs clearly demonstrate the ability of DNA molecules to twist in a long range manner (i.e. supercoil). So long as one assumes that intercalation of dyes and related molecules occurs preferentially in right-handed sections it appears to be possible to interpret results for super-coiled DNA. Another important feature of the SBS model is the manner in which the base pairs are more exposed than in a double helix (Figure 2). This could provide a better explanation of results on the binding of various proteins (which indicate that the latter have a reasonably unimpaired "view" of the base pairs) than is possible for a double helix model [7]. The SBS model also provides specific binding sites for DNA interacting molecules in regions where the backbone bends. Furthermore it can be seen that the SBS structure, being strip-like, may be bent more readily than the rod-like double helix. This and the long range twist property could form the basis of a model for chromosome structure that would permit topological independence of the strands to be maintained throughout the biological processes of replication, transcription and recombination [Rowe, unpublished].

## INTERPRETATION OF PHYSICAL DATA IN TERMS OF A SIDE-BY-SIDE MODEL

Results from quite a wide range of techniques are currently being analysed in a preliminary manner to determine whether distinctive support can be found

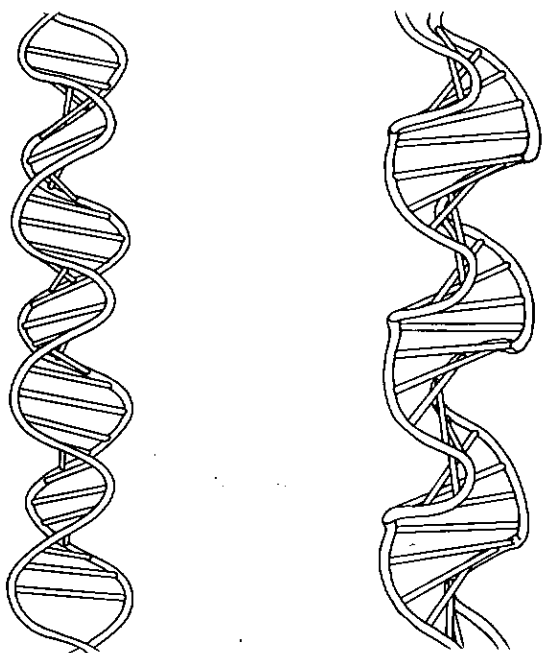


Figure 4. Sketches of a simplified model of the SBS structure (a) side-view corresponding to Figure 3. (b) an angular side-on view (from reference 18)

for the SBS model. If initial support can be found and demonstrated other workers may be encouraged to re-examine existing data and devise new experiments to test the model more thoroughly. Three areas only will be outlined here. They are examples where support for the SBS model may be advanced.

### (1) X-ray Results

As mentioned earlier the general similarity of the two models indicates that the SBS structure may fit the X-ray data almost as well as a double helix. In fact calculations show that the SBS model can produce the characteristic cross pattern of the B fibre form of DNA [7]. However testing the SBS model against the X-ray data for all the available forms is a formidable task. For this reason various model-independent tests of the data have been made in order to see whether there is some indication that one model might be preferred over the other [5-7, 20]. To date the most important result is that obtained from an analysis of the fibre data for DNA using an angular Patterson calculation [5, 6, 20]. This result provides some support for the SBS model. Other studies [Ng, unpublished] indicate that the X-ray data are too poor to allow one to discriminate between the two models on the basis of structure factor calculations alone. This means that the tests [5-7, 20], although also limited by the data, are possibly the only reliable means available for an assessment of the X-ray evidence for the double helix.

### (2) The unwinding of DNA during denaturation

When DNA is heated the two strands separate. Many physical studies have been made of this process. Explanations based on the double helix model [8] appear to be unsatisfactory for two reasons. The first is that when the temperature is rapidly increased the strands separate to a large extent in a time that would not allow unwinding to take place. Furthermore the tightness of the intertwining of the strands seems too great for simple parting apart of the strands of the type allowed by the SBS model for such an "instantaneous" step. The other important factor is the observation from electron micrographs of the formation of single stranded "bubble" regions during denaturation [13]. The implication of these bubble regions is that considerable difficulty would be encountered in transmitting twists through them to the extremities of the molecule for a double-helix model [7, 11].

### (3) Evidence from electron micrographs for side-by-side association of strands

Electron micrographs of partially denatured DNA show no evidence of multiple twisting of the single strands that might be expected for a double helix that is in the process of unwinding. The pictures indicate a simple sideways splitting apart of the strands [13]. Similar micrographs arise from the association of single strands from different species [26]. These heteroduplex micrographs show duplex regions where the strands are complementary and

bubble-like regions where they are not. Furthermore it has been observed that bubbles, having no extensive twisting, are produced when circular DNA samples are partially denatured [23]. Other electron micrograph photographs provide evidence for a significant degree of association of complementary single strands in situations where there are severe topological constraints on the formation of a double helix [9, 15, 17]. Two examples, the formation of "underwound" [9] and "pretzel" [17] configurations, are described in Figure 5. The only explanation of results of this type in terms of the double helix model is that roughly half of the duplex region is in a right-handed form with the remainder adopting some type of structure in which the strands are twisted in a left handed sense. (If base pairing could be shown to occur in this latter region such a result alone would raise interesting questions about the structure of DNA.)

