

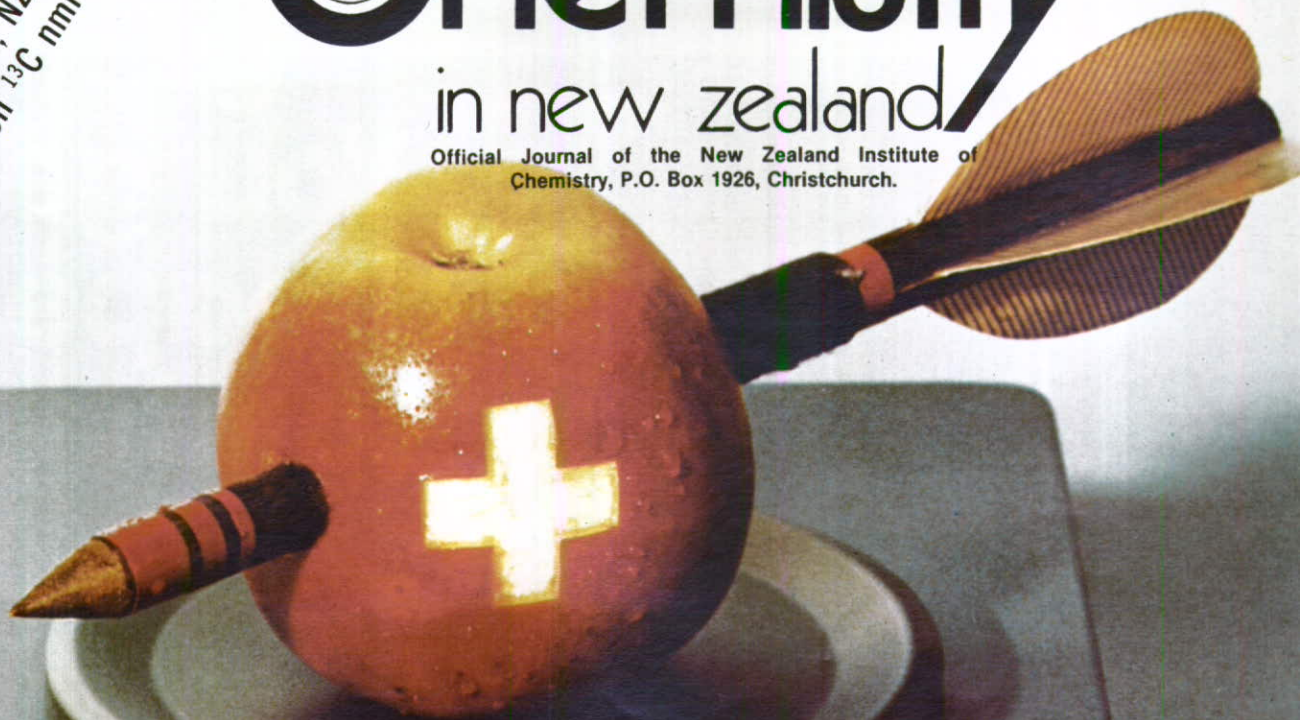
INSIDE: NZIC Salary Survey;  
Pre-Conference Report; NZ Grapefruit  
Silage; High Resolution  $^{13}\text{C}$  nmr In Solids.

August 1980 Vol. 44 No. 4

# Chemistry

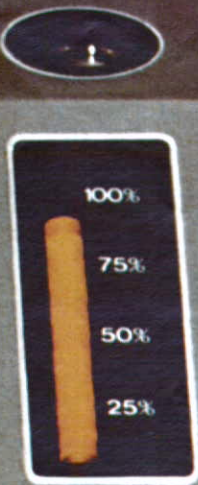
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# Chemistry

in new zealand

Official Journal of the New Zealand Institute of Chemistry

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## Welcome To Conference

In recent times the Institute Conference has rotated quinquennially through Palmerston North, this period being slightly shorter than that predicted from theoretical considerations. Without explaining this discrepancy here, we wish to express our pleasure at being able once again to welcome participants in the 1980 Conference to the Manawatu and the Massey University campus.

The Committee this year has consciously avoided trying to mould the Conference around a single theme. Instead, we have sought to emphasise a particular aspect of current chemical or biochemical activity on each day of the Conference. This has also enabled us to take advantage of over-lapping meetings of the NZ Society of Plant Physiologists and the NZ branch of the Australian and New Zealand Society for Mass Spectrometry.

On Tuesday, August 19 the emphasis is on Plant Chemistry and Biochemistry, with **Prof E. Conn** of the University of California, Davis, introducing the subject with his plenary lecture 'The Chemical Defences of Plants'. Interest in the chemistry of biological systems continues on Wednesday with sessions under the heading of 'Chemical Ecology'. **Dr J. Edgar**, of CSIRO Division of Animal Health, is guest speaker. The plenary sessions of the latter part of the Conference focus on Chemical Instrumentation and Analysis, with Thursday's lecture by **Dr L. de Galan** of the Technical University, Delft, Netherlands, on 'Emission Spectrometry with the Inductively Coupled Plasma', followed by **Prof Campbell's** Presidential Address. On Friday, recent work in GC-MS, as applied particularly to the investigation of foodstuffs, is described by **Dr K. Murray** of CSIRO Food Research Division, Sydney. Finally, in a mini-Symposium on problems associated with the agricultural use of herbicides, we hope to bring together many aspects (industrial, analytical, ecological, toxicological and economic) of a subject of current interest and controversy.

For those with more specialised interests the presentation of well over 100 papers in specialist lecture and poster sessions should ensure that the Conference contains something of interest to all.

Finally, we are sure that participants will make the most of the social occasions, which have always been a most valuable and enjoyable part of the Conference. We look forward to seeing you all.

R.D. Reeves,  
Chairman, Conference Committee

## Polemics From The Pulpit

In casting around for a message to the faithful for this issue, we resisted the temptation to promulgate a bull on 'Duo, Quattor, Quinque — T' as this is a political issue, and guidance from on high says that the religious should not tamper with such matters — as is now being said in Brazil. We were therefore interested to read in the NZ Geothermal Group's Newsletter, Monsignor Stuart Wilson's review of the Heinemann New Zealand Dictionary (Heinemann Educational Books, Auckland 1979, 1337 pp \$9.95), since although the Bible and Beilstein are our primary sources, we do consult other works of reference from time to time. We eschew, by the way, the Encyclopedia Britannica because of its strongly atheistic tone as shown by its dismissal of all codes of football, including soccer and rugby, in one paragraph, while devoting 16 large pages to the gridiron. It is fortunate that another member of the cloth allowed us to peruse his copy and discover this heresy before we considered adding this work of the devil to our library.

The Editor of Heinemann, H.W. Orsman of Victoria University, claims particular stress on scientific and technical terms, but Dr Wilson, whose diocese is geochemistry, feels that this is not so. He mentions many terms from that and related sciences that are omitted and he is critical of those that are included. We noted a glaring omission in the abbreviation section of any reference to the NZIC — we warn the publishers that this should be corrected in future editions, or it will have to be placed on the Index. On the other hand, Heinemann is the only work of reference we have seen that defines a barrel (of petroleum) as being 'equal to 159 litre (sic)' surely an important thing in this energy conscious age. We liked its definition of ether: 'any class of organic compounds with the general formula ROR' where R and R' are alkyl or aryl radicals'. We followed the terms used here through to find that aromatic compounds defined as having a benzene ring in the molecule, which is not good enough. It also slipped with 'lecithin', missing the essential phosphorus, and classing it as 'biology' rather than chemistry, a sin committed in many other places, e.g. with pyrimidine.

This dictionary is modern enough to tell us that the transition metals come between Groups II and III in the Periodic Table which is good, but the editor should know that 'L' in LPG stands for 'liquified' not 'liquid' — 'liquid gas' is a scientific abomination.

A curious omission is Vitamin B<sub>12</sub>, cobalamin, the cobalt compound which is especially significant in NZ because its deficiency caused the scourge of bush sickness as the Soil Bureau has been recently reminding us in the exhilaration of its Golden Jubilee.

With only about 25,000 entries, it is less value for money than some of its competitors, but it fits nicely into the hand, and does reasonably well for chemistry.

Footnote: Monsignor Wilson is right for the wrong reason when he says that Orsman is wrong about the Gordian knot. In the dictionary, it was 'servered (sic) by Gordius' but our classical education at Christchurch Boys' High School (whose centenary next May, combined with the NZIC Jubilee celebrations has led us to declare 1981 a Holy Year) tells us that it was tied by Gordius and cut by Alexander the Great.

S.G. Brooker.



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## What's Happening

The theme of our December issue will be chemical education and any of our readers who have ideas on the subject are invited to write to the NZIC Editor.

In an interesting note in the Journal of the American Chemical Society, (102 380 [1980]) **Ralph Dougherty**, University of Florida, reports that gravitational fields can cause assymmetric synthesis. By reacting hydrogen peroxide and isophorone in methanol in a gas turbine at speeds of 6000-14000 rpm, the product was d or l according to the direction of spin, a rotation of 17.2 but only -3.1 being the maximum values obtained. (Could these results be different south of the equator, like the bath water going down the plug hole?). Dougherty warns that a number of times the tubes exploded, and the gear should be well shielded.

Readers will have read about the setting fire to South Africa's Sasol I coal-to-oil plant at Sasolburg, and the attempt to blow up the new Sasol II. To commemorate the opening of Sasol II, there has been issued a most attractive booklet as supplement to the journal "Chemsa" which we receive as an exchange for our

library. In February last year plans for Sasol III were announced. The booklet gives a potted history of Sasol I, II and III together with a great deal of public relations material and advertising from the companies associated with the project. The plants produce a variety of other products as well as motor fuel, as would be expected with coal as a raw material. There is a fairly simplistic account of the Fischer-Tropsch process as is usual in publicity hand-outs, but despite this, it is an extremely interesting publication, and would be valuable for teachers and people interested in energy research. Copies are available from: Keeble Prins Co., MSOA House, P.O. Box 3080, Johannesburg.

### GC/MS Workshop

At the NZIC Conference this month, the NZ Branch of ANZSMS is organising a specialist gc-ms session and a gc-ms workshop. **Dr Keith Murray**, Food Research, CSIRO, North Ryde has been invited to give a plenary lecture and to lead the discussions at the workshop. Keith Murray has had a great deal of experience in organic ms, including field desorption ms. His experience on gc column packings, sample introduction, spectral interpretation and gc-ms techniques make him an ideal leader for the workshop.

The proposed programme is:

Friday, August 22 (at NZIC venue, Massey University): Plenary Lecture by **Dr K.E. Murray** (CSIRO). 'Some experiences in the Application of Mass Spectrometry to Food Research'. **G.J. Shaw** (DSIR). 'Using the Mass Spectral Search System via Satellite — an update'. **L. Pannell**

(DSIR) 'A Microprocessor Based Data System for Acquisition of Mass Spectra from MZ902 and HP5980 Mass Spectrometers'. **P.T. Holland** (MAF) 'Metabolism of Organophosphate Insecticide, Isazophos, by Ryegrass'. **S.A. Gwyn** (DSIR) 'Analytical Experiences with gc/ms'. (At Applied Biochemistry Division, DSIR): (i) Demonstration of OASIS link (to HIH chemical information retrieval system). (ii) Demonstration of a local mass spectral search system.

Saturday, August 23 (Applied Biochemistry Division, DSIR): Formal talk (by **K.E. Murray**) followed by a general discussion on field desorption mass spectrometry and on gc/ms sampling techniques. Practical demonstration of capillary gc/ms techniques.

In recognition of his 'outstanding contributions' to the work of the Standards Association of NZ, **Mr O.H. Keys** JP, M.Sc., C.Chem, MRIC, FNZIC received the Standards Fellowship Award from Trade & Industry Minister **Mr L. Adams-Schnieder** in June.

Mr Keys became a member of the previous Standards Council in 1963 and was appointed to the new council and executive committee in 1966, on which he served until he retired last March. He has been associated with standards since the early 1930s and more recently as Chairman, Consumer Council.

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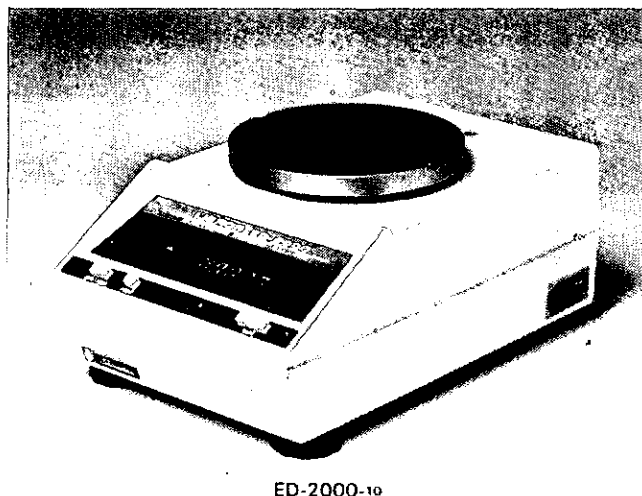
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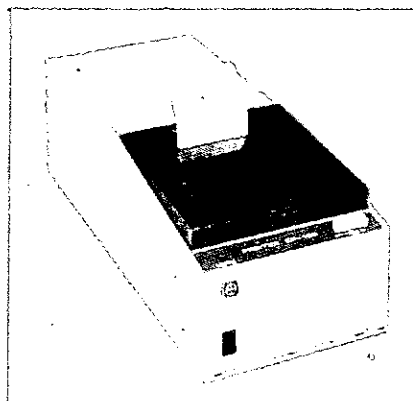
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## People

**Dr Peter Grant**, Otago University, has been appointed to a personal chair in organic chemistry. We offer our congratulations to a chemist who has been very active in NZIC affairs, both locally and on the Council. In June he made a short study leave tour of the USA.

**Prof D.J. Brasch**, also of Otago, attended the 10th International Conference on Carbohydrate Chemistry in Sydney.

We also congratulate **Prof Buckingham** of Otago in being elected to the Fellowship of the Royal Society of NZ.

In the Pharmacy Dept. **Dr Rob McKeown** has been appointed to the Editorial Board of the Australian Journal of Pharmaceutical Sciences.

The address of the Pottery and Ceramics Research Association (PACRA) of which **Dr Harry Percival**, our energetic Wellington correspondent, is Director, has been changed from Private Bag, Lower Hutt, to Box 35-113, Naenae.

**Mr R.E. Colby** has left UEB Industries and joined AHI Paper Products, Auckland. **Mr C.W. Harland** is now Development Manager, Chemical Products, NZ Farmers' Fertiliser Co., Auckland. **Mr D.T. Edwards** is now Manager of Alta Lipids, Wellington. **Assoc. Prof Marion Robinson** has transferred from the School of Home Science, Otago University, to the Nutrition Dept. **Mr L.A. Jenkins**, formerly at the Chemical Engineering Dept. at Canterbury, is now with AIS, Wollongong, NSW. **Dr J.W. Martin** has gone from Texas A & M, College Station, to ANU, Canberra. **Mr R.G. McQueen** is now with Pharmaservis, Kings Langley, NSW. **Miss P.K. Johnstone** has left the Cawthorn Institute and is now living at 21 Usk St, Oamaru. **Mr F. Barnes** has retired from Fletcher Wood Panels, Christchurch. **Mr M.M. Rankin**, of NZ Breweries, Christchurch has also retired. **Dr R. Dolby** of the DSIR Petone has gone to the Research Station at Invermay, Otago. **Mr O.W. Everest** has been promoted to Principal, Green Bay College, Auckland. **Mr B.P. Stansbury** of the Chemical Laboratory, New Plymouth Power Station has gone to Mauri-DYC Foods, Auckland. **Prof F.N. Fastier** has transferred from the Dept. of Pharmacology, Otago Medical School to the Dept of Chemistry at Otago, where **Dr M.R. Grimmitt** is now Associate Prof. **Dr R. Lavery** has been promoted to Professor in the School of Pharmacology. **Mrs E.M. Simpson** has left Kempthorne Prosser Ltd. Dunedin to join Chem Industries in the same city. **Mr R.D. Keen** has transferred from Mobil, Wellington to Auckland. **Dr W.B. Healy** of the Soil Bureau, has been appointed Scientific Adviser at NZ House, London. **Mr L.M. Olivecrona** is now chemist with Technical Waxes Ltd., Petone. **Mr B.G. Lovelock** has been appointed geochemist to KRTA, Leyte, Philippines. **Mrs V.J. Webster** has left the Pathology Dept at Auckland Medical School to go to Prince of Wales Hospital, Randwick, Sydney. **Dr R. Whiting** has

returned from the wilds of Zambia to take a position with Nylex Fletcher Ltd., Auckland. **Dr D.J. Woodhams** is now Assistant General Manager, APV Bell Bryant, Auckland. **Dr T.J. Collins** has gone from Pasadena to Stanford University, California. **Dr A.E. Cutten** formerly of the Dept of Human Genetics, Canberra, has gone to the Dept of Inorganic Chemistry, Sydney University. **Mr L.J. Sweetman** has been promoted to Head of Science at Tangaroa College, Auckland. **Miss K.M. Chapman** has gone from Colenso High School, Napier to Havelock North High School.

**Mr C.W. Angus** is now Manager of Polychem (NZ) Ltd., Wellington. **Mr N. Galloway** has been appointed to Taubmans (NZ) Ltd., Wellington. **Mr D.G. Howard** is now with Solid State Equipment, Lower Hutt. **Dr R.J. Wilcock** has gone from DSIR Petone to the Hamilton Science Centre, MWD. **Dr H.S. Hii** of Yusmin TS, Indonesia, has been made General Manager. **Mr D.R. McFarlane**, Victoria University, is now at Lafayette with Purdue University, Indiana. **Dr R.S. Tan** has left the University of Singapore to be Managing Director of Micro Consultancy Pte. in the same city. **Mr S.D. Thomas** has gone from Ashmead School, Reading, to the Willink School in the same city. **Dr K.M. Taylor** has come from the Roche Research Institute of Marine Research, Dee Why, NSW to the Medical School, Auckland. **Dr Lindsay Main** left the University of Waikato in June on study leave at the University of Exeter where he will be working on mechanisms of nitration reactions with **Prof K. Schonfield**.

**Sir Jack Llewellyn** who came to NZ in 1947 to take over the Dept of Chemistry at Auckland after the retirement of **Prof F.P. Worley**, and introduced many changes, the impact of which is still being felt, and later returned to England to take up a position at the University of Exeter, has retired from his latest position as Director-General of the British Council, which was

established in 1934 to develop closer cultural relations between UK and other nations. It is good to think that Sir Jack has retained his connection with the NZIC in his distinguished career. **Dr W.A. McGillivray**, the retiring Director of the Dairy Research Institute, Palmerston North, has finished his tour of duty in Japan, and is now living at Oropi Road, RD3 Tauranga. We have a special place in our thoughts for Bill as one of our distinguished predecessors in the Editorial Chair, and wish him well.

**Dr Tony Cartner**, who has studied at Otago, East Anglia, and ANU Canberra, has been appointed lecturer in physical chemistry at Waikato University.

**Prof R.H. Stokes**, who made his mark at Auckland University College as a student under **Dr R.A. Robinson**, with whom he wrote the definitive book on Electrolyte Solutions, has formally retired from the Professorship of Chemistry at the University of New England, NSW and the Electrochemical Division of the RACI is striking a medal in his honour. During the war Prof Stokes served as Chief Chemist in the Colonial Ammunition Co., Auckland, but continued his research work, some of it in association with his wife, also a chemist, whose wedding present to him was a hand calculator. The many friends of Prof Stokes in NZ will be pleased to know that he has accepted an invitation to be one of the plenary speakers at the Jubilee Conference in Auckland next August.

The well-known organic chemist, **Prof A.R. Katrisky** of the University of East Anglia, England, has accepted an appointment to the newly established Chair of Organic Chemistry at University of Florida, where he will be freed from administration and elementary teaching to concentrate on research and advanced teaching.

**Bernard Stanley** has retired as Director of Operations, A.C. Hatrick NZ Ltd. to become Marketing Manager, Lockfast Chemicals Ltd., Papatoetoe.

## NOTES TO AUTHORS

There was an omission in the paragraph entitled 'Diagrams & Structural Formulae' in our Notes to Authors, which appeared on Page 114 of our June, 1980 issue.

The paragraph (with the missing words in bold type) should read:

### Diagrams & Structural Formulae:

These should be submitted in such a form as to permit direct photo-reproduction. To that end stencils should be used wherever appropriate and lettering must be of such a size as to remain easily legible after the material has been reduced to either an 85mm column or a 175mm page. Black ink must be used on board, drawing or tracing paper, or plastic sheet. For convenience in reduction diagrams should not normally exceed 420 x 600mm<sup>2</sup> (i.e. A2 size). The originals and two copies of all diagrams and structural formulae are required. Their approximate

position in the text should be indicated in the margin. All diagrams should be numbered in series and a typed list of captions provided.

We apologise for the omission and for any inconvenience it may have caused.

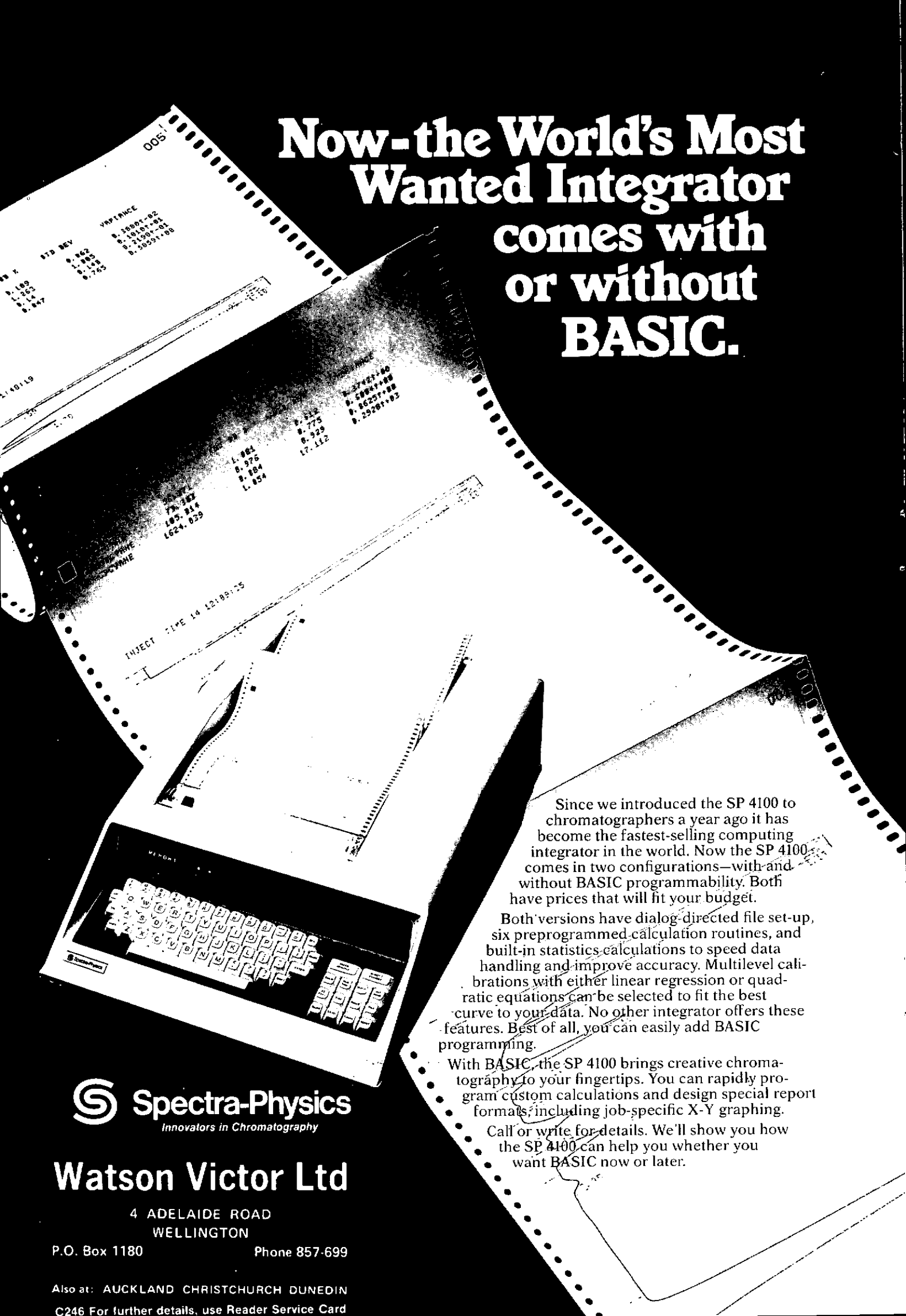
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# NZ Grapefruit Silage

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*New Zealand grapefruit waste ensiled for 60 days produced a good quality soft-textured silage. Analyses were carried out on fresh and dried samples of both the waste and the silage for protein, amino acids, minerals, lipid material, fibre, ash and acidity. Lactic acid content showed a large increase on ensiling, indicating that favourable processing conditions had been obtained. When the silage was used to supplement a grain feed for Jersey cows, the animals readily accepted it. The taste and odour of the milk from the test animals was indistinguishable from that of milk from a control group. It is concluded that silage from NZ grapefruit waste is a useful supplementary feed for ruminants.*

## Introduction

The NZ citrus industry has grown significantly since 1974, the total production of fruit in 1978 being 21,000 tonnes of which almost 7,000 tonnes were processed. A large proportion of this production was NZ grapefruit with a quantity in 1978 of 5,300 tonnes of which 65% were processed (W.J.W. Wilton 1980, pers. comm.).

The major product of the industry is fruit juice, the production of which leaves a residue of about 60%, most of which is discarded. Possibilities for the utilisation of such citrus waste include conversion into products such as candied peels and food additives and extraction of pectin and pharmaceuticals including essential oils. Production of many of these products involves considerable capital investment and, in some instances, larger quantities of raw material than are yet available in NZ. Thus at present such sophisticated treatment of citrus waste is uneconomic. However, silage has been made from oranges and used as a cattle feed in Florida (Becker et. al. 1946). Silage is the material produced by the controlled fermentation of a crop of high moisture content and if silage could be cheaply produced from NZ citrus waste it should find a ready market for feeding to ruminants. Such a product could be particularly appropriate in NZ with its cattle and sheep populations.

The aim in ensiling is to conserve the nutritional material in a condition approaching as closely as possible its natural state. The process is basically similar to the common method of preserving foods by pickling and consists of making the material so acid that decomposition by bacteria is prevented. Acidification is

achieved by anaerobic fermentation of some of the constituents in the raw material which fosters a rapid production of lactic and acetic acids. Such a process was considered particularly appropriate for the waste material from the juicing of NZ grapefruit.

The NZ grapefruit is not a true grapefruit but a natural hybrid whose origin and development is obscure (Farmer 1975). Because of the unique character of the fruit, one cannot assume that silage produced from its processing waste will have the same composition and acceptability as that from other citrus. This paper records the chemical composition on ensiled NZ grapefruit waste and its acceptability as a supplementary feed for dairy cows.

## Materials and Methods

**The ensiling process:** A silo was constructed of concrete blocks lined with polyethylene and measured 2.3m high, 2.2m wide and 3.3m long. During early spring the silo was filled with approximately 15t of NZ grapefruit waste and covered with black polyethylene sheet. The waste was obtained from Pulp Industries Ltd., of Swanson, Auckland, from fruit that had had its juice extracted using a belt-type extractor. The sheet was held down by logs and the whole mass covered with galvanised iron sheets to give additional protection against rain. Random samples were taken from the fresh waste and, after 60 days, at depths of 0.33m, 0.67m and 1.00m in the silo. Samples were stored at minus 18°C.

