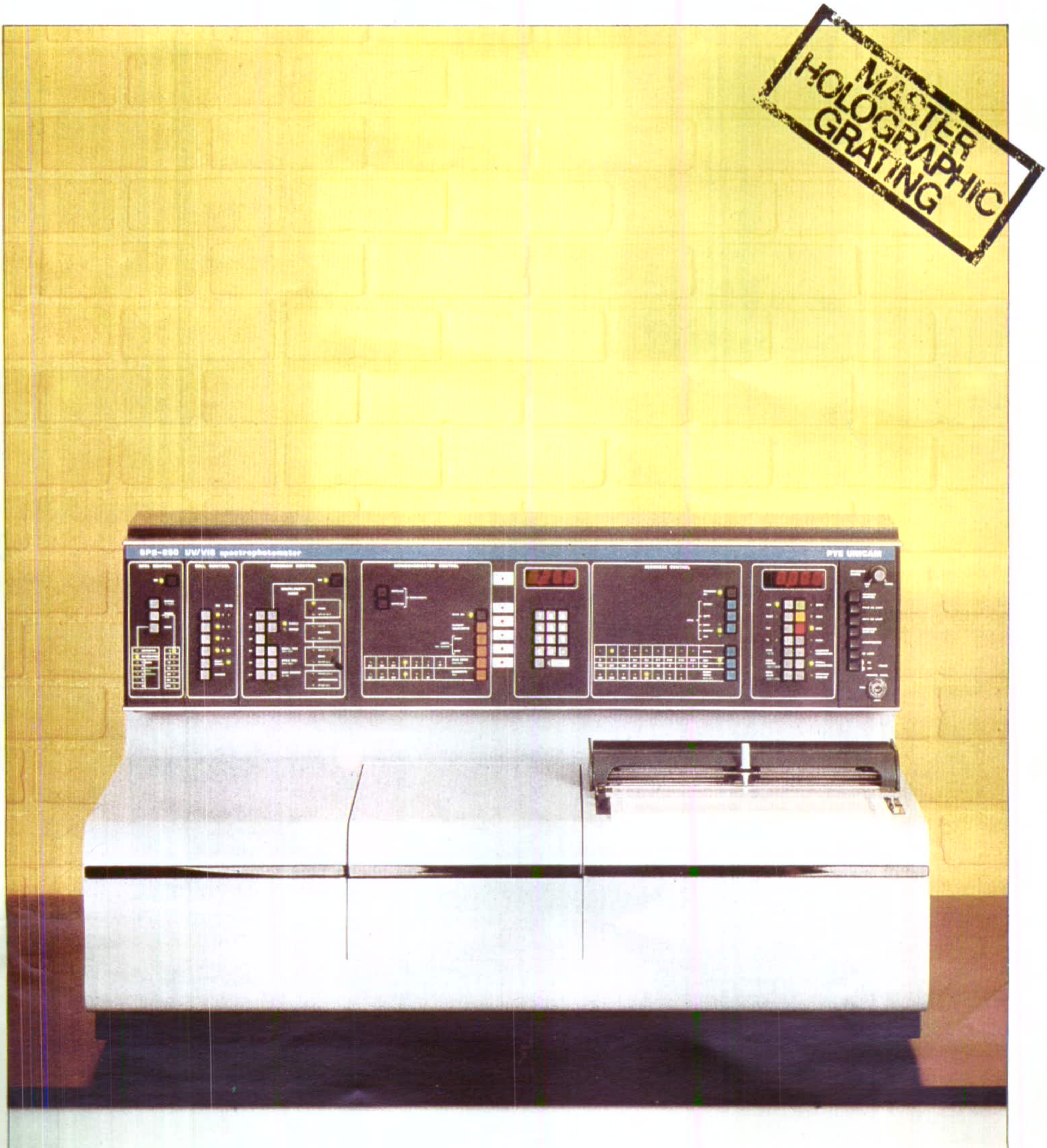
June 1979 Vol. 43 No. 3

Chemistry in new zealand

Official Journal of the New Zealand Institute of Chemistry



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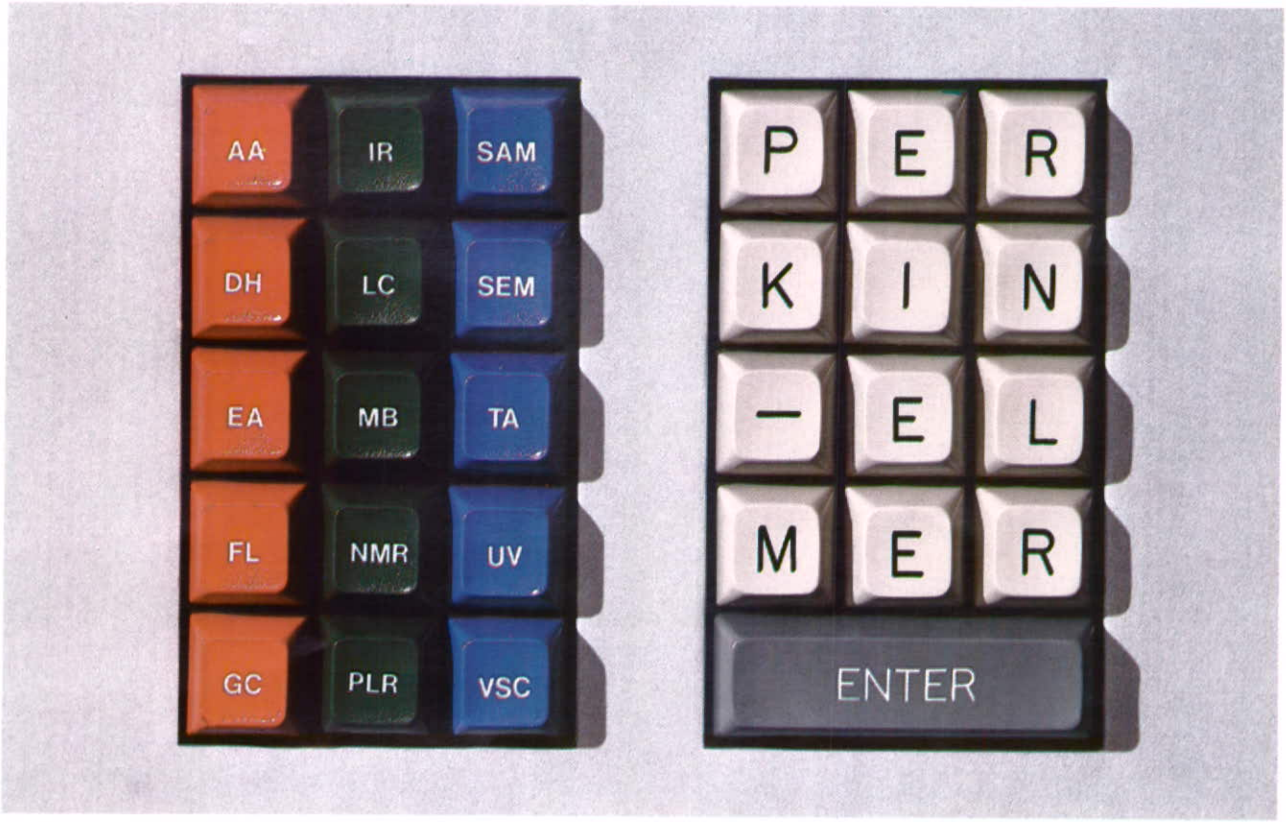

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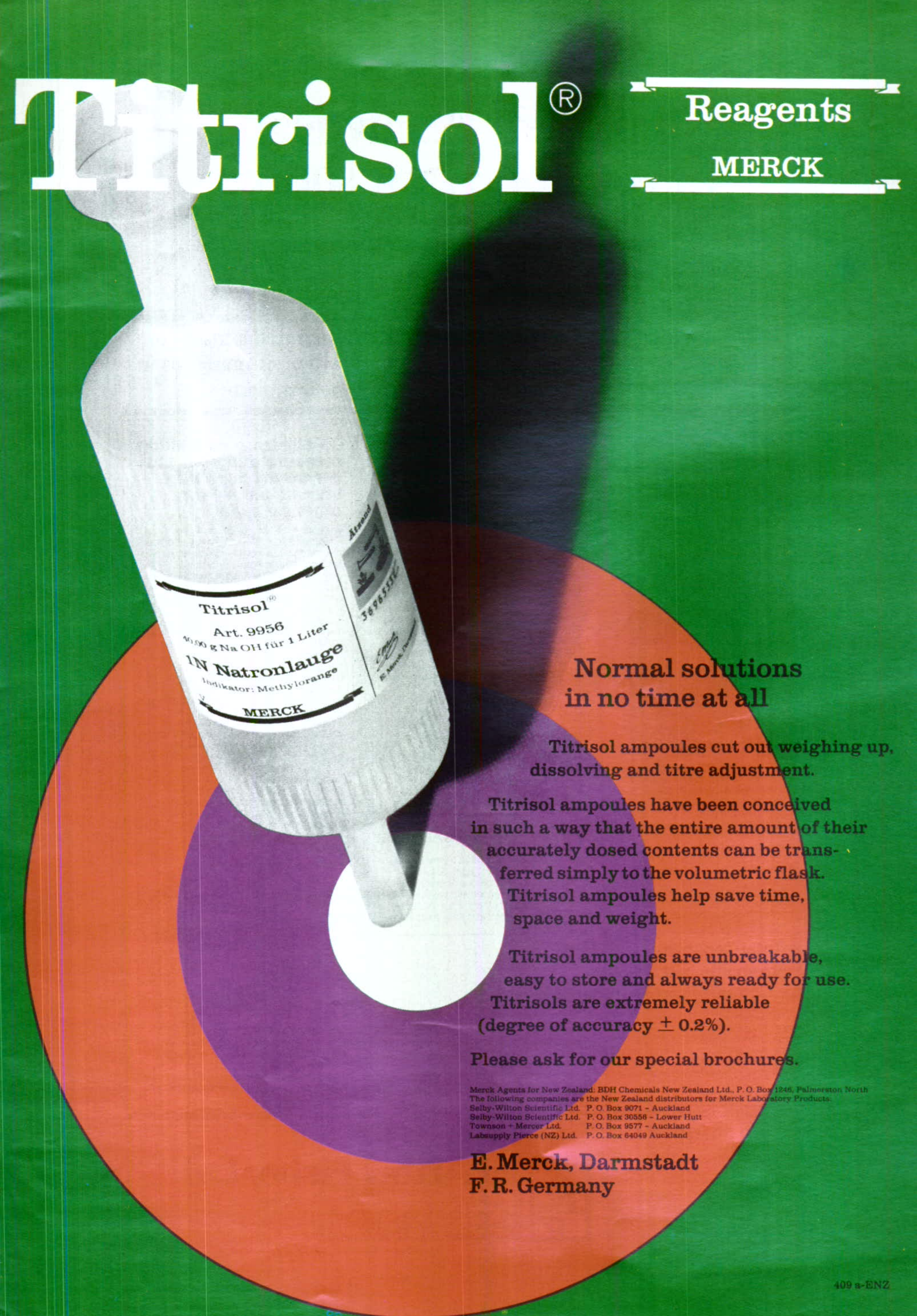
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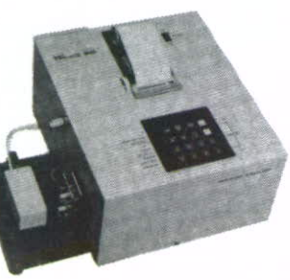

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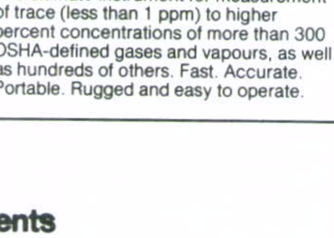

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Guest Editorial

Biochemists And the Institute

BIOCHEMISTS AND THE INSTITUTE.

It is recognised that biochemistry is a young science. Although the first Department of Biochemistry was established in the 1940's the great expansion in this discipline has only occurred since the mid-60's. There are now Departments of Biochemistry at Otago, Massey, Victoria. Lincoln and Auckland. At Otago we presently graduate between between 30 - 40 biochemists at the B.Sc. level per annum. These graduates enter many different areas of employment, including Government research institutes, such as the DSIR and MAF, health service laboratories, University research groups, industry and school teaching where a biochemist can span both chemistry and biology. Considering that the NZ economy is firmly based on biological products it is probably not surprising that there have been ample employment opportunities for graduates in biochemistry. One has only to examine the contents of the recent Institute of Chemistry book "Chemical Processes in NZ" to see the emphasis on biological materials. Traditionally, there have been strong links between chemists and biochemists in NZ and many biochemists are long-term NZIC members.

The biochemist seeks to describe in the language of chemistry the processes occurring in living organisms. A corollary of this definition would be that biochemists must have a sound background in chemistry. Biochemistry is a quantitative science using the skills of the chemist. The development of techniques such as chromatography, radiochemistry, X-ray crystallographny and spectroscopy were essential to the progress of biochemistry.

In NZ there is a Biochemical Society with the stated objective of advancing the science of biochemistry in NZ. It caters primarily for biochemists in university and research organisations. The membership fee to the Biochemical Society is relatively small and is spent almost entirely on bringing overseas biochemical visitors to the various university centres. Because of the academic nature of this activity, the Biochemical Society has little contact with biochemists in industry, schools and polythecnics and service laboratories; i.e. the majority of our B.Sc. graduates. For these people the Institute is an appropirate professional body willing and able to represent their interests. The formation of the Chemical Education group in the Institute demonstrates but one way in which the Institute can serve these groups. The annual conference facilitates the interaction that is essential between chemists and biochemists. The journal provides communication between industry and applied and pure research, much of which in NZ is biochemical. Our scientific community is far too small to support a large number of professional bodies and societies. All biochemists might do well to consider the advantages of joining a long established professional body which has their interests at heart.

Max Shepherd
Dept. of Biochemistry
University of Otago.

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CONTENTS

ALSO FEATURED IN THIS ISSUE: 1979 NZIC CONFERENCE REGISTRATION FORM AND PROGRAMME OUTLINE

STOP PRESS

This space reserved for late news immediately before press time.

NZIC Annual General Meeting 1979

The 1979 Annual General Meeting will be held at Victoria University on August 21, 1979. All members are invited.

AGENDA:

1. Apologies.
2. Minutes of 1978 AGM.
3. Annual Report.
4. Annual Balance Sheet.
5. Election of Officers.
6. Awards and Prizes.
7. Remits
8. General Busines.

Remits: In order to encourage discussion of relevant issues at the AGM, members are invited to submit remits on specific topics.

Remits (including a brief statement of the case of references to sources) should be submitted to the General Secretary, P.O. Box 1926, Christchurch, preferably by July 30.

Only **recommendations** will be made by the AGM, allowing Council to consider Branch opinion, including members unable to attend the AGM, before appropriate action is taken.

J.G. FLETCHER
General Secretary.

ELECTION OF OFFICERS

Pursuant of Rule 16.2 nominations are called for the Offices of (a) Second Vice President, (b) General Secretary, of this Institute. Such nominations which may be made by Branches or any six members, should be made in writing to the General Secretary, P.O. Box 1926, Christchurch, so that they arrive before June 30, 1979. In the case of more than one nomination being received for each of the above officers, then an election or elections shall be held by postal ballot of all members as detailed in Rule 16.6

PROFESSIONAL SITUATIONS WANTED

Organic chemist (Ph.D.) with post-doctoral experience in the field of biologically active compounds seeks position in the fields of synthetic organic chemistry, natural products, biologically active compounds or medicinal chemistry.

Replies to: **CNZ 1001, "Chemistry in NZ", Box 9512, Newmarket, Auckland.**

Comment

Polemics From the Pulpit

We were cheered by the messages of acclaim from our readers on the February issue. We cannot take all the credit: the new impact was due more to the kneedrill of Peter Reaves than to our own exegesis. We would advise those who felt the typeface to be a little small that negotiations with the opticians have broken down so there should be no further complaint.

Since we last spoke **ex cathedra** we have had heart-warming visits to the faithful in the Waikato, Otago and Canterbury Branches; as a result of which we have been described as "ubiquitous" which we can to add our present ecclesiastical and avuncular titles. We were impressed with the life in these Branches and the energy as well as thought put into the service given by various officials without whom the NZIC would not function. As a result it is in good heart. This is not to say there are not weaknesses such as a failure to fully capture the interest of our communicants in industry who constitute the largest part of our membership. One result which particularly concerns us is the difficulty about getting news of the acts of these apostles and their unconverted (non-NZIC) brethren. We must leave it to a later message to expand on this theme; in the meantime we will observe with interest the effect of the industry-orientated programme arranged by the Wellington diocese for the August synod. The newly fledged Industrial Group has our especial benediction.

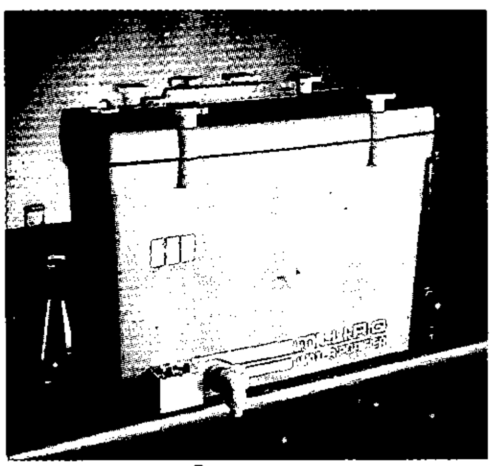
A highlight of our pastoral visit to the South was learning about the celebration of the Einstein centenary at Canterbury which is reported on another page. We hope also to publish later an article on Einstein and chemistry; in the meantime we would like to share some thoughts with you on the text from the Book of Relativity E-mc^2. This fits in with Dr Garth Harris' paper, given at ANZAAS, on the subject of energy options which we publish in this issue, and energy in some form or other will be news for a long time to come. We also heard the Minister of Energy speak to the Auckland Branch energetically but these clerical friends have not said everything. Dr J.E. Sharpe, Queen Mary College, London, is confident that coal fired locomotives on the fluid bed principle would be more efficient than the present diesels. On the biological side Prof. Hughes of Cardiff claims there are possibilities in energy derived from genetically obese strains of rats or worm farming on a tonnage basis.