For the SBS model strands may associate to a much greater extent in situations where intertwining is severely restricted. The long range twist will, however, impose some limit on the extent to which this can occur. It is not possible at this stage to be specific about the magnitude of long range twisting expected for the SBS model, but it can be inferred from certain studies that it would need to be of the order of one superhelical turn per 100-500 base pairs. However any estimate of this type must be viewed with caution as the extent of long range twisting is almost certainly affected by the nature of the chemical environment of the DNA sample.

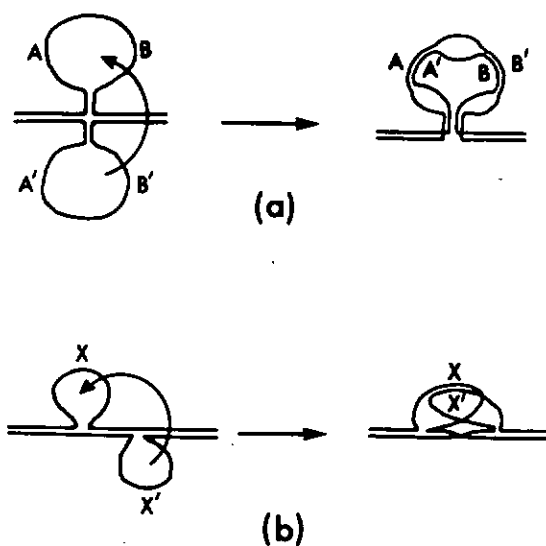


Figure 5. (a) Formation of an "underwound" loop from single-strand stem loop structures which contain complementary sequences. Duplex formation occurs for regions A, A' and B, B' (as observed by Broker et al. [9])

(b) Formation of a "pretzel"-type structure from single-strand loops which are assumed to have complementary sequences [17]. Duplex formation occurs for the X and X' regions (as observed for a heteroduplex formed between the 1 strand of  $\lambda$  p lac SR2-Ms319 and the r strand of  $\lambda$  p lac SR2-Ms384 [17])

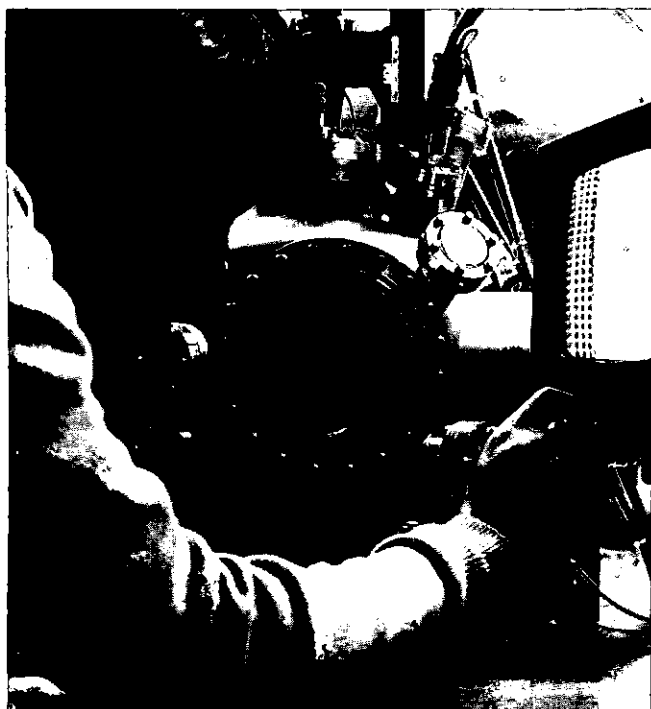
## CONCLUSION

This article gives a brief outline of the SBS model and an indication only of the implications of proposing it as an alternative to the well-established and apparently proven double helix structure. As indicated, the new model has a high degree of similarity with the double helix and the magnitude of the long range twist may be such that the total number of twists of one strand about the other is as high as 10% of that for a double helix under certain conditions. For these reasons it may not be possible to readily distinguish the two models from each other in many studies. It may take some time therefore to resolve the issue satisfactorily, especially if better X-ray data cannot be obtained.