**Sample preparation:** Samples were comminuted in a Kenwood-Peerless comminutor and sub-samples taken directly for analysis. Another part of the sample was heated at 60°C followed by final drying at 100°C in a tunnel air drier for 24hr. (The preliminary drying at 60°C prevented case-hardening and increased the drying efficiency). After drying for 24hr the colour had changed from yellow to very dark brown and the dried material was hard and brittle. The "dried waste" and "dried silage" were finely ground in a Rocklabs 13cm ringmill for 1 minute, passed through a 30 mesh B.S.I. sieve (500 µm aperture), and sub-samples again taken.

**Analytical methods:** Soluble solids were determined as 'degrees Brix' using an Abbe refractometer. Weight loss on drying was determined both by drying at 102°C for 2hr and at 70°C under reduced pressure of less than 1 kPa for 2hr. (Dry matter determination by toluene distillation would have been affected by Maillard reactions in citrus waste). Ash was determined following ignition at 525°C for 12hr. Protein was estimated from the organic N determined by the Kjeldahl-

Table 1: Composition of NZ grapefruit waste and silage

Analysis	Fresh waste	Dried waste	Fresh silage			Dried silage		
			0.33 m	0.67 m	1.00 m	0.33 m	0.67 m	1.00 m
Depth of sample			0.33 m	0.67 m	1.00 m	0.33 m	0.67 m	1.00 m
Soluble solids, °B	13.0	-	11.4	12.0	12.0	-	-	-
pH	3.7	4.0	3.2	3.1	3.2	3.8	3.7	3.5
Wt. loss, 102°C, %	85.7	8.6	87.4	86.8	86.3	1.7	2.0	2.4
Wt. loss, 70°C, %	84.2	-	85.9	85.1	84.5	-	-	-
Nitrogen free extract, %	-	71.6	-	-	-	63.6	66.1	59.8
Protein, %	0.8	6.1	1.3	1.3	1.5	9.3	9.0	10.6
Lipid material, %	-	0.9	-	-	-	2.8	2.5	3.2
Fibre, %	-	9.7	-	-	-	16.4	15.5	19.7
Acid, mmol/100 g	4.7	16.2	8.3	8.9	8.9	26.0	26.6	28.1
Ash, %	0.5	3.1	0.7	0.7	0.6	6.2	4.9	4.3
Lactic acid, %	-	0.1	-	-	-	4.6	4.3	4.0

Gunning method (AOAC 1975), using a conversion factor of 6.25 for N to protein. Lipid material was measured by Soxhlet extraction (AOAC 1975). The method for fibre analysis was a modification of that published in section 7.050 of the AOAC (1975). Titratable acidity was measured potentiometrically by titration to pH 8.1 and reported as mmol/100g. Lactic acid was analysed spectrophotometrically following conversion into acetaldehyde and reaction with p-hydroxydiphenyl (Barker & Summerson 1941). Amino acids were determined by autoanalyser following acid hydrolysis under nitrogen reflux; cystine was determined following conversion to cysteic acid by sealed tube hydrolysis with dimethyl-sulphoxide. Trace elements were measured by atomic absorption spectrophotometry following perchloric-nitric acid digestion. Results are presented as the mean of triplicate determinations. The 'nitrogen free extract', which included sugars and other soluble carbohydrates (Becker et al. 1946), was calculated by difference (100 — sum of the percentages of protein, lipid, fibre, ash and moisture).

After 60 days' fermentation the height of the ensilage had dropped from 1.9m to 1.0m. The material was of similar colour to the original waste but of softer texture and had a sweet citrus smell. On microscopic examination a number of harmless nematodes of the class Rhabditidae were observed.

The results of analysis of the waste and silage are shown in Table 1. The slight drop (ca 1° Brix, equivalent to 2.6% of the total solids) in the level of soluble solids on ensiling the waste can be accounted for by the action of micro-organisms using the soluble solids as a source of energy.

As expected, the ensiled waste had a lower pH than that of the fresh material presumably due to the production of organic acids by micro-organisms. Non-enzymatic browning reactions resulted in the loss in weight of the samples dried at 70°C under low pressure being less than that dried at 102°C under atmospheric pressure. During drying of the fresh waste and fresh silage at 70°C, the colour of the samples changed to dark brown. The colour change for fresh silage was progressively darker the deeper the sample in the silo. These observations on the silage during heating correlated with the greater water loss due to non-enzymatic browning reactions (Table 1). The apparent increase in the level of protein (Kjeldahl N) on ensiling the citrus waste can be explained if the ash content of the material is regarded as remaining constant. On this basis the protein content of the waste had not changed over the ensilage period but nevertheless the level of protein was low. In studies of lucerne silage (Barry et al. 1978) extensive degradation of protein was observed.

The increase in lipid material (Table 1) could be attributed to lipid synthesising micro-organisms, particularly yeasts (Frazier 1958). The acidity also increased on ensiling of the citrus waste. Although the acid in the fresh pulp was citric acid, much of the acidity in the silage would be due to other organic acids (e.g. lactic acid, acetic acid, etc.) produced by the action of micro-organisms on carbohydrates. The acidity decreased on drying of the fresh waste and the fresh silage, probably due to the presence of some volatile acids (e.g. acetic, formic, etc.) in the fresh samples.

Lactic acid content had significantly increased in the silage after 60 days of ensiling. The large increase from 0.14% (calculated on a 'moisture-free' basis) in the fresh waste to 4.35% ('moisture-free') in the fresh silage indicated the activity of lactic acid bacteria.

The 'nitrogen-free extract' of the waste, both on a fresh and ash-corrected basis, decreased following ensiling. The action of enzymes, both microbial as well as those already present in the fresh waste, may contribute to the breakdown of insoluble carbohydrates to soluble

Amino acid	mg g <sup>-1</sup>
Aspartic	4.7
Threonine	1.9
Serine	2.1
Glutamic	6.7
Proline	2.6
Glycine	2.7
Alanine	2.6
Valine	2.8
Isoleucine	2.1
Leucine	3.2
Tyrosine	1.7
Phenylalanine	2.1
Histidine	0.7
Lysine	1.2
Arginine	1.4
Cystine	0.5
Methionine	0.8

Table 2: Amino acid composition of dried NZ grapefruit silage

moieties which could be utilised by the microbial population.

The greatest difference observed between the citrus silage and herbage was in amino acid content; however, citrus silage is intended as a supplementary feed and not a prime source of amino acids. Also, amino acid content of silage is not a good criterion for protein quality in the diet of a ruminant, due to extensive breakdown in the rumen. The amino acids of dried silage are shown in Table 2. Levels are lower than those in most herbage silage with individual amino acids ranging from 10 to 90% of the values commonly found in herbage proteins (Lyttleton 1973).

Table 3 shows that the mineral content of the dried NZ grapefruit silage is similar to that of herbage (Butler 1973) with slight deficiencies exhibited by sodium and phosphorus.

#### Palatability Of NZ Grapefruit Silage And Effect On Milk Flavour

The fresh silage was fed to 10 Jersey milking cows in 20% admixture with maize grain on a fresh basis. The animals consumed the mixture readily and indeed showed a preference for the grapefruit silage mixture as against the straight maize grain. Silage was always fed more than 2hr before milking, as it has been reported that a feed flavour was transferred through dairy cows into milk when citrus press cake silage was fed within 2hr of milking (Becker et al. 1946).

The milk from these cows was organoleptically evaluated by a panel of 3 persons and taste and odour of the milk was assessed as identical to milk from cows which had not been fed citrus silage.

#### Discussion

In this study citrus waste produced a silage with fresh colour and sweet smell, indicating that fermentation had proceeded favourably. Most data on silage have been obtained from ensiled grasses and it is therefore appropriate to consider briefly some of the pitfalls in making herbage silage. If the herbage is quickly and tightly compacted so that little air is available, respiration and the associated production of heat is retarded or even prevented. In such a condition, if the development of acidity is unduly slow, an undesirable (e.g. butyric acid) fermentation may ensue and degradation by proteolytic clostridia take place. This frequently occurs with young

herbage which has been ensiled wet with rain or dew and results in a rancid, relatively unpalatable silage with a pungent and objectionable odour. If herbage is packed loosely, the rise in temperature will be rapid and a high proportion of starchy food materials will be decomposed leading to a loss in feeding value of the herbage. Although the acids produced on fermentation can still be utilised by the animal, these are not as nutritious as sugar or other carbohydrates. Moreover, there may also be an excessive breakdown of proteins during rapid microbial growth. Control of the temperature of fermentation at 32-37°C is suggested as an appropriate compromise to maintain palatability and the nutritive value of herbage silage.

Constituent	Silage content	
	Dried NZGF	Normal content in herbage*
	All values mg kg <sup>-1</sup> of D.M.	
Fe	385	50-300
Mn	23	25-1000
Zn	27	15-60
Cu	15	2-15
Ca	4769	2000-10000
Mg	1279	1000-4000
Na	343	500-10000
K	9658	10000-20000
P	1453	2000-5000

\* Butler 1973

**Table 3: Mineral contents of dried NZ grapefruit silage and pasture herbage**

In citrus silage, the high level of acidity probably acts as a buffer against the possible effects of varying temperatures brought about by various degrees of compaction. In loosely packed citrus waste, the temperature cannot rise too high as the rate of fermentation by bacteria will be retarded at the low pH. In a tightly packed heap of citrus waste, although a rise in temperature is retarded or prevented, the low pH of the medium is not very favourable to butyric acid bacteria (Frazier 1958). Thus the naturally low pH value of the citrus waste will tend to favour the development of lactic acid bacteria which is highly desirable in ensilage. Therefore, temperature control in citrus waste is not critical. The preservative power of lactic acid is aided by the citric acid in citrus silage.

The composition of the silage was similar to that reported for silage produced from Florida grapefruit (Becker et al. 1946). The ready acceptance of the silage by the test animals illustrated the palatability of the product and carry-over of flavour to the milk was not a problem. It seems that the unique character of the NZ grapefruit does not detrimentally influence silage production.

The practice of ensiling herbage with additives is fairly common especially when moisture (from dew or rain) and nitrogen are high and sugars low (e.g. immature grasses are high in nitrogen and low in sugars). The common additives may include molasses, sugar, mineral acids, acetic, propionic and formic acids or the addition of formaldehyde. (The addition of molasses is rapidly becoming obsolete). The overall aim is to conserve as much nutrient value as possible by acidification. Additives are of real value especially in wetter areas when silage making has to proceed without too much regard to weather, and when wilting of the grass is precluded — provided, of course, that the cost of the additive is reasonable. New Zealand citrus waste, which is a very cheap material, will probably prove a good additive for grass silage.

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Although only fresh silage has been thoroughly tested in this study, it is probable that dried silage, and in addition fresh and dried waste of NZ grapefruit, may be excellent supplementary feeds for ruminants. The analytical data suggest few differences nutritionally for ensiling and drying. In Australia and USA, fresh and dried citrus waste material have been used to feed ruminants (Anon. 1977; Becker et al. 1946; Cunha 1973). These forms and ensilage have been found to be acceptable by the animal when the feeds did not consist entirely of the citrus material. The low protein content suggests it would be inadvisable nutritionally to use citrus waste products as the sole ration. Acids produced during the normal silage fermentation can limit the intake of the silage (McLeod 1970), therefore the acidity of the citrus silage may also limit its use in this manner. However, citrus waste products are appropriate supplementary rations in association with protein rich fodder, e.g. legumes, cereals, young herbage, etc. One added advantage of silage is to add bulk to the rations. This bulk was found to be important in minimising problems of bloat, founder, digestive disturbances and abscessed livers, all of which were problems encountered with cattle fed with high concentrate rations (Cunha 1973).

Except for the reduction in acidity, drying did not have a significant effect upon the overall composition of the citrus material. Hence, drying by a process such as roller drying could be a sound way of preserving the waste material.

Thus it would seem that there is considerable potential in the use of citrus waste in NZ as a supplementary feedstuff for cattle.

## ACKNOWLEDGEMENTS

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# High Resolution $^{13}\text{C}$ nmr In Solids

Michael A. Wilson

## Introduction

At the end of the 1960's organic chemists could see ahead of them the real possibility of running  $^{13}\text{C}$  nmr spectra of organic substances, provided that these were soluble in a suitable solvent. Today  $^{13}\text{C}$  nmr spectroscopy is a routine technique. Once again we are on the verge of equally exciting discoveries. Undoubtedly before the 1980's are over routine high resolution  $^{13}\text{C}$  nmr spectra of organic solids will be with us and with it will come the possibilities of exploring intermolecular and intramolecular interactions in organic solids, together with an in-depth knowledge of reactions such as dissolution and precipitation.

Until recently, nmr spectra of solid samples have usually consisted of featureless, broad resonances with little or no information available regarding molecular structure. This is not surprising since chemical shift information is nearly always obscured in the spectra of solids because of line broadening resulting from strong dipolar interactions.

As yet it is not possible to remove dipolar interactions in all systems. Homonuclear interactions are large, about  $5 \times 10^4$  Hz for two protons, and, although theoretically it is possible to remove these by spinning the sample at speeds greater than  $4 \times 10^4$  Hz, this has not yet been achieved. Progress has been made in systems in which one of the nuclei is dilute, e.g.  $^{13}\text{C}$ , so that only long-range, weak  $^{13}\text{C}$ - $^{13}\text{C}$  interactions are present in the solid. The  $^{13}\text{C}$  nuclei are usually attached to other atoms such as protons, so it is still necessary to remove strong heteronuclear interactions such as C-H. This can be done by using large decoupling fields.

A further problem arises in working with dilute spin systems. For nuclei such as  $^{13}\text{C}$  the relaxation times are long, and this can considerably lengthen the amount of time needed between separate pulses. In addition because there are so few nuclei to be observed a large number of scans are needed before an adequate signal to noise ratio is obtained. These problems can be overcome by the cross polarisation technique (CP) which makes use of the short relaxation time of the most predominant nucleus to reduce the relaxation time of the dilute nucleus. When the predominant nucleus is the proton, the technique is known as proton enhanced nuclear induction spectroscopy (PENIS)<sup>1,2</sup>.

## Magic Angle Sample Spinning (Mass) Technique

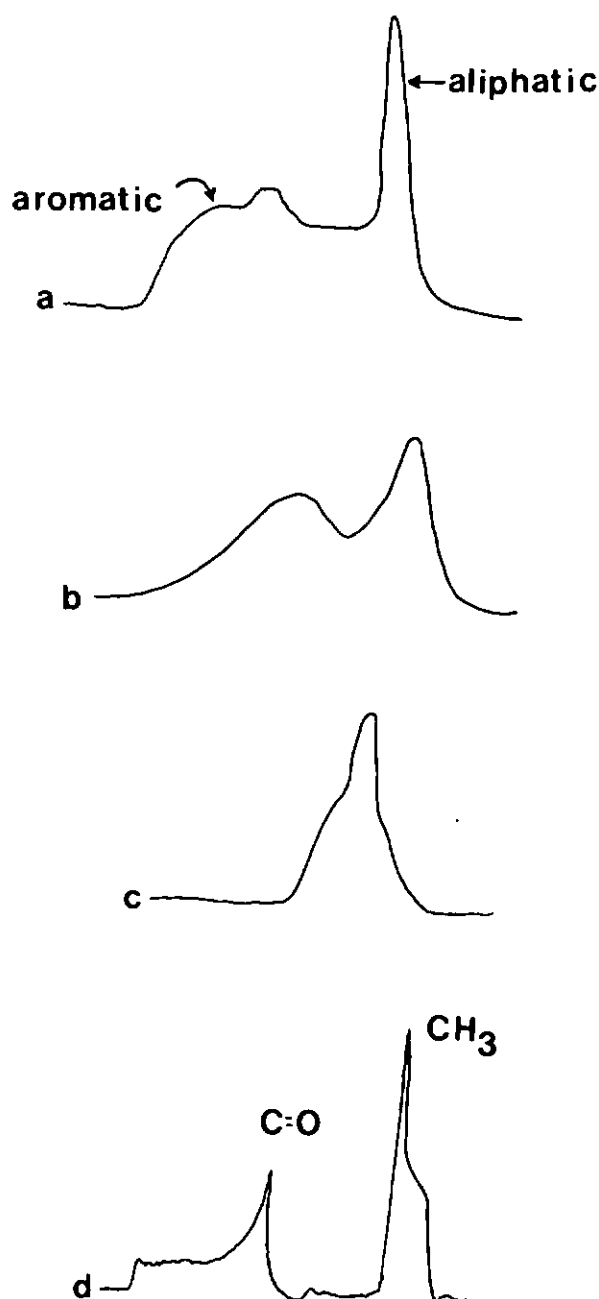
First, sufficient  $^1\text{H}$ -decoupling power must be used to remove the strong direct dipolar  $^{13}\text{C}$ -H coupling that exists in solids. Secondly, the net  $^{13}\text{C}$  magnetization is

enhanced by transfer of polarization from the more abundant protons. This is achieved by matching the frequencies at which the proton and carbon systems precess around applied radio frequency (rf) fields. When experimental conditions are such that both frequencies are the same, then the energy levels become matched. This is known as the Hartmann-Hahn condition.

The theoretical maximum enhancement is equal to the ratio of the gyromagnetic ratios of the nuclei,  $\gamma\text{H}/\gamma\text{C}$  (about 4). The  $^{13}\text{C}$  magnetization under these

Fig. 1 CP- $^{13}\text{C}$  nmr spectra of organic solids

- (a) dihydropyrene (b) a sub-bituminous coal  
(c) glucose (d) solid acetic anhydride



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conditions returns to equilibrium at the  $^1\text{H}$  relaxation rate and thus experiments can be repeated at a much faster rate than in conventional  $^{13}\text{C}$  nmr studies where long delays to allow relaxation between pulses are necessary.

Signals obtained by the CP technique are still relatively broad compared with those obtained by conventional  $^{13}\text{C}$  nmr spectroscopy (Fig. 1). However, this broadening can be very useful in itself since it contains information on chemical shift anisotropy in the solid state, which in turn can give insight into molecular motion.

The remaining line broadening source can be eliminated by rapidly spinning the sample about an axis at an angle of  $54^\circ 44'$  (the 'magic angle') with respect to the axis of the static magnetic field  $^{3,5}$ . When a solid sample is rotated at high speed the nmr spectrum consists of a central line with a set of side lines spaced at constant distances from each side. If the sample is rotated at an angle  $\alpha$  with respect to the applied field, then the angular factor to the internuclear interaction energy can be expressed as  $\frac{1}{2}(3 \cos^2 \alpha - 1)(3 \cos^2 \gamma - 1)$ , [where  $\gamma$  is the angle between the internuclear vector and the axis of rotation] plus some further terms which are responsible for the side lines. The width of the central line is proportional to the factor,  $\frac{1}{2}(3 \cos^2 \alpha - 1)$ . Consequently, when  $\alpha$  is made equal to  $\cos^{-1}(1/\sqrt{3}) = 54^\circ 44'$  the linewidth of the central line can be greatly reduced. The resulting spectra are comparable with high resolution nmr spectra of liquids (Fig. 2).

#### Experimental

The cross-polarization experiment consists of four basic timed sequences of rf pulses. First, the  $^1\text{H}$  protons are polarized by applying a  $90^\circ$  rf pulse of intensity  $H_H$  at the resonance frequency of the protons. The pulse rotates the magnetization vector away from its equilibrium position along the co-ordinate 'z' of the spectrometer's static magnetic field  $H_0$  and into the xy plane along y.

Second, immediately after the initial  $90^\circ$  phase shift has been applied a further  $90^\circ$  shift is implemented such that the field  $H_H$  is redirected along the y co-ordinate colinear with the proton magnetization induced by the initial  $90^\circ$  pulse. This technique is commonly called spin locking. The protons now 'see' themselves in the  $H_H$  field and they precess about the  $H_H$  field at the frequency  $\omega_H = \gamma_H H_H$  where  $\gamma_H$  is the gyromagnetic ratio of the protons. This condition cannot be maintained for long because the applied static magnetic field causes the magnetization along y to return in time to zero. The time taken to do this is called the spin lattice relaxation time in the rotating frame ( $T_{1\rho}$ ).

While the  $90^\circ$  pulse is being applied and during the  $^1\text{H}$  spin-lock condition a rf field  $H_c$  is applied to the  $^{13}\text{C}$  nuclei for a given time (the contact time  $T$ ). There are now two nuclear types  $^1\text{H}$ ,  $^{13}\text{C}$ , precessing at precessional frequencies  $\omega_c = \gamma_c H_c$  and  $\omega_H = \gamma_H H_H$ . Thus if the rf power levels are adjusted so that  $\gamma_c H_c = \gamma_H H_H$  then  $\omega_H = \omega_c$  and a means of transferring magnetization from the  $^1\text{H}$  to the  $^{13}\text{C}$  dilute spin is achieved. The energy levels of the two systems are matched, and the population differences between ground and excited states of the two nuclei are equalised by energy transfer. Furthermore, as  $^1\text{H}$  nuclei are far more abundant (about 100x) the net population difference of the equilibrated system is that of the initial  $^1\text{H}$  difference. Hence the population difference of the  $^{13}\text{C}$  system is enhanced leading to increased sensitivity, and the  $^{13}\text{C}$  nuclei relax at a rate close to that of the original protons. Thus CP  $^{13}\text{C}$  nmr experiments can be repeated at the shorter intervals used in  $^1\text{H}$  nmr studies.

The final step in obtaining the CP spectrum involves terminating the  $^{13}\text{C}$  pulse and observing the resultant free induction decay, while the proton field is maintained (to ensure decoupling). A number of experiments are repeated, averaged, and the free induction decays are

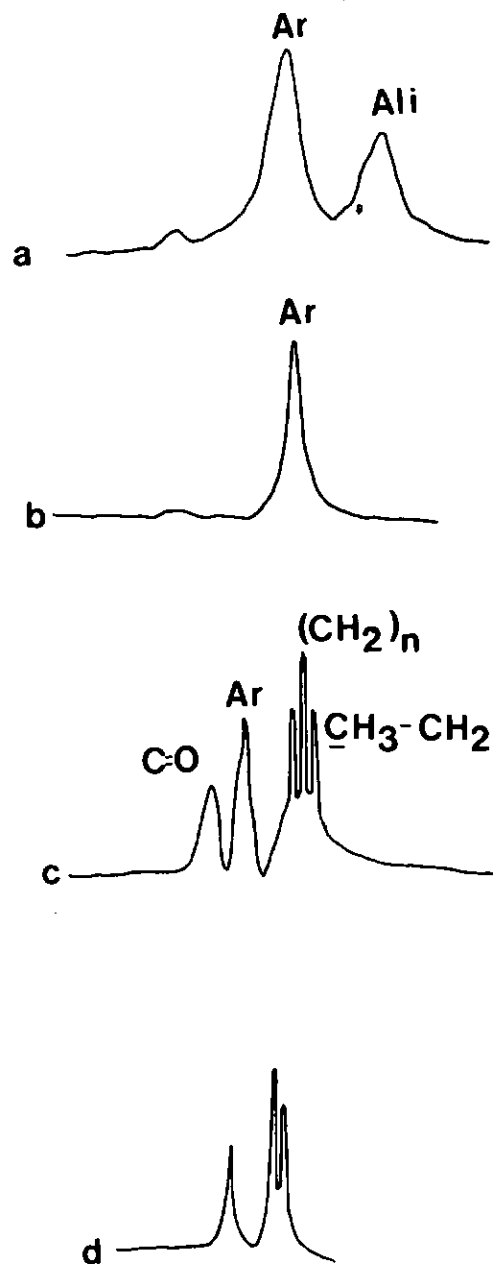


Fig. 2 CP- $^{13}\text{C}$  nmr spectrum with Magic Angle spinning

- (a) a sub-bituminous coal (b) anthracite  
(c) shale organic matter (50 MHz  $^{13}\text{C}$ , 200 MHz  $^1\text{H}$ )  
(d) glucose

fourier transformed to give the frequency domain spectrum commonly encountered in continuous wave nmr experiments.

#### Applications

The structure of heterogeneous solids such as coals and humic materials have never previously been directly determined. Reliance on wet chemical techniques has always left the investigator in the position of deducing structure by inference. It is now possible to obtain separate signals from aliphatic and aromatic carbons in coals  $^{6-9}$  (Fig. 2) and to obtain spectra of solid humic acids isolated from soils  $^{10}$ . When large magnetic fields are used, signals from individual carbon atoms can be resolved  $^{11}$ . More highly resolved spectra will depend on the availability of high-field high-power nmr spectrometers (greater than 300 MHz for  $^1\text{H}$ ) with greater decoupling

## High Resolution (Cont)

power. The technology is already established but the cost of such instruments is approaching the half-million dollar mark. However, this is a small cost to pay when it is realised that coal structure is an important variable in determining the ease of coal liquefaction and that liquid fuels from coal will be the world's transport fuels in the 21st century.

It should now be possible to study both the coal dissolution process, by CP-MASS methods and also the liquefied products by conventional nmr techniques. Consequently, the mechanism of coal conversion can be investigated directly by nmr spectroscopy. The few CP and MASS spectra of coals recorded to date show distinct differences with coal rank. It may therefore be useful as an analytical technique in geological survey work on coals. Spectra of cokes, chars, oil shales, oil sands and bitumens have also been recorded.

A number of spectra of polymers have been published<sup>12-14</sup>. Schaefer and co-workers were able to measure  $T_1$ ,  $T_{1\rho}$ , nuclear Overhauser enhancement factors and cross-polarization relaxation quantities for polymethyl methacrylate, polycarbonate, polyphenylene oxide, polyvinyl chloride, polystyrene and many other materials. Apart from giving detailed structural information about polymers the results give valuable information on chain mobility<sup>14-17</sup>. Spectra of lignin and a variety of woods have been recorded and it has been possible to distinguish the composition of different woods such as maple and pine<sup>14</sup>.

CP and MASS nmr spectroscopy has also been applied to the study of motion in solids and gels and this is already an exciting and rapidly developing field. Early experiments have shown that  $CF_3$  groups rapidly rotate about their axes in solids<sup>18,19</sup>; similarly, molecules of frozen benzene re-orientate about their  $C_6$  axes. Motion often consists of a series of stepwise jumps rather than a continuum as in benzene where movement occurs in a series of  $60^\circ$  steps<sup>20,21</sup>.

## Other High Power nmr Techniques

The Magic Angle spinning method is not the only contender for obtaining useful information about interactions and motion in solids. A multi-pulse sequence known as WAHUHA Spectroscopy (after the inventors of the technique WAUGH, HUBER and HAEBERLEN<sup>22</sup>) reduces line widths in solids from about  $10^4$  to  $10^2$  Hz. Usually WAHUHA spectroscopy is combined with CP-techniques. In the first instance, the protons and  $^{13}C$ -nuclei are cross-polarized and the multiple pulse sequence is applied for a period in which the protons in the lattice are decoupled from each other but not from the

$^{13}C$ . The protons are then decoupled from the  $^{13}C$  nuclei for a further period and the free induction decay is recorded. The data is twice fourier transformed as a function of the two decoupling times. The resulting two-dimensional spectrum can be used to determine C—H distances and orientations.

## Conclusions

High resolution  $^{13}C$  nmr spectroscopy of solids has excellent prospects. This article has briefly outlined some of the developments. Excellent reviews are already available on many aspects of the subject<sup>23-25</sup>. Within the next few years New Zealand should be equipped with at least one instrument capable of such experiments.