What about harnessing the energy of joggers which is so great that we have heard about collisons between them and cars where our four wheeled friends came off second best (and threatened to retaliate, we hear)? We suggest a neat contrivance by which these energetic individuals could work on tread mills with racks in front of them for Chemistry in New Zealand and other reading material so that a threefold object could be achieved: useful energy, fitness and keeping up with the literature — always a problem. Dr D.F. Robinson, Maths Department, Canterbury, has worked out a 12-step operation by which one can calculate the savings achieved by car pooling. It is not surprising that he finds it takes less energy to ride a bike to University.

But to return to our text. Einstein claims that energy is directly related to mass but we cannot but agree with our neighbour Dora Doublechin who finds that if her mass increases, her energy goes down. But let's not be too critical; Einstein also says that E is directly related to C^2, and as we thought about this electromagnetic radiation within the wavelengths of 400 to 800 mm burst upon us — forget about Harrisburg, biomass, methanol, CNG, LPG, fat rats and all that; we will have plenty of energy by simply increasing the speed of the same electro magnetic radiation (i.e. light).

S.G. Brooker

SMALL STILLS JUST BECAME OBSOLETE.



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What's Happening

Auckland branch chairwoman, **Dr. Robyn Dormer**, is currently visiting UK; she hoped to be on hand to congratulate Mrs Margaret Thatcher on her election victory. (On her return, she's promised us comment on her trip. – Ed.)

* * *

Noted with interest by Auckland members. Since his retirement as managing director, NZ Forest Products Ltd., **Alan Mackney** has not yet missed any event to which he's been in invited.

His active involvement in Institute affairs has been confirmed by his appointment as chairman of the NZIC's 1981 Jubilee Conference committee.

Mr P.J.L. Dawson has left Rothmans' Tobacco Co., Napier and has joined Water, Soil and Laboratory Services, Napier.

Dr Michael Reid, recently at DSIR, Mt Albert, Auckland, is now with the Department of Environmental Horticulture of the University of California at Davis.

M. J.C. Young, Laboratory Manager, James Hardie & Co. Pty. Ltd., Auckland, spent from July-December last in Camellia, Sydney, at the research and development laboratory of the parent company. He worked in the building products development section, particularly on the development of new methods of fixing panels to enable structures to withstand cyclonic winds. Mr. Young noted that his close involvement with new materials and techniques enables the NZ company to provide up-to-date information to its customers.

Anzac Fellowships. Attention of readers is drawn to the Anzac Fellowships which are available for periods of 3-12 months' study or investigation in Australia. Enquiries to the Secretary, Anzac Fellowships Selection Committee, Dept. Internal Affairs, P.B. Wellington. Applications close August 1.

Churchill Fellowships are also available to NZ citizens for any project anywhere which will ultimately benefit NZ. Information from the Churchill Trust, Box 12-347, Wellington North. Applications close July 31.

NZ Industrial Gases Ltd, Lower Hutt, has won a Resource Conservation Award for a scheme which will use the 45% carbon dioxide content at present wasted to the atmosphere from the Kapuni gas stream.

Not only will this vaulable gas now be used, but the company will also make significant energy savings by abandoning the present oil burning process of obtaining carbon dioxide. The annual saving will amount to more than 2 million litres of oil, 1.5 million kilowatt hrs of electricity, and nearly 20,000l of mono ethanolamine – a liquid used to extract the CO_2 from the combustion process.

* * *

Mr. J.R. Beck, B.Sc., MNZIC, general manager, Lion Breweries Ltd; has been appointed an associate director. He is responsible for brewing and marketing, holds a Diploma from the Institute of Management, and a number of industry directorships. Mr Beck is on the executive of the Wellington Employers' Assocation, is Chairman, Institute of Brewing (Australia and NZ section), and on the executive of the Brewers' Association being chairman of its industrial subcommittee as well as being a member of the Hop Marketing Committee and the Hop Research Committee. He is a former Auckland branch manager, Lion Breweries.

Recently appointed general manager, technical division, NZ Forest Products Ltd., is **Mr. R.B. (Ron) Hall** who, as noted in our last issue, has succeeded Dr. Ashley Wilson. Aged 48, Mr Hall gained his M.Sc at Victoria University and completed a Diploma in

Hall

Beck

Business and Industrial Administration at Auckland University in 1970.

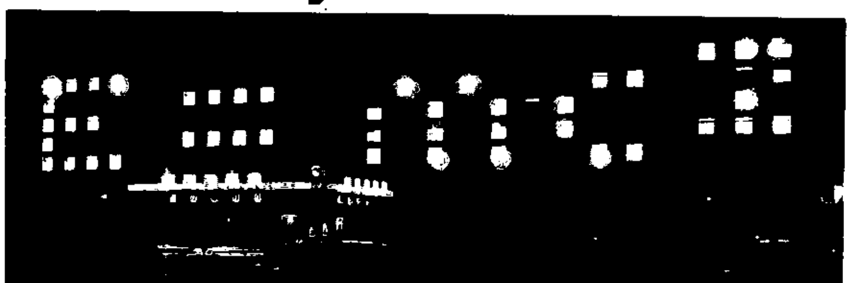
He joined NZFP in April 1953 as a chemist in the Penrose Quality Control group, transferring in 1956 to the then recently formed Research & Development section. He was appointed works chemist for Penrose Industries in 1959 and, in 1969, joined the production management team of Penrose Industries Division as manager, wallboard mills.

* * *

Early planning for the Institute's Jubilee Conference in Auckland in 1981 is already underway. A committee, headed by **Alan Mackney**, has been formed, other members being **Assoc. Prof. D.J. McLennan** (Secretary), **Mrs S. Nolan** (DSIR), **Drs W.A. Denny** (Cancer Research Laboratory) and **J.M. Robertson** (DSIR), **Messrs S.G. Brooker** (Editor, "Chemistry in NZ"), **M.G.C. Gibson** (Auckland Technical Institute) and **K. Seal** (Ceramco); a treasurer has yet to be appointed, probably from the Chemistry Department, Auckland University.

The official conference address is:
Jubilee Conference
c/- Assoc. Prof. D.J. McLennan,
Chemistry Department.
Private Bag, Auckland.

Canterbury Salutes Einstein



March 14 last being the centenary of Albert Einstein's birth, Canterbury University's Science Faculty created a fitting (and, in view of our current energy situation, economic) tribute.

Drs Brent Wilson and W. Barit (Mathematics Department), decided that the faculty should mark the occasion by using photons (an Einstein invention) to spell out the Einstein formula best known to the community at large.

They asked users on the western side of the Rutherford Buildings to switch off their lights, except for those in rooms of the required patterns.

The result, shown here, was photographed by Mr Frank McGregor, ARPS, (Botany Department). (We hope to publish an article in a later issue on Einstein and Chemistry – Ed.)

UTILISATION OF SOLASODINE AS A POTENTIAL ECDYSONE ANTAGONIST

R.C. Cambie and G.J. Potter
Chemistry Department, University of Auckland.

Contraceptive hormones and the anti-inflammatory agents derived from corticosteroids are the two major groups of steroids presently manufactured on an industrial scale. As a direct result of the dramatic increase in the sales of antifertility agents in recent years increasing demands have been placed on the supply of naturally occurring steroids from which these drugs are prepared. The total synthesis of steroids (1) is a complex and expensive process, albeit an ever-increasing area of industrial research, (2) and therefore the continued supply of steroidal drugs relies heavily on the availability of naturally occurring compounds.

At present, the major raw material for the manufacture of steroidal drugs is diosgenin **(1)**, a sapogenin which occurs as a glycoside in the yam, *Dioscorea mexicana*, **(3)** a plant indigenous to Central America. The aglycone can be converted (4) into 3β-acetoxy- pregna-5, 16-dien-20-one **(2)** in 70-75% overall yield, and this latter product is then used for the manufacture of a wide range of steroid drugs. Recently, the Mexican government nationalised the supply of diosgenin (5) with the result that its cost rose rapidly – in fact so much so, that in 1975 Mexican-derived finished steroids were often more expensive than those produced by alternative routes, including total synthesis. (5) Other raw materials are therefore rapidly assuming increased importance as intermediates in the synthesis of steroidal drugs. One such material is the spiroaminoketal alkaloid solasodine **(3)**, a nitrogen analogue of diosgenin, which is obtained from species of the *Solanum* genus.

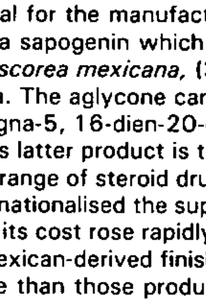
Solasodine

Interest in the *Solanum* alkaloids has been stimulated by the work of Sato, Mosettig and co-workers, (6) who transformed solasodine into 3β-acetoxypregna-5, 16-dien-20-one **(2)** in approximately 64% overall yield by a process similar to that used for diosgenin. Other potentially important synthetic steroidal intermediates have also been derived from solasodine, but by more novel reactions. (7-9) Solasodine is therefore a valuable raw material for steroidal synthesis and much research has been directed towards evaluating its potential as a substitute for diosgenin in the synthesis of steroidal hormones. (10) Recent efforts in NZ have been directed towards the industrial production of solasodine, and as a result, a 3-company consortium in New Plymouth (11) has set up a plant for the commercial extraction of solasodine from the indigenous species *S. aviculare* Forst. and *S. laciniatum* Ait. for the export market. The large scale cultivation of the latter species has been carried out in a number of European and Asian countries (12) while many investigations have been carried out on botanical topics such as the distribution of glycoalkaloids in the plant and its variations during the vegetation period, and on agronomical problems concerning diseases of the plant and its protection. (12)

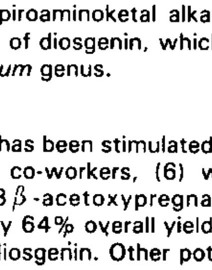
S. aviculare contains approximately 2.5% solasodine on a dry weight basis (whole plant) and it has been reported (13) that *S. laciniatum* contains approximately half this amount, although in both cases the ultimate yield of solasodine, which can vary between 0.9 and 2.8%, is dependent on the climate and soil conditions. The berries and young shoots of these plants contain a somewhat higher proportion of the alkaloid. A detailed investigation of methods for the isolation and hydrolysis of the glycoalkaloids in *S. aviculare* and *S. laciniatum* has recently been carried out in the DSIR at Petone. (13) However, none of the reported methods appear to offer any great improvement over those introduced 20 years ago by the late Prof. L.H. Briggs and his co-workers.(14).

More recently, other *Solanum* species have received attention. These include the Indian species *S. khasianum* Clarke which is reported to yield ca. 2.7% of glycoalkaloid from its berries. (15) Growth trials on this latter species have been carried out in NZ at the Crop Research Division, DSIR, Otara. (16) In accord with the findings of Indian workers, it has been shown that the optimum alkaloid content of the berries corresponds to the period of maturity when they turn from green to yellow. The yield of crystalline alkaloid is then 2.7% from fresh berries compared with yields as low as 0.5% from immature green berries. (17)

The biological activity of both natural and synthetic nitrogenous steroids has been reviewed by Martin-Smith and co-workers. (18) All of the glycosidic steroidal alkaloids tested so far and some of their alkamines show antibiotic activity against certain fungi and bacteria. (12) Solasodine has been shown to possess cardiotonic and antiphlogistic effects in mice and to show some effects on the vascular permeability as well as on the central nervous system while its antiaccelerator cardiac action and that of its glycosides have been studied by Krayer and Briggs. (19) The known repellant action of some *Solanum* glycoalkaloids to the Colorado beetle, *Leptintoarsa decemlineata* Say and its larva has been studied in detail. (20) These alkaloids are inactive against the two Asian potato beetles, *Epilachna sparsa* Herbst and *E. niponica* Lewis (20) and probably against the tobacco hornworm *Manduca sexta* Johan. (21) Some *Solanum* glycoalkaloids have been shown to be nontoxic to housefly larvae, *Musca vicina* Macq. (22) but active against the potato leafhopper, *Epoasca fabae* Harris. (23)



Prof. R.C. Cambie, Ph.D., D.Phil., D.Sc., FRSNZ, is Professor of Organic Chemistry at Auckland Univesity. Formerly a research student of the late Prof. L.H. Briggs, Con Cambie is noted for his work on NZ natural products and their use in synthesis. He has been the recipient of the ICI (NZ) Research Prize (1964), the Hector Medal (1967), and the New Zealand Association of Scientists Research Medal (1969). His current research interests include the utilization of NZ diterpenoids and alkaloids for synthesis and electrophilic additions which involve iodine and thallium (I) salts. His most recent venture is into the field of marine natural products.



Dr. Graeme Potter completed his Ph.D. in organic chemistry at Auckland University in 1978 where he worked as a research student with Prof. Cambie. He is currently carrying out postdoctoral work on the synthesis of gibberellins at the Australian National University, Canberra.

Solasodine (Cont)

Ecdysones

In addition to their use for the steroidal hormone industry, *Solanum* alkaloids hold potential as starting materials for the production of insecticides related to ecdysones. Insects, crustaceans, and other arthropods have tough cuticles or exoskeletons which serve to support and contain their internal organs and muscles. As these cuticles are incapable of growth or modification they are periodically discarded and replaced by new ones. This process of moulting, or "ecdysis", allows the animal to grow and acquire adult characteristics. The various juvenile stages may be similar in appearance, differing principally in size, as in the larval stages (or instars) of caterpillars or bugs, but the final adult forms generally show considerable differences from the last larval instars. In many insects such as moths, butterflies, and beetles, (holometabolous insects), the last moults are accompanied by extensive structural modifications as the animal passes from the last larval instar through the chrysalis or pupa into the winged adult. These remarkable transformations have fascinated man from time immemorial and have inspired and enriched his folklore.

Cuticle regeneration and moulting takes place uniformly throughout the body, and this fact led the Polish biologist Kopec, as early as 1922, to suggest (24) that a hormonal mechanism is responsible for inititating moulting in insects. His conclusions were supported by Wigglesworth (25) who found that the tropical bug *Rhodnius prolixus* could be prevented from moulting by decapitation, provided the decapitation was carried out before a critical time after feeding. Such a decapitated animal survived for a period but did not moult. It could be caused to moult if joined by means of a capillary tube to a larva decapitated after the critical period, so that the blood of the two insects mixed.

The isolation and characterization of the hormone responsible for the moulting was known to be a Herculean task at the outset. Accepting the challenge, Butenandt and Karlson (26) reported the isolation in 1954 of 25 mg of the crystalline hormone, which they named ecdysone, from 500 kg of pupa of the commercially used silkworm, *Bombyx mori.* The elucidation of the structure of ecdysone was difficult since only very little material was available for chemical studies, and it was a further 11 years before its structure was finally established by X-ray studies (27) as being 2β, 3β, 14α, 22R, 25-pentahydroxy-5β-cholest-7-en-6-one (4).

Biological Action Of Ecdysone

Larval moults are initiated by secretion of a hormone of unknown composition from the neurosecretory cells of the brain; this hormone stimulates the prothoracic glands to produce ecdysone which acts on the periphery and causes moulting. If the insect is to develop through the larval stages, presence of the juvenile hormone excreted from the corpus allatum is also necessary. However the flow of juvenile hormone ceases in the mature larva, whereupon the balance of the two hormones is broken and the larva, under the sole action of ecdysone, metamorphoses into the pupa and then further into the final adult stage. As depicted in Fig. 1, the larval ecdyses are controlled by both the moulting hormone and the juvenile hormone, whereas the subsequent pupal and imaginal ecdyses are induced only by ecdysone. If juvenile hormone is injected into insects in their final larval stages they fail to metamorphose, and develop into further stages of larvae; these abnormally large larvae usually cannot shed their skins further and die. For this reason, the juvenile hormones have attracted great interest as potential pesticides.(28)

Alternatively, if instead of maintaining juvenile hormone levels, the insects were induced to moult at inappropriate times during their development by the application of exogenous ecdysones, then this would be expected to disturb the insect's development. This appears to be the case with some insects. For example, Nakanishi has reported (29) a 100% mortality in the final instar of the mosquito, *Culex pipiens molestus,* when it is dipped in an aqueous solution (10 ppm) of ponasterone A (5). Other insects such as the rice-stem borer, *Chilo suppressalis,* showed toxic effects on exposure to a 0.05% methanolic solution of ponasterone A, and there was a 25% mortality in cabbage worms, *Pieris rapae,* which had been fed leaves sprayed with a 0.5% solution of ponasterone A in 10% aqueous methanol. (29).

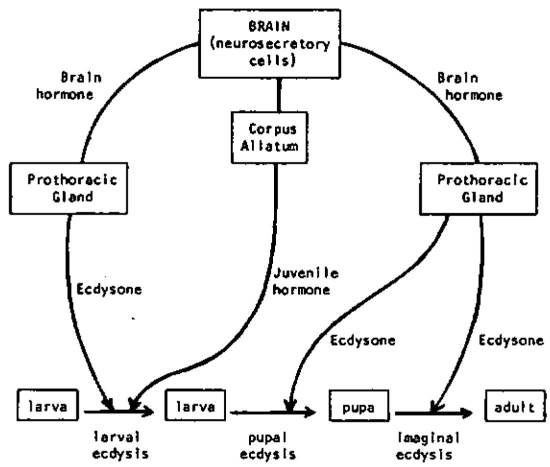


Fig 1: Hormonal control of insect development.

Ecdysones have a promising future as agents for insect control for several reasons. Firstly, they are active in extremely low concentration as long as they reach the insect's haemolymph. Secondly, unlike juvenile hormones, their action is not limited to specific stages and periods of insect development and they are able to produce destructive aberrations in the moulting process at any time during metamorphosis, including the adult stage. (30) They act non-specifically on insects and other arthropods, but are virtually inactive in other animals and in vertebrates, including man, they are apparently harmless.

It has recently been reported (31) that the cocoon spinning of a silk-worm colony can be synchronised when ecdysones are added to the diet (15 mg per 20,000 larvae) at a particular stage during the fifth instar. Extensive field tests have further shown that simultaneous application of lauryl alcohol repels larvae, automatically moving them towards the nesting area where spinning of a high-quality cocoon is assured.