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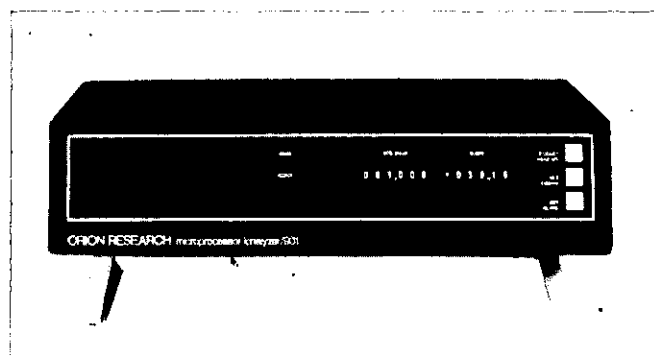
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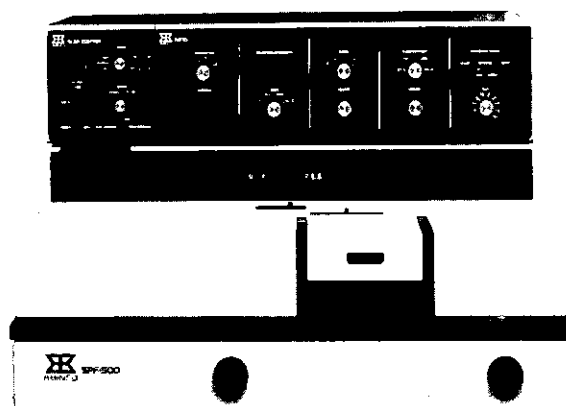
The Automated Auger Microprobe now available at Varian's Surface Analysis Laboratory is used by placing the sample, which can be less than  $10^{-15}$  cubic centimeter in volume, in the vacuum chamber and using the video display to focus the analysis at any particular point on the sample. The automated system quickly produces an Auger electron energy distribution revealing elements present, their distribution, quantity and chemical state.

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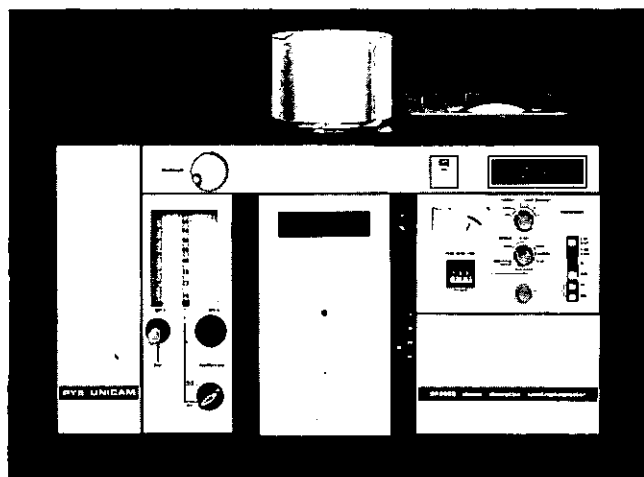
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 Varian Associates  
 611 Hansen Way  
 Palo Alto, CA 94303  
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Orion Research Incorporated, Cambridge, Massachusetts, has announced the Model 901 Microprocessor Analyzer. Push-button standardization and blank correction are the main features of the instrument. It has eleven operating programs and can use pH, redox, specific ion and gas-sensing electrodes. Readout (digital) is in pH units or millivolts, whilst concentrations are continuously calculated and displayed.



The SPF-500 Series Ratio Spectrofluorometer is one of two high performance AMINCO instruments now available. Both the Ratio and Corrected Spectra spectrofluorometers feature precision monochromators, 250-watt xenon-arc lamp, and digital readout of wavelength and scanning speeds.



The SP2900 is a new double beam atomic absorption spectrometer recently announced by Pye Unicam Ltd. It can be used in the integration mode with a graphite tube furnace. It has a concentration calculator that can be calibrated with two standard solutions, even if the response is non-linear. It can be combined with the SP450 sample changer to handle up to 50 samples automatically.