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# THE 1980 NZIC SALARY SURVEY

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Gracefield, Lower Hutt

There were 671 returns of which two were late (i.e. after copy was requested for the journal) and two were from retired persons and so were excluded. This return rate of 63.9% is higher than that for the previous survey.<sup>1</sup> All allowances titled superannuation and insurances over \$1000 (assumed to be superannuation) were excluded; nominated superannuation values varied from \$900 to \$3,750.

All analyses were calculated using GENSTAT.<sup>2</sup> A regression model was fitted only for the industry category with the 'new' information (responsibility level, number in firm and number of technical staff) included. The parameter that accounted for the most variability was responsibility level.

For members in small firms, this is an extremely subjective parameter and it was expected that there could be problems in assessment. Surprisingly, this has not been the case. The percentage variance accounted for by responsibility level was 48 for salary only and 54 for salary plus all allowances. In previous surveys<sup>1 3 4 5 6</sup> only 30 to 35% of the variance could be accounted for in the industry category using all parameters available so that is a highly significant improvement. Little difference is shown in salaries between responsibility levels 1 to 3. These latter levels may not be assessed as well and, of course, employers may consider them not to differ significantly for salary definition.

The second fitted parameter in the regression model was the size of the firm. This increased the variance accounted for from 48 to 57% for salary and from 54 to 58% for salary plus all allowances. The parameter shows an increase of \$1.11 plus or minus 0.19 per person in the firm for salary and \$0.95 plus or minus 0.21 for salary plus all allowances. For example, a chemist working in a company with a staff of 2000 people would earn approximately \$2,165 more than one on the same responsibility level but in a company employing 50 people.

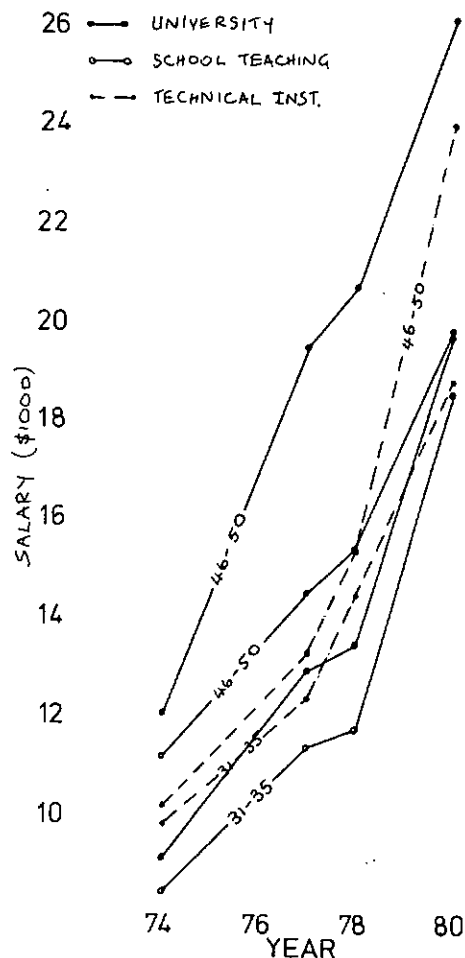
Wendy Singers graduated B.Sc. (Mathematics) from the University of Otago in 1966. She then worked for the Applied Mathematics Division substation, DSIR, at Grasslands, Palmerston North for 3 years. Since 1970 she has worked at Chemistry Division, DSIR.



Graeme Gainsford graduated B.Sc. (Hons) and Ph.D., in Chemistry, from Canterbury University in 1966 and 1969 respectively. He joined Chemistry Division, DSIR, in 1974 after postdoctoral research positions at Ohio State University, University of Sussex and Australian National University (ANU). His research extensively uses X-ray crystallography and computing methods to solve chemical problems; he held a visiting Fellowship to ANU in 1978.



Fig. A



To summarise, the regression equation produced is:  
Salary (in dollars) = 17431 + Responsibility level correction + 1.11 times N (1)

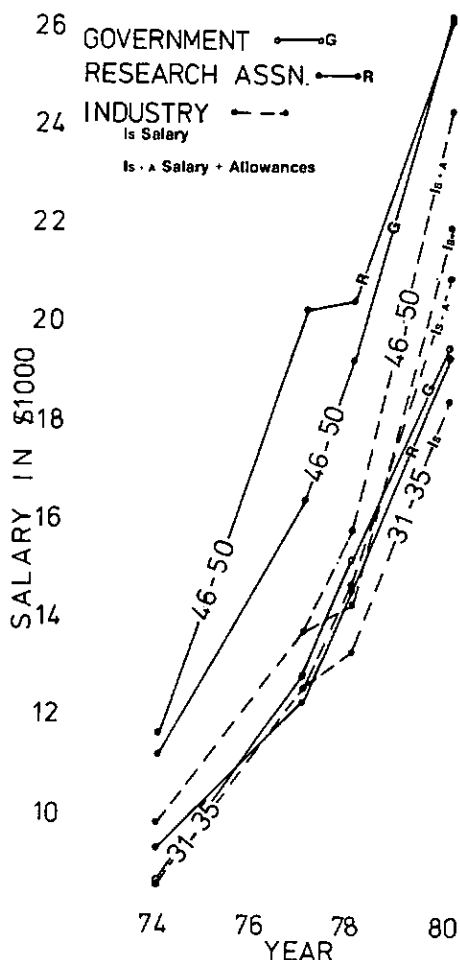
where N is the number in the company, and the Responsibility level corrections (1-6) are -2997, -4442, -3903, -1674, 2102, 10914 respectively.

This result is the predicted mean for industry members; there is however a residual standard deviation of \$3,700 implying that one can only estimate a salary with any certainty to within plus or minus \$7,400! Therefore equation (1) should **not** be used for salary prediction.

Representative movements in salaries since 1974 are shown in the two Figures; the two Industry lines correspond to plots of salary and salary plus all allowances. Salary details for the survey are listed in Tables A, B and C; the "missing values" column in these tables refers to an entry not completed; for example, in Table A, the number in the S + A (Salary + Allowances) row shows allowance(s) which were indicated as present but without an estimate of their financial value.

Allowances are listed in Table D which shows 79% of industry members receive some form of these. The most common are the non-taxable allowance of a car (54% of industry members) and telephone (44%). It is of interest to

Fig. B



### Salary Survey (Cont)

note that 5 of the 14 local government members received bonuses.

Although there is some indication of increase in allowances since 1978, the fewer responses in the industrial sector this year preclude a definite conclusion. Nevertheless, because of the increased income tax rate on higher salaries an identical non-taxable allowance has undoubtedly increased its relative worth since 1978.

The OTHER category in the allowances section was dominated by travel; also noted were electricity concessions (Central Government), tea and married allowances (School Teaching), membership fees for professional bodies, subscriptions, and clothing (Industry), housing finance (Industry), meal allowances (Technical Institutes) and field costs (Industry).

Analyses of the overtime returns showed that, as in the previous survey, only two people had guaranteed

overtime. Seventeen people worked paid overtime, six of these in the industrial group. The unpaid overtime results show an increase in all categories (Table E). This may reflect the survey request that members on salaries should not regard this entry as 'not applicable'. The industrial membership continues to have the highest percentage working overtime while the university and school teaching groups still work the longest hours overtime.

The response to the request for comments was worthwhile. Several industry members found the responsibility level scale 'misleading', particularly those with purely 'staff' functions, or those thought to be above a certain level (e.g. R. & D chemist compared with a Works chemist). It would seem advisable not to use terms that relate to the (1950's) 'Happy Days' era — no self-respecting company ('firm') has a 'sales' (marketing) group in the 80's! One respondent regarded the responsibility criteria as 'too shallow'. It could well be that a combination grading under the headings of duties, supervision-received, decision-making and supervision-exercised (as used by the RIC in Britain) would be more satisfying, even if adding little to the statistical merit of the survey. To confirm a well-known maxim about the worth of any survey the following comments are noted: "The form gets more complicated every year ... could well be simplified", and "Simple, reasonably comprehensive ... satisfying to complete"!

Our conclusions are confined to the 'new' information obtained because no changes in the trends of salary movements have been detected. In the industry sector, there is a reasonable awareness of the responsibility level held, with a corresponding relationship in salaries. The size of the company affects the salary paid with larger companies tending to pay more.

Some suggestions for future surveys have been noted (e.g. engineering as a major function, multiple-function groupings in industry). Comments, particularly about improvements to the survey and form, are welcome. Industry members are invited to suggest an easier and more useful responsibility level system. Any other details or tables (e.g. employment versus primary qualifications) are available from the authors, on request.

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**TABLE A**  
**The Mean, Median, Minimum and Maximum Salaries for Each Employment Group**

Employment Group		Number	Mean	Median	Minimum	Maximum	No. of Missing Values
School Teaching	S	46	19223	18989	12788	28000	0
	S + A		19362	19079	12943	28544	2
Teachers College	S	2	21263	21263	20400	22125	0
	S + A		21448	21448	20770	22125	0
University	S	138	24072	23770	10160	45000	1
	S + A		24063	23735	10160	48000	8
Technical Institute	S	27	20304	20481	14311	24974	0
	S + A		20284	20481	14311	25084	1
Industry	S	195	18208	17700	8750	45500	2
	S + A		20337	19744	8750	51700	18
Central Government	S	158	21474	20381	10181	38038	0
	S + A		21548	20662	10181	38110	6
Local Government	S	12	18656	18448	14280	24160	0
	S + A		18398	18615	14480	22276	1
Research Associations	S	53	22510	20662	10820	44932	0
	S + A		22977	21919	10820	49256	3
Self-Employed	S	5	20100	18000	15000	25000	0
	S + A		24150	25000	17500	31050	0
Hospital Services	S	13	19447	18614	11365	25425	0
	S + A		19266	18443	11365	25425	1
Student	S	7	5087	5500	828	7900	0
	S + A		5216	5500	828	7900	0
Other	S	11	17040	16400	8500	29035	0
	S + A		19035	19034	10850	32250	1

**FOOTNOTE TO TABLE A**

(a) S, Salary; S + A, Salary and All Allowances.

(b) Where Mean different from Median, distribution is skewed. When Mean less than Median, more than 50% of sample are below Mean.

**TABLE B**  
**Age Group — Employment Group**

Age of Group	Empl. Gp.	School	Teach.C.	Varsity	Tech.I.	Industry	C.Govt.	L.Govt.	Res.As.	S.Empl.	Hospital	Student	Other
Up to 24	Number	0	0	1	0	0	1	0	0	0	0	1	0
	Salary	0	0	10160	0	0	10250	0	0	0	0	7900	0
	Taxable	0	0	0	0	0	0	0	0	0	0	0	0
	Non-Tax.	0	0	0	0	0	0	0	0	0	0	0	0
	Total	0	0	10160	0	0	10250	0	0	0	0	7900	0
24-27	Number	5	0	0	0	21	4	0	3	0	1	6	1
	Salary	14530	0	0	0	12682	11547	0	14349	0	11365	4618	8500
	Taxable	28	0	0	0	153	0	0	0	0	0	150	2350
	Non-Tax.	9	0	0	0	793	0	0	16	0	0	0	0
	Total	14568	0	0	0	13651	11547	0	14365	0	11365	4768	10850
28-31	Number	3	0	7	1	38	21	1	10	0	1	0	1
	Salary	17344	0	13945	17661	15949	16830	17210	16284	0	17230	0	15000
	Taxable	0	0	0	0	82	20	450	0	0	0	0	0
	Non-Tax.	0	0	51	100	2409	0	450	5	0	0	0	3068
	Total	17344	0	13995	17761	18486	16761	18110	16289	0	17230	0	18068
32-35	Number	7	0	12	9	34	37	5	8	0	5	0	5
	Salary	18578	0	19691	18709	18392	19507	17421	19348	0	17328	0	14580
	Taxable	57	0	8	0	536	12	130	0	0	0	0	200
	Non-Tax.	26	0	0	23	1859	0	14	78	0	38	0	3099
	Total	18661	0	19700	18732	20918	19799	17565	19531	0	17366	0	17424
36-39	Number	7	1	33	6	22	27	0	12	1	1	0	2
	Salary	18816	22125	21662	20355	18388	21126	0	23506	15000	21820	0	21003
	Taxable	0	0	35	312	61	0	0	0	0	0	0	0
	Non-Tax.	0	0	39	0	2647	0	0	685	4000	0	0	100
	Total	18586	22125	21839	20667	21364	21126	0	25047	19000	0	0	21103
40-45	Number	7	0	36	7	25	15	3	7	1	0	0	0
	Salary	22145	0	24610	22513	20063	23307	19595	24443	17500	0	0	0
	Taxable	196	0	0	0	463	0	299	0	0	0	0	0
	Non-Tax.	374	0	21	30	1637	3	0	0	0	0	0	0
	Total	22715	0	24615	22433	22041	22791	19894	24443	17500	0	0	0
46-50	Number	11	0	24	1	13	14	1	4	1	2	0	1
	Salary	19766	0	26124	21973	21938	26222	18615	26151	18000	22020	0	29035
	Taxable	0	0	0	0	0	0	0	0	11500	0	0	0
	Non-Tax.	149	0	90	0	2325	5	0	62	1550	0	0	500
	Total	19916	0	26214	21973	24263	26227	18615	26214	31050	22020	0	29535
51-55	Number	3	1	14	3	24	20	1	6	2	2	0	1
	Salary	20359	20400	28674	20158	20117	23670	18000	32200	25000	24160	0	20000
	Taxable	0	370	0	0	318	3	150	54	0	0	0	0
	Non-Tax.	33	0	232	0	1378	64	0	800	1600	0	0	0
	Total	20392	20770	28906	20158	21883	23737	18150	33053	26600	24160	0	20000
56-60	Number	3	0	9	0	11	14	1	3	0	1	0	0
	Salary	21429	0	32506	0	21525	27642	24160	27129	0	23390	0	0
	Taxable	0	0	429	0	0	13	0	0	0	0	0	0
	Non-Tax.	5	0	20	0	1344	5	0	0	0	15	0	0
	Total	21434	0	32644	0	22671	27659	0	27129	0	23405	0	0
61-65	Number	0	0	1	0	5	5	0	0	0	0	0	0
	Salary	0	0	32000	0	21100	22753	0	0	0	0	0	0
	Taxable	0	0	0	0	240	0	0	0	0	0	0	0
	Non-Tax.	0	0	0	0	1000	170	0	0	0	0	0	0
	Total	0	0	32000	0	22340	22923	0	0	0	0	0	0
66+	Number	0	0	0	0	0	0	0	0	0	0	0	0
	Salary	0	0	0	0	0	0	0	0	0	0	0	0
	Taxable	0	0	0	0	0	0	0	0	0	0	0	0
	Non-Tax.	0	0	0	0	0	0	0	0	0	0	0	0
	Total	0	0	0	0	0	0	0	0	0	0	0	0

**TABLE C  
MAJOR FUNCTION — EMPLOYMENT GROUP**

Major-Fn		School	Teach.C.	Varsity	Tech.I.	Industry	C.Govt.	L.Govt.	Res.As.	S.Empl.	Hospital	Student	Other
Research	Number	0	0	7	1	1	65	1	31	0	2	2	3
	Salary	0	0	15100	20000	21414	22035	24160	20873	0	22990	4760	20669
	Taxable	0	0	0	0	0	0	0	0	0	0	0	0
	Non-Tax.	0	0	14	0	150	31	0	14	0	0	0	67
	Total	0	0	15115	20000	21564	22011	0	21000	0	24159	4760	20735
Teaching	Number	36	0	3	19	0	0	0	0	0	0	1	0
	Salary	17906	0	18791	19479	0	0	0	0	0	0	7900	0
	Taxable	55	0	0	60	0	0	0	0	0	0	0	0
	Non-Tax.	55	0	0	5	0	0	0	0	0	0	0	0
	Total	17929	0	18791	19543	0	0	0	0	0	0	7900	0
Research & Teach.	Number	0	0	117	1	0	0	0	0	0	0	3	0
	Salary	0	0	24391	20481	0	0	0	0	0	0	5787	0
	Taxable	0	0	11	0	0	0	0	0	0	0	300	0
	Non-Tax.	0	0	40	207	0	0	0	0	0	0	0	0
	Total	0	0	24460	20668	0	0	0	0	0	0	6087	0
Develop.	Number	0	0	1	0	25	7	1	2	0	3	0	0
	Salary	0	0	14951	0	16906	21349	17210	23831	0	19182	0	0
	Taxable	0	0	0	0	0	0	450	0	0	0	0	0
	Non-Tax.	0	0	0	0	1348	0	450	0	0	48	0	0
	Total	0	0	14951	0	18431	21349	18110	23831	0	19230	0	0
Adm/Lab	Number	0	0	1	0	26	15	3	8	0	1	0	0
	Salary	0	0	32000	0	17081	27088	17773	30081	0	24160	0	0
	Taxable	0	0	0	0	219	16	116	41	0	0	0	0
	Non-Tax.	0	0	0	0	965	11	0	994	0	0	0	0
	Total	0	0	32000	0	18306	27115	17889	31115	0	24160	0	0
Adm/Prod.	Number	1	0	0	0	32	0	1	0	0	0	0	0
	Salary	23877	0	0	0	17176	0	18280	0	0	0	0	0
	Taxable	0	0	0	0	124	0	500	0	0	0	0	0
	Non-Tax.	100	0	0	0	1645	0	0	0	0	0	0	0
	Total	23977	0	0	0	18880	0	18780	0	0	0	0	0
Adm/Gen.	Number	7	0	5	3	30	9	1	3	1	0	0	0
	Salary	24239	0	33725	24137	24551	28940	18000	30244	25000	0	0	0
	Taxable	0	0	600	0	424	0	150	0	0	0	0	0
	Non-Tax.	371	0	149	37	3384	15	0	266	3200	0	0	0
	Total	24611	0	34473	24662	28788	28955	18150	30511	28200	0	0	0
Adm/Oth.	Number	1	2	1	1	11	2	0	1	0	0	0	1
	Salary	25868	21263	37400	22656	21863	24165	0	29772	0	0	0	8500
	Taxable	0	185	0	0	180	0	0	0	0	0	0	2350
	Non-Tax.	0	0	0	100	3547	0	0	3100	0	0	0	0
	Total	25868	21448	0	22756	26292	24165	0	32872	0	0	0	10850
Sale/Ser.	Number	0	0	2	0	18	1	0	0	0	0	0	0
	Salary	0	0	14545	0	15973	19800	0	0	0	0	0	0
	Taxable	0	0	0	0	770	0	0	0	0	0	0	0
	Non-Tax.	0	0	1250	0	2869	0	0	0	0	0	0	0
	Total	0	0	15795	0	19781	19800	0	0	0	0	0	0
Anal./Test	Number	0	0	0	0	9	48	4	4	0	5	0	3
	Salary	0	0	0	0	14139	18589	18539	16501	0	16900	0	14800
	Taxable	0	0	0	0	189	9	113	0	0	0	0	0
	Non-Tax.	0	0	0	0	66	1	18	100	0	9	0	1534
	Total	0	0	0	0	14394	18695	18669	15895	0	16909	0	15534
Proc./Qual. Control	Number	0	0	0	0	14	1	0	0	0	0	0	0
	Salary	0	0	0	0	15365	16192	0	0	0	0	0	0
	Taxable	0	0	0	0	161	400	0	0	0	0	0	0
	Non-Tax.	0	0	0	0	391	0	0	0	0	0	0	0
	Total	0	0	0	0	15736	16592	0	0	0	0	0	0
Consult.	Number	0	0	0	0	1	1	0	2	4	0	0	3
	Salary	0	0	0	0	13000	19949	0	18319	18875	0	0	14500
	Taxable	0	0	0	0	0	0	0	0	2875	0	0	267
	Non-Tax.	0	0	0	0	0	0	0	0	1388	0	0	4131
	Total	0	0	0	0	13000	19949	0	18319	23138	0	0	18898
Tech. Ser.	Number	0	0	0	0	19	5	1	2	0	1	0	0
	Salary	0	0	0	0	17807	15498	18750	17258	0	17230	0	0
	Taxable	0	0	0	0	213	0	250	0	0	0	0	0
	Non-Tax.	0	0	0	0	1479	9	0	0	0	0	0	0
	Total	0	0	0	0	19600	15507	19000	17258	0	17230	0	0
Other	Number	1	0	0	2	7	4	0	0	0	1	1	1
	Salary	20200	0	0	21282	16866	17587	0	0	0	23390	828	29035
	Taxable	0	0	0	370	43	0	0	0	0	0	0	0
	Non-Tax.	0	0	0	0	2815	0	0	0	0	15	0	500
	Total	20200	0	0	21652	18555	17587	0	0	0	23405	828	29535

**TABLE D**  
Distribution of allowances over the employment groups (missing groups do not receive allowances)

Employment Group:	S. Teach.	Varsity	T.Inst.	Industry	C.Govt.	L.Govt.	Res.As.	S.Empl.	Hos.Sv.	Other	
<b>TAXABLE ALLOWANCES:</b>											
Car	0	0	0	3	1	1	0	0	0	0	No.
	—	—	—	4000	400	500	—	—	—	—	Mean
	—	—	—	3000	—	—	—	—	—	—	Min
	—	—	—	5000	—	—	—	—	—	—	Max
Telephone	0	0	0	4	2	0	1	0	0	0	No.
	—	—	—	198	123	—	144	—	—	—	Mean
	—	—	—	40	66	—	—	—	—	—	Min
	—	—	—	400	180	—	—	—	—	—	Max
House	0	1	0	2	0	0	0	0	0	0	No.
	—	1000	—	1040	—	—	—	—	—	—	Mean
	—	—	—	520	—	—	—	—	—	—	Min
	—	—	—	1560	—	—	—	—	—	—	Max
Guaranteed Overtime	0	0	0	1	0	0	0	0	0	1	No.
	—	—	—	500	—	—	—	—	—	2350	Mean
	—	—	—	—	—	—	—	—	—	—	Min
	—	—	—	—	—	—	—	—	—	—	Max
Insurance	0	0	0	2	0	0	1	0	0	0	No.
	—	—	—	85	—	—	180	—	—	—	Mean
	—	—	—	20	—	—	—	—	—	—	Min
	—	—	—	150	—	—	—	—	—	—	Max
Allowances	2	2	1	3	1	0	0	0	0	1	No.
	600	1050	1132	686	*	—	—	—	—	800	Mean
	200	100	—	200	—	—	—	—	—	—	Min
	1000	2000	—	1547	—	—	—	—	—	—	Max
Bonuses	0	0	0	19	0	5	0	1	0	0	No.
	—	—	—	1429	—	290	—	9000	—	—	Mean
	—	—	—	70	—	150	—	—	—	—	Min
	—	—	—	6000	—	450	—	—	—	—	Max
Other	0	2	1	1	1	0	0	1	0	0	No.
	—	550	740	66	400	—	—	2500	—	—	Mean
	—	100	—	—	—	—	—	—	—	—	Min
	—	1000	—	—	—	—	—	—	—	—	Max
<b>NON-TAXABLE ALLOWANCES:</b>											
Car	2	2	0	106	1	0	3	3	1	1	No.
	240	1427	—	2349	1000	—	1850	2000	*	3000	Mean
	180	354	—	11	—	—	900	1500	—	—	Min
	300	2500	—	5000	—	—	2800	2500	—	—	Max
Telephone	7	1	1	85	5	1	1	2	3	1	No.
	158	144	110	167	70	72	150	300	68	144	Mean
	100	—	—	50	50	—	—	200	15	—	Min
	288	—	—	500	90	—	—	400	143	—	Max
House	3	0	0	9	1	0	0	0	0	0	No.
	1250	—	—	1473	*	—	—	—	—	—	Mean
	1000	—	—	520	—	—	—	—	—	—	Min
	1500	—	—	3000	—	—	—	—	—	—	Max
Insurance	0	0	0	26 + 21†	0	0	1 + 2†	1 + 1†	0	1	No.
	—	—	—	145	—	—	200	250	—	68	Mean
	—	—	—	20	—	—	—	—	—	—	Min
	—	—	—	600	—	—	—	—	—	—	Max
Allowances	2	4	3	48	3	0	3	2	0	1	No.
	700	450	136	835	83	—	1683	800	—	500	Mean
	400	200	100	150	45	—	300	600	—	—	Min
	1000	1000	207	3000	120	—	4000	1000	—	—	Max
Bonuses	0	0	0	9	0	0	0	0	0	0	No.
	—	—	—	1491	—	—	—	—	—	—	Mean
	—	—	—	25	—	—	—	—	—	—	Min
	—	—	—	7000	—	—	—	—	—	—	Max
Other	6††	4	0	26	1	1	10	1	0	1	No.
	37	511	—	663	800	450	74	200	—	200	Mean
	15	100	—	33	—	—	49	—	—	—	Min
	140	1503	—	4000	—	—	250	—	—	—	Max
<b>NUMBER</b>	15	14	6	152	14	6	16	3	3	5	
<b>PERCENTAGE</b>	33	10	22	78	9	50	30	60	23	45	

**Footnotes for Table D:**

† Second Figure — number with superannuation excluded. See text.  
†† Allowances were mainly Tea and Married allowances.

**TABLE E**  
**Percentage of Employment Group Working Unpaid Overtime**

OVERTIME	School Teaching	University	Industry	Central Govt.	Research Assn.	Total
Nil	26.1	26.8	22.1	55.1	37.7	35.2
1-3	6.5	5.1	24.6	12.7	28.3	15.3
4-6	8.7	18.1	22.6	15.2	13.2	17.2
7-9	13.0	15.2	10.3	7.0	7.5	10.8
10-14	21.7	18.1	9.2	5.1	3.8	10.3
15 and over	13.0	13.0	9.2	3.2	3.8	7.8
Unspecified	10.7	3.6	2.0	1.9	5.7	3.3

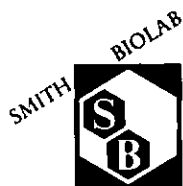
**TABLE F**  
**Age Group — Responsibility Level (Industry Only)**

AGE OF GROUP	Res. Level	1	2	3	4	5	6	Res. Level Independent
Up to 24	Number	0	0	0	0	0	0	0
	Salary	0	0	0	0	0	0	0
	Total	0	0	0	0	0	0	0
24-27	Number	4	7	3	7	0	0	21
	Salary	12550	12212	12963	13108	0	0	12682
	Total	14455	12447	13088	14802	0	0	13651
28-31	Number	6	1	6	10	14	1	38
	Salary	13883	12000	12930	16939	17557	18000	15949
	Total	15202	17144	15055	18674	21321	0	18486
32-35	Number	3	3	3	13	8	4	34
	Salary	16520	18800	12867	16422	19097	28625	18392
	Total	18547	21600	14113	17508	22392	33722	20918
36-39	Number	1	1	1	4	12	3	22
	Salary	8750	18300	11650	15976	19336	23300	18388
	Total	8750	22470	11650	17081	23102	28357	21364
40-45	Number	2	1	2	3	11	5	24
	Salary	18880	17400	17455	17384	19822	23662	19940
	Total	19170	21767	17455	19203	21995	32915	21916
46-50	Number	1	0	0	5	5	2	13
	Salary	19547	0	0	16350	25980	27000	21938
	Total	22247	0	0	17000	29306	30823	24263
51-55	Number	0	1	3	9	9	2	24
	Salary	0	12302	19886	16791	20635	37000	20117
	Total	0	12402	20936	17236	23468	41825	21883
56-60	Number	1	1	0	3	3	3	11
	Salary	13000	17250	0	17748	24145	26948	21525
	Total	13000	20250	0	17748	26628	28988	22671
61-65	Number	0	0	2	2	0	1	5
	Salary	0	0	19875	16875	0	32000	21100
	Total	0	0	21225	17625	0	34000	22340
66 +	Number	0	0	0	0	0	0	0
	Salary	0	0	0	0	0	0	0
	Total	0	0	0	0	0	0	0
Age Group Independent	Number	18	15	20	56	62	21	192
	Salary	14562	14609	15052	16260	19947	26741	18183
	Total	15989	16398	16188	17360	23148	32473	20314

# What's missing from this picture?

**Color!** We left it out on purpose to make a point. All of these products, indeed all food products, are inseparably bound in the consumer's mind with their appearance — primarily their color. This attribute — color — is probably the single most important factor in

judging the quality of agricultural products. Don't shortchange yourselves or your customers with guesswork. Call or write us now for a demonstration in your plant of one of the proven Gardner colorimeters. We'll work with you to help you get your products to market.