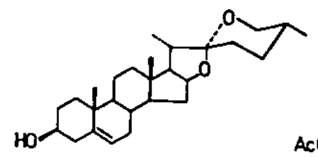
Structure And Activity Of Insect Moulting Hormones

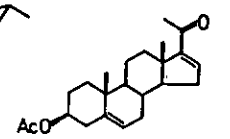
Although ecdysone (4) and several related compounds have been obtained from a variety of insects and crustaceans, the chemistry of ecdysones would still be in its infancy if it were not for the isolation of much greater quantities of ecdysones from plants. Such ecdysones are known as phytoecdysones in order to distinguish them from the so-called zooecdysones which are isolated from arthropods. In the conifers, the Podocarpaceae (32) and Taxaceae (33) families are good sources of phytoecydsones, and many of the ecdysone-rich species are large trees that occur in extensive forests, particularly in NZ. To date, approximately 40 naturally occurring moulting hormones have been isolated and all have been found to be steroids which are structurally related to the ecdysone molecule. It is possible therefore to examine the effect of structure of the ecdysones on their moulting hormone activity with a view to assessing the relative importance of various structural elements of the molecule for biological activity. Thus, it has been shown that the following structural features are necessary for a high moulting hormone activity of steroidal compounds: (i) a *cis*-fusion of rings A and B of the steriodal skeleton; (ii) a β-hydroxy group at C-3, and a 14α-hydroxy group; (iii) a keto group at C-6 conjugated with a 7,8-double bond; and (iv) a steroidal side chain with an appropriately (R)-orientated hydroxy group at C-22.

Ecdysone Antagonists

Certain synthetic steroids with only minimal structural features of the ecdysones have been found to severely inhibit moulting and metamorphosis in the development of insects; i.e. they can act as ecdysone antagonists. Investigation of a series of such compounds revealed (34) that in general, those which were most toxic had a low moulting hormone activity, and *vice versa*. The observation of the sterilising effect by many ecdysone analogues on the females of the housefly, *Musca domestica*, is also of considerable interest (35) since it suggests that ecdysones can be used as models for the development of safe and specific antifertility agents for insects. Rigorous correlations between structure and activity were not observed, but the presence of a 6-keto group is apparently necessary both for sterilising activity and for toxicity.

Recently much work has been carried out with azasteroids which have been found to be potent inhibitors of insect moulting and metamorphosis. Thus, since the initial report (36) that 22,25-diazacholesterol **(6)** inhibits the normal growth and development of larvae of the tobacco hornworm, *Manduca sexta*, Robbins and his group (37) have carried out studies on the structure-activity relationship of more than 20 azasteroids. They found that certain 25-azasteroids [viz. **(7)**, **(8)**, and **(9)**] were also potent inhibitors of the 24,25 sterol reductase enzyme, and they caused an accumulation of desmosterol and blocked the conversion of plant sterols into cholesterol in certain insects. Since insects must derive their essential cholesterol through conversion of plant sterols, azasteroids which interfere with this sterol metabolism have obvious potential as insecticides.


(1)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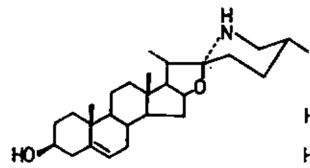
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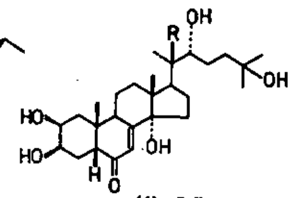
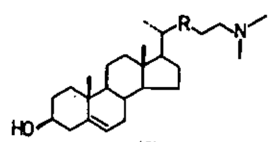
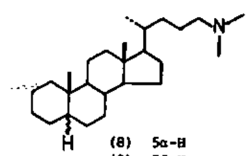
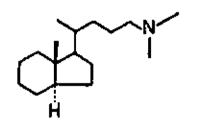

(4) R=H
(5) R=OH


(6) R= -NH-
(7) R= $-CH_2-$


(8) 5α-H
(9) 5β-H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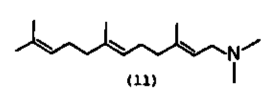
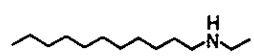

(11)


(12)

Robbin's results indicated (38) that for an azasteroid which will inhibit insect growth and development, a prerequisite was a side chain of variable length containing an amino group which was preferably a tertiary amino group. Robbins also found that N,N,δ-7α-tetramethyloctahydro-1-H-indene-1-butanamine **(10)**, which lacked the A and B rings of the steroid nucleus, possessed similar activity to the azasteroids **(7)**, **(8)**, and **(9)**. Several branched and straight chain secondary and tertiary amines [e.g. **(11)** and **(12)**] were like-wise shown (39) to have inhibitive effects upon development and metamorphosis in larvae of the tobacco hornworm. Certain of the amines which were related structurally to compounds with juvenile activity in insects, also blocked development in some insect species. These compounds are lethal or inhibit development in all larval stages and thus differ in action from compounds with juvenile hormone activity where the principal effect is to block the penultimate or ultimate moult.

Nitrogen-containing steroids therefore show inhibitive effects on insect growth and development, and this fact, together with the observation that many synthetic analogues of ecdysones also inhibit the moulting and metamorphosis of insects, gives rise to the possibility of fundamentally new hormonal insecticides. One may expect that, apart from the high activity of the compounds, insect pests will be unable to adapt to these insecticides. In the light of this premise, the synthesis of nitrogen-containing analogues of ecdysones was intitiated in the Chemistry Department of the University of Auckland in 1975. The approach to forming nitrogen-analogues involved modification of the readily available steroidal alkaloid solasodine as starting material. Preliminary results (17) indicate that the approach is most promising.

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Antibiotics From NZ Plants:

A Re-evaluation Of Some Maori Folk Medicine

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In this paper we propose to examine some aspects of Maori folk medicine and discuss aspects of our studies of a potent antifungal agent isolated from *Schefflera digitata*, "seven-finger" or "Pate".

The belief that the pre-European Maori people made extensive use of the native flora as a source of materia medica is widely held and has been promoted by a recent popular book "Medicines of the Maori" (17) but there is little real evidence to support this view. What few practical cures they had developed appeared to be limited to the treatments of wounds and the initiation or control of defaecation (e.g. diarrhoea) (9). Elsdon Best (4), writing in the late 1890's, was of the opinion that plants played only a minor role in Maori folk medicine since the pre-European Maori looked largely to his religion to seek both the cause and cure for his illnesses. They believed that illness and death were caused by an infringement of "tapu" and therefore the cure would be found in rituals of appeasement to lift the tapu. However, many of these rituals involved the use of plant materials. Thus when Europeans began to colonize NZ and were seen to take medicinals by mouth these old rituals may have formed the basis for experimentation and imitation (5). The paucity of Maori medical folklore is in marked contrast with other non-European peoples such as the Aztecs, Incas and many West African and South American tribes. Many of these peoples had a sophisticated knowledge of the medical and toxicological properties of their local flora and made extensive use of plant extracts for medical purposes, arrow poisons, fish poisons, etc. (14, 18, 19).

Brooker and Cooper (8) produced a useful monograph on the use of native plants by the Maori people for medical purposes. A more recent review by Fastier and Laws (11) on the status of the search for drugs from NZ plants reiterated the belief that any Maori use of herbal remedies developed after the coming of the European colonists. What little work has been done has been involved with a search for plants with pharamacological activity (11).

This world-wide neglect of the potential of the plant kingdom as a source of new drugs and pharmaceuticals has been highlighted in a recent review by Farnsworth and Bingel (10). It has been variously estimated that there exist 250,000 - 500,000 species of higher plants on this planet and yet less than 5-10% of these have been investigated for pharmacologically active principles. Even today, the research effort put into screening plant materials for chemotherapeutants is pitifully small considering the vast size of the untapped potential.

In our current studies at Canterbury we have attempted to remedy this situation by examining the various local members of the Araliaceae for antibiotic activity since there was some folk-lore evidence that the leaves of *S. digitata* were used by the Maoris to treat skin diseases

Solasodine (Cont)

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such as ringworm (8) and this was confirmed by preliminary screening tests in this department (unpublished results; B.Sc. Hons. projects; Banks 1972, Bong 1974). In the light of the above various extracts of leaves of *S. digitata* were tested for activity against a variety of dermatophyte fungi of the species *Microsporum* and *Trichophyton* and were found to be remarkably specific for these dermatophytes but much less active against other common bacteria, fungi and yeasts.

Initially research focused on finding the best methods and solvents for extracting the antifungal principle from freeze-dried leaves of *S. digitata.* It was found that diethyl ether was the best solvent and the extracts were concentrated and fractionation on aluminium was followed by preparative TLC on silica gel which eventually yielded a reasonably pure material with strong antibiotic activity. This compound was unstable in air but stable in ethereal solution. It could be cloated on TLC plates by its reactions with phosphomolybdic acid in ethanol or with isatin in concentrated sulphuric acid. The UV spectrum of falcarindiol proved to be of little use in identification since, unlike most other polyacetylenes, the UV spectra of interrupted chromophores such as occur in falcarindiol are less distinctive. The IR spectrum suggested the presence of two triple bonds and also hydroxyl group intramolecular H-bonding. Use of ^{13}C-NMR spectroscopy subsequently confirmed the presence of conjugated triple bonds, two hydroxyl groups, a vinyl grouping and a *cis* double bond.

Chemical ionisation mass spectrometry of the diacetate gave an *m/e* ratio of 344 and this was consistent with it being derived from the known structure: $CH_2=CH\text{-}CH(OH)\text{-}C\equiv C\text{-}C\equiv C\text{-}CH(OH)\text{-}CH=CH\text{-}(CH_2)_6CH_3$ heptadeca-1:9-diene-4:6-diyne-3:8-diol or "falcarindiol" which had been first isolated by Bohlmann *et al.* (7) and later fully characterised by Bently *et al.* (3). Table 1 lists several polyacetylenes related to falcarindiol that have been isolated from the Araliaceae. Recently Kemp (16) has isolated facarindiol from *Aegopodium podagaria* and demonstrated its activity against a number of plant pathogens.

Table 1. **POLYACETYLENES IN ARALIACEAE**
(Ref. Bohlmann Et Al. 1961, Chemmie. Ber. 94; 958)

FALCARINOL
$CH_2:CH.CH(OH).\ C\equiv C.C.\equiv C.CH_2.CH:CH.C_7H_{15}$
Panax ginseng

FALCARINONE
$CH_2:CH.CO.C\equiv C.C\equiv C.CH_2.CH:CH.C_7H_{15}$
Hedera Helix (IVY)
Aralia elata — *Polyscias fructicosa*
A. racemosa — *P. ginseng*

FALCARINDIOL
$CH_2:CH.CH(OH).C\equiv C.C\equiv C.CH(OH).CH:CH.C_7H_{15}$
Schettlera digitata (Seven ginger)
Falcaria vulgaris.

FALCARINDIONE
$CH_2:CH.CO.C\equiv C.C.\equiv C.CO.CH:CH.C_7H_{15}$
A. californica

FALCARINOLONE
$CH_2:CH.CO.C\equiv C.C\equiv C.CH.(OH).CH:CH.C_7H_{15}$
A. nudicaulis — *A. mandschuriaea*
A. californica
A. racemosa.

It is also of interest that a number of other polyacetylenic compounds from plants have been reported to be active against phytopathogens. The first reported acetylenic compound involved in defence against plant pathogens was wyerone acid (12). Allen and Thomas (1,2) have isolated two antifungal polyacetylenes; safynol and dehydrosafynol, from Safflower plants infected with *Phytophthera drechsleri.* The concentration of these compounds increased dramtically after infection which suggests that their formation may be in response to fungal attack. Several synthetic acetylenic compounds have been shown to be capable of inhibiting the growth of a number of micro-organisms including phytopathogens (20).

The distribution of polyacetylenes within the plant kingdom is of great interest to chemotaxonomists since they occur regularly in only five families; namely the Araliaceae, Campanulaceae, Compositae, Pittosporaceae and Umbelliferae (6). Reasons for the widespread occurrence of polyacetylenes within these plant families has not been adequately explained but would seem to be involved with protection against phytopathogens. Other polyacetylenes, such as those found in the roots of the water dropwort, *Oenanthe crocata,* and of fool's parsley *Aethusa cynapium,* are highly poisonous and thus could protect the plant from grazing animals (13, 15).

From the pharmacological point of view the antifungal action of falcarindiol is very interesting; firstly because of its marked specificity for dermatophyte fungi and secondly because it appears to act by inhibiting spore germination. This is in marked contrast to other antifungal agents such as griseofulvin which attacks only the growing mycelium. Our current work is now concerned with attempting to find out how falcarindiol interacts with the fungal spore; preliminary results suggest that the organisation of the spore's metabolically vital membrane systems is destroyed by falcarindiol.

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	G	0.1N	0.1M
Iodine	G	0.1N	0.05M

Nitric acid	G	N	M
	G	0.1N	0.1M
Oxalic acid	P	0.1N	0.05M
Potassium bromate-bromide	P	0.1N	M/60
Potassium dichromate	G	0.1N	M/60
Potassium hydroxide	P	N	M
	P	0.1N	0.1M
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	G	0.02N	0.02M
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Sodium thiosulphate	P	0.1N	0.1M
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NZIC Conference:

PROGRAMME DETAILS, SPEAKER PROFILES

The Institute's annual conference is to be held in collaboration with the Biochemical Society at Victoria University, Wellington. For those yet to register for the August 20-23 meeting the registration form is repeated as the centre fold of this issue. The conference programme drawn up by the Committee should have wide appeal to the industrialists and to those more academically inclined. In any event, those responsible for its preparation and its execution are **Neil Curtis (Chairman), John Craig (Secretary), David Weatherburn (Treasurer), Eric Beanlands, Gary Burns, Alan Clark, Stuart Dickson, John Featherstone, Walter Freitag, Rod Furkert, Graham Gainsford, Brian Halton, Colin Pritchard, and Stuart Smedley.**

Each day of the meeting has been assigned an industry-based theme with plenary and other related invited lectures occupying from 2-4 hrs. These latter lectures will run concurrently with the specialist group meetings which will involve invited and contributed papers. In this respect the organisers apologise for the inadvertent omission of the Polymer Group from the list of Specialist Groups published in the earlier information. In addition to these meetings, time has been set aside for **Dr Robin Mitchell** to present his 1978 Easterfield address, for the President, **Dr. Ted Harvey**, to address the delegates, and for the Institute Annual General Meeting. The various themes, lecture titles and details of the speakers appear below.

Monday, August 20.
CARBONACEOUS RESOURCES

Dr. M.C. Probine (Asst. Director-General, DSIR) "Technology and Industrial Development with Special Reference to the Chemical Industry".

Dr. A.F. Wilson (Wellington Executive, NZ Forest Products Ltd.) "Timber as a Renewable Resource".

Dr. B.V. Walker (Technical Director, Liquid Fuels Trust Board) "Alternative Transport Fuels from Indigenous Fossil Fuel Resources".

Dr. Merv Probine trained as a physicist and gained his first degrees in this country and his Ph.D. from Leeds University; he is a Fellow of the Royal Society of NZ. From 1967 he was Director of the Physics and Engineering Laboratory until his appointment as Assistant Director-General, DSIR, in early 1977.

Dr. Ashley Wilson gain degrees in Chemistry (to Ph.D.) at Canterbury University and undertook postdoctoral work in physical organic chemistry at Florida State University with Prof. Leffler. After a period of employment in US and Canadian cellulose-petrochemicals industries, he returned to NZ in 1964 to take up a research position with NZ Forest Products. His initial work with NZFP involved coated papers and subsequently pulping and papermaking research. This was followed by a period (1969-1974) as Technical Superintendent at the Kinleith mill after which he returned to the Technical Centre as divisional General Manager. In January of this year he moved from Auckland to become Wellington Executive.

Dr. Basil Walker trained as a chemical engineer at Canterbury University and has qualifications in the commerce field. On graduating he was employed by the Chemistry Division, DSIR and transferred to the Industrial Processes Division on its formation last year.

In 1975 he was appointed chairman of a working party on methanol as a fuel and was seconded last year to the Liquid Fuels Trust Board as Technical Director where his work is particulary involved in alternative fuel options based on natural gas. He is married with 3 children.

Tuesday, August 21.

PROSPECTS FOR THE CHEMICAL INDUSTRY

W.E. Russell, (Group Technical Manager, NZ Farmers Fertilizer Co. Ltd). "Inorganic Based Industries".

Speaker to be Arranged "Organic Based Industries".

E.D. Andrews (Fletcher Holdings) "Agriculture Based Industries".

Wednesday, August 22.
HEALTH BASED INDUSTRIES

Mr. D.J. Jull (Technical Director, Glaxo Laboratories (NZ) Ltd.) "Pharmaceutical Industry in NZ"

Dr. R.P. Garland (Chief Chemist, NZ Pharmaceuticals Ltd.) "NZ Fine Chemicals: From the Source to the Sink".

Mr David Jull was born and educated in England and qualified as a veterinary surgeon from the Royal Veterinary College. After 2 years in general practice he came to NZ to join the Hikurangi Co-op Dairy Company. He transferred to Glaxo Laboratories in 1958 and spent two years on microbiological research in London developing manufacturing methods for veterinary vaccines.

He is currently Technical Director of the company and has the responsiblity for production, quality assurance and local development work on human and veterinary pharmaceuticals and special purpose foods.

Dr. Dick Garland trained as an organic chemist at Canterbury University and after graduating with his Ph.D. joined TVL to work in the Special Projects Division.

In 1975 he joined NZ Pharmaceuticals as Chief Chemist at the time that bile acid production commenced. His work in this area earned him the Institute's first ICI Industrial Chemistry prize last year. He is married with 2 children.

In addition to the two plenary lectures outlined above, the Health Based Industries theme will continue (concurrently with other specialist sessions) from 11.00 to 12.30 with invited lectures from **Dr. Bill Denny** (Cancer Research Laboratory, Cancer Society of NZ) on "What Risks Do We Really Run from Carcinogenic Chemicals?" and from **Dr. Brian Shorland (Honorary Lecturer in Biochemistry, Victoria University) on "How Good is Our Diet Today?" Bill Denny** is well known in the Institute and is Associate Editor of the Journal while Brian Shorland is recognised for his major contributions in the fields of fats and oils and is the sole NZ chemist in the world "Who's Who"! The theme will continue throughout the afternoon with contributed papers.