## CHEMICAL CROSSWORD — by Mike

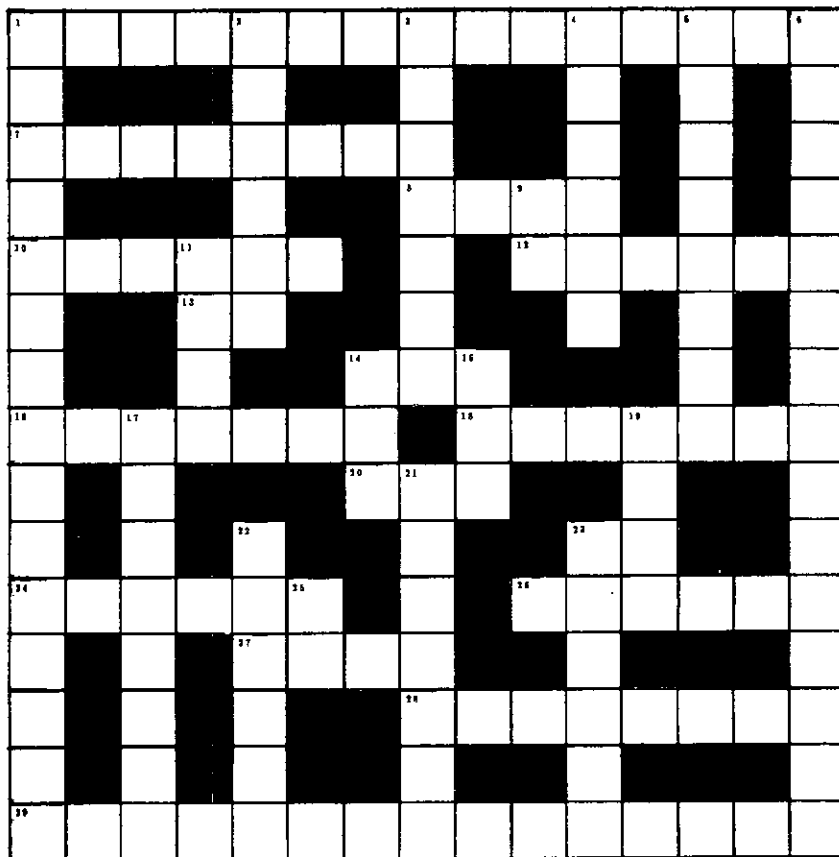
### ACROSS

- 1 Great unraveller of protein mysteries, some do say (7, 8)
- 7 Saturated acid of 23 (8)
- 8 Function can be square but not rectangular (4)
- 10 Unswerving control (6)
- 12 Starve! and speed (2, 4)
- 13 Exercise (2)
- 14 Large salty body (3)
- 16 Sweetness of grapes (7)
- 18 With 4 forms 26 (7)
- 20 Tail? (3)
- 23 Half a joke and half a half! (2)
- 24 Silver neat — confused but paternally related (6)
- 26 Research Institute in USSR? (3, 3)
- 27 1 Noseless pentose foreigner (4)
- 28 Bury remainder, we hear, for gains of usury (8)
- 29 4 and 18 make up the heart of the matter (7, 8)

- 23 Unsaturated alkyl 7 (6)
- 25 Hesitant expression for our queen? (2)

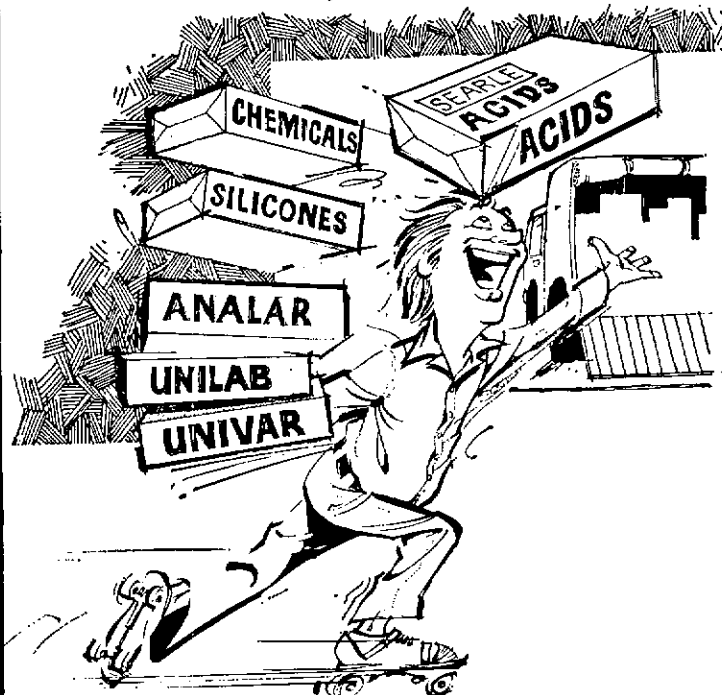
### DOWN

- 1 Reduction? No, quite the opposite! (15)
- 2 Able to perform (3, 3)
- 3 Sweet, with flower in mouth, we hear (7)
- 4 May with 18 form 29 (6)
- 5 Non-magnetic stirrer? (8)
- 6 Little Ronald voted in on space station? — track around 29 (8, 7)
- 9 Brewers measure (2)
- 11 Large scale picture (4)
- 14 14 across we hear (3)
- 15 Also (3)
- 17 Acid of 92? (8)
- 19 Creature sounds like feet! (4)
- 21 41 (7)
- 22 Still standing, standing still (6)



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## THE INSTITUTE'S LIBRARY

The Institute has now gifted the bulk of its collection of periodicals, including some 37 titles not received elsewhere in New Zealand, to the library at Massey University. There will be some regret at the loss of this valuable collection built up over twenty years, but a new home had to be found for them, and part of the contract with Massey is the University's undertaking to bind complete volumes, which is already under way. The availability of the journals to members of the NZIC is not impaired in any way by the new arrangement.

The Institute has retained a number of journals put out by sister bodies, and these will be retained in the library of the Auckland War Memorial Museum. The staff there are happy to service these journals in association with the Institute's Honorary Librarian, S. G. Brooker. It is also hoped that Council may be able to find a little money each year to make an attack on the binding of them.

The Hon. Librarian is anxious to complete many gaps in the holdings of the journals retained; if any member can help, copies should be sent to him

c/- Library,  
Auckland Institute and Museum,  
Private Bag,  
Auckland.