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WITH RESIDENT REPRESENTATIVES IN HAMILTON, PALMERSTON NORTH AND DUNEDIN.

15040C



# NZIC 1980 CONFERENCE

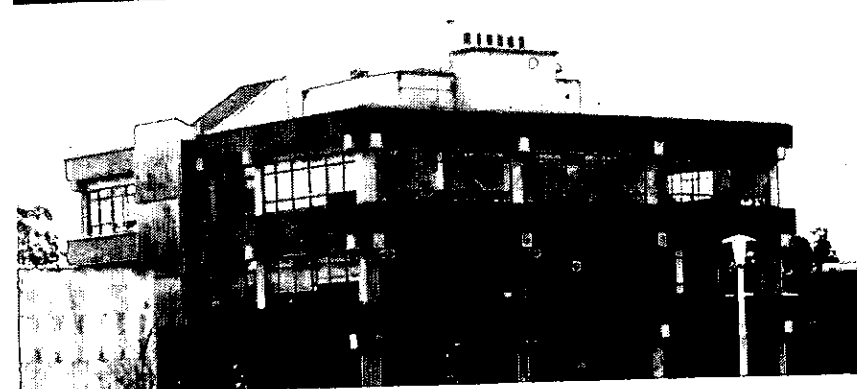
## MASSEY UNIVERSITY



### SPECIAL REPORT: CHEMISTRY'S ROLE IN MANAWATU BRANCH AREA

Some of the research establishments in the Branch area: (Top) Grasslands Division, DSIR; (Left centre) Plant Physiology Division, DSIR; (Right centre) Dairy Research Institute; (Bottom) Food Science & Technology Department, Massey University.

— Photos: Miss M.E. Soulsby, DSIR, Palmerston North.



Industries in the Branch area shown on Page 150 are (Top left) Wattie Canneries Ltd., Hastings; (Top centre) Hawkes Bay Farmers Meat Co. Ltd., Whakatu; (Top right) NZ Farmers Fertiliser Co. Ltd., New Plymouth; (Centre left) Natural Gas Corporation of NZ, Kapuni; (Centre right) Lactose Co of NZ Ltd., Kaponga; (Bottom left) New Plymouth power station; (Bottom right) Ivon Watkins-Dow Ltd., New Plymouth.

Photos: C.B. Johnson

# CHEMISTRY'S ROLE IN RESEARCH, INDUSTRY IN MANAWATU BRANCH AREA

This special report was compiled by our Manawatu Branch Editor, Dr Cecil B. Johnson.



Most people associate the Manawatu Branch of the Institute with Palmerston North and its immediate surrounding area. This, however, is a false picture of the Branch's territory which, according to Rule 23.1 of the Institute, includes "The Taranaki, Hawkes Bay and Gisborne Land Districts . . .". Within this area there is a wide diversity of industries primarily based on agricultural and horticultural production. The Hawkes Bay area is well known for its orchards and the related fruit and vegetable processing industries, while Taranaki is probably best known for its dairy products. Most leading export industries are represented here and it is now well known that major chemical engineering developments based on natural gas will be built in the Taranaki area.

Palmerston North, with its "triangle" of the Massey University Campus, Divisions of the Department of Scientific and Industrial Research (DSIR) and the Research Associations, is the focus for basic research. Research carried out by individual

industries is usually related to their product preparation and formulation and quality control measures. An important component in this work is the development of methods to increase efficiency of industrial production by either the use of new machinery or of new processes. Unfortunately, this may result in a non-compensating loss of employment opportunity in some currently labour-intensive industries.

#### Massey University

The following articles describe some of the chemical and biochemical research in four Departments at Massey University.

For many projects, particularly in the area of food science, there have been developed close links between these Departments and the appropriate Divisions of the DSIR. Both the Sheep Husbandry and Veterinary Science Departments are also involved in similar agricultural co-operative enterprises. Many projects are funded by grants and research contracts from DSIR, other Government agencies or from private enterprise sources.

## Department of Chemistry, Biochemistry & Biophysics, Massey University

G.G. Pritchard and I.D. Watson

The research activities of the Department of Chemistry, Biochemistry and Biophysics reflect two basic principles which have guided the development of the teaching programmes in the Science Faculty at Massey University since it was established in 1964. These were, firstly, that basic scientific training and research should be complementary to the programmes of the applied science faculties and the research institutions with their obvious emphasis on the particular needs of NZ industry. Secondly, the emphasis of the research and training programmes in physics and chemistry should have a strong biological orientation. From these principles and with the integration of the three disciplines of physics, chemistry and biochemistry within a single department, the development of collaborative research programmes and a multidisciplinary approach to a variety of problems has followed.

The dependence of NZ on protein-based exports underlines the need for training post-graduate students in the fields of protein chemistry and biochemistry. This is evident in the strong

emphasis on protein research in the department. Research on polyunsaturated fatty acid metabolism, on alcohol metabolism in humans, on environmental chemistry and heavy metal and trace element analysis, on nutritional biochemistry, the molecular structure of *Pinus radiata* cell walls, microbial toxins and the biochemistry of dairy microorganisms are other areas related to specific problems of current interest and importance to this country.

**Protein purification:** One very practical aspect of the protein research programme is the search for more effective methods in the large scale isolation of proteins from raw materials. This has resulted in the development by **Dr Ayers** and his group of improved ion-exchange and affinity chromatography resins.

**Protein Structure:** The analysis of protein structure involving primary sequence determination and crystallographic determination of the three-dimensional structure forms the basis for several major research programmes. One recent achievement by this group was the elucidation of the sequence and full three-dimensional structure of the proteolytic enzyme from Chinese gooseberries which has provided an understanding of the relationship of its structure and catalytic function. Considerable progress has been made by **Drs Midwinter, Moore** and **McIntosh** and their co-workers towards the determination of the primary sequence of the glycolytic enzyme phosphofructokinase. This ambitious undertaking could contribute significantly to an understanding of the molecular

basis for the regulatory role of this enzyme in carbohydrate metabolism.

The crystallography group (**Drs Baker, Rumball and Anderson**) is currently focussing its attention on two metallo-proteins — lactoferrin, an iron-binding protein from human milk, and azurin, a copper-containing electron transport protein from bacteria. Complementing the approach by this group is a study by **Drs Brodie and Ainscough** and their students on the role of metal ions in these proteins and in related organo-metallic model compounds. The three-dimensional structure of another very different class of proteins — the fibrous proteins, collagen from connective tissue and the actin-myosin complex of muscle is the subject of a research programme under **Dr Parry**. Other proteins under study in the department include coagulation factors (**Dr McIntosh**) and complement activation factors (**Dr Hardman**).

**Peptide synthesis:** A quite different approach to the study of protein structure-function relationships is being made by a group led by **Drs Hancock and Harding**. This involves chemical synthesis of peptides using an automated Merrifield synthesiser. This group is currently developing improved methods for peptide synthesis and is also assessing the value of High Pressure Liquid Chromatography techniques in both preparative and analytical aspects of peptide research.

**Enzyme kinetics:** Another important contribution to the programme on protein chemistry comes from a group engaged in the kinetic analysis of enzyme activity with

Chemistry in New Zealand

particular emphasis on fast processes using stopped-flow spectrophotometry. This group (including **Drs Buckley, Blackwell, Hardman, Crow** and their students) is at present directing attention primarily to a study of the enzyme aldehyde dehydrogenase from sheep and human liver tissues.

**Alcohol research:** The particular interest in the enzyme aldehyde dehydrogenase arises from the objectives of another research team in the department under the leadership of **Prof Batt** which is investigating the metabolism of alcohol in humans and in experimental animals. A detailed study of aldehyde dehydrogenase, which catalyses the metabolism of the toxic intermediate acetaldehyde formed during alcohol oxidation, constitutes one aspect of this group's programme. The programme includes a study by **Dr Kitson** of the mechanism of action of the drug disulfiram which is used in the treatment of chronic alcoholism. These *in vitro* studies are being complemented by two *in vivo* studies on various aspects of alcohol metabolism. **Dr Crow** and co-workers are carrying out studies using rats to determine the effects of very high alcohol doses on the rates of ethanol clearance while isolated rat hepatocytes are being used to study the effects of fructose on ethanol metabolism. **Drs Greenway and Couchman** and their students are engaged in a study of the effects of alcohol and other factors on the metabolism of steroid hormones and neuroamines in humans. **Mrs Watson** is studying the influence of total body water volume and total fat mass on blood alcohol concentrations in adult men and women. The group has also contributed to the assessment of techniques for the measurement of breath alcohol levels and has an on-going programme studying rates of alcohol clearance in groups of human volunteers.

**Physical Chemistry of Biological Systems:** A knowledge of the energy and entropy changes involved in interactions between protein molecules and solvents is of particular importance in understanding the behaviour of complex biochemical systems. Information about these interactions is being sought by a group comprising **Prof Malcom, Drs Hedwig, Watson** and **Kumaran** (a visiting worker) using microcalorimetry, dilatometry and manometry. The group is also studying the binding of metal ions to nucleotides.

A number of groups are involved in applying specific physical techniques to systems of biological interest. **Drs Jolley and Callaghan** are using pulse field gradient NMR spectroscopy to measure diffusion-coefficients of macromolecular solutions and liquid crystals. **Dr Pinder** and **Mr O'Driscoll** have constructed a laser light scattering device which is being used, among other things, to investigate the tertiary structure of proteins. **Dr Lewis** is carrying out studies on the transport properties of macromolecules (including  $\beta$ -casein) by ultracentrifugation techniques. He is also developing isotachopheric techniques. The mass-spectrometry unit under the direction of **Prof Hodges** houses an upgraded high resolution MS9 mass spectrometer. This is being used in the elucidation of the

## Chemistry's Role In Research

structure of a wide variety of organic compounds and also provides a national mass spectrometry service.

**Environmental Chemistry:** The biological orientation of research in the department is further exemplified in the studies of **Drs Brooks and Reeves** on the uptake and accumulation of heavy metals by plants. This group has identified and studied a range of plants with the unusual ability to accumulate very high concentrations of normally toxic heavy metals such as nickel, cobalt and copper. The group is also interested in the analytical and environmental chemistry of such potential pollutants as lead, mercury and arsenic.

**Lipid Research:** A long term programme by **Dr Hawke** and his students concerns two important aspects of lipid metabolism — the biosynthesis of polyunsaturated fatty acids and galactolipids in photosynthetic tissues and the metabolism of these lipids when ingested by ruminants. Current research on fatty acid biosynthesis is concerned with a key enzyme in this process — acetyl CoA carboxylase and also with oleate and linoleate desaturation. Ruminant studies have dealt with the lipolysis of plant lipids and the biohydrogenation of unsaturated fatty acids.

**Dr Husbands'** group is studying the metabolism of fatty acids, especially long chain polyunsaturated fatty acids in sheep and in rodents. They are investigating the effects of varying the diet on membrane properties using the red blood cell ghost as a model membrane system. They are also studying the interactions between serum lipoproteins and cell membranes.

**Nutritional Biochemistry:** **Dr Wilson** and her research students are investigating two different aspects of non-ruminant nutrition — the nutritional value of leaf protein concentrate for poultry and the development of methods for the separation and estimation of thiamine and its derivatives.

**Regulation of protein synthesis:** The research programme directed by **Dr Tweedie** on the regulation of protein synthesis provides opportunities for post-graduate training in this rapidly developing field of research. Since the most widely studied examples of eukaryotic protein synthesising systems have involved proteins which are secreted by the cell, **Dr Tweedie** and his students have focussed their attention on two enzymes localised in the cytosol of liver cells — fructose biophosphatase and ATP-citrate lyase. While the former enzyme has proved to be more amenable to analysis, the lyase is of potentially greater interest since its level in the cell is subject to control by the nutritional status of the animal. Current research is directed at overcoming practical problems in the study of this enzyme.

**Plant cell wall structure:** The molecular structure of primary cell walls of *Pinus radiata* tissues is being studied by **Dr Andrew** and his co-workers. The programme includes a quantitative analysis and partial structural

determination of the cell wall polysaccharides, the use of a range of extraction procedures to determine interpolysaccharide linkages and an assessment of the role of cell wall phenolic compounds and protein. The relevance of cell wall structure to growth and differentiation and to infection by the pine blight fungus is also being investigated.

**Microbial biochemistry:** Several different aspects of microbial metabolism are being studied in the department.

**Dr Chick** is engaged in a study of the biosynthesis of dothistromin, a polyketide-derived furanofuroanthraquinone toxin, produced by the pine-blight fungus. The structure of this compound was originally determined by the mass spectrometry group. Another project under the supervision of **Dr Chick** concerns the enzymology of the chryomonad alga *Ochromonas malhamensis* with a view to elucidating the control of the carbohydrate metabolism in this facultative autotroph.

Aspects of the basic biochemistry of two different groups of bacteria used for cheesemaking are being studied by **Dr Pritchard** and his research students. The regulatory properties of glycolytic enzymes such as lactate dehydrogenase, pyruvate kinase and phosphofructokinase of the lactic acid starter bacteria are being investigated. Another project is concerned with the mechanisms regulating carbohydrate metabolism in the Swiss cheese propionibacteria. The membrane-bound electron transport system of this latter group is also being studied with the aim of elucidating the bioenergetic mechanisms of these and other related anaerobic bacteria.

A comparison of the above summary of research in the department with similar summaries for the Applied Biochemistry Division and the Plant Physiology Division of the DSIR and of the Dairy Research Institute would reveal several areas of overlap and of mutual interest indicative of the close interrelationship between the university and the research institutions. As well as the direct government financial support channelled through the University Grants Committee, the department has received substantial support from the Medical Research Council, the National Heart Foundation, Tasman Vaccine Laboratories, the Development Finance Corporation and research contracts with the Forest Research Institute.

## Biotechnology Department, Massey University

I.S. Maddox

The central theme of research within the department is the processing of biological raw materials, with the joint aims of improving existing processes and the development of processes for new

## Chemistry's Role In Research

products from existing raw materials. Most of the research is essentially "applied" rather than "fundamental", although the latter is often required to provide a full understanding of a process. Invariably, research activities are concerned with the NZ context and collaboration with local industry is common.

One recent successful project in association with a local company was the utilisation of gall, a by-product of the meat industry. A process was developed to produce the free bile acids, cholic acid and deoxycholic acid, which are exported as starting materials for the synthesis of corticosteroids. Research in this area has continued with the aim of developing a microbial fermentation process for further transformation of the bile acids to higher-value products. In the same context of microbial steroid transformations, cholesterol is being investigated as a potentially valuable raw material for the steroid industry. This sterol can be obtained from beef spinal cords and brains, and present research is directed at both improving extraction methods and developing a microbial process for conversion into higher-value products. The latter are particularly useful in the synthesis of steroidal contraceptive agents.



Dr Ian Maddox

One biological process which has often been neglected in the past is the treatment of municipal and industrial wastes. Process design characteristics of various industrial effluents are currently being developed and novel fermentation technology is being investigated for the treatment of certain high-strength effluents. Whey from the dairy industry is an example of such an effluent, and anaerobic filtration is one approach being studied. This process has the advantage of coping with a high liquid throughput, and its application to production of ethanol from whey is also being investigated, ethanol having a potential use as an automobile fuel. Fluidised bed reactors and immobilised cell technology are also being evaluated as novel fermentation processes for ethanol production. Such processes should provide reduced capital costs and increased production rates.

Whey is potentially a valuable raw material for several fermentation products. In addition to ethanol, processes are being investigated for the production of n-butanol and citric acid. The former has a potential use in methanol-gasoline fuels to prevent phase separation, while the latter is widely used as an acidulant in the food industry. At present, both chemicals are imported.

Methane represents another fuel which can readily be produced from waste materials by a process of anaerobic digestion. Research into the inhibitory effect of carbon dioxide on this process is currently being carried out, as is the operation of an anaerobic digester in such a manner as to produce volatile fatty acids rather than methane. These acids can subsequently be reacted chemically to form diesel fuel replacement.

As evident from the above, departmental interests lie in energy production. However, research into energy use and conservation can provide more immediate cost savings in several industries. Recently, a survey was carried out by the department to ascertain the rates of energy use for various manufactured food products. This has uncovered some processes which are particularly inefficient users of energy and improvements to these processes are now being investigated.

The meat industry represents an important area of biotechnology and research here is directed at both process and product design. Currently being investigated are the functional characteristics of different known proteins in comminuted meat systems. Once these characteristics are known manufacturing processes can be modified

accordingly to ensure a standard product. Similarly, control factors for frozen cooked beef cuts, and the properties of dried and fermented sausages are being studied, as well as a study of heat transfer during the freezing and thawing of foods.

A problem that is often encountered with products of biological origin is microbial spoilage. Some products are easily preserved by e.g. freezing, but others are more difficult. Semi-processed wool skins for export to Europe provide such an example and are generally treated with salt and other chemicals to prevent microbial spoilage. However, occasional problems still occur and the organisms involved are presently being studied in an attempt to solve the problem. Similarly, survival of salmonellae in salted meat products is receiving attention.

The research interests described here may seem diverse, but the central theme should be apparent. Essentially, biological raw materials are produced by agriculture and undergo some processing prior to export. Process design and operation are important in reducing costs and maintaining quality. For NZ industry to remain competitive research into these areas must be a continuing process. The use of materials that are currently being wasted will provide new products and efficient technologies must be developed in these areas. The next decade will no doubt see increased research into these technologies, particularly in the fermentation field.

## Department of Food Technology, Massey University

E.L. Richards

Food Technology may be defined as the application of the sciences and engineering to food manufacture and preservation. The training of a Food Technologist is therefore multidisciplinary and demands a solid base of chemistry, biochemistry, microbiology, physics, mathematics and engineering on which to build the applied studies of food processing and related technology. Chemistry and biochemistry are therefore essential and very important components of the courses for the first 3 years of the 4-year B.Tech. (Food Tech.) degree. Papers in these fields in the first 2 years are taught in the Department of Chemistry, Biochemistry and Biophysics but the Department of Food Technology is responsible for Food Chemistry III and Applied Chemistry III in the Third Examination. The aim of Food Chemistry is to make the student familiar with the chemical, physical and functional properties of food constituents and ingredients. This includes the macronutrients (carbohydrates, lipids and proteins), the micronutrients (vitamins and minerals) and also compounds responsible for the colour and flavour of foods. These latter cover a wide spectrum of organic chemistry and include terpenes, carotenoids, phenolics and heterocyclics. As well as chemical properties the paper aims to give an understanding of the chemical and biochemical changes which occur during processing and storage and which influence food quality by changing

flavour, colour, texture and nutritive value. The paper in Applied Chemistry is concerned with the instrumental analysis of biological systems and with the physical chemistry of gels, foams and emulsions, crystallisation and macro molecules in solution.



Prof Ted Richards

The Food Technology Department is also responsible for teaching Dairy Chemistry for both the Faculty Diploma in Dairy Technology and the post-graduate Diploma in Dairy Science and Technology.

In addition to the teaching responsibility the Department is involved in a wide range of research activities. Among these are many projects which are chemical in nature, and these include:

• **Starch Gelatinisation:** The pastes formed on heating an aqueous suspension of starch granules may be used to regulate the texture of foodstuffs. In many cases starches derived from NZ wheat varieties do not perform this function as effectively as starches derived from other wheat sources. A detailed

Chemistry in New Zealand

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investigation of the pasting of wheat starch is being performed. Viscoelastic behaviour is being studied by evaluating the dynamic shear stress response to small amplitude oscillations using a coaxial viscometer. In addition a joint project is being carried out with the Chemistry Department in which NMR is being used to study starch-water inter-relationships.

• **Flavours From Non-Enzymatic Browning Reactions:** Amadori compounds (l-amino-l-deoxyketoses) are important intermediates in non-enzymatic browning reactions. On degradation these compounds produce volatiles which contribute to the flavour of thermally processed foods. In this Department the pyrolysis of Amadori compounds is being studied by using GLC-mass spectrometry

to identify volatiles formed and thermal analysis to study the kinetics of pyrolysis. Radioactive-tracer studies have been used to study reaction pathways.

• **Wine And Fruit Juice Chemistry:**

(a) The chemical and physical changes, particularly colour changes, occurring during extraction, fermentation, clarification and ageing of grape and apple wines.

(b) The role of pectic substances and pectic enzymes in the extraction of juice from grapes and in subsequent processing operations.

(c) The solubility relationships of limonin, the bitter principle in NZ grapefruit juice.

• **Effect Of Processing On The Nutritive Value Of Foods:** The kinetics of vitamin destruction in food processing is being studied. The information obtained will be used to predict losses during different methods of heat processing and so aid in the design of improved food processes. Initially the losses of vitamins A, C and riboflavin in a number of basic foods during heat processing under controlled conditions are being determined.

## Department of Soil Science, Massey University

R.W. Tillman, J.K. Syers and M.A. Turner

The Department of Soil Science has had a long involvement in applying chemistry to soil systems. Some current work is briefly reviewed below.

**Use of Radioactive and Stable Isotopes as Tracers:** The use of isotopes is now well established and the Department of Soil Science has ready access to a wide range of detection equipment which enables it to use both stable and radioactive isotopic tracers.

Three current areas of interest are:

(a) **Determination of the depth of the soil from which plants obtain their nutrient supplies:** This will differ depending on plant and soil type and may also be affected by management practice, e.g. drainage.

The depth of rooting and nutrient uptake is gauged by implanting solutions labelled with one or more isotopes at differing depths within the soil profile. The uptake from the respective depths is obtained from the levels of isotope measured in the plant leaves some time later.

Present work is restricted to the use of the radioactive isotopes of phosphorus ( $^{32}\text{P}$ ) and sulphur ( $^{35}\text{S}$ ).

(b) **Characterisation of the plant-available phosphorus pool in soils:** At any given moment in time, the rate of phosphorus uptake by a plant root is dependent upon the concentration of phosphorus in the soil solution. Although this concentration is obviously an important parameter it is very difficult to measure *in situ*. Attempts have been made, with varying degrees of success, to find a chemical extractant which will extract this immediately plant-available pool of phosphorus.

Work in this department has used two radioactive isotopes of phosphorus ( $^{32}\text{P}$  and  $^{33}\text{P}$ ) to differentially label the various pools of soil phosphorus. Growing plants have then been placed in contact with this labelled soil and the isotope ratio obtained in the plant compared to that in various chemical extractants. The chemical extractant

with the isotope ratio nearest that in the plant should be the one which most closely mirrors the plant-available pool. This technique can also be used to determine whether different plant species obtain their supplies of phosphorus from different soil pools.

(c) **Transformations of soil organic matter:** The radioactive isotopes of phosphorus and sulphur and the stable isotope of nitrogen ( $^{15}\text{N}$ ) are being used to monitor the transformations of soil organic matter. These transformations, which in large part govern the supply of nutrients to the plant, are extremely complex and being microbial in origin are not readily amenable to conventional chemical techniques of investigation. Isotopic tracers present one of the few opportunities to obtain quantitative information on these transformations.

**Use of Electroultrafiltration to Characterise the Nutrient-Supplying Power of Soils:** Large quantities of many important plant nutrients are often held in an adsorbed form on the surfaces of soil colloids. These adsorbed nutrients are in equilibrium with the soil solution from which they are taken up by plants. The "tightness" of this adsorption and the ease with which nutrients can be desorbed when the concentration in the soil solution is decreased are important soil parameters.

West German researchers have applied the principles of electrodialysis to this

problem and have developed an instrument designed to strip adsorbed ions from a soil surface by the application of an electrical potential. The process has been termed electroultrafiltration.

One of these instruments is currently being evaluated in the Department of Soil Science. Emphasis is being placed on the tightness of binding of the various pools of soil potassium, magnesium and sodium.

**Mechanisms of Anion and Cation Adsorption by Soils and Soil Components:** Adsorption of many chemical species in soils appears to occur by mechanisms other than a simple electrostatic attraction to a charged surface. The mechanisms of this so called "specific adsorption" are currently being investigated in the department of Soil Science. Emphasis is being placed on the anions sulphate and phosphate, and the cations cadmium and zinc.

Techniques used in these investigations include:

- The use of automatic pH titrimeters to monitor  $\text{OH}^-$  or  $\text{H}^+$  release during adsorption.
- The measurement of changes in surface charge brought about by progressively increasing surface coverage.
- The use of isotopes to measure changes in both long- and short-term exchangeability at varying degrees of surface coverage.

The Department of Soil Science is well equipped to apply a range of chemical techniques to studies of the soil system and its role in primary production in NZ.

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# CHEMISTRY'S ROLE IN GOVERNMENT AGENCY RESEARCH

Department of Scientific and Industrial Research

Palmerston North is the headquarters of the Applied Biochemistry (ABD), Grasslands and Plant Physiology (PPD) Divisions of the DSIR. Other Divisions with substations here include Applied Mathematics, Crop Research, Entomology, Physics and Engineering Laboratory, Plant Diseases and Soil Bureau. Research Associations in Palmerston North, serving the corresponding manufacturing industries, are the NZ Dairy Research Institute (DRI) and the NZ Leather and Shoe Research Association (Inc.).

## Applied Biochemistry Division, DSIR

C.B. Johnson and staff of the Division

Research in ABD involves the application of biochemistry, organic chemistry, microbiology, animal physiology and animal nutrition to aspects of plant-animal interactions. This basic research is primarily for agricultural industries, but an increasing amount of work is being done for other industries such as fisheries, horticulture and food processing. While some investigations are relevant to plant production, the main areas of research are concerned with plant composition — plants such as animal foods and both plants and animals as human foods. In this article some examples of the Division's chemical and biochemical research will be described.

### Nitrogen Fixation

The fixation of nitrogen by bacteria of the genus *Rhizobium* in root nodules of legumes is a unique example of intimate symbiosis. This process is of considerable importance to the NZ agricultural economy, as the use of legumes in horticultural and pastoral farming greatly reduces the requirement for nitrogenous fertilisers, which are expensive in terms of energy and overseas funds. Nodule formation involves infection of the root tissue by *Rhizobium* bacteria (which are present in most soils) followed by considerable differentiation by both plant and bacterial cells to form the nodule structure with its nitrogen-fixing bacteroids. Studies at ABD are aimed at understanding the process of infection and legume nodule development at both the biochemical and genetic levels. The areas of specific research relate to the interaction between *Rhizobia* and plant membrane and cell wall constituents and to enzymology of the processes which influence the flow of metabolites through legume nodules.

Electron microscopy is used to investigate the morphogenesis of legume root nodules and the ultrastructure of rhizobial bacteroids. These studies are aimed at a better understanding of the legume-bacteroid interactions and the taxonomy of the genus *Rhizobium*. The Division maintains a large collection of *Rhizobia* strains isolated from a variety of pasture and crop legumes which provides

Applied Biochemistry Division is primarily concerned with in-depth research on various aspects of interactions between plants and micro-organisms, insects or animals. Research at Grasslands Division is directed to increase knowledge of the interactions of soils, plants and animals in various NZ climatic and geographic situations and, through this knowledge, to improve the plant materials and management techniques available to pastoral farmers. Plant Physiology Division carries out research on the physiology of adaptation of plants to the NZ climate. This Division is responsible for running the Climate Laboratory, which consists of 24 controlled-environment rooms, as a national research facility available to scientists in all NZ research institutions.

the background for the investigation of symbiotic bacteria-plant interactions. Close contact is maintained with other groups working on nitrogen fixation, with some studies being carried out under contract in the universities.