Thursday, August 23.
PROSPECTS FOR BIOCHEMICAL INDUSTRIES

Prof. B.J. Ralph (School of Biochemical Technology, University of New South Wales) "Biotechnology and Agro-Industrial Development"

Dr. G.W. Butler (Asst. Director-General, DSIR) "Biochemical Industries Based on Crops". (Dr. R.W. Bailey co-author).

Prof. Bernhard Ralph, the 1979 Biochemical Society guest lecturer, has for many years been involved in biochemical engineering especially in the area of modern fermentation pro-

CONFERENCE SPEAKERS

(Left to right) Dr M Probine, Prof. B Ralph, Drs A Wilson, R Mitchell and D Garland

cesses. Under his leadership the school of Biological Technology at the University of NSW has made some significant contributions in the areas of wood waste fermentation, chemical transformations and mineral leaching.

Bernhard Ralph was born in NZ and received his primary and part of his secondary education in Nelson. After a family move to Tasmania he gained his batchelor's degree from that University and his Ph.D. from Liverpool. He is a Fellow of the Australian Academy of Technological Sciences.

He entered the University of NSW as a lecturer in Biochemistry and was appointed to the foundation Chair of Biochemistry and Head of the School of Biological Sciences in 1959. Subsequently, he became Head of Biotechnology and Bioengineering within the School of Biological Science. In 1968 Biological Technology was established as an independent School of which he remains Head. He has served as Dean of Science and has been Dean of Biological Sciences since 1968. He has served as Federal President and NSW Branch President, RACI and has had several terms as Visiting Professor in various Universities.

Dr. Graham Butler trained as a chemist at Auckland (to M.Sc.) and then transferred to Massey and Otago to develop his interest in plant biochemistry and animal nutrition. His doctoral work was carried out in Sweden and after a period of research he was appointed Director of Plant Chemistry (now Applied Biochemistry) Division DSIR in 1965. He is a Fellow of the Royal Society of NZ and took up his present position as Assitant Director-General, DSIR, in 1974.

His paper is co-authoried by his successor in Palmerston North.

The Biochemical theme will run concurrently with other specialist sessions from 11.00 am.m. and invited lectures from **Mr. N. Jarman** (General Manager NZ Fishing Industries Board) and "Biochemical Prospects in the Meat and Fish Industries" and **Dr. P.A. Munro** (School of Engineering, Auckland University) on "Potential Applications for Adsorbant Support Technology in NZ" will be given.

The 1978 Easterfield address "Chemical Intrigue **and Biochemical** Sabotage" will **be delivered by Dr. Robin Mitchell** (Plant Diseases Division, DSIR) at 7.30 pm. on Monday, August 20. The Institute's AGM will be held at 7.30 pm. on Tuesday, August 21 and the **Presidental Address** will close the scientific meetings at 4.30 pm on Thursday, August 23.

Specialist Group Meetings

At the time of going to press full details of the specialist group meetings are unavailable. However, the following programme outlines are to hand:

Analytical:- Sessions for the contributed papers are to be arranged and an invited lecturer is probable.

Biochemical:- In addition to the plenary and invited lectures on Thursday, August 23, contributed papers in lecture and poster form will be held throughout the period of concurrent sessions. Review lectures from **Dr. T.W. Jordan** (Biochemistry Dept., Victoria University) and **Dr. H.C. Ford** (Wellington Clinical School) will also be given.

Chemical Education:- The Education Group programme will cover Tuesday and Wednesday, August 21 and 22. Attention is to be fucussed on "Careers on Chemistry" (August 21) and Curriculum Development (August 22) under the following topics "Frontiers of Chemistry, Industrial Processes, and Careers Opportunites" and "Educational Theories and Curriculum Development" respectively. It is hoped that participants will come prepared to debate the merits (or otherwise) of the present 6th and 7th form chemistry prescriptions.

Poster-type sessions will be held on "Audio-visual equipment and its Application" and "Chemical Games and Demonstrancions."

In addition, Education group members are asked to note the prelunch Health-Based Industries invited lectures on Wednesday, August 22. The Education Group AGM will be held at 1.30 pm on August 22.

Chromatography:- The meeting will encompass the contributed papers.

Crystallography:- In addition to contributed papers, an invited lecture by **Dr. Andrew Johnson** (Division of Chemical Physics, CSIRO, Melbourne) has been arranged. Dr. Johnson, a research physicist, is involved in theoretical and practical developments in the field of electron diffraction. His work is providing information about localised areas of solids which hitherto could only be speculated upon. Undoubtedly, this will be of great interest to all chemists involved with crystalline solids and their surface properties.

Electrochemistry, Thermodynamics and General Physical Chemistry:- The planning for these sections is still in a preliminary stage. However, invited lectures are anticipated and the following topics likely — Physicochemical aspects of energy conservation, corrosion in geothermal fluids, geochemistry, electrochemistry and theromdynamics.

Industrial:- Contributed lectures on the daily industry based themes and less formal discussion sessions will be held.

Inorganic:- Two invited lectures are being arranged and sessions on organometallic and general coordination chemistry are envisaged.

Mass Spectrometry:- The group has organised invited lectures on the themes of Chemical Ionization Mass Spectrometry and Data Acquisition. **Dr. Graeme Wright** (Canterbury University) will speak on "An Introduction to Chemical Ionization", and **Dr. Pannel** (Canterbury University) on "Applications of Chemical Ionization". **Dr. Shaw** (DSIR) will speak on "The NIH Data System and Chemical Information" and **Dr. P.T. Holland** on "Data aquisition in Mass Spectrometry". Contributed papers and the group AGM will also be accommodated.

Organic:- In addition to the contributed papers, invited lectures will be provided by **Dr. Murray Munro** (Canterbury University) on "Recent Advances in Marine Natural Products Chemistry" and by **Assoc. Prof. Stew Rutledge** on "Synthesis with Electrophilic Iodine". It is anticipated that a third invited lecturer will be available.

Polymer:- Contributed papers and the group AGM will be programmed.

The Student Papers Competitiion will be interspersed among the specialist group sessions on Thursday, August 23.

A full social programme has also been arranged and the meeting will conclude with the Conference Dinner on Thursday, August 23. However, a one day seminar on "Problems Encountered in Collecting Forensic Exhibits" is to be held on Friday, August 24. Those interested should contact **Dr. P. Cropp**, Chemistry Division, DSIR, Private Bag, Petone.

New Zealand Institute of Chemistry

1979 ANNUAL CONFERENCE

Victoria University, Wellington August 20-23

The New Zealand Chemical Industry: Prospects And Perspectives.

The Scientific Programme will commence at 2 p.m. on Monday, August 20 and conclude at 5.30 p.m. on Thursday, August 23.

PROGRAMME OUTLINE

MONDAY, AUG. 20: THE NEW ZEALAND CHEMICAL INDUSTRY

An overview — M. Probine (DSIR)

CARBONACEOUS RESOURCES

(i) Renewable Resources — A. Wilson (N.Z. Forest Products Ltd.)
(ii) Non-renewable Resources — B.V. Walker (Liquid Fuels Trust)

TUESDAY, AUG. 21: PROSPECTS FOR THE CHEMICAL INDUSTRY

Inorganic Based Industry — W. Russell (N.Z. Fertiliser Co.)
Organic Based Industry — Speaker to be arranged.
Agriculture Based Industry — D. Andrews (Fletcher Holdings)

WEDNESDAY, AUG. 22: HEALTH-BASED INDUSTRY

The Pharmacenticals Industry — D. Jull (Glaxo Laboratories Ltd.)
Biomaterials — R.P. Garland (N.Z. Pharmaceuticals)

THURSDAY, AUG. 23: PROSPECTS FOR BIOCHEMICAL INDUSTRIES

Detailed programme unavailable at time of going to press.

(See over for further details and registration form)

In addition to the daily conference themes detailed above the programme will include:
The 1979 Easterfield Address – R.E. Mitchell (Plant Diseases, DSIR).
The Littleton Lecture.
The Presidential Address.

The various Specialist Groups will hold their own sessions during the late morning and each afternoon except for the first day. Furthermore, contributed papers from industralists and others compatible with the various industrial themes are especially called for. The traditional Student Papers Competition will be incorporated into these concurrent sessions.

The NZIC Annual General Meeting is scheduled for 7.30 p.m. on Tuesday, August 21.

A full social programme has been arranged and the meeting will conclude with the Conference Dinner on Thursay, August 23. However, a one – day seminar on "Problems Encountered in Collecting Forensic Exhibits" is planned for Friday, August 24. Those interested are asked to contact: **Dr. P. Cropp, Chemistry Division, DSIR, Private Bag, Petone.**

CONTRIBUTED PAPERS

This is the **only call** for contributed papers to the Industry-based daily themes and the more traditional Specialist Groups. Papers are invited on any aspect of chemistry. They may be presented in lecture or poster form and the author's preference will be followed where possible. If more papers are submitted for lecture presentation than time allows, authors may be asked to reconsider their mode of presentation.

15 minutes will be allowed for each lecture session plus 5 minutes for discussion. Overhead and 35mm projectors will be available.

Posters will be displayed on bulletin boards. Authors are to be in attendance throughout their relevant poster session for discussion of their contribution and answering of questions. At the end of each session posters will be removed to a general display area for the duration of the Conference. Contributors will be provided with appropriate facilities and more detailed instructions will be provided after the receipt of the abstract.

Authors will be notified of the acceptance of otherwise of their paper(s) by the end of June.

Each contribution will be allocated to one of the following groups and authors must specify which one their contributions is for:

Analytical, Biochemical, Chemical Education, Chromatography,
Crystallography, Electrochemistry, Industrial, Inorganic,
Mass Spectrometry, Organic, Thermodynamics.

ABSTRACTS

Contributors to both lecture and poster sessions should submit a short abstract typed (preferably with one and one-half spacing) on A4 paper in a form suitable for photocopying. The line width should not exceed 15.5 cm and the depth (including title etc.) not more than 10.5 cm. The heading should include the title (capitalised), author(s') name(s) and affiliation. The name of the person presenting the paper should be underlined. The abstract must be sent to and received by

Dr. J.T. Craig, Conference Secretary, Chemistry Department,
Victoria University, Private Bag, Wellington.

NO LATER THAN MAY 30, 1979.

Please indicate clearly whether it is for poster or lecture presentation and which specialist session the contribution is to be considered for. Late arrival will prejudice acceptance.

REGISTRATION AND ACCOMMODATION INFORMATION

The registration form below should be completed and returned **before July 4**; A late fee of $10 ($2.50 per day for daily registrants) will apply after this date. Only the persons attending the scientific programme are required to pay a registration fee.

Accommodation is available from Sunday, August 19, at Weir House and Victoria House, both of which are within 5 minutes' walking distance of the Conference venue, and a number of twin rooms are available. If you wish to share a twin room with a specific partner please indicate this on the form. Participants may elect for FULL BOARD at a cost of $16 per day or DINNER, BED and BREAKFAST at $14 per day (for twin accommodation deduct $3 per day from each of the rates). For those not requiring lunch in College, a light lunch will be available in the University Union on a "pay-as-you-go" basis. Should motel accommodation be preferred advise the Conference Secretary and give full details of your requirements at your earliest opportunity. Precise accommodation costs will be forwarded to registrants with deposit receipts.

Tear Across

REGISTRATION FORM Please complete and return this form together with your remittance **BEFORE JULY 14** to:
Dr. J.T. CRAIG, CONFERENCE SECRETARY, CHEMISTRY DEPT., VICTORIA UNIVERSITY, PRIVATE BAG, WELLINGTON.

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REGISTRATION FEES

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Student	$7.50	N/A	$. . . . .
Late Fee after July 4	$10	$2.50	$. . . . .
If daily circle days	M Tu W Th		$. . . . .
ACCOMMODATION DEPOSIT	$10		$. . . . .
CONFERENCE DINNER ($12 per person)			$. . . . .

REMITTANCE ENCLOSED
(payable to: NZIC Conference) $. . . . .

The following flights will be met:

Auckland	Flt. 451 arr. 11.00
Hamilton	Flt. 591 Arr. 12.10
Christchurch	Flt 448 Arr. 10.30
Dunedin	Flt 480 Arr. 9.25

THE NEW ZEALAND FERTILISER MANUFACTURERS' RESEARCH ASSOCIATION (INC.)

RESEARCH DIRECTOR

As Dr John Rogers wishes to retire at the end of May 1980 the New Zealand Fertiliser Manufacturers' Research Association (Inc.), FMRA, invites applications for the position of Director of its well equipped laboratories established in 1950 20 kilometres south of the City of Auckland. It is desirable that the director-elect be available early in 1980

FRMA is financed jointly by the Fertiliser Industry and New Zealand Government. Established in 1947, it undertakes research of importance to New Zealand agriculture and the Fertiliser Industry. Although the current research programme is concerned primarily with the manufacture and use of superphosphate, this is expected to widen to include alternative phosphatic and other fertilisers.

Three hectares of two soil types are leased from DSIR at the Otara Research Station on which long term field trials, begun in 1954, 1963 and 1970, with superphosphate and other phosphate fertilisers are in progress. Staff establishment is 24, including 12 graduates, and the annual budget about $400,000.

Responsibilities

The director is responsible to the Management Committee representing the New Zealand fertiliser manufacturers and the New Zealand Government for the efficient conduct of FMRA's research programme which is prepared triennially in consultation with industry, government, university and FMRA staff. This programme is subject to annual review. Currently 70% of the research effort is on fertiliser manufacture and 30% on fertiliser use.

Duties

The director is the Management Committee's chief executive officer and the duties include:

1) control of the professional and technical officers and support staff;
2) preparation and management of FMRA's financial budget;
3) presentation of the results of research to the Fertiliser Industry and where applicable, to agricultural and other organisations, as well as representing the Industry on a national and at times international level in technical matters of common interest to FMRA.

Qualifications

Good academic qualifications including university degree in science or engineering are essential. In addition the director is required to have:

1) research experience;
2) broad knowledge of New Zealand science and technology;
3) sound administrative judgment and the ability to bring out the best in a team of dedicated staff;
4) ability to communicate and negotiate with industry, government and university leaders and laboratory staff of all levels;
5) capacity to establish and maintain easy working relationships with a wide range of professional scientists and engineers.

Salary

The director's salary is determined by the Management Committee in agreement with the Higher Salaries Commission and is currently offered in the range $21,437 to $26,002. The salary is reviewed from time to time.

In addition to salary the Association subsidises contributions to the New Zealand Government Superannuation Fund or a scheme administered by the National Provident Fund.

Fares and removal expenses will be paid for the director-elect and his dependent family.

Method of Application

Formal application (which will be treated in strict confidence) should include age, full details of experience, academic and other qualifications, and name two referees who will furnish confidential reports on request. They should be sent to:

The Secretary,
New Zealand Fertiliser Manufacturers' Research Association (Inc.),
P.O. Box 2080,
Auckland 1.

by August 31, 1979.

C140 For further details, see Reader Service Card.

ENERGY FARMING IN NZ

G.S. Harris,
NZ Energy Research and Development Committee

1. Introduction

The concept of energy farming was first mooted as a serious option for NZ in 1974 by research workers with an interest in processing biomass to liquid fuel and laboratory research commenced at that time. The overall concept of energy farming was studed during the formulation of Energy Scenarios for NZ (1) this work being undertaken mostly in 1975 and 1976. The Energy Scenarios were first published in 1977 and some futher work undertaken in early 1977 was published in April 1978. DSIR and Massey University have held seminars on energy farming in 1975 (2) and 1978.

The Energy Scenario Research clearly identified transport and the supply of liquid fuels for transport as being the most important energy supply problem facing NZ. It also pointed out the potential for energy farming but drew attention to the many unknowns related to this technology.

Since 1974, there has been much research in Universities and Government Departments on the processing of crops to fuels but only recently have significant results started to become available. There has been great interest in the private sector in this concept after some misgivings when the idea was first put forward. In 1977 the NZ Energy Research & Development Committee, which was already funding research on energy farming, decided to set up a group to study the technology as a whole — that, is a systems study of energy farming. The main objective of the study is to answer the question "what is the potential of energy farming in NZ?" This research commenced with a Workshop in September 1977 attended by research workers from Government, industry and the Universities.

The research has been completed and the final report is now being written for publication in 1979. This paper discusses some of the issues raised in the final report of the Energy Farming Research Group.

2. Objectives

The group has been studying all aspects of energy farming using data which are fairly readily available to determine the potential of energy farming for NZ. The study is being undertaken from the national point of view. If the concept of energy farming is eventually accepted for implementation, feasibility studies will be required for particular processing plants based on areas of land dedicated to supply biomass for that plant.

Garth Harris holds the degrees of M.E. (Auckland) and Ph.D. (NSW) and has been associated with problems of water supply, irrigation and sewage in Australia and Malaysia. He has also studied traffic engineering, pollution, environmental problems, suburban development, benefit/cost analysis and computer programming. He has been a part time lecturer on water quality management at the University of NSW. Dr Harris is married with 3 children.

The study has the following principle components.

1. Evaluation of land suitable and available for various crops.
2. Technical, economic and environmental evaluation of agricultural crops as a source of biomass (sugar beet, fodder beet, maize, lucerne, oats, pasture).
3. Technical, economic and environmental evaluation of forestry (radiata pine).
4. Evaluation of other crops on which there is less information than the crops mentioned above.
5. Technical and economic study of 10 processing routes to produce liquid or gas.
6. Study of distribution and use of alternative fuels.
7. Environmental and social implications of energy farming.

Since the start of the study much work has been undertaken on distribution and use of alternative transport fuels and much more is planned as a result of the formation in November 1978 of the Liquid Fuels Trust Board. Since this work is incomplete and since it is beyond the resources of the Energy Farming Research Group to effectively study this topic, the group has concentrated on the remaining 6 study components.