The list of wanteds is as follows:—

### **Chemistry in Canada:**

vol. 2, nos 4, 8;  
vol. 5, nos 4, 8;  
vol. 7, no. 9;  
vol. 9, nos 7, 8;  
vol. 12, no. 4;  
vol. 20, nos 11, 12;  
vol. 21, no. 9;  
vol. 25, no. 8;  
vol. 26, nos 2, 4, 5;  
all from vol. 26, no. 7 onwards.

### **Canadian Journal of Chemical Engineering:**

all issues subsequent to vol. 51, no. 5.

### **Chemistry (American Chemical Society):**

vol. 40, no. 4;  
vol. 43, no. 1;  
vol. 48, nos 6, 8.

### **Chemistry in Britain:**

vol. 4, no. 4;  
vol. 5, no. 11;  
vol. 6, no. 3;  
vol. 9, nos 6, 10, 11, 12;  
all vol. 10;  
vol. 11, nos 1-9.

### **Education in Chemistry:**

vol. 9 and all since.

### **IUPAC Information Bulletins:**

we have only nos 24-29, 31, 32, 36-40, 42-45, 48-51. All others wanted.

### **Reviews of Pure and Applied Chemistry (Royal Australian Chemical Institute):**

vol. 11, no. 4;  
vol. 12, no. 1.

### **Pure and Applied Chemistry (IUPAC):**

vols 1-12;  
vols 23 onwards.

### **R.I.C. Monographs for Teachers:**

no.17.

### **R.I.C. Reviews:**

all required from vol. 3, no. 2 onwards.

### **R.I.C. Journal:**

any copies would be welcome.

### **Australian Chemical Institute Journal and Proceedings:**

vol. 1, nos 3, 5, 6;  
vol. 2, nos 9, 10;  
vol. 4, no. 7;  
vol. 6, nos 3-12 inclusive;  
vol. 7, nos 1-4;  
vol. 9, nos 11, 12;  
all vols 10 & 11;  
vol. 12, nos 1, 10, 11, 12;  
vol. 13, nos 1, 3;  
vol. 14, no. 11;  
vol. 25, no. 11;  
vol. 30, no. 5;  
vol. 31, nos 5, 8;  
vol. 37, no. 3.

### **Journal of the South African Chemical Institutes:**

vol. 1, no. 1;  
vol. 28, no. 1.

### **South African Industrial Chemist:**

vol. 1, no. 3;  
vol. 2, nos 3, 5, 6, 7, 8, 10;  
vol. 7, nos 4, 5;  
vol. 13, no. 10;  
vol. 14, no. 3;

vol. 18, nos 4, 8, 10, 11;  
vol. 19, no. 7 in 1966 combined with—

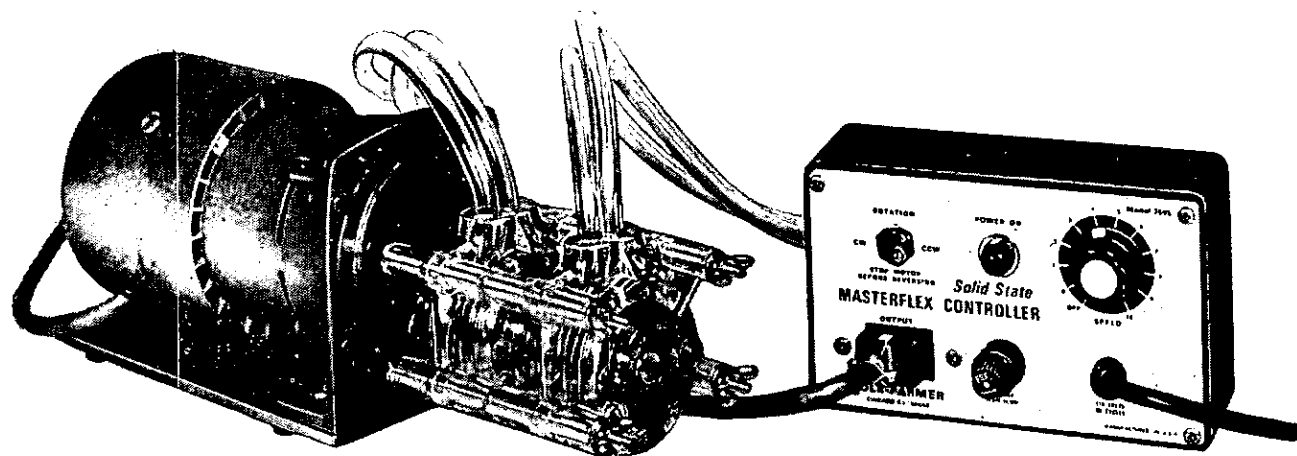
### **South African Chemical Processing:**

missing vol. 1, nos 1, 2;  
vol. 3, nos 2, 3, 4, 5, 6;  
vol. 4, nos 1, 2, 3, 4, 5.

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## BOOK REVIEWS

*Order in Polymer Solutions* — edited by Karel Solc. 1976 (320 pages). Price £11.10. Midland Macromolecular Monographs Volume 2. Gordon and Breach Science Publishers.