### Non-Nutritional Plant Components

Many natural plant products within plants affect the feeding behaviour of phytophagous insects. Some of these substances are toxins and quite general in their effects while others act as feeding deterrents inhibiting the feeding of specific groups of insects. Still others act as attractants or stimulants encouraging particular insects to feed on a particular plant. Information is being gained by a group of researchers in the Division on the chemical factors influencing plant resistance towards insect predation to help in the development of resistant plants leading to new strategies of insect control. In addition, characterisation of insect toxins gives information on new structural types of compounds that may be suitable for insecticide development.

Apart from the pasture situation, the native flora offers much scope for plant-insect studies as over 60% of NZ insects are restricted to plants of one genus or species, indicating the existence of chemical barriers to non-adapted insects. A study of some *Podocarpus* species has given a series of novel diterpene lactones with insect toxicity down to 1 ppm. Also, some native ferns and some *Podocarpus* species are rich sources of phytoecdysones, compounds with insect moulting hormone activity, and they provide a range of chemicals for study of the chemistry and biochemistry of insect moulting. An understanding of these processes and the effects of phytoecdysones may allow new approaches to insect control and give insights into the ecological significance of these natural products. Co-operative research in this area is being carried out with researchers in Entomology Division.

Phenolic natural products are of biological importance and may confer disease and insect resistance in plants and affect nodulation of legume roots. It is considered desirable to gain a more complete picture of the occurrence and biological effects of legume isoflavonoids particularly the isoflavan vestitol in order to develop resistant white clovers.

Plant tannins are condensed phenolics. They have been shown to aid protein nutrition of ruminants by preventing

protein digestion in the rumen and to control the effects of the physiological disorder known as bloat by preventing protein-stabilised foaming of rumen contents. The Division is concerned to establish the usefulness of tannin-containing forages from the way they improve digestion in the grazing ruminant and how they affect symbiotic nitrogen fixation.

Solasodine, a steroidal alkaloid produced in certain native solanum species, is of importance as a base for making hormone drugs. Factors affecting the synthesis and breakdown of solasodine have been studied here. Present work in this area includes an investigation of possible alkaloid transport between the shoot and root in Solanum/tomato grafts, the identification of possible new steroid metabolites in roots and older leaves of solanum plants and aspects of the nutrient element requirements of *Solanum aviculare*.

### Food And Its Production

A diverse array of investigations into many aspects of food chemistry and biochemistry are being undertaken by the Division. These include the keeping and processing quality of some neglected major vegetable crops such as pumpkins and onions, the aroma of some subtropical fruit and of essential oils and the isolation of the proteolytic enzyme actinidin from kiwifruit. More effective methods are being developed for measuring plant carbohydrate polymers, in particular the structural carbohydrate pectin which may be related to quality aspects of some vegetables. The effect of plant fibre (a complex mixture of carbohydrates that is slowly or poorly digested) on the absorption of food components is a research area that is being re-developed.

Proteins and lipids, representing two of the main essential human and animal nutrients, are major products of our farming industry. The effects of diet on the composition of tissue-free amino acids and on lipid biosynthesis are being studied. Although these amino acids are usually incorporated into proteins, the possibility that their carbon chains may be incorporated into lipids also is being investigated.

Overfatness is currently one of the major problems associated with the production and sales overseas of NZ sheepmeats. The aim of the research in this area at ABD is to understand the

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## Chemistry's Role In Research

mechanisms controlling the process of lipid (and protein) deposition and adipose depot development in sheep. This involves research on the rate of lipid synthesis, lipid storage and enzyme activity. Tissue culture procedures are being developed.

Related to this work, are the detailed analyses of ovine adipose tissues for which a comprehensive coherent method of analysis for a wide range of fatty acids is being developed. This involves both quantitative measurement of medium chain length (C<sub>6</sub> to C<sub>9</sub>) fatty acids, some of which have been shown to be important characteristic ovine flavour constituents and present in the ppm range, and a detailed analysis of longer chain acids with particular reference to the location of double bonds in unsaturated components. This involves the use of modern methods of reverse phase liquid chromatography of fatty esters together with the gas chromatographic separation and mass spectrometric analysis of suitable derivatives and of chemical fragmentation products. The use of capillary gas chromatography-mass spectrometry is an important analytical tool for this work and for the above-mentioned aroma studies. Work in this area will be assisted by the Division's satellite link to the Telenet Global Network for accessing mass spectral data from the Chemical Information System.

The health and productivity of animals is related to their intake of minerals as well as organic nutrients. Minerals may be obtained either directly from the ingestion of soil by grazing animals or from plant material. Thus, the uptake by plants of minerals, such as calcium, magnesium and sodium, is important for adequate nutrition of grazing animals. Studies are underway to find how the accumulation of mineral elements is controlled and how it is related to the nutrition of plants.

Although the problems of mineral deficiencies in grazing ruminants in NZ are recognised, their physiological and biochemical functions are not completely understood. In addition, the mineral requirements of ruminants for the various physiological functions are in many instances poorly defined, and many of the dietary and animal factors affecting the absorption and availability of macro and micro elements are not known. Present investigations involve the use of isotopes in balance and slaughter studies in order to determine quantitatively the pathways of the absorption, storage, transport and excretion of minerals. It is hoped to provide a better understanding of the factors associated and thus determine

more precisely the mineral requirements for maintenance, growth, pregnancy and lactation.

ABD has for a long time had a strong interest in evaluating the nutritional characteristics of the herbage species grown in NZ. The work ranges from simple grazing trials to detailed studies of digestion. These include feed composition analyses together with studies on the physical and fermentative breakdown of food taking place in the rumen. Many of these investigations and those involving the measurement of salivary flow rates and protein composition of saliva are undertaken to determine factors affecting bloat susceptibility of cattle. Another area of study involves the role of the microbial population of the rumen in food breakdown and changes in this population with changes in the diet of the animal. An important recent finding was that of the presence of anaerobic hypomycetous fungi in the rumen contents of cattle and sheep. These organisms could be of more significance than previously thought in the digestion of lignocellulose.

### Grasslands Division, DSIR

Most of the chemistry in the Division involves applying existing chemical principles to agricultural research. Analyses of the major and, to a lesser extent, the minor nutrients in plant, soil and water samples provide basic information for research in the general areas of plant nutrition, nutrient cycling, soil fertility, plant breeding and other agronomic research carried out at Grasslands, Palmerston North, and the Division's 6 Regional Stations.

A range of analyses are carried out routinely for the Division's scientists and principal analyses include: plant and soil Kjeldahl nitrogen, total phosphorus, specialised soil phosphorus and potassium extraction tests, total magnesium, calcium, nitrate, nitrite, sulphur in plants and soils, soil carbon, organic matter in soils and of course soil pH.

The majority of the analyses are colorimetric determinations and 6 continuous flow auto analyser channels connected to flow colorimeters are available. In addition the laboratory is equipped with 4 continuous-flow flame photometer channels for sodium, potassium and calcium analyses and an atomic absorption spectrometer for the analysis of other cations pertinent to the work carried out in the division.

In the Division's programme on the nitrogen cycle in pastoral agriculture, acetylene, ethylene and hydrogen gases are analysed by GLC during measurements of nitrogen fixation. The GLC is also used for measurement of nitrogen

oxide fumes from soils and CO<sub>2</sub> production during soil respiration experiments. Nitrate and ammonia in the soil solution are measured in several soil organic matter studies.

In studies on the physiology of ion transport and uptake in plants the activities of potassium ions and hydrogen ions in plant cells are measured using ion-specific and pH microelectrodes.

Other projects involving chemistry include:

- determination of soluble carbohydrate levels in plants to provide input data for

a model of plant growth

- measurement of the nutritive values of herbage by assessing its digestibility using an enzymic solubilisation of dried plant material
- diffusion of phosphate in soils
- measurement of phosphorus fractions in plants
- nitrogen transformation in the soil and subsequent loss from urine patches
- gel-electrophoresis analysis of plant proteins in biochemical genetic studies
- isolation and biochemical characterisation of mutants in energy pathways in rhizobia.

### Plant Physiology Division, DSIR

P.G. Roughan and staff of the Division

#### W.A. Laing and J. Christeller

Productivity of many plant species is demonstrably limited by the biochemical process termed "photorespiration". This photorespiration is now attributed to an oxygenase activity of ribulose biphosphate carboxylase, a key enzyme in photosynthetic CO<sub>2</sub> fixation. Past research has provided an understanding of the changes in the activity state of the enzyme modulated by substrates, co-factors, pH and chloroplast metabolites. This had also led to the development of valid methods of assay for both activities of the enzyme. Current studies are aimed toward an understanding of the catalytic mechanisms of both reactions using physical, chemical and kinetic techniques. It has recently been shown at PPD that the kinetic parameters are altered by the nature of the divalent cation present and these species are now providing a useful probe for studying enzyme action.

Other biochemical investigations include the regulating function of light activated, photosynthetic enzymes, carbohydrate metabolism in legume nodules and nitrogen isotope discrimination by plants.

#### P.G. Roughan and C.R. Slack

Failure to grow at temperatures lower than 12-15°C is characteristic of many plant species that are of economic benefit to NZ agriculture. This chilling sensitivity is currently attributed to the phase-separation of lipid components of cell membranes with subsequent impairment of normal membrane function. Unsaturated fatty acids are thought to be the primary determinants influencing this phase-separation behaviour, so that the greater the degree of unsaturation of the membrane lipids, the lower the temperature at which phase separation occurs. Studies at PPD on the biochemistry of polyunsaturated fatty

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acid biosynthesis in plants are aimed at arriving at an understanding of how the lipid composition of biological membranes may be controlled.

Results to date indicate that while chloroplasts are the sole sites of palmitate and oleate synthesis *de novo*, further processing of three long-chain fatty acids occurs primarily in the endoplasmic reticulum. Oleate is desaturated to linoleate only after the former has been incorporated into phosphatidylcholine of the endoplasmic reticulum and further desaturation of linoleate to linolenate probably occurs only after the diacylglycerol moiety of phosphatidylcholine has been transferred to diacylgalactosylglycerol of the chloroplast envelope.

Fatty acid synthesis *de novo* by isolated spinach chloroplasts appears to be controlled in part by the rates of removal or utilisation of the immediate products of the fatty acid synthetase, oleoyl- and palmitoyl-ACP. A new model describing polyunsaturated fatty acid biosynthesis in relation to plant lipid metabolism has recently been published in the *Biochemical Journal* (Vol. 188, pp. 17-24, 1980).

**C.R. Slack and P.G. Roughan**

The proportions of the different unsaturated C<sub>18</sub> fatty acids in the oil seed triacylglycerols of different crops are

species specific but can be modified by the temperature regime during seed maturation. Part of the plant lipid research at PPD has been aimed at understanding the mechanisms of C<sub>18</sub> fatty acid desaturation, the route of incorporation of these fatty acids, oleate, linoleate, and linolenate, into triacylglycerol and the control processes that regulate the fatty acid composition of this lipid. Results to date from *in vivo* labelling experiments with [<sup>14</sup>C] acetate and [<sup>3</sup>H] glycerol, *in vitro* enzyme studies, and an examination of the short term effects of temperature on the fatty acid composition of specific lipids implicate phosphatidylcholine as a key intermediate in the desaturation of oleate to linoleate, as a source of polyunsaturated diacylglycerols for triacylglycerol synthesis. The relative rate of incorporation of oleate into phosphatidylcholine and of oleoyl phosphatidylcholine desaturation could regulate the proportions of the different unsaturated C<sub>18</sub> fatty acids in triacylglycerol.

Phosphatidylcholine synthesis and oleate desaturation appear to be restricted to the endoplasmic reticulum, while triacylglycerols accumulate in specialised organelles — the oil bodies. Currently, studies are being made of the possible mechanism of lipid transfer between organelles of the membrane properties and synthetic capabilities of

the oil bodies.

**W.D. Sutton and B.D. Shaw**

Research into the metabolism of legume root nodules at PPD has centred on the interactions between the plant host and bacterial symbiont. In contrast to broth-cultured rhizobia, the organisms recovered from nodules have low viability and are sensitive to both osmotic shock and mild detergents. This is attributed to a change in the structure of the bacterial cell wall and is controlled by the plant host: the mechanism is not yet known.

Studies with detached nodules showed that inhibitors selective for either plant or bacterial protein synthesis reduced the incorporation of [<sup>35</sup>S] methionine into rhizobial proteins and prevented the normal development of nitrogenase activity. Rhizobia isolated from nodules by zone sedimentation through sucrose gradients incorporated [<sup>35</sup>S] methionine into a reproducible pattern of proteins including major components with similar electrophoretic mobilities to nitrogenase sub-units.

In detached nodules, energy for nitrogen fixation appears to be mainly derived from the catabolism of sugar via the Embden-Meyerhoff pathway which is localised predominantly in the plant cytoplasm rather than in the nodule rhizobia. Nodules actively fix CO<sub>2</sub> via phosphoenolpyruvate carboxy-lase and this provides a major source of oxaloacetate which is used as a carbon skeleton for amino acid synthesis.

## Dairy Research Institute

**L.K. Creamer**

The NZ Dairy Research Institute (DRI) is the principal research organisation of the export sector of our dairy industry. It was set up in 1927 to help the rapidly expanding industry cope with quality problems being experienced with our two dairy export products, rinded Cheddar cheese and salted, sweet-cream butter. From this beginning it survived the depression, and made major contributions to the war effort on the food front. Subsequently it assisted the industry to cope with post-war expansion and the product diversification forced on the

industry in the 1960's by the threat of Britain — virtually our only market at that time — joining the EEC. This threat also "encouraged" the industry to take advantage of every possible method of economising and the DRI was involved in many important developments. Since Britain joined the EEC, the industry has had to rely more and more on non-British markets for the sale of its dairy products, and much success has attended the DRI efforts to help the industry diversify its products and markets.

In essence the DRI is organised around

*Dr Laurie Creamer*



the major product groups: cheese, butter and other milkfat products, milk powder, casein and related products and whey products. These sections are supported by multi-product research sections, such as the New Uses Section, the Protein Section and the Biochemistry Section. In addition there are servicing sections such as the Library, the Analytical Chemistry, the General Microbiology and Information Sections, and quite extensive maintenance and development workshops. The product-orientated sections each have a portion of the Processing Hall for larger scale experimentation as well as the usual laboratory and office space. There is also a considerable number of industry trials so that projects can be tackled on the lab. bench, in the Processing Hall or out on the processing floor of the dairy company.

The first effect of the necessity for diversification was to produce skim milk powder and anhydrous milkfat which were sold into South-East Asia to be recombined into products such as milk, evaporated milk and sweetened condensed milk. More recently, whole milk powders have been developed for a similar purpose.



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Cheeses other than Cheddar were investigated and there are now substantial quantities of many varieties exported, including Egmont, a variety especially developed in NZ primarily for the Japanese market.

The advent of tanker collection of milk made casein-making a profitable alternative to pig-feeding and NZ casein and casein products now dominate the world market. In USA there are over 500 food products that include casein or caseinate. These range from 'artificial' Mozzarella cheese through 'instant breakfast' to coffee whiteners or creamers.

The isolation of whey proteins by heat coagulation or ultrafiltration of casein or cheese whey has been developed recently and promises to be an important development.

In many instances the DRI is involved in the improvement in efficiency of a particular process; for example it has developed the system of mechanised cheesemaking used almost universally in NZ and in many overseas factories as well. The development of systems for starter handling (starter is the bacterial culture added to milk to develop the acidity needed in cheesemaking) and more recently the production of frozen starter cultures has also been undertaken.

The development of new products is one of the most important of the DRI functions, but now attention is being directed to one of the industry's current and growing problems: the economic

disposal of whey. This fluid material is the major by-product of the cheese and casein industries and in the days of the small cheese factory it was put into the local creek. With the growth in factory size consequent on the introduction of milk tankering and the use of skim milk for casein-making, the local creek could not cope. In pollutant terms the major element in whey is lactose, a galactosyl-glucose, which is not especially soluble (15%) nor very sweet. These properties limit its value and there is a considerable effort being expended in estimating the potential for lactose hydrolysis, fermentation to fuel alcohol, fermentation to methane, growth of single cell biomass for animal feed, etc.

### NZ Leather And Shoe Research Association

Tony Passman

LASRA is concerned with research and control aspects relating to animal husbandry, raw hide and skin preservation, hide and skin preparation for export in the pickled or part processed condition, tannery operations to the finished leather and final product performance.

The work programme is approved annually by industrial representatives on three technical committees and the intention is to provide relevant activities for as great a part of this varied membership as possible.

The Association is evaluating stock breeds in terms of their leather making qualities and works in conjunction with the agricultural research establishments to secure supplies of skins. Recent work has demonstrated the marked influence of feed regime on leather area yield and quality and particular breeds of sheep were found to be unsuitable for wooskin production, an important export orientated industry in NZ.

Traditional methods of producing pickled pelts from lambskins are being questioned and LASRA is examining the relative importance of the current manufacturing stages and evaluating newly introduced processing vessels. A chemical depilatory system devised by the Association is being assessed in the works situation where improved wool quality has been revealed together with marked reductions in effluent loading. A system of directly using ovine pancreas glands in pelt production has obviated the need to buy proprietary enzyme preparations and one large NZ company has adopted the technique.

In work related to wooskin tanning, possible aluminium based replacements for the chrome salts currently relied on for collagen crosslinking are being investigated. Chromium is a finite and

politically sensitive resource and has particular disadvantages where wool whiteness is concerned. Selected oxazolidine compounds are being tested as wool lustring/decrimping agents to overcome toxicity and durability limitations in the present day methods; the major concern is to produce a wool treated so that it will recover its spring after being compressed during shipment overseas. Means have been developed for treating tannery wastes and in some centres local authorities will deal with such trade effluents. Costs of treatment are however high and the Association is working on methods for reducing effluent loads by greater recycling and re-use. A project is underway which will evaluate the feasibility of screening out the partly digested keratin material removed from hides during the early processing stages. Once recovered efficiently and economically, uses for this protein byproduct will be sought.

Tony Passman



On the leather products front, LASRA is investigating methods of making lamb suede more resistant to colour transfer in wear without adversely affecting the leather quality. This problem, called "crocking", has been cited as an important restriction on the increased export of NZ manufactured suede garments.

As far as footwear is concerned, current emphasis is being placed on adhesion of solings to uppers and the influence of chemicals used in the leather making procedures will be one of the factors to be investigated. In particular the influence of oils used to soften the leather will be appraised in relation to the adhesive systems being used in the footwear industry.

LASRA monitors components used in footwear for their relative and absolute properties and at present non-leather linings, laminated ovine leather linings

and laces are being evaluated by means of specific bench tests and wear trials.

Although relatively little fundamental research work is undertaken by LASRA, the Association is engaged in SEM\* and TEM† studies into the origin and properties of the thermal coating, the material overlaying the grain layer of leather known to tanners as the "enamel". This "enamel" coating has a marked influence on the aesthetic properties of the finished leather.

The Association is actively concerned with the writing and promotion of standards and specifications for its industries and much effort is being directed to this area. Current areas of activity are safety footwear standards and pelt packaging for export.

\* Scanning Electron Microscope

† Transmitting Electron Microscope

### NEW ANALABS CATALOGUE

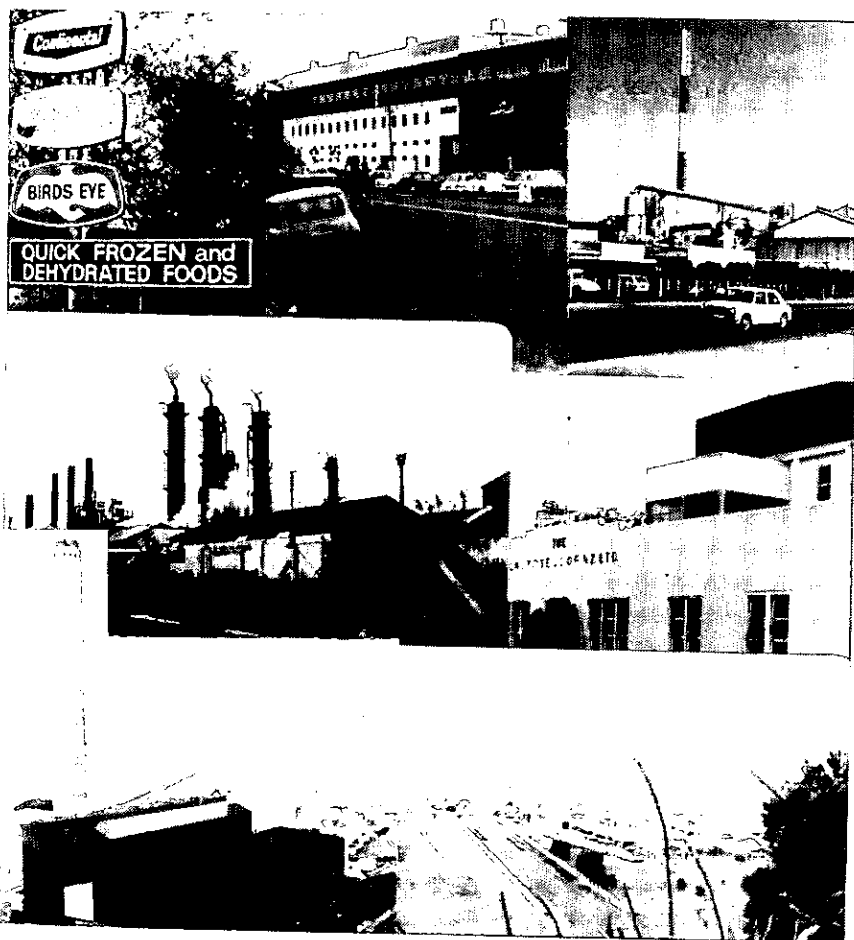
The most comprehensive line of aids for use in the control of all areas of environmental pollution is featured in the catalogue recently published by Analabs, a unit of Foxboro Analytical.

The new 31-page catalogue lists the complete line of Analabs tools, methodology and latest techniques for collecting, isolating, detecting, identifying and quantitating environmental samples. The updated reference standards lists include new offerings of suspect agents containing amino and nitro groups. Included are compounds currently regulated by OSHA as carcinogens, those recommended by the Interagency Testing Committee (ITC) for potential action by EPA under the Toxic Substance Control Act and organics which are monitored for water quality under the Safe Drinking Water Act.

Additionally, the catalogue lists environmental clean-up agents, gas chromatography packings and columns for particular separations and standard or custom syntheses of chemicals as kits or individual samples.

Copies of the new 1980 Analabs Environmental Standards and Accessories catalogue are freely available from W. Arthur Fisher Ltd., Auckland.

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production aspects from how each component of a product is prepared and processed and the whole formulated, to methods of packing and palleting. Quality assurance checks are made at all stages of production. Most analytical methods have been developed over many years by the parent overseas company, although some methods have been developed in NZ for specialised application here.

#### Meat And Related Products

The meat industry (followed closely by the woolen and dairy industries) is the principal earner of overseas funds, achieved mainly through the export of frozen meat. Within the area covered by the Manawatu Branch, freezing works are located at Gisborne, Wairoa, Whakatu, Hastings (2), Feilding (2), Longburn, Wanganui, Patea, Hawera, Eltham and Waitara. Although many of these works supply local markets, the majority are geared towards export of their products. According to the statistics, about 57% of the mutton, 71% of the beef and 90% of the lamb meats produced in NZ are exported.

The Whakatu works of the Hawkes Bay Farmers' Freezing Co., located near Napier, is an example of an export-orientated works. Here, more than 2 million sheep and 70,000 beef animals are slaughtered each year. Immediately after slaughter and prior to storage, the carcasses are passed over high voltage electrical stimulation equipment to accelerate their conditioning. This process, developed by the Meat Industry Research Institute in Hamilton, allows the carcasses to be rapidly frozen soon after slaughter without toughening the meat (see page 89, June, 1980).

In the works, the laboratory is relatively small but it plays an important part in the overall production. Water testing, in particular bacteriological analyses of effluents, is an important part of the laboratory's work along with byproduct analyses. Tallow analyses include free fatty acid estimations, colour and, in some cases, bleachability tests. Meat and bone meal, destined for pig and poultry feed formulations, is analysed for fat and protein content, calcium phosphate, ash, moisture and sieve range. Solutions used in the fellmongery works are also analysed.

Significant amounts of hides, skins and pelts are exported each year. Most freezing works have fellmongery sections to process these products. Tanneries process the hides to further stages than is done at the works, thus adding extra value to these export items. There are tanneries located at Napier (4), Hastings (2), Feilding, Wanganui and Stratford.

Another important byproduct of freezing works is gall, a tarry substance prepared by concentrating bile collected from the bladders of slaughtered sheep and cattle. This is processed into nine pure bile acids by a series of precipitations, decolorisations, crystallisations and centrifugations at the NZ Pharmaceuticals Ltd. plant at Linton. The company, jointly owned by the freezing companies and ICI Tasman Ltd., processes about 150 tonnes of gall each year for an export return in excess of \$2 million. The range of fine biochemical products from NZ Pharmaceuticals will

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#### Food Processing and Related Industries

##### Fruit and Vegetables

Food may be considered to be a complex mixture of (bio)organic chemicals that undergo a series of reactions during processing. One well known food processing industry is that of J. Wattie Canners Ltd., which has its head office and principal factory in Hastings. Other processing factories of this company are located at Gisborne, Christchurch and Timaru. These factories are probably best known for their canning of fruit, fruit jams, tomato-based products and vegetables and for their frozen vegetables. The Gisborne branch also produces frozen fish fillets, frozen prepared meals ("convenience foods") and pet foods. Although these products are mainly distributed on the NZ market, a steadily increasing amount is being exported.

Factory laboratories carry out quality control analyses on all food items from when they arrive at the factory and at every production step to the finished product. This involves analyses both of food constituents and bacteriological analyses. Food technologists, dietitians and cookery experts are involved with the development of new products. As the company manufactures and lithographs its own cans for food and beverages, research is also carried out in areas such as the use of improved tin plate lacquers and of suitable inks for the labels.

J. Wattie Canners is linked through its parent company, Wattie Industries Ltd., with a diverse range of manufacturers grouped in two operating divisions. General Foods Corporation (NZ) Ltd.

manufactures and markets under a variety of labels ice cream, frozen pastry and related products, snack foods and frozen table poultry and is also involved in transportation and storage of frozen products. Companies within the other division, Cropper-NRM Ltd., produce flour, stock feed, cereals, starches and allied products, some consumer food lines and supplies for industry and various building products. Wattie Industries also have interests in a number of other companies producing both food and non-edible products. These divisions and associated companies have factories, offices, depots and selling outlets throughout NZ.

"Down the road" from J. Wattie Canners is the food processing factory of Unilever NZ Ltd. This factory, along with a smaller one at Motueka, produces a wide variety of dehydrated foods. Examples of some of their products include vegetables, soups, sauces, gravies and a variety of "complete" meals. The 37 product lines made here result in the production of 275 different packs. About 60% of the dehydrated vegetables are exported.

Yearly throughputs of individual food items vary from a few tonnes to thousands of tonnes. Upon receipt, the food is cut or peeled, washed, blanched, dehydrated and then packed. Many unusual processing techniques are continually being developed. An example of this is the pricking of peas prior to blanching to improve the dehydration-rehydration process.