3. Land Use

The concept of terrestial energy farming involves using land to produce an agricultural or forest crop. The land so used needs to be both "suitable" for the crop and "available". While critieria for "suitability" can be written in terms of soil type, climate and topography, the criteria for availability depend on definition of an energy farming processing plant in a particular locility. For instance, only if farmers have an idea of the price to be paid for a crop will they say that some or all of their farm is "available". Hence, the study concentrated on land suitability. The results for maize, beet, (sugar and fodder), lucerne and radiata pine are given in Table 1. For the first 3 crops, most of the suitable land is presently high value agricultural land. This same land is suitable for radiata pine, but in addition, there is much marginal farmland, scrub, cutover native forest — land which could conceivably be used for a new more profitable activity such as energy farming.

TABLE 1.
INTERRELATIONSHIPS OF ENERGY CROP LAND SUITABILITY (hectares)

Total area considered	**25,668,900**
Total areas suitable for crops:	
Maize	2,447,000
Beet	3,089,700
Lucerne	4,373,000
Radiata Pine	7,057,500
Areas suitable for crops in common:	
Maize/Beets	1,908,300
Maize/Lucerne	1,600,200
Maize/Radiata Pine	1,937,300
Beets/Lucerne	2,232,300
Beets/Radiata Pine	2,577,300
Lucerne/Radiata Pine	3,498,000
Area suitable for radiata pine alone:	**3,144,000**

The table was compiled from soil maps at a scale 4 mile: 1 inch with a miniumum plot size of 80 hectares. While these maps were checked with Ministry of Agriculture & Fisheries district officers and Forest Service Conservancy officers, it will be necessary to undertake more detailed studies both at the regional and local level to determine what is the ultimate land potential for energy farming. In general terms it can be stated that the area of land which is potentially available for energy farming using any of the crops — fodder beet, maize, lucerne or radiata pine — is well in excess of the land area which would be required to supply 100% of the liquid fuel requirements in 2000. (Ministry of Energy projections of transport demand).

4. Agricultural Crops

The study of agricultural crops has proceeded with the philosophy that any crop which is used for energy farming should be integrated into the existing farming situation. If energy farming were to proceed with agricultural products, then the existing farmers with their knowledge of particular crops and farming techniques would be required to change their method of management in only a comparatively small way to produce the energy crops. In many cases it is quite possible that stocking rates could be held at existing levels. In this way energy farming would be more likely to succeed.

The second point of philosophy in the study has been to minimise the energy inputs used in growing the energy crop. Generally, conventional technology and practice has been used and no attempt has been made to minimise energy inputs through such new practices as low tillage cropping.

A range of crops has been studied and the energy ratios, energy yield and production costs for some are presented in Table 2. It is readily apparent that fodder beet is the best of the crops studied and this crop is the one which has been mainly considered in the remainder of the study.

There are a number of unknowns concerning beet particularly the yield of fermentable sugars and the storing qualities in various parts of the country, especially North Island. It is highly desirable that extensive trails of fodder beet be undertaken to obtain a better understainding of the qualities of fodder beet and desirable agronomic practices for energy farming.

TABLE 2.
ENERGY RATIOS AND PRODUCTION COSTS FOR FOREST AND AGRICULTURAL CROPS

Crop	Average collection distance km	Net Energy Yield at Factory GJ/ha/yr	Energy Ratio	Production Cost $/ha	Production Cost $/ODT
Fodder Beet (grown in 5 year rotation with pasture)	16	366	24	864	40
Maize (grown in a continuous maize system)	16	270	17	744	96
Maize (rotational pattern with pasture)	16	273	20	612	79
Pasture	16	193	19	939	87
Lucerne	16	192	26	726	66
Gorse		192	90	118	11
Radiata Pine (grown as energy forest 18 yr rotation)	20	194	21	#	50
Radiata Pine (30 yr rotation)	20	160	32	#	32*

* This amount is the cost for low grade logs in a conventional forest the bulk of which would be for sawn timber — i.e. only low quantities at that cost.
# These amounts are not relevant since the trees take many years to reach maturity.

5. Forestry

Radiata pine is a resource which could be used for energy farming. Current planting rate exceeds 40,000 hectares per year and the total exotic forest area exceeds 700,000 ha. While the existing mature forest is almost entirely committed to providing feedstock for existing processing plants and for export and domestic demand, the fate of the forest now being planted has by no means been determined. Thus in the early 1990's a large quantity of wood could become available for energy farming. A decision now to implement energy farms based on forest crops would mean that such crops probably could not be available until well into the 1990's because of the growing time required for any species.

The energy ratios and production costs for radiata pine are given in Table 2. Two different forest planting schemes have been considered:

a) energy forest 18 year rotation
b) conventional forest 30 year rotation

It should be noted that both for forest and agricultural crops, the opportunity costs are included in the production cost and that for agricultural crops this is a major proportion of the total cost while for radiata pine it is small.

The energy ratios for radiata pine are high showing that there is an adequate energy return. Transport is an important item — the processing plant should be sited close to the forest (or a beet processing plant).

Studies have been made of the use of forest residues and wood wastes, but it is not possible to obtain sufficient quantities of these to manufacture large amounts of liquid fuels. It is acknowledged, however, that these may well be the feedstock of the first processing plants because they are much cheaper than whole tree feedstock.

6. Other Species

A wide variety of other species has been suggested as being more suitable for energy farming than "conventional" species; for instance, gorse, macrocarpa, sugar cane, eucalyptus, potatoes, artichokes, willows, etc. For many of these there is only limited information available on growing conditions and on the yield of crop per hectare year. Hence any evaluation of them must be of a lower order of accuracy than for the species mentioned earlier. In addition, substantial farming of a different species may involve farmers or foresters in significant changes in their management techniques. For this reason, any alternative energy crop would need to be significantly better than "conventional" crops in order to succeed at least in the initial period. Over the longer term, a different energy crop could well become important.

Processing To Transport Fuel

The following process routes have been considered:

Beet to ethanol
Wood to ethanol
Maize to ethanol
Forage to methane
Forage to ethanol and methane
Wood to methane
Wood to hydrogen
Wood to methanol
Wood to synthetic gasoline
Wood to electricity

There are basically two processing routes which can be used to transform the biomass into a fuel for use in vehicles. The first of these, fermentation, is biological in character and operates at normal tempteratures and pressures. The study has shown that small scale plants processing feedstock at the rate of 200 – 1000 oven dried tonnes/day could be economic. There is much experience in NZ on fermentation plants of various types (e.g. brewing, wine making, sewage treatment) so that they may well be favoured in the initial stages of any energy farming programme. This study has shown however that the fermentation plants, to be economic, require crops from highly productive land, some of which is currently used for intensive cropping and livestock production.

The second processing route is gasification which uses high temperatures and pressures. The gasification routes tend to be economic at a larger scale, i.e. from 500 OD tonnes of feedstock/day to 2500 OD tonnes/day. There is little experience here with this type of plant and indeed it is the subject of much overseas research and development. It does however have the advantage over fermentation plants in that it should operate well using a woody feedstock such as radiata pine, straw residue or gorse and hence an energy farming process using this route would either use land which is not of great value for other more intensive activities or, in the case of straw residues, use a feedstock with little alternative use.

In Table 3 the cost of fuel produced by some of the various routes studied is presented. The cost of feedstock is shown together with the proportion it represents of the total cost and in all cases, this is a high proportion of the total cost. It should be noted that since the energy ratios are high, the cost is by far the most important criterion — i.e. provided there is a good value for net energy, energy farming will only succeed if the cost is low enough. The current cost of gasoline is also given and it will be noted that, for the best routes, the cost of ethanol or methanol is not greatly above the current cost of gasoline.

The processing of forest products in NZ is conventionally through a highly integrated forest-industrial system. For conventional agricultural products the degree of integration is considerably less. For energy farming it would be essential to develop a fully integrated agro-industrial system for efficient production of transport fuel. The cost of transporting feedstock to the processing plant is a significant proportion of the cost of production. There are economies of scale in the various process routes, e.g. a large gasification plant processing 2500 ODT of wood/day is more economic than a 1000 ODT/day plant. However, a larger processing plant intake means a larger area of land which is required to supply the plant and hence a larger average and more costly feedstock collection system. When feasibility studies for plants in particular regions are undertaken, there will be a need to strike a careful balance between land suitability and availability, transport distance including relation of the transport network to land availability, and processing plant size and location.

8. Environmental & Social

In all of the above studies, environmental factors have been considered. For instance, allowance is made in design of the processing plants to recycle the waste materials to farms where this is appropriate. Cropping systems have been designed to interfere as little as possible with the existing farm environment and for most, the use of fertiliser has been minimised.

A small survey of the maize industry in the Waikato was undertaken. This shows that a diversification into an energy farming crop will have its main effect at the farm level, with other consequences likely as repercussions run out from that point. There is, however, some uncertainty as to the degree of the effects on farm operations and beyond until further details on the energy farming operations are known. Farmers and people associated with the farming industry are very receptive to the idea of energy farming but it is apparent that some additional incentive may be required in the initial phases. This will be sensitive to the scale of operation in the locality.

9. Conclusions

The answer to the question "what is the potential for energy farming in NZ?" is clear. There is adequate land area to supply our transport fuel requirements in the year 2000 by processing agricultural or forest crops especially grown for that purpose. The net energy is high and the cost not greatly above the ex-refinery cost of gasoline at present.

The two most economic process routes are fodder beet to ethanol and radiata pine to methanol.

Because of the large amounts of Maui natural gas which are becoming available shortly, it is unlikely that energy farming will be used in a major way for transport fuel until at least the 1990's when the Maui field is starting to be depleted. Because of the long lead times, however, it would be highly desirable to undertake a development and demonstration programme in the 1980's with the objective of having 1 or 2 commercial plants operating by 1990.

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The contributions of these people and many others who have assisted is gratefully acknowledged.

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TABLE 3

COST OF TRANSPORT FUEL

Feedstock and Fuel	Feedstock Cost ODt/d	Processing Plant Size ODt/d	Production Cost(2) c/1(3) in 15% blend	c/1(3) pure	$/GJ	Feedstock Cost / Total Cost
Gasoline ex refinery	-	-	-	12.8(1)	3.7	-
Fodder Beet to ethanol	40	1000	13.0	17.5	5.7	0.72
Radiata Pine to methanol	30	2500	12.0	19.0	6.8	0.34
Radiata Pine to methanol	50	2500	16.5	25.5	9.0	0.5
Radiata Pine to ethanol	30	1000	20.0	27.0	9.3	0.62
Forage to methane	87	200	N.A.	33.5	13.7	0.80
Maize to ethanol	96	1000	33.0	44.0	19.6	0.70

Notes:
1. Gasoline cost is December 1978.
2. Other costs are June 1977.
3. Costs are quoted in c/l of gasoline equivalent, i.e. since alcohols burn more efficiently in engines, a lower amount of energy is required for the same distance travelled when compared with gasoline.

Biotechnology — The State Of The Art

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General Outline Of Scope Of Biotechnology

As a background to my later comments, I want to very briefly summarise the nature of Biotechnology as a new disciplinary area, and to try to emphasise its essential characteristics. Historically, it has arisen from the use of multi-disciplinary approaches to solve various problems of development in the fermentation and biological process industries. For example, the needs for quantitative data on the transfer of nutrients, sterilisation and the maintenance of sterility, and on the control of temperature in the large-scale production of acetone and butanol during World War I in England and the upscaling of penicillin production in England, the USA during World War II demanded a better understanding of the physico-chemical basis of microbial nutrition and the effects of environmental factors. The not-so-worthy practical objectives of the large-scale cultivation of micro-organisms for use as biological warfare weapons in the fifties promoted fundamental studies on the kinetics of bacterial growth, the development of practical and theoretical studies on the continuous culture of micro-organisms and stimulated the concept of mathematical modelling as a powerful tool for better understanding of the operation of microbial processes. The commercial pressures for higher productivity in fermentation processes and the demand to exploit as far as practicable the very extensive powers of micro-organisms for chemical manipulation led to extensive screening programmes and to the development of techniques for mutation and selection, and for the preservation of micro-organisms, which have extended the scope of microbial processes beyond anything that might have been imagined at the turn of the century.

The majority of these developments have been characterised by the deployment of techniques and methodologies derived from a number of disciplines other than those of classical microbiology and these multi-disciplinary inputs have eventually crystallised into the relatively-new interdisciplinary area which we call Biotechnology, in the same way that Biochemistry has arisen from chemistry, the biological sciences and medicine, and Food Technology has emerged as a separate entity from multi-disciplinary inputs from chemistry, chemical engineering, microbiology and other biological disciplines.

It is important in new interdisciplinary areas, that its proponents see clearly the characteristics of the new discipline which they profess and the appropriateness of the methodology and concepts at their command to particular areas of development. To take biochemistry as an example, while many of the methods of the biochemist are chemical, his objectives are the explanation of biological, not chemical processes. The primary objective of the food technologist is not the understanding of the chemistry or the microbiology of foods, but the devising of ways and means by which the edible portions of plants and animals may be processed for human consumption. The biotechnologist is primarly concerned with the innovation, development and optimal operation of processes in which biochemical catalysis has an irreplaceable role.

Characteristics Of Biotechnology As A Discipline.

Biotechnology has a twin-faceted central core, which is concerned with the obtaining of the best possible catalyst for a particular process, and with the construction of the best possible environment for that catalyst to discharge its function.

[i] **Obtaining the best possible catalyst.** In the vast majority of cases, the most effective, most stable and convenient form for the catalyst for a biochemical process is a whole organism, and it is for this reason that so much of biotechnology is concerned with microbial processes. The methodologies which are to hand in this area are those which enable the selection of superior organisms from the natural environment pool, the modification of organisms by mutation and the construction of organisms by genetic manipulation. These methodologies can only be rationally applied against a background of understanding of microbial physiology, biochemistry and genetics and a constant sighting of the objectives to which they are aimed. The preservation of superior organisms is another important aspect and, in some cases, the wide range of techniques necessary for the isolation of particular catalysts, their purification and stabilisation.

[ii] **Devising and optimising the environment for the biochemical process.** This second facet of Biotechnology embraces reactor design, the techniques of best presentation of the raw materials upon which the catalyst system must act, the provision of devices for the maintenance and control of physico-chemical parameters such as temperature and pH, the determination of the best operational patterns whether batch-wise or continuous flow, and with an eye to considerations important for the recovery of the product and the disposal of the wastes from the process.

All biotechnological practice involves, to a greater or lesser extent, the vast body of information which comprises these two principal facets of the discipline. It will be evident that in the tackling of new problems in biotechnology, different aspects will have differing weights and importance, and that within Biotechnology, as in all disciplines, its proponents will acquire specialisations which draw heavily on one or more of the input disciplines.

The Areas To Which Biotechnology Is Applicable

I have briefly outlined the body of information which comprises Biotechnology and defined its objectives. It remains in this introduction to indicate the principal areas to which Biotechnology may be applied. They are:

[i] **Fermentation Technology**. Historically the most important area and still that in which most biotechnological problems arise.

[ii] **Enzyme Technology**. An important area the rate of development of which has been slowed by obstacles of a non-technical kind.

[iii] **Waste Technology**. A biotechnological area of great and continuing importance, especially when coupled with the conservation and recycling of resources.

[iv] **Environmental Technology**. Of increasing importance and an area to which the full weight of biotechnological concepts have not yet been applied.

[v] **Renewable Resources Technology**. This is an area in which Biotechnology emerges as the analogue of Food Technology in the provision of processes for the utilisation of the non-edible parts of crops, agricultural and non-agricultural, as new sources of chemical raw materials and energy. It is likely to be an area of very great importance within a decade or so.

The Growing Points In Biotechnology.

To come now to the principal reasons for the presentation of this lecture, namely, the definition and description of what appear to be the growing points of Biotechnology and the areas to which most effort and endeavour will be applied in the immediate future.

[i] **A Re-look at Existing Processes** There is some evidence that the capacity of Biotechnology to look at existing processes as a whole and with an integrated approach is becoming appreciated. A good example is the production of alcohol by fermentation, perhaps the oldest of fermentation processes, and one which has received

scant serious attention for a long time. The impending shortage and certain price increase of hydrocarbon fuels has stimulated interest in alcohol as an alternative for some purposes, and a stepping up of alcohol production by orthodox processes is already in progress in some countries. A more rational approach has been suggested by several groups in various parts of the world. Why not a long hard look at the microbial production of alcohol as an integrated process? Some very basic questions have been asked. Is a yeast the best organism to employ? There are bacterial species which produce ethanol faster than yeasts; could such organisms be genetically manipulated to give even better performance? Are the reactors commonly used for alcohol fermentations the most suitable? Could process operation be improved by continuous flow operation and more effective recycle of organisms? Is there some way of overcoming the limitations imposed by product inhibition? Can the highly energy-consuming recovery of alcohol by distillation be circumvented by a more energy-efficient process? And, perhaps most basically of all, is alcohol in fact the most desirable end product if the objective of the process is an alternative liquid fuel; perhaps acetone with its amenability to oxygen elimination by subsequent chemical processing might be a better bet; or perhaps, the target should be direct production of hydrocarbons by a photosynthetic organism.

Biotechnology has a greater capacity to see these problems as a whole than any one of the component disciplines which may contribute to the solution of particular aspects of the problem, and it is to be hoped that those who provide the financial resources for the solution of this and similar problems have some awareness of this fact.

(ii) **The Potency of Applied Microbial Genetics** The first step in the de novo solution of a problem in Biotechnology is the securing of the appropriate organism or catalyst; without a good organism, much time and effort may be fruitlessly expended in the devising of processes to accommodate it. The increasing realisation of the importance of this first step is evidenced by the addition to many well-known biotechnology research teams in recent years of groups skilled in microbial and biochemical genetics and the turning to biotechnological objectives of the vast accumulation of information and techniques which have accumulated in the study of molecular biology over the past 20 years or so. Historically, the selection of organisms from the natural environment and the use of random mutation and selection have served the development of microbial processes well, but the tools are now available for a much more rational approach to the securing of the "objective-tailored" organism or derived isolated catalyst. This is probably one of the most important area of development in Biotechnology.