Those who are familiar with the published Discussions of the Faraday Society will easily be able to imagine what this book is like. It contains the papers read and the associated discussion at the second annual Symposium organised by the Midland Macromolecular Institute in Michigan in August 1973. The proceedings of the first Symposium, which coincided with the Dedication Ceremonies of the Institute, have already been published as volume 1 of this series under the title "Trends in Macromolecular Science".

Like its predecessor this volume deserves the highest commendation, both for the significance and quality of its subject-matter and for the excellence of its presentation.

The existence of organised structures in solutions is a subject equally interesting to chemists and physicists working in the field of synthetic and natural polymers as well as to biochemists involved in the study of processes taking place in living organisms. There are six review papers and six research papers covering the following topics: helix-coil transition in specific sequence biopolymers; conformational properties of optically active stereoregular polymers; solvation properties of biopolymers; preferential solvation and its effect on polymer dimensions; association of synthetic polymers; and association-dissociation phenomena in biopolymers. The discussion comments which follow each paper are valuable in raising significant points or questioning weak assumptions.

It is disappointing that there is such a long time interval between the date of

the Symposium and the appearance of this volume. Nevertheless part of the delay was caused by the requirement that each of the papers was reviewed before publication which is rarely the case with reports of symposia proceedings, and considerably enhances the value of this account.

The book is more suited to the specialist research worker in physical chemistry and biochemistry than to the general reader. It is likely to be expensive but is certainly worth purchasing either for library or personal use.

G. N. Malcolm

*Progress in Analytical Chemistry, Volume 8* — edited by I. L. Simmons and G. W. Ewing, Plenum Press, New York, 1976; 336 pp., \$35.40.

This volume contains a selection of papers presented at the Eastern Analytical Symposium held in New York in October, 1975. The fourteen contributions deal with various aspects of recent work in atomic spectroscopy, environmental chemistry, chromatography, vibrational spectroscopy and molecular luminescence spectroscopy.

The first three articles deal with atomic absorption and emission methods for the analysis of metals, alloys, glasses, ceramics and clinical samples. The contributors' experiences with electrothermal atomizers are discussed extensively. Two chapters are concerned with elemental analysis of municipal incinerator effluents (by atomic absorption and instrumental neutron activation), and drinking waters (by atomic absorption and ion-selective electrode). There is a short discussion of the use of bonded microparticle ion exchangers for biochemical separations. The development of liquid-sample injection systems for GLC is described, and a comprehensive review of gas-solid chromatography is presented. A short paper reports some applications

of Raman spectroscopy to complex systems, and the analytical potential of coherent anti-Stokes Raman spectroscopy (CARS) is explored. Techniques for measuring fluorescence lifetimes in the nanosecond range are discussed, and the final paper reviews the use of fluorescence and phosphorescence in drug analysis.

The articles vary as much in their approach as they do in their subject matter. Some papers present results obtained by well-established techniques, and barely qualify for inclusion in this book. Others, such as the article on CARS, deal with fields of potential, rather than proven, analytical utility. In general, the papers on specific research projects of the contributors themselves (e.g. trace element levels in southern New Jersey drinking water, GC-MS analysis of diphenylhydantoin in blood, Raman studies of phospholipid-water gels) appear to be less appropriate than the wide-ranging reviews of recent progress.

The book has been produced in type-written format, and some sacrifices have been made in the interests of speedy production. Many of the articles show evidence of poor proofreading by the contributors, and the editors appear to have taken no action to remove more than a hundred errors of spelling, typography, grammar and chemistry.

Because this book contains several different types of article, selected from a very wide field, it is unlikely to appeal as a volume for the chemist's personal library. However, by including useful reviews such as those on luminescence techniques in drug analysis (J. A. F. de Silva), gas-solid chromatography (R. L. Grob), and atomic spectroscopic analysis of glasses, refractories and ceramics (W. M. Wise and J. P. Williams), the editors have tried to ensure that the book contains something for everyone with analytical interests. It should therefore find a place in the larger institutional libraries.

R. D. Reeves



## INDUSTRIAL CHEMISTRY PRIZE (Sponsored by ICI Tasman Vaccine Limited)

A new prize of \$200 for meritorious achievement in the field of industrial chemistry has been donated to the NZIC by ICI Tasman Vaccine Limited. The Regulations governing the award are set out below. The first applicants will be invited to submit documents by 30 April, 1978.

The NZIC Council records its appreciation to ICI Tasman Vaccine Limited for its generosity in establishing this prize which will enable outstanding work by Institute members in the field of industrial chemistry to be recognised.

1. A prize of \$200 will be awarded annually.
2. The prize will be awarded for meritorious achievement in the field of industrial chemistry.
3. The prize will be restricted to financial members of the New Zealand Institute of Chemistry of any grade of membership. In the case of joint work the prize may be shared between two or more members.

4. 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.
5. 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.
6. Two or three assessors will be appointed by the Council of the Institute of Chemistry 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.
7. Applications or nominations must be submitted to the Administrative Secretary N.Z.I.C., P.O. Box 1926, Christchurch, before 30 April each year.