Specifications have been developed for each food line, covering a wide range of

continue to be extended for export to many European countries, UK, America and Japan.

#### **Dairy and Related Products**

Dairy products, the third most valuable of our export earners, are produced mainly in the Taranaki area. Of the 15 cheese factories in the Branch's area, 9 are located in Taranaki and 6 in the Manawatu and Wairarapa. Butter, casein and milk powder are made at 10 factories in this area. The Rennet Co of Eltham produces a range of fancy cheeses, as well as rennet which is used in cheese making and in the manufacture of rennet casein for use in the plastics industry.

Products from these factories are marketed by the Dairy Board which also supplies the customer's product specifications. Factory laboratories employ a number of chemists, microbiologists and related support staff. Products are subjected to quality control analyses according to the various specifications. Microbiological swabs of personnel and equipment are taken within the factories and tankers to isolate undesirable or dangerous contaminations.

Lactose is isolated from whey, a byproduct of cheese making, by the Lactose Co. of NZ, Kaponga. The whey, containing some 6% solids, including 4.4-5% lactose, is concentrated in various stages by falling film evaporators to a thick syrup containing 65% solids. Lactose, which crystallises from the syrup, is separated by centrifugation and is refined to remove the last traces of protein before being rotary dried and milled to specified mesh sizes. Most of the

lactose produced here, about 9,500 tonnes a year, is exported to countries in the Pacific Basin for use in pharmaceuticals (tablets) and in baby foods. Whey protein concentrate, a byproduct of the lactose isolation process, is used as a protein additive in some feeds.

A number of analyses are carried out on the final product, e.g. colour and sediment (for grading purposes), metal analyses, moisture, optical rotation, ash and bacteriological analyses. Analyses are also made on materials in the production lines, primarily for lactose content (by infra-red) and total solids.

#### **Pharmaceutical And Food Manufacturing**

Glaxo Laboratories (NZ) Ltd. manufacture in Palmerston North a range of human and veterinary pharmaceuticals plus foods and consumer products. Tablet manufacture involves the granulation of powders using standard mixing techniques, fluid bed drying of granules, the compression of granules into tablets followed by, if necessary, sugar coating by classical pan coating methods. Ointments, creams and lotions are made by standard techniques for fatty ointment bases or oil-in-water emulsions. For their penicillin products, they use an isolated suite with a sterile manufacturing area to produce antibiotic preparations for injection and intramammary use. Roller drier techniques are employed for their cereal products; other foods are dry

blended with automatic machinery.

A particular feature of Glaxo's production is their rigid quality control with the emphasis on built-in quality involving the use of the Code of Good Pharmaceutical Manufacturing Practice by the entire production team. Glaxo employ personnel with degrees in medicine, veterinary medicine, pharmacy, microbiology and analytical chemistry. Many of their technical staff have certificates or diplomas in specific areas of industrial chemistry, pharmacy or microbiology.

#### **Chemicals Producers**

##### **Fertilisers**

A range of different fertiliser formulations based on superphosphate are made and marketed by the East Coast Fertiliser Co. Ltd. at Napier and the NZ Farmers' Fertiliser Co. at New Plymouth. In the first stage of the process, sulphur (a byproduct of natural gas production in Canada) is converted to 98.5% sulphuric acid. The Napier plant also produces oleum (20% SO<sub>3</sub>) for sulphonation of alkylates in detergent manufacture. A byproduct of this acid production, heat, is converted into electricity either for use at the plants or to be fed into the national grid.

Most of the plants' sulphuric acid production ends up in superphosphate. Trace elements are mixed with the superphosphate in a variety of

## **Chemistry's Role In Industry**



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### **THE LACTOSE COMPANY OF NEW ZEALAND LIMITED**

#### **MANUFACTURERS OF:**

**WYNDALE Lactose**

**WYNDALE Whey Protein Concentrate**

#### **NZ AGENTS FOR:**



**HIGH CONTRAST  
Hand Refractometers**

## Chemistry's Role In Industry

formulations. The New Plymouth plant also produces basic chromium sulphate which is used in the tanning industry.

Quality control analyses can be divided into the two aspects of manufacture, namely the sulphuric acid line and the final superphosphate product. Gas and liquid monitoring in the acid plant is undertaken on a routine basis to determine rates of conversion of the various chemical reactions and to measure the final acid strength. Both physical (e.g. screen analyses) and chemical (e.g. phosphorus content—both soluble and total, levels of trace element additives, free acid etc.) analyses are carried out on the raw materials and on the finished products. Monitoring of effluents, especially dust emissions, is of particular importance in these plants.

### Weed Control Chemicals

Ivon Watkins-Dow Ltd., New Plymouth, is a well known manufacturer of weed eradication chemicals. This company also supplies a range of other industrial chemicals, plastics, surfactants, pharmaceuticals and animal health products. Ivon Watkins Ltd. was founded in 1944 and in 1964 became associated with Dow Chemical Co., Midland,

Michigan, USA. Technical assistance is available from the Midland offices, though many of the NZ processing methods tend to be different from those used in USA.

Many different weedkiller formulations are available, each for a specific use. Phenoxy esters, based on either 2,4-dichlorophenoxyacetic acid (2,4-D) or 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) are components in many formulations. The acids are prepared by etherification of the corresponding phenols by chloroacetic acid and then are esterified, usually by butanol. Some phenoxypropionic esters are prepared by a similar method using 2-chloropropionic acid instead of chloroacetic acid. Another series of esters is prepared from 2-methyl, 4-chlorophenol and chloroacetic acid (MCPA) or 4-butyrolactone (MCPB). A series of secondary amine-substituted chlorotriazines are prepared from 2,4,6-trichloro-1,3,5-triazine (cyanuric chloride) and the appropriate amine(s). All of these products are formulated (combined with suitable solvents and/or surfactants) as solutions, granules or wettable powders to give either selective weed control or to give a wide spectrum of plant control.

The company also prepares lauryl-sulphates from the appropriate aliphatic alcohols or aliphatic alcohol ethylene oxide adducts and chlorosulphonic acid for the surfactant industry. Benzalkonium chlorides for use in disinfectants and as a wood preservative are prepared from tertiary alkyldimethylamines and benzyl chloride. A range of fungicide and insecticide formulations is also prepared here.

All products prepared by the company are subjected to manufacturing specification quality control analyses. An important analysis is that for TCDD (2,3,7,8-tetrachlorodibenzo-p-dioxin), an impurity formed during the chlorophenol preparation stage of 2,4,5-T manufacture. The maximum level of this compound in 2,4,5-T, as set by government regulation, is 0.1 parts per million. All reactive chemicals are subjected to accelerated rate calorimetry analyses to determine suitable conditions for their storage and use.

### Inorganic Chemicals

A good example of a small-scale inorganics industry is that of Scientific Services Laboratories in Napier. The main line of work undertaken by **Geoffrey Husheer** and his assistant **Barry Streeter** is the repackaging of bulk hydrochloric acid from NZ Forest Products Ltd. They have made a preliminary investigation into the

# A hand on the land



Herbicides and insecticides for healthy pastures and profitable crop yield—just some areas where IWD products are used.

Ivon Watkins-Dow Limited pioneered and established the agricultural chemical industry in New Zealand and continue to give research and development high priority.

That's how the TORDON\* herbicide products were developed and why we now have available LORSBAN\* insecticides, improved dairy hygiene products like MYCOSAN\*S and more recently flowable formulations on atrazine and simazine in ACTAZINE\* 5A SIMAZOL\* 5A and ELIMINEX\* Herbicides.

*Best wishes  
for the  
Conference.*

IWD  
IVON WATKINS-DOW LTD  
Box 144 New Plymouth

## ALONGSIDE THE FARMER FOR THE FUTURE OF NEW ZEALAND

\*ACTAZINE, ELIMINEX, SIMAZOL, MYCOSAN Registered trademarks of Ivon Watkins-Dow Ltd. \*TORDON, LORSBAN Registered trademarks of The Dow Chemical Company.

## Chemistry's Role In Industry

production of high purity concentrated hydrochloric acid and are finalising details of the distillation equipment. Most analytical grade hydrochloric acid that is used in chemical laboratories is now imported, but here is a potential supply of a NZ product. To determine the NZ requirements for this chemical, Mr Husheer would be grateful if stores' purchasers in Government, University, Industrial and School Laboratories would contact him. Other projects that Mr Husheer has under investigation include the recovery of spent vanadium pentoxide from fertiliser works, the recovery of nickel and chromium from stainless steel and copper from small electric motors and the production of battery acid.

### Non-Ferrous Metals

Another well-established industry in New Plymouth is that of McKechnie Metal Products Ltd. which manufactures a wide range of copper, brass and aluminium products. Two copper tubing alloys used in domestic and industrial water systems and in electrical conduction equipment are made by the company. It also produces a wide range of brasses, alloys based on a mixture of copper (usually 56-80%) and zinc. The physical properties of brasses are determined by their copper/zinc composition and by the presence of minor amounts of other elements. These elements include lead (improves machinability), tin (increases resistance to corrosion), nickel (imparts whiteness) and iron, aluminium and silicon (increase tensile strength). The brass, after being cast as billets, is extruded into a variety of different shaped rods or tubes.

Pure aluminium, of good ductility, can be strengthened by the addition of small amounts of magnesium, silicon, manganese, iron and copper. These alloys are now widely used in architectural components, particularly for door and window frames. Many different shapes are extruded and anodised by the company. Anodising of aluminium is a process which induces thickening of the natural protective oxide film on the metal surface. This film will not crack, peel or chip unless it is excessively stressed; it is hard wearing, corrosion resistant and decorative. Films may be coloured by the addition of dyes or pigments.

Elemental composition and processing treatment specifications for an alloy determine the conditions under which that alloy can be used. Therefore, before casting, samples of alloys are taken for analysis of a wide range of elements by spark spectrometry. Traditional wet analytical methods are also used in the laboratory, particularly for incoming raw materials. In some cases, extruded samples are taken for microscopic examination of cut and polished surfaces.

### Natural Gas Production

Until the early 1970's, crude oil and natural gas were obtained from 4 wells at Moturoa in New Plymouth. During the 1950's and 1960's approximately 200,000 gallons of crude oil were distilled each year to yield about 40,500 gallons of motor spirit ("Peak" petrol). Production decreased to about 70,000 gallons per year of crude oil towards the end of this

period and stopped soon after the Kapuni field was developed.

Natural gas and condensate are now obtained from two areas, namely the Kapuni and Maui fields. The Natural Gas Corporation of NZ plant at Kapuni is most impressive with its large vent stack steam plumes, flares and pipelines. Here, natural gas from the Shell, BP and Todd Oil Services Ltd. wells "over the fence" is processed before it enters the Auckland-Wellington pipelines. The crude gas contains about 44% carbon dioxide which is removed and vented to the atmosphere. Installation of equipment to recover the carbon dioxide (ca. 17,000 tonnes/year) is now almost complete. Two other important byproducts are propane and butane. These components of liquefied petroleum gas (LPG) would condense at the high pressures in the transmission pipelines.

Modifications are continuously being made at this plant. Extra gas compression capacity has been installed to cope with extensions in the north-south pipeline. Some gas from the Maui field is processed here.

Hydrocarbons from the Maui field are brought ashore in two submarine pipelines at Oaonui on the Taranaki coast. Preliminary treatment takes place on the off-shore drilling platform where sand and other solid particles are removed and the hydrocarbons separated into the gaseous and condensate components which are piped ashore separately. At the on-shore treatment station, further hydrocarbon liquids and trace quantities of water are removed from the gas before it is combined with a small amount of gas removed from the condensate and piped inland. Some of this gas enters the pipeline, formerly used by the Natural Gas Corporation, to the New Plymouth power station. Condensate is sent to the Marsden Point refinery for processing into gasoline.

The next major stage in development of the petrochemical industry in Taranaki will be the conversion of Maui gas to methanol. Methanol from this source should be available by 1983 and "Mobil Process" synthetic petroleum by 1985. This could supply 33-50% of NZ's requirement for motor fuel whereas at present 8% is supplied from condensate hydrocarbons.

### Power Generation

The recently commissioned power station at New Plymouth is situated in the shadow of Paritutu, close to the old oil wells. Originally the station was to use coal, then it was modified for oil but now Maui gas is used. This 600 megawatt (maximum) station is designed for base load operation to minimise stress and corrosion problems during the start-up of the generators, during which fuel oil is used initially to heat the boilers until the generator's output reaches 80 megawatts, when the natural gas is turned on.

Boiler waters are automatically monitored for dissolved impurities, the results being displayed in the control room. The main work carried out by the

laboratory is that of water analyses of all feed and boiler systems and oil and diesel analyses. Problems experienced here for the staff relate to the need for almost "instant" analytical information to allow changes in operating procedures and isolation and repair of defective parts. Aqueous contaminant levels are necessarily very low; typically silicon must be less than 0.02 ppm and sodium less than 0.01 ppm.

### Analytical Laboratory

In Napier, the private analytical laboratory of Water, Soil and Laboratory Services carries out principally soil analyses for commercial fertiliser companies and pesticide and herbicide residue analyses for agricultural chemical companies. This laboratory, under the management of Peter Dawson, also does water analyses through referral from the Ministry of Agriculture and Fisheries in Hastings. Other industries using these services include tanneries, wineries, freezing companies (for protein analyses) and smallgoods manufacturers (for preservative levels). For these analyses the laboratory is equipped with, in addition to standard laboratory apparatus, an atomic absorption spectrophotometer, a Hewlett Packard gas chromatograph with flame ionisation and electron capture detectors and a Tracor 560 gas chromatograph with flame photometric and nitrogen/phosphorus detectors.

The laboratory is called on in a consulting capacity for insurance claims and for problem solving or quality assurance for local Hawkes Bay industry. Being the only independent private laboratory in the area, it also acts as a distributor of laboratory chemicals and glassware, selling on behalf of the main scientific supply houses.

*(The Branch Editor wishes to thank the people, too numerous to mention, who contributed to this article).*

### DIFFSTAK BROCHURE

Technical details of the complete range of Edwards Diffstak Mk 2 vacuum pumping systems are now available in a single reference brochure.

The Diffstak Mk 2 range gives clean high vacua with air pumping speeds from 130  $l s^{-1}$  to 2000  $l s^{-1}$ , and the wide range of options includes pneumatically or manually operated valved versions. Unvalved versions offer higher ultimate vacua and are suitable for systems where no high vacuum valve is required.

Unvalved Diffstak are also available with copper compression gaskets for clean pumping coupled with the highest ultimate vacuum.

The brochure can be obtained by writing to the NZ agents, Selby-Wilton Scientific Ltd.

**C059 For further details, use Reader Service Card.**

# NZIC ANNUAL REPORT 1979-80

On behalf of the Council we have pleasure in presenting the NZIC Annual Report for 1979-80.

## Section 1

### Elected Officers:

President: Prof. A.D. Campbell  
 First Vice-President: Dr A.J. Ellis  
 Second Vice-President: Dr S. Simpson  
 Secretary: J.G. Fletcher

### Branch Delegates to Council

Auckland: Drs L. Eyres, P. Boyle  
 Waikato: Drs C. Devine, A. Wilkins  
 Manawatu: Dr A. Brodie  
 Wellington: Dr B. Halton  
 Canterbury: Dr R.F.C. Claridge  
 Otago: Dr P.K. Grant

### Officers Appointed by Council

(These appointments continue until the date shown, but are renewable. Appointments are made at the November meeting of Council).

Registrar: D.J. Hogan (31/12/81)  
 Administrative Secretary: Mrs N.E. Wignall (31/12/80)  
 Editor: S.G. Brooker (31/12/80)  
 Hon. Librarian: S.G. Brooker (31/12/80)

### Committees Appointed by Council

#### Membership:

Prof. A.D. Campbell (31/12/80);  
 Dr. J. Rogers (31/12/81)  
 Assoc. Prof. D.J. Brasch (31/12/82)

#### Publications:

Dr R.F.C. Claridge (31/12/80)  
 Dr L. Eyres (31/12/80)  
 S.G. Gray (31/12/81)

#### Energy & Chemical Resources:

Dr J.G. Wright (31/12/80)  
 Dr A. Metcalfe (31/12/81)  
 Dr I.D. Watson (31/12/82)

#### Hazardous Chemicals:

A.C. Kennet, R.H. Hopgood, D.J. Ogilvie;  
 one corresponding member from each Branch

#### Public Affairs:

Drs M. Kingsford, A. Wilson, J. Featherstone

#### Archives:

Dr R.F.C. Claridge, Mrs N.E. Wignall, Registrar

## Section 2:

The year has been one of continued activity at all levels in the Institute.

### Prizes

Prize winners in 1979 were as follows: I.C.I. Prize: Dr B.K.G. Theng. Industrial Chemistry Prize: M.B. Rands. Chemical Essay Prize: S.L. Marshall. Conference Student Paper: R. Tasker, University of Otago.

### Annual Conferences

The Annual Conference for 1979 was held at Victoria University of

Wellington in August. The conference was a considerable success as a forum for discussion. It also realised a financial surplus. The profits from this conference will give a welcome boost to our overseas visitors travel fund.

Many papers echoed the conference theme: "The NZ Chemical Industry: Prospects and Perspectives". Because the theme was concentrating attention on the NZ scene it was decided that local,

rather than overseas, speakers were more appropriate and the only invited overseas speaker was the Biochemistry visitor, Prof B. Ralph, University of NSW, Australia. The Council is grateful for the efforts of Prof N.F. Curtis (conference chairman), his committee and the supply houses who generously supported the conference.

### I.U.P.A.C.

At the invitation of the NZ Committee for Chemistry the Chemistry in New Zealand

### Membership:

During the year the following changes in membership have taken place.

Members elected to Fellowship	19
New Members	31
Re-instated	7
Graduates elected to Membership	15
New Associate Members	11
New Graduate Members	29
New Technician Members	9
Resignations	13
Deaths	5
Deleted	18

Consolidated membership figures for the last four years are as follows:

	1977	1978	1979	1980
Auckland	339	367	345	368
Waikato	94	110	114	113
Manawatu	124	123	126	134
Wellington	306	313	309	319
Canterbury	174	176	183	177
Otago	105	109	110	111
Overseas	138	150	168	182
	<u>1280</u>	<u>1348</u>	<u>1355</u>	<u>1406</u>

### Obituary:

We record with regret the deaths during the year of the following members: Dr H.E. Annett, R.C. Gibbons, E.F. Hubbard, Dr Elsa B. Kidson, W.F. Rolt.

### Specialist Groups:

Group	Secretary	NZIC	Non-NZIC	Total
Analytical	D.J. Hogan	35	3	38
Biochemistry Society	A.M. Robertson	69	85	154
Chemical Education	D.T. Howarth	146	252	398
Chemical Engineers	E.R. Palmer	.	.	.
Chromatography	J. Zabkiewicz	115	73	188
Electrochemistry	A.J. Eastal	40	28	68
Geochemistry	J.B. Finlayson	29	96	125
Organic Chemistry	K.E. Richards	87	5	92
Polymer Chemistry	M.C. Cochrane	58	19	77
Thermodynamics	D.V. Fenby	.	.	.
X-ray	.	.	.	.
Chrystallography	W.T. Robinson	25	2	27
Trace Elements and Health	T.E. Kjellstrom	.	.	.
Industrial Chemistry	J.R. Yolland	.	.	.

\* Figures not available.

President represented the NZIC at the 30th IUPAC Assembly in Davos, Switzerland along with Dr T.A. Rafter. Dr T.R. Hitchings, National Representative on the Commission on Teaching of Chemistry presented a plenary lecture at the third International Conference on Chemical Education in Dublin in August 1979 and also organised a seminar on Chemical Education at the Regional Education Centre for Science and Mathematics in Penang, Malaysia. NZ is currently represented on 12 of the IUPAC Commissions.

**International Meeting Of Chemical Society Presidents**

The President attended the 7th International Meeting of Chemical Society Presidents in Washington DC in September 1979. Representatives of 36 National Societies were present. The President presented a lecture to open discussions on Aid to Developing Countries but unfortunately the desire of certain members of the American Chemical Society to form an International Chemical Society tended to overshadow all other proceedings at the meeting and little progress was made on other topics. Your President does not see the need for an International Chemical Society open to individual membership. Such a society could undermine National Chemical Societies. Also some form of regional representation would be necessary and this should rightly belong to the National Chemical Societies. Although a working party was formed to further explore the possibilities of such a Society, 23 National Chemical Societies have stated in letters to the American Chemical Society that they are opposed to the formation of the International Society.

**Federation of Asian Chemical Societies**

The Institute has joined the Federation of Asian Chemical Societies in order to help co-ordinate activities of the Chemical Societies in this region. Other members include Chemical Societies in Australia, Hong Kong, India, Indonesia, Iraq, Korea, Malaysia, Philippines, Singapore, Sri Lanka and Thailand.

**1981 Jubilee Conference**

The Auckland Committee (Chairman A.W. Mackney, Secretary Dr D.J. McLennan) is preparing for a monster Jubilee Conference in Auckland August 23-28, 1981. This promises to be an outstanding event in the history of the Institute and should attract record attendances. Branches have been invited to arrange local events and regional activities such as school lectures, science open days and to highlight local achievements in applied science.

**History Of Chemistry In NZ**

Institute members will be pleased to note that good progress is being made with a history of chemistry in NZ. This publication which is being written in sections covering broad topics is under the general editorship of Dr P.P. Williams of Chemistry Division. This will be a very welcome addition to the Institute publications.

**Guidelines**

A series of 'Guidelines' have been prepared to facilitate the operations of the Institute. Guidelines for NZIC Annual Conference Committee and Guidelines for Specialist Groups are typical of this series.

**Environmental Committee**

An Environmental Committee is being set up in the Otago Branch (Chairman Prof R. Laverty, Secretary Dr W. Temple) with corresponding members in other Branches. It is anticipated that this committee will prepare reports and comment on matters related to chemicals in the environment in areas not covered by the already well established Hazardous Chemicals Committee which is more associated with the handling and transport of potentially hazardous chemicals and procedures in emergencies.

**Salary Survey**

A salary survey was conducted during the year by Dr G. Gainsford and assistants. Results are published in this issue (August 1980) of Chemistry in NZ. Industrial members continue to place considerable importance on this survey.

**Public Affairs**

The Institute is endeavouring to enter the public information field cautiously but with well informed comment on issues of the day. To this end the Public Affairs Committee under the chairmanship of Dr M. Kingsford has made several statements during the year.

**Finance**

In times of outstanding inflation, such as at present, the officers of Council have been conscious of keeping costs to a reasonable minimum, consistent with giving a professional service. It is pleasing to note that a small surplus has been maintained so that one day the Institute will have a fund from which to launch activities such as the attraction of more overseas visitors, legal defence of members or publicity campaigns.

**Chemical Processes In NZ**

The Auckland Branch has successfully promoted this excellent publication and has established an ongoing committee of Drs R. Dormer, J. Packer, L. Eyres, Mr M.G.C. Gibson and Mrs F. Gifford. It is to be hoped

that further orders will continue to be received.

**Overseas Visitors**

During the year Prof E.Vogel visited Branches as an official NZIC visitor. He was a popular speaker and the tour was organised by Dr B. Halton.

**Acknowledgements**

The Institute relies very heavily on its members to serve on sub-committees. Many of these are quite time consuming positions but the standing of the Institute depends very much on these activities being carried out efficiently. The Institute is very grateful to a large group of very willing workers.

A.D. Campbell (President)  
J.G. Fletcher (Secretary)

**KEEP IN TOUCH!**

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

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NZ Institute of Chemistry,  
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Christchurch**

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**New Appointment/Job Title [if applicable] .....**

.....

**Company & Address .....**

.....

.....

**Effective date .....**

**Signature .....**

**THE NEW ZEALAND INSTITUTE OF CHEMISTRY (INC.)  
BALANCE SHEET AS AT 30TH APRIL, 1980**

<b>1979</b>		
\$		
	<b>CURRENT LIABILITIES:</b>	
1,414	Sundry Creditors.....	1,246.10
70	Subscriptions in Advance.....	<u>245.16</u>
(1,484)	<b>TOTAL CURRENT LIABILITIES:</b> .....	1,491.26
	<b>SPECIAL ACCOUNTS:</b>	
649	Overseas Visitors	
	Travelling.....	1,959.32
635	Easterfield.....	<u>566.86</u>
(1,284)	<b>TOTAL SPECIAL ACCOUNTS:</b> .....	2,526.18
	<b>ACCUMULATED FUNDS:</b>	
13,528	Balance, 1/5/79.....	17,108.49
400	Add: Legacy ex Est. C.G.W. Mason.....	—
3,180	Excess of Income over Expenditure for year.....	<u>1,795.31</u>
(17,108)	Balance, 30th April, 1980 ..	18,903.80
		<u>          </u>
<u>\$19,876</u>		<u>\$22,921.24</u>

<b>1979</b>		
\$		
	<b>CURRENT ASSETS:</b>	
5	Petty Cash Funds (Net) ..	148.75
3,720	Bank of New Zealand ....	2,807.98
679	Air N.Z. — Deposit A/c & Prepaid Travel .....	163.78
4,582	Subscriptions in Arrears ..	2,036.67
—	Prepayments — 1980/81 Conferences .....	497.06
—	Sundry Debtors — Publication Subscriptions	551.00
65	Journal Advertisers	<u>          </u>
(9,051)	<b>TOTAL CURRENT ASSETS:</b> .....	6,205.24
	<b>INVESTMENTS AT COST:</b>	
1,000	North Canterbury Hospital Board Stock (1/11/84) (5.25%) .....	1,000.00
1,000	Lyttleton Harbour Board Loan (1/7/80) (6%) .....	1,000.00
500	Lyttleton Harbour Board Loan (1/7/98) 6.25%) .....	500.00
3,500	U.D.C. Group Holdings Ltd. Debenture Stock Bank of New Zealand ....	—
—	Term Deposits — Various Terms .....	14,000.00
4,500	General Finance Ltd. — Debenture Stock .....	<u>          </u>
(10,500)	<b>TOTAL INVESTMENTS:</b> .....	16,500.00
	<b>FIXED ASSETS (at Cost)</b>	
	Office Equipment .....	834.80
	Less: Depreciation .....	<u>618.80</u>
(325)	<b>TOTAL FIXED ASSETS:</b> .....	216.00
		<u>          </u>
<u>\$19,876</u>		<u>\$22,921.24</u>

We have audited the books of the New Zealand Institute of Chemistry (Inc.) for the year ended 30th April 1980, 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 and Income and Expenditure 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, 1980.

Christchurch: **Shanahan, Winder, Tomlin & Co.**

27th June, 1980.

Per: .....  
A.J. Tomlin

**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.
2. Membership Subscriptions in Arrears — Subscriptions in arrears over 1 year have been written off.