(iii) **Reactor Design**. Those of us whose researches include studies of the operation of microbial processes in natural environments know only too well that the limitations on the rate and extent of the processes are usually environmental rather than organismal; in other words, the nature of the natural "reactor" in which the process takes place prevents the full manifestation of the potentialities of the organism. While the limitations which reactor design places on the productivity of microbial processes have been recognised for a long time, the majority of commercial fermentation processes have relied upon relatively simple, substantially interchangeable versions of the stirred tank reactor, and the shortcomings of this device have impeded the development of some processes. The last few years have seen extensive innovation in reactor design and these developments have included cycling reactors of the type designed by ICI for their methanol biomass process, tower reactors and improved devices for the transfer of nutrients and oxygen in fermentations in which the broth is highly viscous. The latter development promises the rapid extension of processes for the production of microbial gums and related, high molecular weight and viscous materials.

The current interest in the possibilities of photosynthetic organisms for the direct production of raw materials has highlighted the inadequacies of the traditional ponding systems as biological reactors and the design of more efficient photobiological reactor systems would open the way for some very important and extensive new developments.

(iv) **Automatic Control of Processes** While micro-organisms are profoundly affected by the nature of the environment in which they operate, they also by their activities alter the nature of the environment, a sort of biological Le Chatelier's Principle. The maintenance of an environment in which micro-organism productivity is constantly optimal is extremely difficult by virtue of the number of contributing factors and the complexities of their interactions. The solving of the problems involved in the continuous automatic maintenance of optimal environmental conditions for microbial processes is an area of intensive current activity. It involves identification of the most significant parameters, the construction of adequate models of processes, the devising of sensing techniques of sufficient specificity and fast-enough response time to continally monitor the process, the interfacing of process information to a suitable computing system and the devising of programmes to interpret the data and to command suitable regulatory devices. Extensions of these developments involve other aspects of the whole process such as the preparation of raw materials, the sterilisation of equipment and the recovery of produce.

(v) **Renewable Resources Technology Developments**. As mentioned earlier, this is an area in which Biotechnology is increasingly involved and one in which some of the most significant contributions may be made in the future. It is in many ways a "super-multi-disciplinary area" in which Biotechnology is one of the input disciplines along with plant breeding and agronomy, land use and water resource technology. Principal areas to which attention is currently being directed are:

More complete utilisation of traditional agricultural crops, via degradation of cellulose and hemicelluloses to sugars and subsequent microbial conversion to useful products.

Direct production of hydrocarbons or of materials readily converted to hydrocarbons by improved plant species (**Guayale** and other **Euphorbiaciae**), by metabolic control of other plant species (enhanced resin production from **Pinus radiata** by herbicide injection, essential oils from **Eucalypt** species), by cultivation of fresh water algae (**Botryococcus**) and salt water species (marine phytoplankton).

Use of a diversity of algal species as producers of raw materials (e.g. starch) complementarily to orthodox agricultural crops. These developments would involve use of land not suitable for orthodox agriculture, the designing of novel photobiological reactors, much more extensive recycling of currently waste carbon dioxide and the devising of process patterns which would enable the conservation by recycling of nutrients (particularly phosphorus) and water.

(vi) **Exploitation of the Geological Enivornment** Some of the mechanisms by which the chemical elements are cycled geochemically are biological, as are some of the processes by which elements are concentrated from the very dilute pools of the lithosphere and the hydrosphere into ore bodies. The natural processes can be accelerated by human intervention, sometimes with disastrous effects environmentally but sometimes with considerable benefit in the securing of essential metals not economically recoverable by other means. Principal areas of research and development in this area are:

The simulation of the biogenesis of ore bodies.

The recovery of metals from low grade sulphidic ores by bacterial leaching.

The recovery of metals and other elements from low grade non-sulphidic ores by heterotrophic organisms energised by organic wastes or mixed populations of phototrophs and heterotrophs.

The development of control regimes, based on biotechnological principles, for the minimisation of environmental damage by metal solubilisation and acid generation arising from mining operations.

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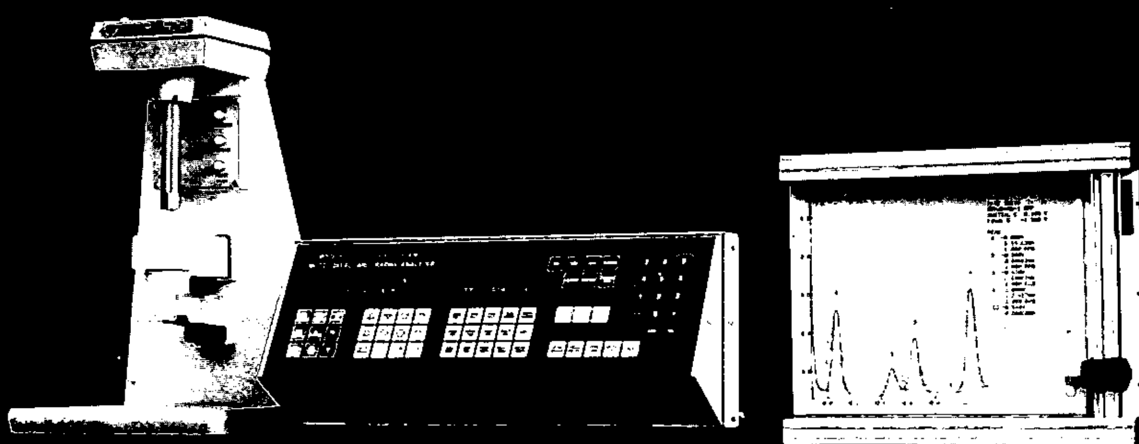

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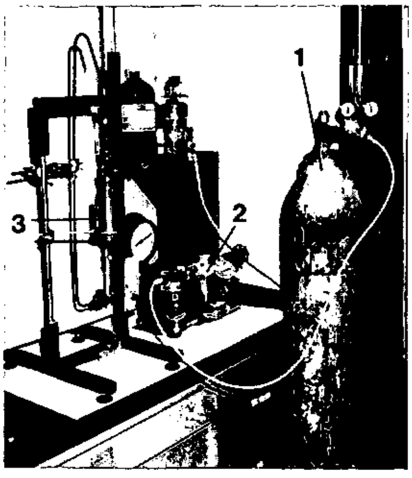
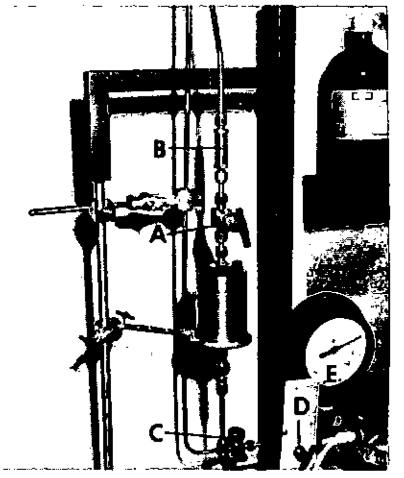
Fig.1 (left): Total column packing assembly. The principal components are: gas cylinder (1); Haskell pump (2); slurry reservior (3).

Fig 2 (right): Close-up of slurry reservoir assembly. The principal components are: on/off valve (A); pressure relief valve (B); non-return valve (C); optional needle valve (D); pressure guage (E).





HPLC COLUMN PREPARATION AND EVALUATION

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Introduction

Development and improvement of pumps and detectors has been rapid since the transition from classical to high performance liquid chromatography (HPLC). However, the column and its contents is still the determing factor in the application and effectiveness of the technique (1).

Classical LC used relatively large particles and low operating pressures, for which a simple slurry packing technique was adequate. There was also an attempt to use gas chromatographic expertise for packing columns by a dry fill-and-tap routine for which smaller particles could be used. The limitations of the dry fill-and-tap packing method became apparent as particle sizes dropped to 50 microns for irregular, or 20 microns for spherical packings. It was difficult to produce good columns with smaller particles; they suffered from settling and loss of efficiency in later use. The availability of 5-20 micron particles necessitated the development of better packing techniques (2); column dimensions were also affected as long narrow bore columns could not be packed as efficiently as shorter wide bore columns. Further work established that generally the optimum column length was between 100-250mm with an internal diameter of 4-5mm (3).

As column technology developed pressure requirements also became lower and the demands on the rest of the system less. It is currently possible to obtain 5000 theoretical plates of efficiency from a column 60 x 4.5mm ID filled with 5 micron packing and operated at pressures as low as 400psi. In contrast a column 200cm long, operated at an impractical 21 000psi, would be required to generate the same number of plates if filled with a 20 micron packing (3).

On the basis of the above considerations, plus the cost factors involved, it was decided that a 100 x 4.6mm ID stainless steel column was the simplest and cheapest column type to make. Furthermore, the practical requirements for making such columns has been recently published (for silica gel packings) and personal contact with the authors had established the reliability of the equipment and techniques(4).

Methods

The details of the column packing method have been described by us previously* and are based closely on the techniques described by Webber and McKerrell (4), and others (5,6). A similar non-balanced density slurry packing method was used, together with a simplified packing reservoir design constructed in our workshops.

Figs. 1 and 2 show the total column packing assembly. The pump is a pressure amplifier type (Haskell Model DST 150 AC, though a better version would be the DSTV-122; these only require a dry air or nitrogen primary pressure source), capable of generating up to 15 000psi; however actual packing pressures do not need to exceed 6000psi. A high pressure gauge and non-return valve are essential (to prevent a pressure surge reversing back through the column and disrupting the packing); a needle valve is not. A pressure relief valve may be positioned before the on/off valve, but the system is self-limiting because of the amplifier pump used.

Carbon tetrachloride was the solvent most frequently used by us, so that after the 8 step packing sequence was completed, the columns required backflushing with a solvent immiscible with CCl_4 to remove air trapped in the inlet filling. It is also good practice not to store columns filled with halogenated solvents. Pre-conditioning has not been found necessary with these packings as deactivation does not occur with dry solvents.

Results

Much has been written (7) as to which are the useful parameters for column evaluation and comparison, but since our packing technique and column design was an attempt to follow as closely as possible the methods of Webber and McKerrell we considered it appropriate to express our results using the same parameters. It should also be pointed out that we did not have the same HPLC equipment as they did so that some differences due to extra-column effects could be expected. No allowance has been made for these, but as we consider that our system is fairly representative of readily available commercial units, our results are considered to be comparable with other systems.

All the evaluations described were with the following HPLC equipment; Rheodyne 7120 loop injector; LDC IIG pumps; Tracor 970A uv detector operated at 254 nm.

* Reported at the Chromatography Group Workshop, Massey University, May 1978. Full descriptions of the packing routine are available on request.

Column Preparation (Cont)

The characteristics of some of the silica gel columns packed by us are given in Table 1. The results with the Partisil columns are generally as good as one can get with equivalent commercially available columns (for equal column lengths). The Partisil 20, 10 and 5 micron columns show a steady but not dramatic increase in efficiency with decreasing particle size. A much greater improvement was anticipated, but as mentioned earlier extra-column effects may be responsible for masking the difference between our columns. Even the best column filled with Partisil 5 micron packing, only gave 3510 theoretical plates (with m-nitroaniline) at conditions similar to those in the literature (4) for an equivalent packing (Table 1, lines 3 and 5). It was obvious that there was a considerable difference in the overall efficiency of the two systems, although to be accurate there was also a variation in the k' values indicating a difference in solvents or silica gels. Further improvements in column efficiency will undoubtedly result from the use of spherical instead of irregular silica particles. This is illustrated by the result obtained with the Zorbax column, which in our system gave an efficiency similar to the best published Partisil 5 result.

TABLE 1.
Comparison of column efficiencies for different particle sizes and types.

Packing	Column Length	k'	$N_{Theoretical}$	$N_{per\ metre}$
Partisil 20	10 cm	1.63	2180	21800
Partisil 10	10 cm	1.63	2837	28370
Partisil 5	10 cm	1.61	3510	35100
Partisil 5*	10 cm	1.99	6700	67000
Zorbax-Sil** 5-6 micron	25 cm	2.53	14080	56320

Solvent: 1:49:50 isopropanol : CH_2Cl_2: hexane
Partition coefficient k' = (tr-to)/to : Efficiency N = $16(t_r/\text{peak width})^2$
Standard compound: m-nitroaniline
*** Result quoted from Webber and McKerrell**
****Commercially produced column.**

TABLE 2
Comparison of column efficiencies for different reverse phase packings.

Packing	Solvent	Column length	k'	$N_{Theoretical}$	$N_{per\ metre}$
Lichrosorb RP2 5 micron	2	10 cm	4.54	226	2260
Lichrosorb RP8 5 micron	2	10 cm	13.15	2387	23870
Brownlee RP8* 10 micron	2	10 cm	10.22	1108	11080
Partisil ODS 10 micron	2	10 cm	4.22	850	8500
Whatman ODS* 10 micron	2	25 cm	4.19	1920	7681
Waters C18* 10 micron	3	30 cm	2.04	3562	11870
Zorbax ODS (1)* 5-6 micron	3	25 cm	4.39	6063	24252
Zorbax ODS (2)* 5-6 micron	3	25 cm	5.34	10043	40170

Standard compound was anthracene in each case
Solvent 2 was 62.5% $MeOH/H_2O$ + 0.2% H_3PO_4
Solvent 3 was 85% $MeOH/H_2O$ + 0.1% H_3PO_4
***indicates commercially prepared column**

The same technique was used for packing reversed phase columns and the results are presented in Table 2. It was found that differing column efficiencies were obtained, depending on the packing type. The Lichrosorb RP 2 packing gave very poor results; the cause is still unknown. In contrast the RP 8 packing could be used to produce columns with over 20 000 plates/metre equivalent, but this depended on the packing solvent employed. With a different slurry solvent (e.g. containing isopropanol) the same packing gave a column with only 12 000 plates. The 5 micron particle size packings generally gave more stable suspensions than was possible with the 10 micron ones and the columns obtained were similar to commercially available ones (although it should be stressed that we did not have an exact equivalent, so the difference may not be as great as it appears from our data).

It was also difficult to compare our Partisil ODS columns with any other than the Whatman ODS column available commercially. It was clear that each manufacturer produced a C_{18} reversed phase packing with quite different characteristics, as exemplified by the need to use increased proportions of methanol in the eluting solvent. Thus though our columns were of a similar efficiency to the Whatman one, they were still markedly inferior to other commercially available columns, notably the Du Pont Zorbax ODS. However it should be stated that this column was filled with 5-6 micron spherical particles. It should also be noted that such comparisons between columns may be somewhat misleading as column use plays a significant part, as illustrated by the two Zorbax ODS columns (marked (1) and (2)) which differed only in age, but the efficiencies differed by a factor of two.

Similarly it is difficult to eliminate all the extra-column effects. These may not be very evident in low-efficiency column systems, but become of some considerable significance for high efficiency column operation. We have found that simply using alternative tubing and couplings with the same column may alter apparent efficiencies by 10% while the insertion of a precolumn filter unit decreased efficiency by approximately 25%.

Conclusions

The principle advantages of packing HPLC columns are: cost (in the region of $50 per 10cm column); efficiency (easily repacked if poor quality performance); and flexibility in problem solving (packings and column combinations can be altered at will). Together with the ability to tackle different problems has come an appreciation of the need for further development with spherical packings and reduction of extra-column effects to increase overall system efficiency.

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The AC88: A virtually ideal electronic analytical balance for individual weight determinations, serial weighings to zero and compounding with net total display. The AC88 is equipped with the incomparable *Mettler DeltaRange.*
The A30: An electronic analytical balance that is ideally suited for weighing in and for repeat weighings. Connect a calculator and you have a system capable of automatically processing weighing data.
Both balances feature superior operating convenience. With Mettler's single control bar, even unskilled personnel can operate an analytical balance.
Ask for our brochure. It describes these two electronic analytical balances in detail.

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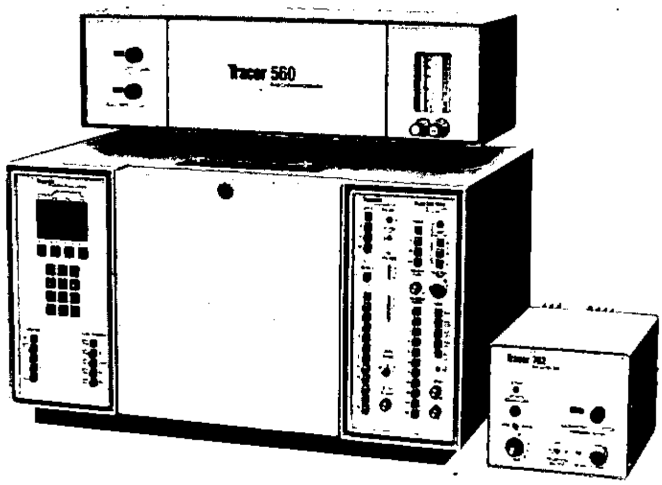
Tracor

if you don't have Tracor chromatographs in your lab...

Gas Chromatography

A Tracor 560 gas chromatograph equipped with the New HALL® 700A Electrolytic Conductivity Detector and the Tracor 702 Nitrogen-Phosphorous Detector can do specific analysis of almost any class of compounds.



700A HALL® Electrolytic Conductivity Detector

The new HALL® 700A is more compact and up to 10 times more sensitive than its predecessors. It incorporates such new features as

- An automatic solvent venting valve and a differential conductivity cell for improved long term stability
- A new microreactor platinum resistance heater/sensor which allows for faster and more accurate temperature control of the reaction zone
- A combustion tube of small I.D. nickel tube which gives more efficient conversion of the combusted compounds

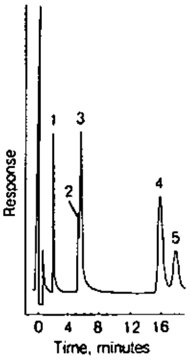
The 700A also incorporates a bipolar-pulsed excitation signal across the cell electrodes which eliminates the non-linearity, cell heating and capacitive noise problems previously associated with other conductivity measurements.

702 Nitrogen-Phosphorous Detector

The Tracor 702 Nitrogen and Phosphorous Detector has several outstanding features over other available nitrogen phosphorous detectors. *First*, the source desensitizer allows the user to inject *chlorinated solvent derivatizing agents* and ordinary solvents without degenerating or destroying the source. Second, the source is electrically heated/precision temperature controlled for better source life even in the event of column flow loss. Next, source alignment is quick and easy with alignment tool provided. What can you do with the Tracor 560/700A/702 element selective chromatograph?

- Specific detection of halogen, nitrogen or sulfur compounds over a 10^4 linear range with the HALL® 700A Electrolytic Conductivity Detector.
- Specific detection of nitrogen and phosphorous compounds with easy detector operation using the 702 Nitrogen-Phosphorous Detector.