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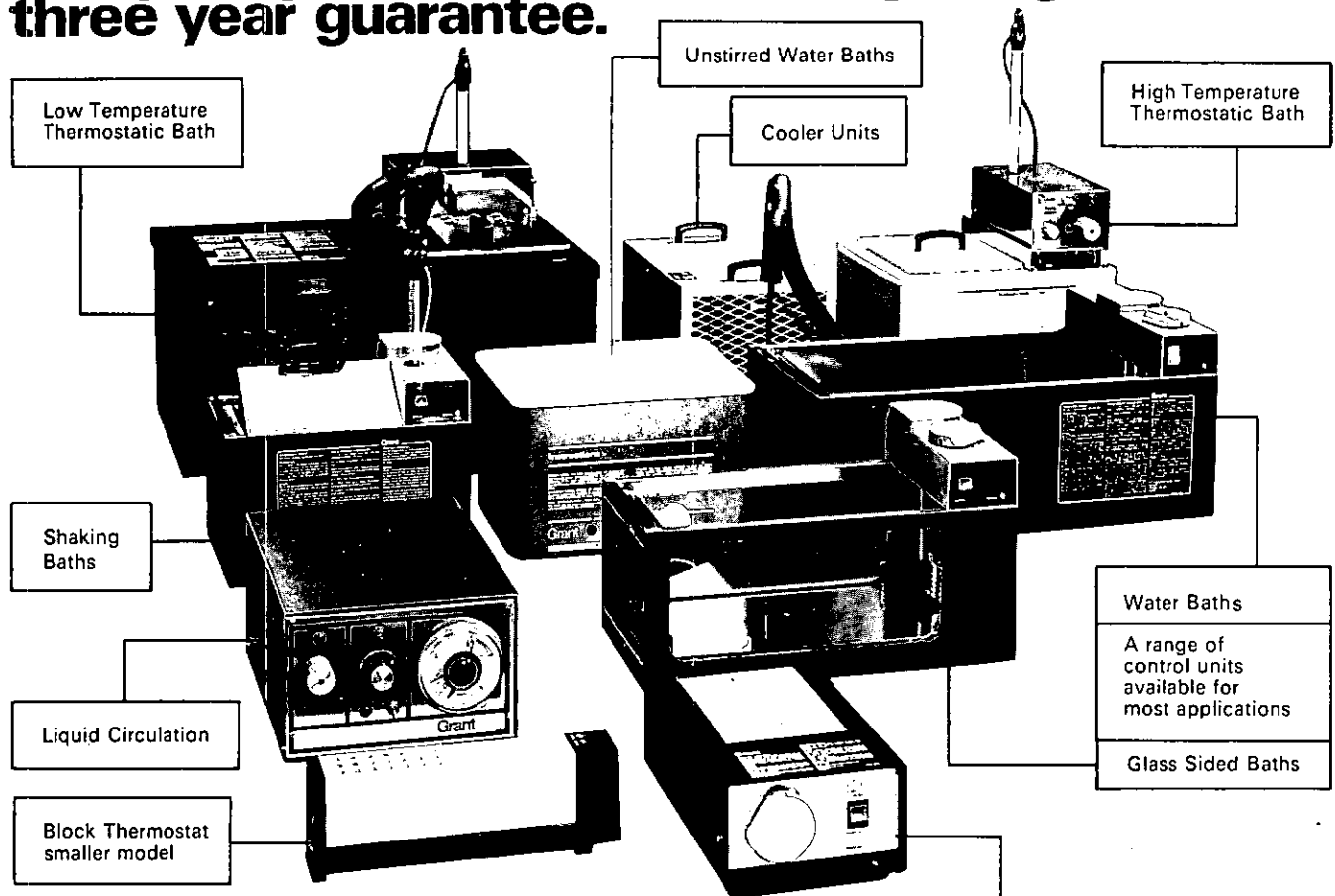


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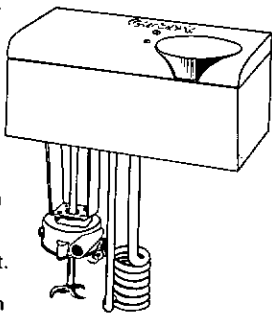