**THE NEW ZEALAND INSTITUTE OF CHEMISTRY (INC.)  
INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 30TH APRIL, 1980**

1979			1979	
\$			\$	
	<b>EXPENDITURE:</b>			<b>INCOME:</b>
	<b>ADMINISTRATIVE EXPENSES:</b>		(22,153)	Subscriptions — Annual ... 20,236.44
5,284	Honoraria .....	5,687.78		
4,158	Printing, Stationery, Postages, Tolls etc. ....	2,413.40		
—	Computing, Address Labels etc. ....	711.55		
3,492	Travelling Expenses .....	3,357.06		
1,200	Branch Expense Allowances .....	1,500.00		
148	Legal Fee .....	—		
691	Audit Fee .....	525.00	(1,013)	1,382.43
—	Travel Grant — Chem. Ed. Conference .....	100.00		
—	Conference Costs paid by Institute .....	88.32		
—	Prizes .....	90.00		
—	Donation — Rutherford Biography .....	200.00		
40	Subscriptions — Royal Society of N.Z. ....	40.00		
—	Common Concern .....	56.00		
85	S.A.N.Z. ....	85.00		
—	N.Z.I.E. ....	—		
109	Water Research Group ...	50.00		
	Depreciation — Office Equipment .....	109.00		
(15,207)		15,013.11		
	<b>PUBLICATIONS:</b>			
8,183	Journal — Publisher .....	4,200.00		
390	Journal — Honorarium ...	600.00		
—	Chem. N.Z. ....	238.51		
1,289	Sundry Publications .....	1,542.02		
(9,862)		6,580.53		
	<b>Less: Revenue from:</b>			
3,337	Journal Advertisers .	—		
1,746	Sundry Publication Sales .....	1,770.08		
(5,083)		1,770.08		
(4,779)			4,810.45	
3,180	Excess of Income over Expenditure .....		1,795.31	
<u>\$23,166</u>			<u>\$21,618.87</u>	

**OVERSEAS VISITORS TRAVELLING ACCOUNT**

966	Payments Made .....	435.00	1,183	Balance 1/5/79 .....
649	Balance 30/4/80 .....	1,959.32	432	Conference Surplus .....
				1,744.85
<u>\$1,615</u>		<u>\$2,394.32</u>	<u>\$1,615</u>	<u>\$2,394.32</u>

# Radial Compression Column Technology In HPLC

C.A. Bishop, ANAC Ltd, Auckland

The development of high performance liquid chromatography has been watched with great interest over the past decade by analysts from a variety of scientific disciplines. The development of a comprehensive theory has recently begun to elucidate the complex interactions that occur between the stationary phase, the mobile phase and the analyte. By aiding the prediction and manipulation of the retention characteristics of a molecule, or class of compounds, this theory has markedly enhanced the flexibility of HPLC. Chromatographers in general would agree that the heart of any successful HPLC system is the column and its associated packing material. Obviously this must be linked to an efficient pumping system capable of generating high velocity pulse-free liquid flows.

Development of the technique as a whole depended on the introduction of column packings capable of withstanding the higher pressures associated with higher flow rates required to improve chromatographic efficiency. At first fully porous or pellicular silica particles were used, either surface coated or uncoated depending on the nature of the analyte. The size range of these particles was generally 37-50 microns and for analytical applications 50cm x 2mm I.D. stainless steel columns were chosen. However, the pellicular packing has low capacity while the fully porous particles exhibited relatively slow mass transfer with consequent peak broadening. More recently 5-10 micron fully porous spherical silica beads have been packed in typically 10-30cm x 3.9mm stainless steel

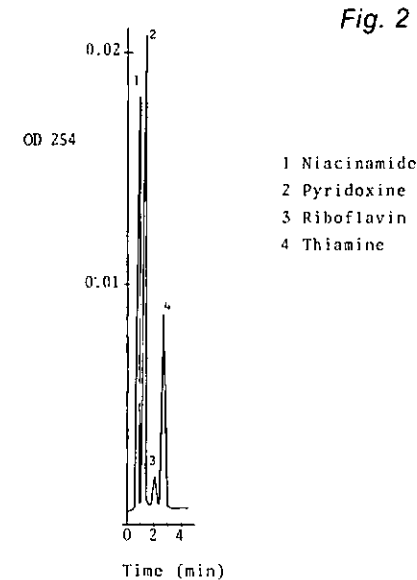


Fig. 2

columns, allowing highly efficient analyses. The success of such columns relies not so much on the silica packing, although this is obviously an important variable parameter, as on the efficiency and reproducibility of the column packing technique. Poor packing methodology will inevitably mean poor chromatographic results.

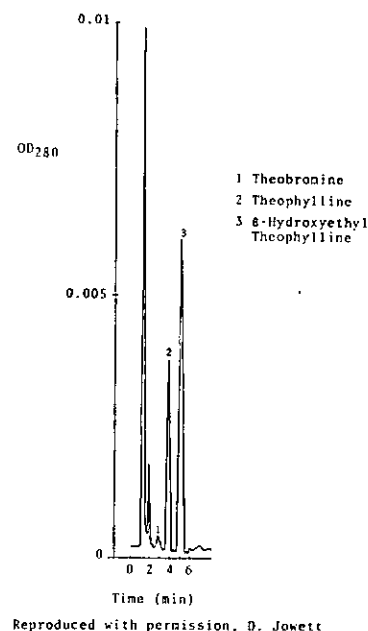
Waters Associates' research and development scientists soon recognised the potential advantages of an alternative column packing technology, namely radial compression. For analytical work the uniform fully porous small particle diameter packing materials are placed in a flexible walled polyethylene cartridge, 10cm x 8mm, and radially compressed by placing the cartridge into a Radial-Compression Module and simply depressing three pressurising levers. This results in the uniform application of hydraulic pressure to the entire outer surface of the cartridge which is transmitted to the packing material. This then eliminates column voiding and channelling by forming a highly efficient, homogeneous bed which enhances reproducibility and reliability. LC separations are performed while the cartridge is under pressure and when completed the cartridge can be

decompressed and removed from the compression module, without the requirement for it to be full of solvent, and re-used repeatedly without losing efficiency. Cartridges are available for both normal and reversed-phase chromatography.

Currently, radial compression separation systems are being used successfully in a wide variety of applications. Fig. 1 shows the analysis of p-bromophenacyl esters of fatty acids using a reversed-phase cartridge. The analysis, with baseline resolution of each of the acids, is complete in 45 minutes at a flow rate of 4ml/min. This is a significant improvement on a similar separation carried out on a standard stainless steel column.

Fig. 2 shows the separation of water soluble vitamin standards again using a reversed-phase cartridge. Excellent resolution of the components is achieved in 3.5 minutes. This is obviously a very real advantage for quality control of vitamin content in a number of areas such as the food and dairy industries.

Fig. 3



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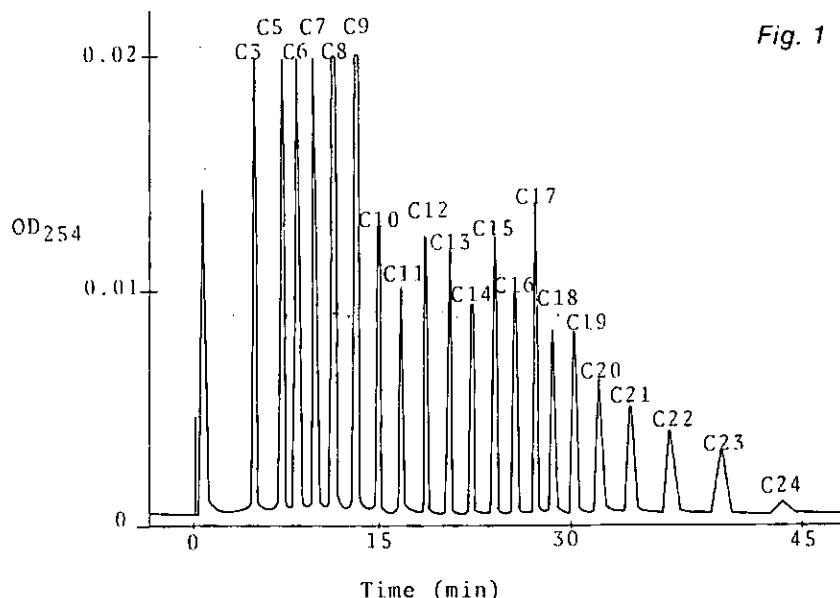


Fig. 1

The radial compression cartridges used can be compressed and recompressed repeatedly and simply. This, along with their low cost, makes it possible to economically dedicate a cartridge to a particular analysis. Where a large number of samples must be run, and time is an important factor, radial compression has the advantage of allowing much higher flow rate due to the short length and wider diameter of the cartridges. This also allows rapid re-equilibration of a column and regular solvent changeover without damaging the packing, a significant advantage when the sample contains compounds which are reversibly adsorbed to unreacted silica sites.

Radial compression systems are therefore ideally suited to routine screening of both biological and non-biological samples. Fig. 3 shows the



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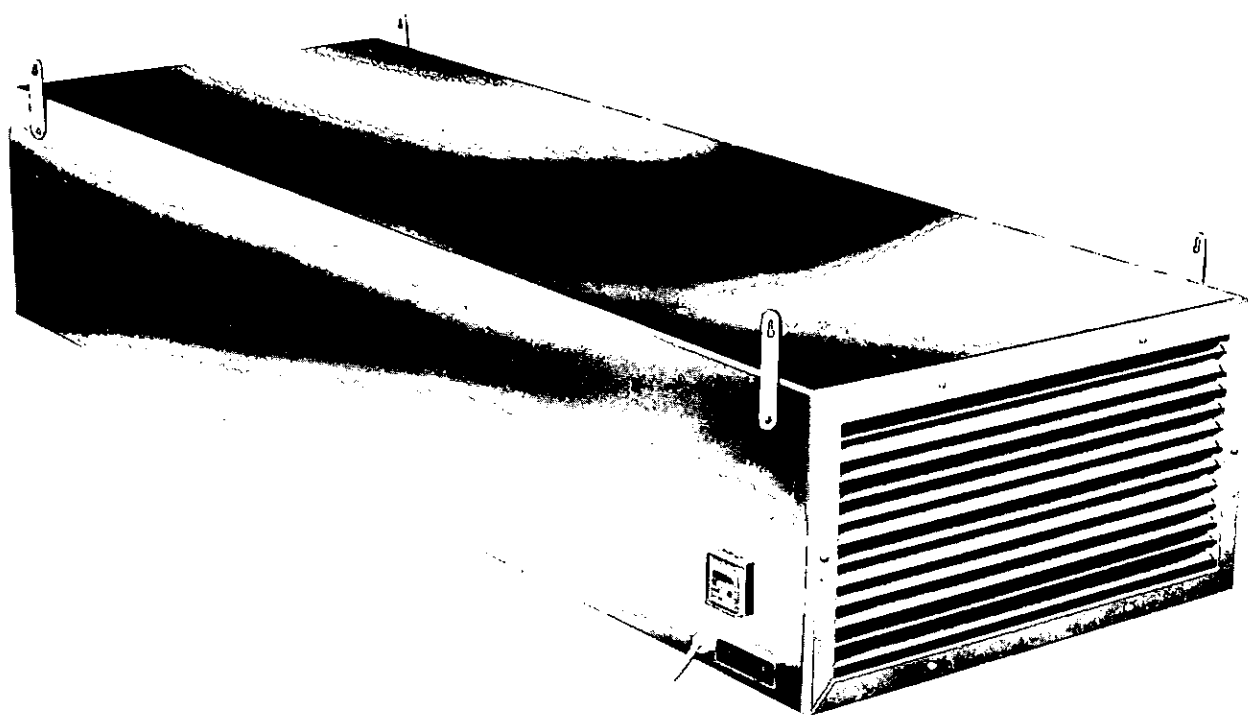
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## Radial Compression (Cont)

analysis of theophyllines carried out in a hospital laboratory using a reversed-phase cartridge. The separations are rapid, exhibit excellent peak shape and resolution and require only minimal sample preparation.

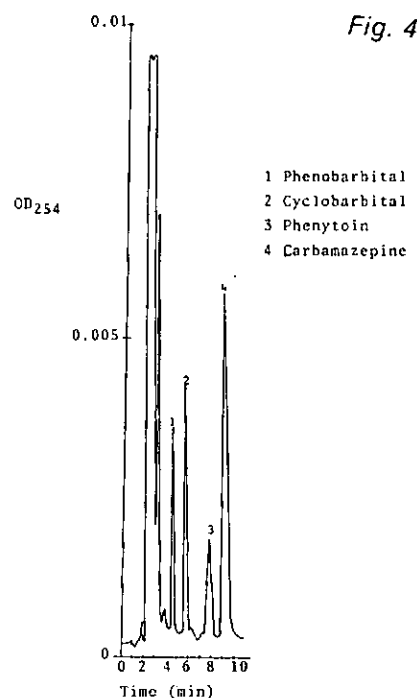
Fig. 4 shows the analysis of a series of anticonvulsants, again carried out on a routine basis in a hospital laboratory. These assays are done on alternate days using cartridges dedicated to the particular analysis.

Radial compression systems are now being used routinely as part of complex peptide and protein investigations, including the sequence determination of proteins, as well as structure/function determinations. Fig. 5 shows the separation of the apolipoprotein fragments C-I, C-II and C-III-1. In this case a long, shallow gradient of increasing acetonitrile concentration was used to separate these complex proteins. 10mg of sample was injected allowing collection and further identification of the peaks. This high sample capacity of radial compression cartridges gives them a

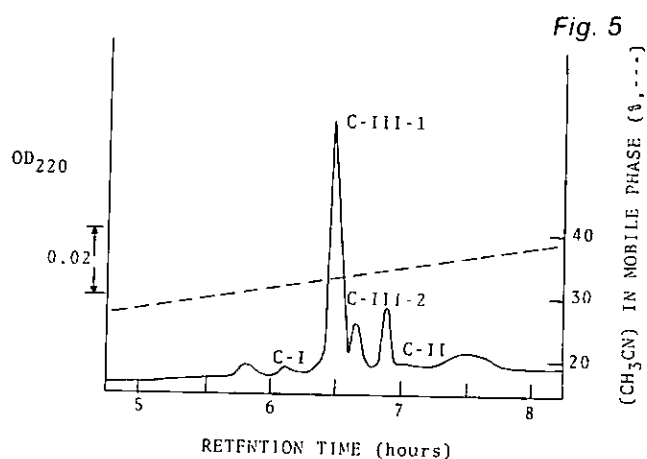
semi-preparative capability along with their normal analytical function.

Prior to the development of the analytical radial compression system, a preparative scale liquid chromatograph was developed by Waters Associates allowing purification of pure components from complex multigram mixtures in 5 to 45 minutes typically. The principle of the operation and advantages obtained are similar to those achieved on the analytical system. Flow rates of up to 500ml/min can be achieved on either normal or reversed-phase cartridges and gradients can also be used. Fig. 6 shows the purification of 10 grams of the tetrapeptide Leucyl-glycyl-glycyl-glycine on a reversed-phase cartridge and includes a recycle of the required fraction to increase purity. The purification was complete in 20 minutes. Analysis of the fractions by analytical HPLC with confirmation by amino acid analysis and mass spectrometry showed the required product to be homogeneous.

The above examples suggest that radial compression is now an established technology with significant advantages of speed, resolution, reproducibility and the capacity to withstand severe physical, thermal and chemical shocks without risk.



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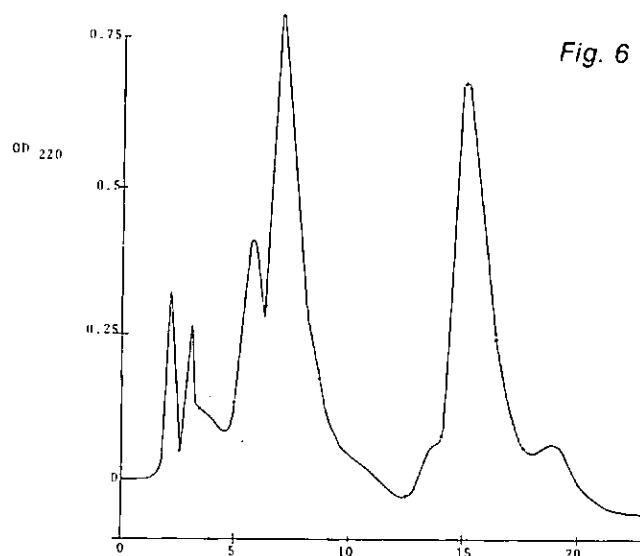


Fig. 6



Sinclair



Shepherd

**Ron Shepherd**, staff manager, ICI head office, has retired after 32-years' service with the company:-

Born and educated in Christchurch, Ron graduated M.Sc. with honours in chemistry from Canterbury University in 1940. In 1941 he took up a studentship in radio physics which led to a commission in the Royal NZ Navy as a Radar Officer. His early war service included some time instructing on the use of new equipment and was followed by active service aboard the famous cruiser HMNZS Leander.

Ron joined ICI in April 1948 as a Technical Service Officer dealing mainly with problems concerning general

chemicals and plastics. The following year he transferred to Auckland area office as Technical Service Officer remaining there until 1952, at which time he returned to Wellington for a short period as assistant to the technical manager.

Ron then moved to Christchurch as assistant manager in the South Island area office. He returned to Wellington in 1957 to become Techno-Commercial Officer, Technical Department. In 1973 he was transferred to Personnel Department as Staff Development Manager and was appointed Staff Manager in 1974.

**Mr R.M. Sinclair**, group leader at Chemistry Division, DSIR, has recently retired after 32 years' service.

Mr Sinclair graduated with a Master of Science degree in Chemistry from Canterbury University College in 1942. After a brief period in the armed forces, he was transferred to munitions work for the Australian government.

He then returned to NZ to become chief

chemist for a Wellington paint manufacturer. In 1948, Mr Sinclair joined the Dominion Laboratory (now Chemistry Division), DSIR. The following year he took charge of the Paint Section.

He was largely responsible for greatly improved standards of paint performance in the protecting steelwork in hydro electric structures and in road making. His work on protective coatings has involved him in most of NZ's major construction projects.

In recent years his section (now called the Applied Chemistry Section) has expanded its work to include the testing of a wide variety of goods for the Government Stores Board. Some of these products have been oils and greases, soaps and detergents, and aerosol insecticides.

Mr Sinclair became a group leader in 1977 with responsibility for the Applied Chemistry, Forensic and Toxicology Sections. In 1979 in a reorganisation of management he took control of Food and Information as well as Applied Chemistry.

## T. J. SPROTT and ASSOCIATES

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HP Liquid Chromatograph Model 5000	Varian
Recorders, Model 9176	Varian
Integrator/computer data unit Model CDS111	Varian
U-V/vis spectrophotometer Model 634	Varian
Infra-red spectrometer Model 357	Perkin Elmer
Colorimeter, visible	EEL Colorimeter
Atomic absorption spectrometer, Model 575	Varian
*AA Lamps	Varian, Active Ion
Polarimeter	Bellingham & Stanley
Viscometer	Brookfield
Viscometer Redwood	Stanhope Seta
Viscometers, glass U-tube	Goddard, Technico
Constant temperature baths	Gallenkamp, Grant
pH meters (2)	Townson and Mercer, Chemtrix
Dissolved oxygen meter	DELTA Scientific
Conductivity meter	Chemtrix
Refractometer, Abbe	Atago
Carbon Furnace	Wild Barfield
Lloyd gas analysis burette	Gallenkamp
Bomb calorimeter	Baird & Tatlock
Explosive gas meter	MSE
Digestion Bombs, Teflon Furnace	Parr Instruments
Jaw crusher for rocks	Selby Wilton
Ring grinder for rocks and minerals	Rocklabs
Fire assay furnaces (3)	Furnace Engineering
Microscope, phase contrast etc.	Reichert
Microscope, binocular	Watson
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Steriliser, steam	Mercer & Sons
Freeze drier	Edwards
Anaerobic jars	BBL
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\*Zn \*Zr

## Instrument Purchase: A Public Analyst's View:

T.J. Sprott

The past 40 years have seen a dramatic change in the scope of work and equipment required by the Public Analyst. When the writer first entered the industry in the early 1940s a Public Analyst could operate quite successfully if he had a balance, an oven, a potentiometer with a quinhydrone electrode or, if he were lucky, a hydrogen electrode, a microscope, and — luxury of luxuries — a refractometer. UV and IR spectrometers were still in the future as far as the commercial operator was concerned. GLC and AA had not been heard of although the emission spectrograph was in use.

As the new generations of instruments came along, it was necessary to decide which were desirable and economic, the priorities to be established, and at the same time techniques developed to meet the widely ranging requirements of the public analytical industry.

This same development brought about a need for specialisation. The old-time analyst could make a living quite well with simple equipment (so long as he also had a book of litmus paper) and he has been described — not without some justification — as a jack of all trades.

Those days have passed. The modern public analytical chemist must have AA, GLC, UV—viz spectrometer, IR spectrometer, HPLC, polarimeter, a very versatile microscope assembly, glass electrode pH meters, conductivity meters etc. The list seems to be endless. We have not yet been able to justify the purchase of a mass spectrograph nor an NMR unit and an XRF unit is still only a dream. No doubt all of these and more will come as time goes by.

In selecting equipment of this nature, particularly the first piece of equipment of any particular type, the following questions arise:

- Do we really need the equipment?
- If we put it in will it be economic?
- Who is going to operate it?
- Which brand shall we buy?
- Which accessories shall we buy?
- How shall we finance it?

The earlier questions in the list are the hardest as they call for an assessment of the future requirements of the industry and it is clearly difficult to estimate the need for a service which we have not been able to offer in the past. Fortunately, to date the need for new equipment seems to have developed as soon as it has been installed, so perhaps capability itself supplies the need!

Economics are hard to determine in advance and, in fact, new equipment can usually be justified only on a 'cash flow' basis, taking into account depreciation allowances and so on. If conventional accounting methods were applied we would probably not buy any new equipment.

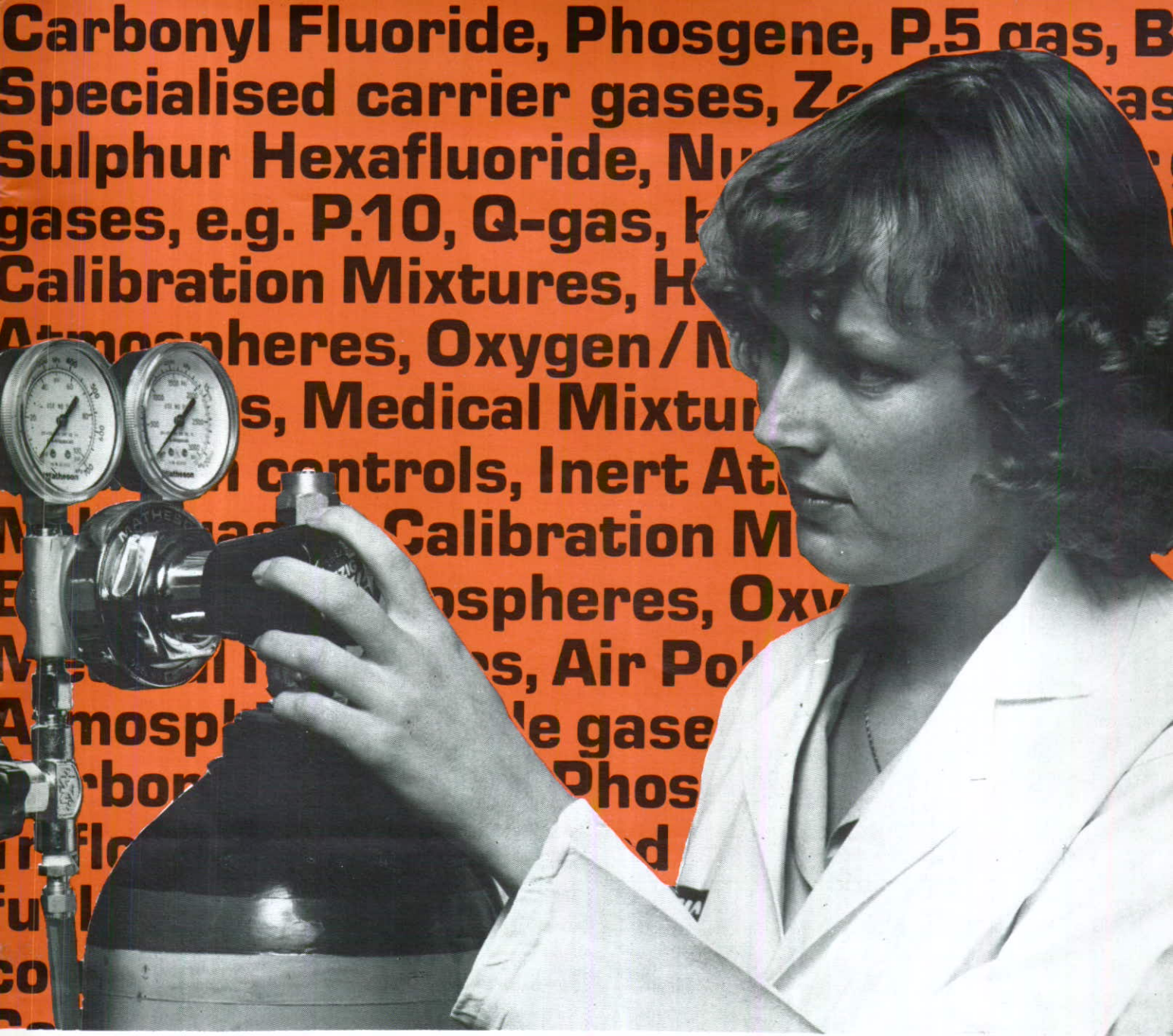
Finally the decision of make and supplier... Firstly, we need the widest possible versatility in any new apparatus and only the best which we can afford will do. And, in fact, we will normally do without equipment rather than buy a cheaper model. It is better to wait a little to be able to buy the best available. After all, the first cost is usually forgotten fairly soon, particularly if the equipment is a joy to work with.

As far as suppliers are concerned, T.J. Sprott & Associates is perhaps of the old school. We place great store on loyalty, both to suppliers as well as clients. We do not lightly change suppliers and will not be enticed away from one who has been a faithful supplier, simply because of a cut price offer. We may have the reputation as hard negotiators. It is probably true, but we stand for fair dealing both as buyers and sellers and we believe that our many suppliers take the same view.

Finally, having bought a piece of apparatus, we always extend the invitation to the supplier that he may at any time refer prospective buyers to us and bring them to see the equipment in an actual working environment, to bring with them samples for processing and so on. And this same invitation is extended to all those who are interested in analytical equipment. Members of the Institute, and all those who are interested in analytical chemistry, equipment, methods and so on, are always welcome.

After all, you may decide not to buy the apparatus after all and elect to have the work done by us!

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## The Fletcher Memorandum



Midwinter greetings!

It's probably not new developments in chemical science that will affect our profession over the next decade or so, but rather advances in microprocessors, changes in legislation and social attitudes. If this is so then, in order to remain 'professional', one wonders what continuing education the Institute should be offering its members.

The NZIC has faced up to this with a series of mini-courses covering many aspects of the engineering profession. Some University Extension Departments and Technical Institutes are offering short courses including cassette tape/slide versions you can do at home (in bed?).

Could promoters advise the editor so that we can publicise them?

In this vein, the Royal Society has some films available (mainly for schools and tertiary institutions). They are:

- Social evolution in 2 Mexican ant species
- Biology of the Leech
- Circulation of Water in Karst
- Medicinal drug development
- Energy and Agriculture
- Planet Mars
- Nuclear Power: Pro and Con

Intrigued to note that **Drs G. Wright, A. Metcalf and P. Harland** carried the Chemistry-in-Action programme to Timaru (350), Westport (70) and Greymouth (70). Well done. **Harry Percival** tells me he addressed a large crowd of potters and chemists in Christchurch recently. Meanwhile Aucklanders — together with Australian Corrosion Association — listened to a mighty talk on osmosis (causing unwelcome curves) in fibreglass reinforced boats. Seems these "mixed" meetings are a good idea for cold winter nights.

The NZ Winston Churchill Memorial Trust is inviting applications from "persons of ability and experience, whether gained professionally or otherwise, who will contribute to the general advancement of their field, or to the

benefit in general of NZ". (Readers of 'Penthouse' need **not** apply!). Application forms from Box 12347 Wellington.