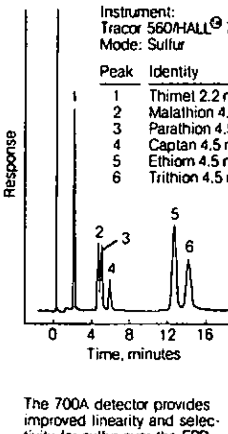
702 NPD
Phosphorous



Instrument: Tracor 560/702 NPD

Peak	Identity
1	Thimet—1.8 ng. ea.
2	Malathion—3.6 ng. ea.
3	Parathion—3.6 ng. ea.
4	Ethion—3.6 ng. ea.
5	Trithion—3.6 ng. ea.

700A HECD
Specific Sulfur Mode

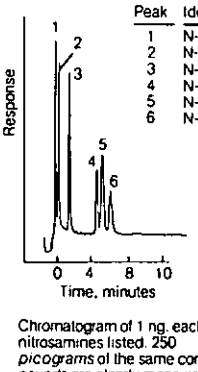


Instrument:
Tracor 560/HALL® 700A
Mode: Sulfur

Peak	Identity
1	Thimet 2.2 ng
2	Malathion 4.5 ng
3	Parathion 4.5 ng
4	Captan 4.5 ng
5	Ethiom 4.5 ng
6	Trithion 4.5 ng

The 700A detector provides improved linearity and selectivity for sulfur over the FPD.

Specific Nitrogen Mode
Nitrosamines



Instrument:
Tracor 560/HALL® 700A
Mode: Nitrogen

Peak	Identity
1	N-Nitrosodimethylamine
2	N-Nitrosodiethylamine
3	N-Nitrosodipropylamine
4	N-Nitrosodibutylamine
5	N-Nitrosopiperidine
6	N-Nitrosopyrrolidine

Chromatogram of 1 ng. each of nitrosamines listed. 250 *picograms* of the same compounds are clearly measurable.

Contact Tracor for Chromatrographic Conditions.

Tracor Instruments

P.O. Box 32-076, Devonport, Auckland 9. Telephone: 451-305

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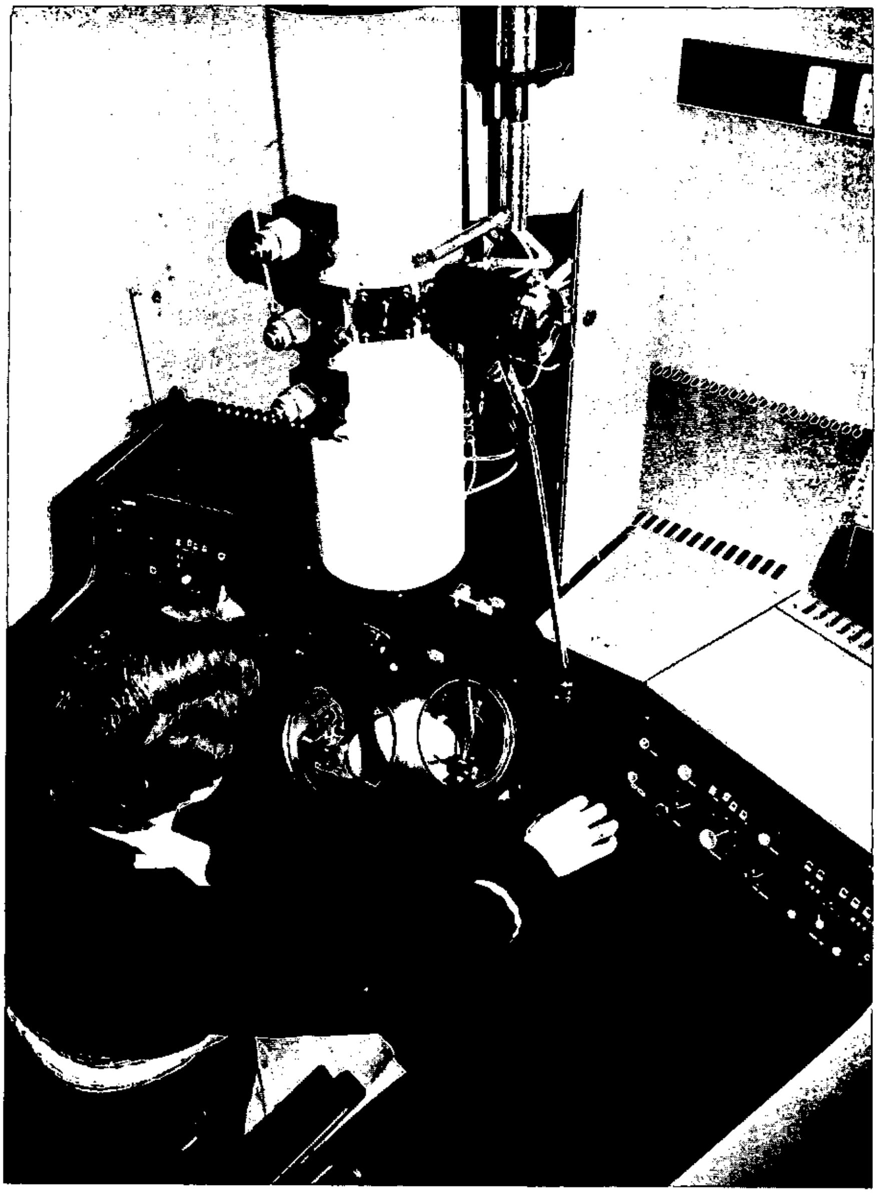
Electron Microscopes Playing Vital Role In NZ Research



The Meat Research Institute's new transmission electron microscope, the only one in the Waikato, is made available to other users, such as the Waikato Hospital, Waikato University and Ruakura Agricultural Research Centre as well as catering for the Institute's own work.

It is used for many purposes such as providing a diagnostic service to the hospital on kidney and lung disease, by Ruakura for studies relating to facial eczema, wine production, growth studies, and a diagnostic virus identification service; the university uses the microscope to study such things as adaption of photo receptors to varying environments, and soil and bacterial identification.

MIZINZ uses the TEM for many projects, including the study of myosin, connectin, electrical stimulation and blood splash in lambs.

The new Philips EM 400 has enabled studies requiring high resolution to be undertaken easily and the resulting pictures to be of very high quality. This is due to the extremely low contaminaton rate and the increased resolution.

Conceived by the Philips organisation "to lead electron microscopy into the 1980's" (according to a 1975 press release) two examples of its EM400 advanced research electron microscope are playing vital roles at the Meat Industry Research Institute, Hamilton, and the DSIR's Physics & Engineering Laboratory, Lower Hutt.

The unit fulfils two basic requirements: as an advanced transmission electron microscope, it preserves the detail in sensitive specimens and produces optimum resolution and contrast in distortion-free images from everyday specimens; and is a versatile, stable optical platform for present and future micro-analytical systems.

Its versatility is being proved at MIRINZ, where the unit provides a diagnostic service to the Waikato Hospital, is used by Ruakura scientists for facial eczema studies and by Waikato University for soil and bacterial identfication in addition to the Institute's own research needs.

Specimens are protected against contamination and erosion by a clean high-vacuum system pumped to 10^{-7} torr or better, in the specimen area, by an ion-getter pump. The oil-free high vacuum circuit including the ion pump and the column is separated from the auxiliary vacuum system by a 200*u* differential aperture placed in the second projector lens, at the base of the column. Deterioration of the vacuum in the viewing chamber and plate camera, due to out-gassing of wet plates for example, has no discernible effect on the vacuum around the specimen. The clean vacuum construction in the column is based on the use of stainless steel liner tubes to reduce the number of vacuum seals required, the remainder being of Indium metal wherever possible. Adjustable parts such as aperture drives are constructed with metal bellows to allow the required movement without the need for sliding seals.

Seven lenses provide flexibility to the optical system. The five imaging lenses are used to obtain a number of standard operating ranges with maximum convenience, accuracy and fidelity in image reproduction. An example is the main magnification range from 50x – 800,000x.

At each of 39 magnification steps the lenses are programmed to produce an image of maximum area with minimal radial and spiral distortion and minimum curvature of field. Of particular importance is the ability to compensate for imaging aberrations produced by electron energy loss in thick specimens and to produce sharp

A new level in HPLC sophistication and simplicity.

Micromeritics proudly introduces its new 7600 microcomputer-based Liquid Chromatograph . . . a beautiful blend of engineering sophistication and operating simplicity.

We've taken the most advanced features available in HPLC today and packaged them so that you can have the exact system or components to fit your specific application. Both gradient and isocratic integrated systems are available to accommodate rigorous quality control and methods development needs, or the comlex analysis functions of research and development laboratories.

7500 Gradient Liquid Chromatograph.

SIMPLE KEYBOARD ENTRY

All operating commands can be made from a single microcomputer based control module. An alphanumeric display readout continually informs the operator of time, status for such parameters as flow rate, pressure, solvent concentration and column temperature.

TOTAL ANALYSIS REPORTING

Comprehensive analysis reporting is achieved through a printer/plotter which not only provides the chromatograms, but also a printout of gradient/solvent conditions, flow rate, pressure, temperature and operational status. Sample retention times, peak area and height, percent of concentration, sample and injection numbers can also be printed out.

TOTAL AUTOMATION

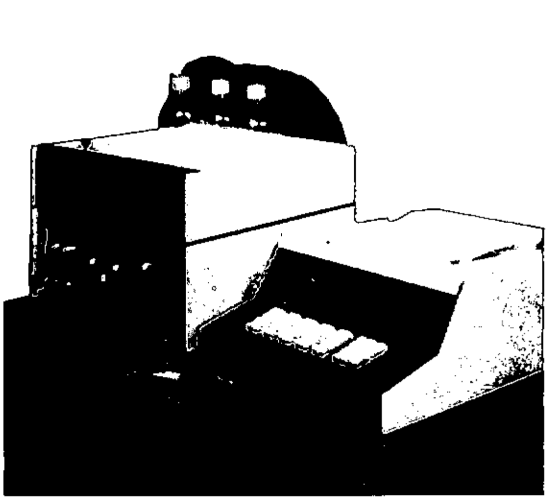
The 7500 system can be totally automated to give you unattended analysis around the clock. It can initiate 192 analyses of up to 64 samples . . . automatically.

SOPHISTICATION

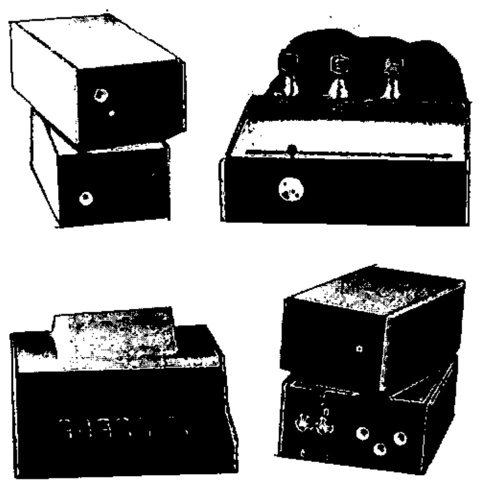
The 7500 LC system exceeds all criteria for the two general analytical situations:

Routine, repetitive analyses when operating parameters are predetermined and remain constant from analyses to analyses. Fundamental research applications when system parameters must be changed to optimize separation of sample components. Fully unattended operation for these gradient and isocratic analyses is available with the inclusion of the 725 AutoInjector.

A variety of safety checks are programmed into the system, providing shutdown in case of malfunction.



7500 Isocratic Liquid Chromatograph.



Individual components.

SIMPLICITY

In the microcomputer controlled 7500 system, it is possible to do complete, unattended methods development on several samples, consecutively. Repetitive injections of sample groups requiring up to ten different analyses conditions may be automated.

The system requires little operator training because user-instrument interface has been minimized. Parameter entry and keyboard are designed for operational ease. The Control Module provides alphanumeric prompting. Only a basic understanding of the fundamental chromatographic components is assumed.

Standard upper and lower pressure limits are incorporated in the pump to protect certain crushable column packings and against sudden pressure loss. A test routine checks for problems common to most pumps, such as check valve malfunction, seal leakage and out of solvent condition (air in pump). On detecting a malfunction, the 740 Control Module will automatically stop the pump and other priority equipment. A loss of flammable solvent in the heated column compartment will also set off and alarm. A sensor circuit allows the operator a period of time to correct the leakage before controlled components are automatically shut down.

The 7500 HPLC is a preassembled, integrated system with components packaged in an attractive, space saving cabinet. Bench operator training is minimized; LC expenditures are optimized in that purchase of a system may be tailored to need. The Micromeritics 7500 Liquid Chromatograph offers simplicity in operation, sophistication in design.

AVAILABLE IN COMPONENTS

You have the option of buying as much or as little of the system as you presently need. The 7500 system is available as individual components, so you can buy what you need now and add more later as your requirements dictate.

1. **750 SOLVENT DELIVERY SYSTEM** — a reciprocating HPLC pump offering pulse-free solvent delivery based on patented *flow multiplexing* design. Unit may operate in constant pressure or constant flow mode to 6000 psi and is universally adaptable to other Micromeritics HPLC components. Flow precision is ± 0.50% and the pump can be operated at flows from 0 to 20 ml/min.
2. **740 CONTROL MODULE** — gives microcomputer control, keyboard entry of all system functions. Automatic signal for overpressure, underpressure (leaks) flammable solvent leaks in the column compartment and pump malfunction. Printer Plotter and Full Data Reduction optional.
3. **725 AUTOINJECTOR** — a self contained, microprocessor controlled Automatic Sample Injector designed for unattended analyses. Easily interfaces with any LC, many computors. Capable of automatically injecting up to 64 samples at 3 injections per sample. Accuracy and reproducibility ± 1%. Accepts operating pressures to 600 psi.
4. **753 TERNARY SOLVENT MIXER** — added to Isocratic system allow low pressure Isocratic solvent blending for up to three solvents (100% — (A + B) = %C). Addition of 740 control module allows gradient operation.
5. **731 COLUMN COMPARTMENT** — includes injector valve, oven compartment, column heating block and solvent reservoir tray. Precise temperature control of column is accomplished by direct contact to heated block. Injection may be manual or motorized.
6. **771 RI DETECTOR** — detects solvent/solute differences over the entire refractive index range without prism change. Temperature variations are effectively controlled with a thermally stable detector head.
7. **786 VARIABLE WAVELENGTH DETECTOR** — identifies compounds absorbing from 195 to 750 nm. Continuously variable wavelenths and superior light source/optics provide uniform linearity, maximum sensitivity and unexcelled resolution. Analytical or preparative.
8. **726 INDIVIDUAL SAMPLE PROGRAMMER** — interfaces with the 725 AutoInjector to provide preprogrammable variations in number of injections, rinse vial location and turntable indexing.
9. **PRE-PACKET MICROSIL HPLC COLUMNS** — both packing materials and completed columns meet or exceed all HPLC requirements for high efficiencies and improved resolutions. Available for all reversed, normal phase, and Ion exchange applications.
10. **705 STIRRED-SLURRY COLUMN PACKER** — can be used with your HPLC or pump to pack columns with 5 and 10um materials. Reproducibly packs efficient columns using a slurry technique. Simple, economical, fast.

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images over the whole screen area. The use of Programmable Read Only Memories allows the range, with all its variables, to be controlled by a single 39-step switch. Other changes in optics required in this range, such as insertion or removal of the objective aperture at the correct magnification (by pneumatic servo-mechanism), choice of appropriate stigmator and stigmator range, display or printout of magnification, occur automatically at the appropriate step.

Another advantage of such sophisticated 'memory controlled' electronics is that other optical programmes can be chosen in the future without any hardware changes. The system is further open to external control or read-out via analogue or digital methods, which is foreseen for operation with other electronic devices as part of an analytical system.

For the EM400, Philips developed a new eucentric goniometer stage combing specimen tilting with high resolution without sacrificing the ease of operation of this type of stage. The stage is provided with a pre-pumped airlock and 8 special holders for specimen orientation, treatment etc. Two versions are available.

Freedom of access to the specimen results from a new octagonal stage-block with 8 ports, 4 of which can be available to allow experimental treatment or analysis devices to be placed in proximity to the specimen from outside the column. This arrangement immediately allows near-optimal take-off geometry for an energy dispersive X-ray detector, with consequent increased sensitivity micro-chemical analysis.

Numerous improvements in the instrument's operational facilities include completely automatic exposure sequences for the 35mm roll film camera and also for a new pneumatically-operated 36 plate or cut film camera; print out on the photographic plate, and, if required, on a separate paper printer, of magnification, high tension, exposure number and operator identification.

An interesting innovation is the ability to make a series of exposures with a pre-programmed focus step between them. This 'robot' form of operation is designed to meet the increasing need to make micrographs from highly beam-sensitive materials (biological molecules, polymers etc) when reduced illumination and contrast make operation virtually blind.

Daily maintenance is largely eliminated due to the clean high-vacuum system and minimum contamination of parts and a column that is pre-aligned with electro-magnetic fine alignments.

Recent option additions to the EM400 are a new STEM unit and a twin objective lens.

The former is said to give the microscopist a choice of 3 basic imaging modes and various analysis modes.

Rapid switching between TEM, STEM and SEM is made possible by the provision of preset alignment controls, while up to 6 signals are pushbutton selectable. These include:

- STEM bright field — using a disc transmitted electron detector;
- STEM dark field — with an annular transmitted electron detector for high efficiency imaging of biological specimens;
- STEM dark field divided by bright field — easily obtained since the disc and annular elements are concentrically mounted;
- SEM secondary electrons — for high resolution topographic imaging;
- SEM backscattered electrons — for atomic number, crystallographic and sub-surface information;
- X-rays — for energy — dispersive analysis of micro-volumes.

Any combination of the available signals can be superimposed on the viewing screen, permitting ready comparison of various types of information from a given specimen area. Alternatively, images can be displayed side by side in a split-screen presentation.

A dual magnification system gives the further option that a signal can be viewed at a selected magnification on one half of the screen, while simultaneously being shown alongside a zoomed value 1x — 4x larger.