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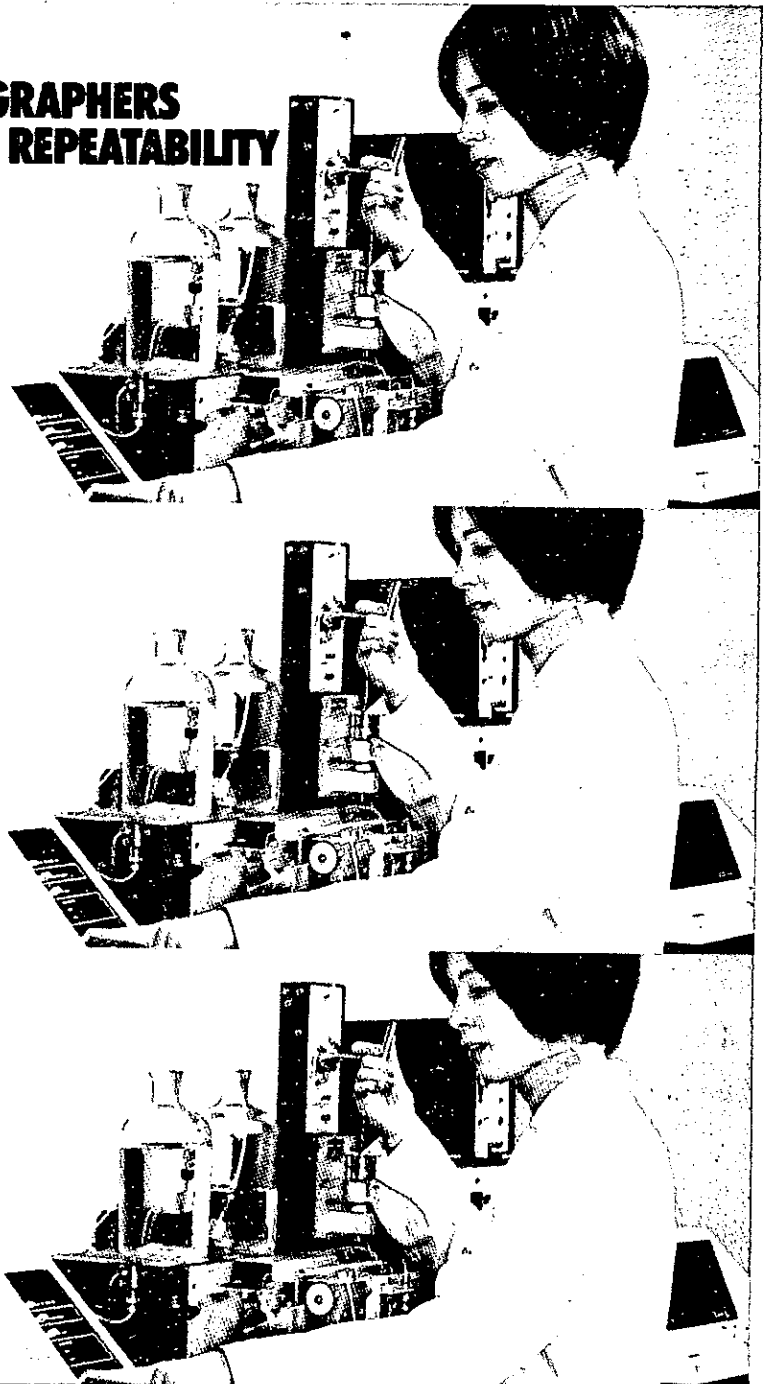
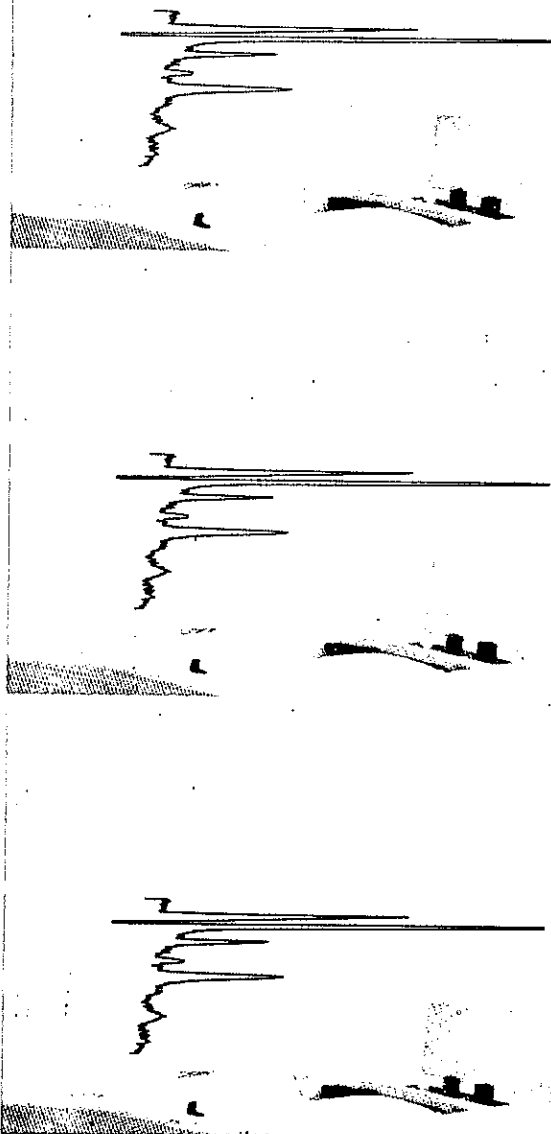
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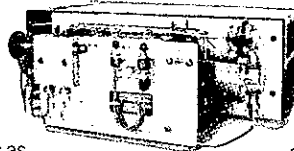
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