The International Union of Pure and Applied Chemistry has produced two reprints from its news magazine "Chemistry International":

"Presenting your Research Results" (a manual for chemists presenting papers at international chemistry conferences) and "Index of Chemical Nomenclature". The former should be mandatory reading for every "paper giver". Copies available from the Registrar, Box 1926 Christchurch.

IWD Ltd public relations office is offering speakers on 2,4,5-T and other subjects. Good for everyone to hear "the other side". Contact **Rosalene Newman**, IWD, Box 144, New Plymouth.

Fascinated by a career success story in a recent 'Management' magazine. It follows the success of **John Wareham** from a raw graduate to the head of his own international recruitment consultancy, Wareham Associates. Does anyone know of an NZ chemist who has had similar success in building a chemical empire?

Cheers — see you at Conference!



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## BRANCH NEWS

### Manawatu

On May 13 the Branch held an Energy Symposium at Whararata, Massey University. The symposium was chaired by **Dr I.D. Watson** (Department of Chemistry, Biochemistry and Biophysics, Massey University), a member of the NZIC Energy Committee. **Mr W.F. Birch**, Minister of Science and Technology, discussed a wide range of possible future developments in his paper entitled 'A synopsis of energy strategy in NZ'. **Mr R.W.L. Makeig**, Planning and Supply Director, Mobil Oil (NZ) Ltd, spoke on the 'Conversion of Natural Gas to a Suitable Petroleum Fuel by the "Mobil Process"'. The meeting concluded with an address by **Prof A.L. Titchener**, Technical Director, Liquid Fuels Trust Board, on the 'Production and Potential uses of Methanol'. Lively question and answer periods followed each address.

The June meeting took the form of a Mini-symposium on Lipids in which the structure, synthesis and analysis of triacylglycerols (triglycerides) were discussed. **Dr J.C. (Clem) Hawke** (Department of Chemistry, Biochemistry and Biophysics, Massey University), chairman of the Symposium, provided a brief introduction on the subject of 'Stereo specificity in Triacylglycerols'. **Dr R. (Bob) Norris** (NZ Dairy Research Institute, Palmerston North) discussed current methodology and problems in the

synthesis of triacylglycerols. Stereo-specific analyses of triacylglycerols by the Brockerhoff method, with examples from studies on the composition of milkfat, were discussed by **Dr Mike W. Taylor** (Food Technology Department, Massey University). **Dr Paul T. Callaghan** (Department of Chemistry, Biochemistry and Biophysics, Massey University) described the use of various aspects of  $^{13}\text{C}$  nmr spectroscopy to study molecular dynamics of tristearoylglycerol and related lipids. The Symposium concluded with **Dr Cecil B. Johnson** (Applied Biochemistry Division, DSIR, Palmerston North) giving a brief description of methods that have been developed for the location of double bonds in unsaturated fatty esters and possible ways that limitations in these methods may be overcome.

The Branch's 1980 Annual Addresses to 6th and 7th Form pupils in the Manawatu and Hawkes Bay area were presented by **Dr Robert R. Brooks** (Department of Chemistry, Biochemistry and Biophysics, Massey University) on the 'Environmental Chemistry of the Heavy Metals'. Dr Brooks spoke principally on environmental pollution by various mercury and lead compounds throughout NZ. Other contaminants, eg arsenic and cadmium, were discussed during the question period at the end of Dr Brooks' presentation.

The Branch will hold its AGM on Monday October 13 at 7.30 p.m. in the NZ Dairy Research Institute's cafeteria. The Chairman's address will be given by **Mr Stan White** on 'A Chemist in the Freezing Industry!' Further information about this meeting is available from **Mr M.W. Pritchard**, Grasslands Division, DSIR, Palmerston North.

### Wellington

The Presidential address from **Prof A.D. Campbell**, Otago University, was given at the May meeting. He spoke on 'Analytical Chemistry' and discussed the place of

analytical chemistry in University undergraduate courses and its status as a profession, the registration of analytical laboratories, and some recent advances in analytical chemistry.

The June meeting involved a visit by branch members to the Unilever factory at Petone. A brief explanation of the processes for the manufacture of detergents and soaps etc was given, followed by a tour of the plant.

### Canterbury

The April meeting was organised by the Chemical Education Group. **Terry Hitchings**, principal of Riccarton High School, spoke on 'Chemical Education — how do we stand internationally?' and was able to draw upon his experiences at recent chemical education conferences he attended in Ireland and Yugoslavia.

The May meeting was held jointly with members of the NZ Institute of Food Science and Technology. **Prof Paul Mulcock**, Department of Microbiology, Lincoln College, spoke on 'Ethanol Production through the ages'. Following the meeting members availed themselves of the opportunity to make a gas chromatographic analysis of their own home brews and following this they put the beverages to a more intimate test.

The June meeting was combined with the Canterbury Potters' group. The speaker was **Dr Harry Percival**, Director of PACRA, whose talk was aimed jointly at the chemists and the potters, the title being 'Earth and fire — the chemistry of pottery'.

### Chemistry In Action Series 1980

This series of lectures for senior school pupils has been operated for many years now by the Canterbury Branch. This year the programme was for the first time taken across the Alps to the wilds of the West Coast.

Some 200 Christchurch 6th and 7th formers heard **Dr Gordon Rodley**,

### ACROSS:

- Kind of appendage found on 7s without medication (6).
- Sweet syrup, with the Queen out in a cold bath (6).
- Group smaller than its homologue, but a thousand greater (7).
- Hold tight with a hundred fish (5).
- Editor, and man responsible for degradation (5).
- Vile element? Without, that is a hard metal (7).
- Splinter of 'airs? Mostly active without oxygen (11).
- Opposed to slang information, and attacked by some globulins (7).
- Taste of a point in the desert (5).
- Painter without 19 (5).
- E.g. like a rose in the middle by the sound of it (7).
- Fully reduced car (2,4).
- Branch of chemistry

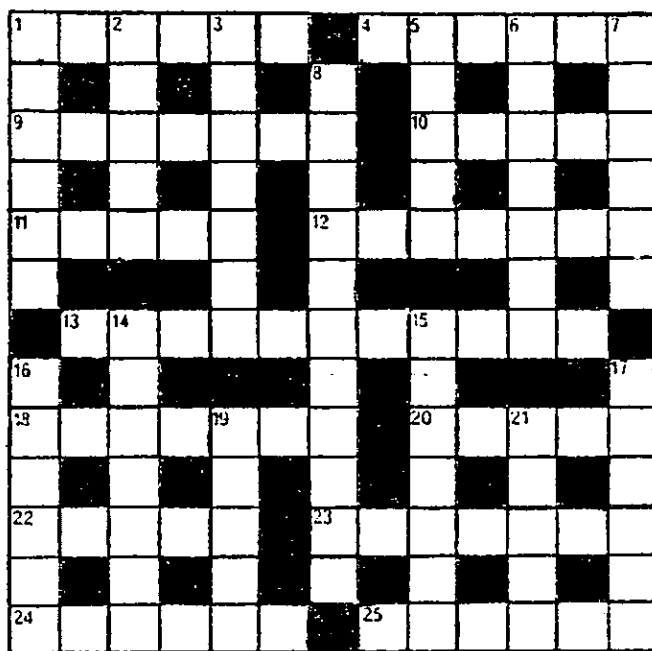
from a cubic metre, and nothing more (6).

### DOWN:

- 14 without feeling (6).
- A singular finding? (5).
- He drank the queer old dean's health (7).
- Milky prefix (5).
- They attack my results, constructively one hopes (7).
- French vegetables, but may take advantage of 13 in English (6).
- Another activity of 13 (11).
- A type of 1 down, but not real (7).
- The newborn smell of sodium? (7).
- ... the fats by swapping a point for its neighbour in 8 (6).
- 22's equivalent of a lab (6).
- Substrates for 8 and 13 (5).
- Did this make the fruit 20 23? (5).

# Chemical Crossword

By Laurie





# University News

## Auckland Chemistry Department

**Prof Barry J. Welch**, University of NSW School of Chemical Technology, has been appointed to the Chair of Chemical and Materials Engineering. He takes up his appointment in November, replacing as Head of Department **Prof A.L. Titchener** who is now Technical Director, Liquid Fuels Trust Board.

**Dr David E. Williams**, formerly a Research Officer at IMI Titanium in Birmingham has moved to the AERE, Harwell to undertake applied research on electrochemical and materials problems.

**Prof B. Kamenar** is visiting the department in the second half of 1980. He is Professor of General, Inorganic and Crystal Chemistry at the University of Zagreb, Yugoslavia, and is the immediate past President of the Croatian Chemical Society.

The following visitors delivered lectures in the Department: **Prof A.R. Battersby**, Cambridge University; **Prof P. Le Quesne**, Northeastern University, Boston, Massachusetts; **Dr M. Davis**, La Trobe University; **Prof E. Frieden**, Florida State

## Branch News (Cont)

Canterbury University Chemistry Department, discuss the question 'DNA — do we really know its structure?' As well as becoming better informed on the subject of DNA itself those present will have learned that it is healthy to question scientific 'facts', that chemists don't know the answers to many complex questions, that our chemical knowledge expands almost daily through publications and that today progress often involves application of a wide range of physical techniques at the interface between traditional scientific disciplines.

The Norah Dickie Hall in Timaru responded to bangs, pops and other chemical wizardry as **Dr Alan Metcalfe** intrigued some 350 South Canterbury students with a discussion of 'NZ energy resources and their utilisation'. As well as being spectacular, chemistry can also be rewarding, varied and challenging, as **Dr Graeme Wright's** illustrated talk to the same audience on 'Careers in chemistry' was able to demonstrate.

The Timaru programme was taken on an extended tour this year, for the first time being repeated to capacity houses in both Greymouth and Westport. The speakers at these venues were **Dr Peter Harland** (substituting for Alan Metcalfe) and **Dr Graeme Wright**.

## Otago

In May **Prof E. Richards** of Massey spoke on sugar-amine reactions in flavour development.

In June there was a dinner at the Otago Polytechnic, followed by a joint meeting with the Otago Teachers' Association with a panel discussion on the interface between secondary and tertiary chemical education.

University; **Prof E. Vogel**, University of Cologne; **Dr L.N. Mander**, Australia National University.

**Dr D.J. McLennan** will present a paper to the IUPAC Physical Organic conference at Santa Cruz, California in August, and will then visit universities in USA, Canada, UK, Ireland and Israel.

## Massey

### Sheep Husbandry Department

A World Congress on sheep and beef cattle breeding will be held in NZ from October 28 — November 13. The aims and objects of breeding programmes in NZ, especially those developed in the last few years, will be described by sheep and cattle breeders and animal scientists. Technical sessions will be held at Massey (November 3-5) and at the Christchurch Town Hall and Lincoln College (November 10-12). The application form and deposit must be received by the Congress Organiser by September 15. Further information may be obtained from **Dr R.A. Barton**, Congress Organiser, Massey University, Palmerston North.

## Victoria

**Dr John Featherstone** left NZ at the end of June to take up a research position at the Eastman Dental Centre, Rochester, NY, USA. He will continue his investigations into the fundamental chemistry of dental decay and its chemical reversal or prevention. The work will be supported by a large NIH grant.

**Dr Featherstone** was a MRC Senior Fellow based jointly at the Dental Research Unit and in the Chemistry Department, Victoria University. One recent aspect of his work has been the development of a mouthrinse which will rapidly diffuse into areas of early decay and rebuild the enamel. This was to be presented at the European Caries Research Organisation meeting in Marburg, Germany, July 1980. Another area of study which will continue in Rochester is the role of trace elements such as fluoride and zinc from drinking waters in the chemical reactivity of dental enamel (apatite). The properties of apatite can be changed markedly by substitute atoms. In some areas of USA the natural water supply trace element content has been linked with very low dental decay levels. A study of the basic chemical process involved is necessary in order to use this information for preventive measures.

**Mr D. Nelson** is the 1980 recipient of the Colgate Travel Award, available to young

research workers under the age of 35 years. He achieved this distinction as a result of his student paper presented at the annual meeting of the NZ International Association for Dental Research in Dunedin in late May. The award takes him to Adelaide for the 1980 Australasian meeting in August.

**Prof G.O. Aspinal** (York University, Ontario) visited the Department and delivered a seminar entitled 'Chemical Approaches to the Structures of Polysaccharides and Glycoconjugates', while en route to the IUPAC Carbohydrate meeting held recently in Sydney. A large contingent of the Victoria carbohydrate group, headed by **Prof R.J. Ferrier**, also crossed the Tasman for this international conference and presented papers at the meeting.

## Canterbury

### Chemistry Department

Recent visitors who have given seminars and lectures have included **Dr Michael MacLaury**, General Electric Co., New York (Fundamental and applied research in a large multinational corporation); **Prof Christopher Reed**, University of Southern California (Spin state/Stereochemistry relationships in Iron Porphyrins); **Prof Emmanuel Vogel**, University of Cologne (Arene Oxides); **Prof Rubin Battino**, Wright State University, Ohio (Fun approach to Thermodynamics); **Dr Jack Elix**, ANU, Canberra (Lichen Chemistry); **Dr Raymond Butcher**, Howard University, Washington DC (Structure of Nickel Dimers); as well as the perennial **Stan Brooker** of no fixed abode (Fats Chemistry).

**Prof Michael Hartshorn** recently returned from a visit to USA and UK during which he attended the annual meetings of both the ACS and the Chemical Society and visited a number of laboratories.

## Otago

### Biochemistry Department

**Dr John Cutfield** has left for a year's study leave at the University of York.

**Dr Tony Reeve** has taken up an appointment as research officer with **Dr R.T. Wilkins** whose research is funded by the National Cancer Society, the Otago Medical Research Foundation and the Medical Research Council.

**Dr Ian Forrester** presented papers at two meetings in USA in May and June. The first was sponsored by the Academy of Sciences and was concerned with the structure and function of Calmodulin. The second was at the University of Wisconsin on Calcium binding proteins.

### Pharmacology Department

**Dr Rosemary Beresford** has been appointed temporary lecturer.

## News From Govt. Departments

### DSIR — Chemistry Division

**Dr B. Cleverly** from the organic section has resigned. **Mr L.J. Wright**, who recently completed work for a Ph.D. at Auckland University, has joined the Natural Products Section. **Mr V. Williams**, a recent

graduate from Otago University, has joined the organic section. **Mrs H. Beaumont**, a recent graduate from Massey University, has joined the Water Laboratory.

Chemistry in New Zealand

## Cover Story

# Better Service The Cornerstone Of KMS Marketing Strategy

A comprehensive client service, which includes carefully selected products and salespeople, is the cornerstone upon which the recently restructured Kempthorne Medical Supplies Ltd. is attracting more business in an already competitive marketplace.

It has also adopted a novel approach in marketing scientific and laboratory equipment to a discerning clientele. Late last year, KMS introduced its 'open warehouse' marketing concept where products are displayed so that potential buyers can wander around, browse and select without escort. Warehouses are located in Auckland, Wellington, Christchurch and Dunedin. Knowledgeable sales staff are, of course, readily available to answer questions and provide information.

Has this concept succeeded? The answer, according to KMS Scientific Department product manager **Paul Balchin** and the company's marketing manager **Donn de Silva**, is a firm "Yes". But the company has taken its client service some steps further.

Periodically, it invites selected clients to what could be called 'social sales forums' whereby they are given individual attention, briefed on specific product developments in a relaxed 'soft sell' atmosphere with refreshments provided.

For additional buyer convenience, the company also has small but well-stocked consumer goods showrooms at 2 locations where household durables and similar products may be purchased at wholesale prices.

The company is maintaining its commitment to service by continuing to stock at its 4 warehouses.

In addition to regular sales representative calls, KMS customer service staff periodically visit clients to meet purchasing officers and others who may be just voices over a telephone or signatures on an order. "We place great value on face-to-face contact with our clients," says Mr Balchin. "If you know the person to whom you're speaking, it makes matters much simpler when a client has a problem he believes we can solve."

Although, in fact, a new company — it was formed early this year following the acquisition and merger of Kempthorne Prosser and Medical Supplies by NZ Farmers Fertiliser Co Ltd. — KMS bears a name which dates back to NZ's colonial era. In fact last year this country's pharmaceutical manufacturing industry — launched in 1879 by Australian drug salesman T. Kempthorne and Welsh chemist E. Prosser — celebrated its centenary.

But herein lies one of KMS corporate problems. "Many people have for so long equated the name Kempthorne with pharmaceuticals that it has been a challenge for us to 'sell' our name and services in the scientific and laboratory equipment field," comments Mr Balchin.

Currently the company's growing market share and committed backing by the parent company is resulting in its being sought after by leading manufacturers for its distribution expertise. To complement this healthy situation, KMS general manager **Bryan Mogridge** has just returned from an overseas trip to the company's principals and other interested parties, spelling out future plans.

The new company's main objective is to provide a wide range of quality consumables, durables and instruments (many ex stock) in an efficient and timely manner to the scientific market. Mr Balchin emphasised this by stating that "ex stock we can supply from a simple filter paper to a state of the art Swiss analytical balance."

Representative of KMS product range are the following:

- **Precisa** electronic top loading balances catering for requirements from 0-300g to 0-3500g. Reflecting the engineering precision for which the Swiss are renowned, these balances feature up to date electronics and are competitively priced.
- **Zeal** thermometers and hydrometers. KMS is NZ's largest stockist of this high quality unit and offers an extensive ex-stock selection.
- **Whatman** filter papers and associated products. Again a comprehensive ex-stock selection is offered.
- **Megason** ultrasonic cleaners featuring instant start, constant power, 80kc frequency for high speed precision

**Dr C.D. Stevenson** (Water Laboratory) recently spent 4 weeks in China as a consultant for the World Health Organisation assisting at a training course in Peking on Water Quality monitoring and management. The course participants were selected from anti-epidemiological stations throughout China.

### DSIR — Applied Biochemistry Division

**Dr Gwyn Moseley** from the Welsh Plant Breeding Station, Plas Gogerddan, near Aberystwyth, arrived here in May for a 12-month study period. Dr Moseley has received a Stapleton Travelling Fellowship and will be working in the Division's Nutrition Group on the breakdown of feed in the rumen and its passage out of the rumen.

**Dr R. (Dick) T.J. Clarke** recently returned after 12 months' study leave at the University of Utrecht, The Netherlands and the University of Alberta, Canada. Before leaving NZ, Dr Clarke was elected to be the NZ member of the Management Committee of the 'Co-operative Research Project on Food Production and Presentations', a project operated under the auspices of the Organisation for Economic Co-operation and Development (OECD). While in Europe he attended several OECD meetings.

**Mrs Jane E. Lancaster** of the Lincoln substation recently left for 4 months' study leave at Liverpool University. She will be visiting the Institute for Horticultural Plant Breeding, Wageningen and the Technical Research Centre of Finland. While overseas Mrs Lancaster will be studying the flavour precursors of and the composition of onions as well as other aspects of the biochemistry of major vegetable crops.

**Prof Reg Moir** recently left here after spending 3 months of his sabbatical leave (from the University of Western Australia) in the Nutrition Group of the Division. While here, Dr Moir addressed a seminar on 'Sulphur Metabolism in Ruminants'.

**Prof J.G. Torrey**, Maria Moors Caliat Foundation for Botanical Research, Harvard University, Boston, a recent visitor to the Division, presented seminars on the 'Potential of actinorhizal plants in biomass production' (at ABD) and 'Problems associated with root differentiation and physiology' (at PPD). These seminars centred on recent experimental discoveries on the non-legume-actinomyces (actinorhizal) symbioses.

### NZ Dairy Research Institute DRI Board

**Prof A.G. Williamson** has been appointed by the Minister of Science and

Technology to the Board of the Institute following the expiry of the second term of **Dr R.H. Thornton**. The Migister has also advised that **Dr R.W. Bailey** will serve as an 'alternate' to **Dr G.W. Butler** who normally deputises for **Dr E.I. Robertson** on the Board of the Institute.

### Staff Movements

**Dr Peter S. Robertson** recently travelled to Australia, USA and Canada to visit dairy processing and research establishments as part of a familiarisation with the world dairying scene following his appointment as Director.

**Mr Peter G. Hobman** recently travelled to USA and Europe with a Dairy Board mission to assist in the investigation of methods for utilisation of the components of whey.

**Mr John J. Higgins** attended the VIth International Fermentation Symposium in London, Ontario, during July and also visited a number of companies who are producing alcohol by fermentation.

New staff appointed recently include **Dr Jim Barnett** (Effluent Technology), **Miss Philippa R. Lorimer** (Product Evaluation) and **Dr Peter G. Wiles** (Engineering Services).

## KMS Strategy (Cont)

- cleaning, heterosonic frequency sweep.
- **Eppendorf** precision equipment for pipetting and dispensary use. This German company is an acknowledged international leader in this technology.
  - **Precision Sampling** syringes to meet the highest analytical demands.
  - **Clements** laboratory centrifuges with a wide selection of tube carriers and adaptors (models usually ex stock). Either unispeed for large batch centrifuging or multispeed for large batch and investigative work.
  - **Chemtrix** low cost instruments and electrodes for environmental, industrial and scientific measurements. This US company is a major supplier of such products.
  - **Morbank** high quality volumetric glassware. A wide range of pipettes, flasks, cylinders and separating funnels is available.
  - **Bel Art** laboratory plasticware and associated labware is among the most impressive ranges available and a large selection is held by KMS for ex stock delivery.
  - **Activion** hollow cathode lamps suitable for use with any atomic absorption spectrophotometer. A selection is available.
  - **Alltech Associates** offer everything for chromatography — and prove it with a 160-page catalogue.

Backed by these suppliers of international repute, KMS has good reason to face the future with confidence and, importantly, has charted its course accordingly.

## Australian Display Produces Worthwhile Sales

Sales figures recorded by exhibitors at the Australian Measuring, Testing and Control Equipment Display held in Auckland in June indicate that Australian firms should eventually be able to substantially increase their share of the \$30 million NZ import market for this specialised equipment. Immediate sales of over \$100,000 were recorded, while more than \$400,000 of further sales are being negotiated.

Thirteen Australian forms exhibited new products and systems at the 3-day trade display. One of the aims of the exhibitors was to consolidate existing agency arrangements.

Products displayed highlighted the depth and breadth of the specialised sector of Australian industry represented in the display; several exhibitors launched new products on the local market. One introduced a spectrum computer while another presented a range of testing equipment suitable for electrical authorities and for testing laboratories.

Even highly specialised equipment, such as salinometers and digital phase angle meters found buyers among the broad range of visitors to the display.

Commenting that sales figures for those firms exhibiting at the display pointed to a sound future for Australian exports to NZ

The display marked an important milestone for Niven Process Engineering (NZ) Ltd., whose principals, Wallace & Tiernan Pty Ltd., were exhibiting. Nivens this year celebrates its 53rd year of representation for the US-based company, making it the oldest non-US agent in the W & T international network.

of the specialised equipment represented, an Australian Trade Commission spokesman said:

"Major capital development projects planned in NZ for the 1980s will further enhance sales. These projects include development in the fields of petroleum gases, synthetic fuel, oil refining, steel, aluminium, timber processing and paper production."

The spokesman said the recent liberalisation of our import licensing controls on certain types of measuring, testing and control equipment enabled several exhibitors to take advantage of a market previously protected from imports.

Immediate sales of equipment as a result of the display exceeded \$100,000. However, further sales of \$440,000 are now being negotiated.

The sales impetus of the display is expected to be reflected in sales here over the next year, of Australian measuring, testing and control equipment worth at least \$870,000.

More than 400 trade visitors attended the display, including 48 people from other centres — Wellington, Christchurch and New Plymouth — who were flown to Auckland as the ATC's guests.

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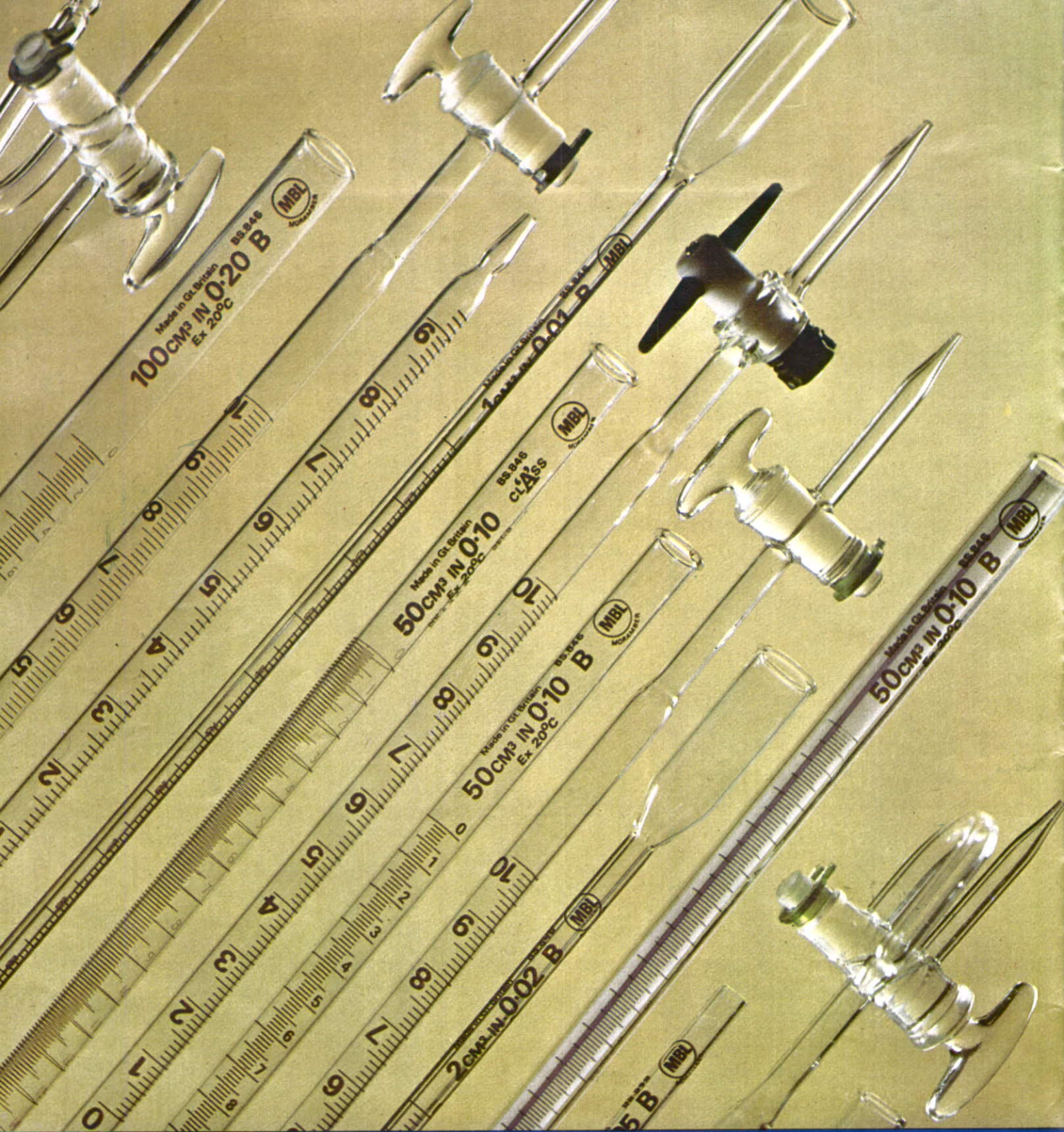
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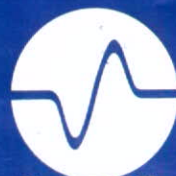
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