Using the split-screen mode, 2 successive exposures can be made on the same piece of film at different goniometer tilt angles, providing a correctly aligned stereo pair.

Independent adjustment of brightness and contrast allows easy choice of different imaging modes. Line time and number of lines are also independently controlled. A special 1000x line time facility produces excellent counting statistics for X-ray analysis.

The STEM unit is complemented by a wide range of modular plug-in accessories for the optimisation, manipulation and recording of scanned images, including a focus control, photomonitor and second display monitor.

The twin objective lens for the TEM/STEM systems offers high resolution in both modes by simple switchover. In conjunction with the high tilt goniometer stage, it is said to offer a good combination for imaging and analytical work.

The design of the specimen stage/pole piece area permits specimen tilt of up to ±60°, while free access is available for a comprehensive range of detectors.

A particular advantage is that an X-ray detector with a 20° take-off angle can be fitted, with a highly efficient collection angle of more than 0.13 sr. Specifically suited to the X-ray analysis of thin samples, this enables measurements to be performed without tilting the specimen.

Instrumentation In Research

METALS, MINERALS ANALYSER

A low-cost sequential spectro chemical analyser, manufactured by Labtest Equipment Co., Melbourne, is now available in NZ through the local representatives, Advanced Electronics Ltd.

Called a "Gloscan", it features "Globoost", a boosted glow discharge source developed by the CSIRO Division of Chemical Physics (ref. Gough D.S. Sullivan, J.V., Analyst 1978, Vol. 103, 887,890).

The sample to be analysed forms the cathode of the boosted glow-discharge lamp. The resultant emission is beamed through a scanning monochromator. A number of spectral lines are selected corresponding to the elements to be determined. Under control of a micro-processor the monochromator slews to each line in turn to allow sequential measurement of the emission signal from the corresponding elements.

Most metals sputter sufficiently well to be determined in the "Globoost" discharge. Samples that can be analysed for all required elements, including the major constituent, are brass, bronze, steel, zinc, die cast and aluminium alloys.

Minerals and other non-conducting minerals can be analysed after grinding and mixing with a pure metal powder such as copper or silver.

The claimed features of the system are'

- A simple spectrum giving the minimum amount of matrix effects due to spectral interference.
- Wide dynamic range from ppm level a major constituent concentration.
- High precision and accuracy at all concentration levels.
- Possibility of determination of the non-metallic elements, carbon, sulphur and phosphorous.

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FERROGRAPHY: Analysis By "Iron Writing"

D.J. Sinclair
Analytical Products
W. Arthur Fisher Ltd.

Modern design in today's machinery tends to totally enclose most of a machine's moving parts. It becomes a time consuming and costly exercise for the maintenance or lubrication engineer to dismantle a machine for visual inspection. There is the increased danger of failure during shut-down and start-up as well as the loss of production due to the shut-down of a continuous process.

For this reason oil analysis becomes a valuable tool in predicting incipient machine failure. The technique of emission spectroscopy on the oil sample is in widespread use as a means of analysing for abnormal wear. Basically, the assumption is a rapid increase in metal in the lubricant is indicative of abnormal wear. Though the technique measures the quality of each of several metals in the oil, it does not distinguish between free metal, metal oxides or other metallic compounds. Nor does it give information on the various wear mechanisms that may occur in the particular machine under examination.

Ferrography, or "iron writing" is an analysis technique that provides information on the particles themselves.

Running-in of a machine results in a high proportion of wear particles. Cutting type wear particles appear during plant commissioning. Their reappearance later in the life of the machine is indicative of a serious wear condition. Opposing surfaces of roughly the same hardness in diesel engine cylinder walls, piston rings and other components leads to rubbing wear. Contamination of the lubricant can rapidly increase normal rubbing wear of components. A high proportion of large to small particles in a gear system is found in rolling bearing fatigue.

To determine the above types of wear, the Foxboro Analytical ferrograph employs the influence of a magnetic field on ferromagnetic and paramagnetic particles found in the lubricant. The Foxboro Analytical direct reading ferrograph is designed primarily as a screening tool and is suitable for depot or plant use.

The amount of large and small particles deposited is measured by the extent to which light is attenuated.

Whereas spectrographs are insensitive to large particles, the ferrograph does not have this disadvantage due to its ability to select optically for large and small particles. Time to carry out the test is less than 5min.

For further analysis, the oil sample is treated and pumped through the ferrograph analyzer, which adheres the particles to the ferrogram slide.

As a result of a magnetic field, polymeric and non-ferrous particles are deposited because of transfer to them of small quantities of magnetic materials during the rubbing process. As the slide is mounted between the poles of a permanent magnet and the distance between slide and magnet changes slightly, the magnetic field increases along the slide. Combining this field force increase with the visocity of the sample results in particle distribution along the ferrogram slide, the larger particles being deposited nearer to the entry point.

Once the ferrogram is formed, it is examined optically for particle type and numbers. Though a scanning electron microscope can be used in research to give in depth focussing and high resolution of particles, it does not give the contour definition of a bichromatic microscope. For routine use, a bichromatic microscope is best as opaque objects appear red while transparent objects appear green. Oxides and metallic particles can be differentiated by colour. A useful technique employed is heating the ferrogram to 330°C for 90sec. This results in no change in colour for chromium or aluminium but bronze becomes a darker brown, cast iron a light brown and low carbon and steels turn a temper blue colour. Progressive heating will cause changes in different particles at different temperatures.

Ferrography is thus a worthwhile tool for monitoring running-in of new machinery, as well as for planning a maintenance programme. With proper identification of the parts worn, those parts can be on hand prior to the shutdown keeping losses to a minimum.

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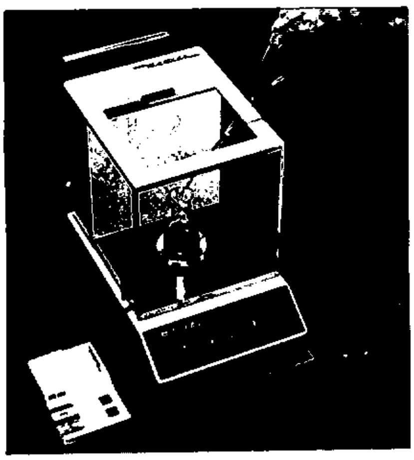
ANALYTICAL BALANCES

Featuring a single control bar to facilitate use, Mettler AC88 and A30 top-loading analytical balances are now available in NZ through Watson Victor Ltd. A touch of the bar switches the balance on and off and tares it.

The AC88 is suitable for individual as well as serial weighings and as a prescription balance. Anywhere within its overall 80g weighing range, a 10 times more accurate fine range — the Mettler DeltaRange — can be recalled with a touch of the single control bar, as often as desired. In the fine range, up to 8g can be weighed in — accurate to 0.1mg. The balance is then tared by pressing the control bar. This brings the Mettler DeltaRange back into play and weighing can start all over again with the usual analytical accuracy of 0.1mg.

The GC301 application input device is another important feature of the Mettler PC Series. This attachment brings out the "hidden intelligence" of the AC88 and enables it to determine net totals, enter reference weights for serial weighings, and count small parts or pieces.

The A30 analytical balance is used primarily for serial investigations with repeat weighings — with or without a printed weighing record. An optional BCD output makes it possible to use the A30 as a system balance, i.e., for the automatic processing of weighing results, statistical quality control etc.



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ANALABS EXTENDS

The Foxboro Analytical's company Analabs Inc. is taking on an extended look. Formerly dealing only with chromatography chemicals and accessories, the new division will now also handle infra-red accessories, as well as Ferrography accessories.

As with the other Foxboro Analytical instrumentation, Analabs accessories are available through W. Arthur Fisher Ltd.

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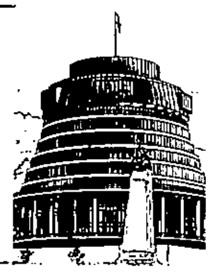
Parliamentary Point Of View

By Ian Shearer, MP



Having been until quite recently a scientist, I am mindful of the fact that a survey carried out not too long ago showed that scientists were ranked second behind doctors and ahead of clergymen on a prestige list of 9 professions. In view of the usual standing of politicians within the community, I am aware that my "standing" in society has probably plummetted since I became an MP. Nevertheless, I still view much of my work with a scientific eye and hope that through this column, I can keep readers informed on matters scientific in the body politic.

New Government Caucus Committee: The Minister of Science and Technology and of National Development, Mr W.E. Birch, quickly established a Government caucus committee on National Development and Science after his appointment and asked me to be its chairman. Naturally I accepted. This committee is rapidly becoming one of the most active, interesting and enthusiastic groups currently working in Parliament. In order to better acquaint ourselves with the various sector councils for which the Minister is responsible, the committee arranged meetings with senior representatives of the Planning Council, the National Research Advisory Council, the Committee on Women and the Commission for the Future. So far valuable discussions have been held separately with the 3 subcommittees of the Planning Council (Economic, Social, Regional Development) and with the National Research Advisory Council. In addition several members accepted an invitation to visit the Physics Engineering Laboratories, DSIR, and found the time very well spent.

Quote from the NZ Planning Council Report "Economic Strategy 1979."

"Estimates of extent to which wages and salaries will have risen during the year to March 1979, vary from 13½% to 17%. With output rising by only about 1% during the period, labour costs per unit of output will have risen appreciably."

A recent report in the NZ Herald quoted statisitics showing that across the Tasman 20,000 potential junior jobs disappeared for every 1% rise in wages.

Marsden Pt A Cracker: The decision to proceed with the expansion of the Marsden Pt refinery has one interesting additional feature. In 1971 expansion plans included a catalytic cracker for Marsden but this plan lapsed with a change of Government. Now it has been decided that the expansion will provide capacity to convert (crack) fractions in the fuel oil range into gasoline, aviation fuel and automotive diesel oil. Because our imported Middle-East crude oil only provides some 50% of fuel oil it is currently necessary for NZ to import large quantities of refined gasoline to make up the shortfall.

The paper presented to the 49th ANZAAS Congress by Keith Ovenden entitled "The Politics of Funding Scientific Research" proves to be a thought = provoking 48 pages well worth closer study.

Legisation: Three bills which were introduced into the House late last year for recess study are likely to be of interest. These are the Toxic Substances Bill, the Pesticides Bill and Restricted Drugs Amendment Bill. The first two are fairly substantial documents each involving the establishment of a new board. The Toxic Substances Bill will have powers to appoint advisory committees along the lines of the present Poisons Committee. The Pesticides Bill replaces and repeals the Agricultural Chemicals Act 1959 and its amendments and provides for a Pesticides Board to replace the present Agricultural Chemicals Board. Again power to appoint advisory committees will be given.

The third much smaller bill is a measure to retain those requirements of the Poisons Act 1960 that relate to drugs, when the latter statute is repealed. As the Toxic Substances Bill deals with substances that are not medicines, some control must be retained for medicines with toxic properties. The Restricted Drugs Amendment Bill provides this control as a temporary measure until another piece of pending legislation, the Medicines Bill, has been enacted.

GASES AND RESEARCH

Philip Best, Product Manager Special Gases, NZ Industrial Gases Ltd.

Today, the researcher is confronted with an array of specialist analytical machinery that his predessors only dreamed of. The proper selection of consumables for your chosen equipment is very important. Gases form an integral part of many analytical tools. Selecting the correct purity of gas for use in equipment such as gas chromatographs, flame ionization detectors and the like can have a great bearing on the success of the project. The use of commercial grades of gas can be a false economy where more pure grades of gas have been developed for use in analytical tools. When one considers the cost of setting up a laboratory, training technicians where necessary, the cost of instruments and the cost of time, and what is dependent on the results, the few dollars that may be saved by purchasing lower purity gases can be very much false economy. One wrong result could wipe out hours or maybe years of painstaking working.

A good example of a specially developed gas is zero gas. Zero gas was developed for use in flame ionization detectors. It refers to material which has a low hydrocarbon content, needed to prevent high background noise. An unstable flame reduces sensivity and the possibility of loss of accuracy. Helium is a general carrier gas for gas chromatographs. Most analysts using thermal conductivity detectors use high purity helium. Some more sensitive instruments use ultra high purity, of the order of 99.9999% pure. However, the analyst, depending on the amount of analysis he is making could use argon, hydrogen or nitrogen, these would be the normal alternatives — and certainly there can be others.

Clearly one would not want to use oxygen or air because these gases would burn out the thermal conductivity filaments. However, those using ultrasonic detectors are in the somewhat enviable position of being able to use any gas as a carrier. For instance, they could use high purity oxygen if they were trying to analyse for impurities in oxygen. In other words, taking the background out of the gas. Flame ionization or flame photometric detectors commonly use hydrogen zero gas and Air zero gas to create the flame with either helium zero gas or nitrogen zero gas as the carrier. Some people prefer to substitute mixtures of 40% hydrogen/60% nitrogen or 40% hydrogen/ 60% helium for hydrogen as the fuel gas. Electron capture detectors require either 5% methane or 10% methane in argon with nitrogen as the carrier gas. The nitrogen should be ultra high purity because the electron capture detector is sensitive to water and oxygen thus one wishes to keep these purities at as low a level as possible.

Calibration standards are necessary for gas chromatographs. Gas chromatographs, unfortunately, are not self-calibrating. One needs some kind of known reference to compare against the unknown i.e. a reference standard is required.

NZ Industrial Gases in this country has the technology and the expertise to carry out the manufacture and analysis of gas mixtures.

One must be certain that the calibration mixture does not contain any impurities that are going to interfere with your results. For instance, argon and oxygen elute on a molecular sieve column at the same time. If you are trying to analyse with a small amount of argon and your mixture contains some oxygen, the comparison response peak would represent oxygen plus argon, and erroneous result.

Generally, once a gas mixture has been prepared, thoroughly mixed and made homogenous, it may remain that way almost indefinitely. However, there are some gas mixtures which require some consideration. Clearly, certain types of reactive gases cannot be mixed together and also there are gas mixtures that should preferably be prepared in aluminium rather than stainless steel cylinders. These gases include carbon monoxide, hydrogen sulphide, nitric oxide, sulphur dioxide and vinyl chloride.

When the analyst is sure that he has the correct type of purity of gas for his needs he must be certain that the gas remains equally pure from gas cylinder to analyser. To do this he must be very careful about the transfer system used between the cylinder and the instrument. There are two common areas where contamination may occur; one is the introduction of impurities, the other is the absorption or the reaction of the components within the transfer system itself. To ensure that one does not introduce impurities into a pure gas or mixture it is recommended that one always uses a pressure regulator that is constructed with a metal diaphragm and has a fluorocarbon seat and gasket materials such as "Kel-F" or "Teflon" and that any valves in the system be of a metal diaphragm packless construction. Of course, all lines should be metal tubing not rubber or plastic which will allow gas to seep out to the atmosphere and atmospheric gases to seep into the line. The materials of construction must be compatible with all the gases in the mixture, for instance, one would not use a brass regulator with a ppm ammonia mixture.

In addition to very pure gases being available to the analyst there are also available instruments which will allow for purification of gases, for instance, a hydrogen purifer which is capable for removing oxygen and water from argon, helium, krypton, Methane, xenon and mixtures such as P-10 (10% methane in argon). Such an instrument will also remove hydrogen, some nitrogen, carbon monoxide and carbon dioxide from these gases.

There are 4 points which the user should keep in mind when using gases in expensive analytical equipment:

1. The carriers gas should be specified for the temperature and type of analysis.
2. The calibration gas mixtures and standards must be prepared to ensure a proper mixture - inpurities in the background gas may or may not cause problems in the analysis.
3. The user must select (with the help of his supplier) the proper transfer system for both carrier gas and the calibration mixture. This is most important for satisfactory results.
4. When in doubt concerning the right answers to the first 3 conditions, the user should contact the supplier and discuss both the problems and the applications with someone on the technical staff.

Often the price of the gas is the least important consideration in a gas-orientated analytical system. The choice of the proper gas and the proper gas transfer system can mean the difference between a good and a poor result. A researcher may be depending very heavily on the results afforded by his equipment. There can be no substitute for getting correct results the first time.

Instrumentation In Research

Instrumentation In Research

CONSTANT TEMPERATURE OVEN FOR HPLC

An accurately and reproducibly controlled column temperature is essential in HPLC. Retention time for different compounds depends on several factors of which temperature is often significant. For instance, in qualitative analysis a temperature difference of only 1 or 2°C can cause the elution time for two compounds to be reversed (Snyder, 1974). It is, therefore, essential to know the column temperature, be able to accurately control it and to be able to repeat the separation at some future date with a high degree of confidence.

The Micromeritics Instrument Corporation, Georgia, USA, represented here by Sci-Med (NZ) Ltd., claims to have resolved the problem.

Previous methods — for instance forced air or static hot air ovens — could only guess at the column temperature since the column was not part of the feedback control system. Jacketed columns immersed in circulating fluid are inconvenient. Experience has shown that adequate column temperature control cannot be obtained by heating only the column walls — the mobile phase carrying the injected sample must be heated before entering the column. Therefore, by effectively incorporating both the column and the incoming solvent line with the oven block, the temperature of all components is accurately known.

The newly designed oven block incorporates sunken channels for the columns and a groove for the solvent line. Columns and lines are clamped in place for intimate contact with the oven block. The block in turn is heated by a pad to provide evenly distributed heating without hot spots or temperature gradients.

A precision temperature transducer, in close proximity to the heat source and the columns, transmits continuous readings to a sophisticated electronic control module. The transducer uses a fundamental property of silicon transistors to provide a current proportioned to absolute temperature. The device has linearity superior to thermocouples and all other conventional sensors.

Temperature is controlled by comparing the measured temperature with the selected temperature to produce an error value. The magnitude of this error governs the duty cycle of the heat pad. When equilibrium is obtained, the duty cycle is continuously updated to compensate for heat losses.

The oven temperature may be set and sensed by an external controller. For instance, a microprocessor can "hunt" at different temperatures and then make repeated runs with unsurpassed accuracy. Equilibration time is reduced to a few minutes following a temperature adjustment.

Tests have shown accuracy of ±1°C of specified temperature with better than 1/10°C control hand reproducibility from ambient to 150°C. Therefore, the use of this oven provides a high degree of confidence in the repeatability of analyses.

C011 For further details, use Reader Service Card.

WATER PURIFICATION

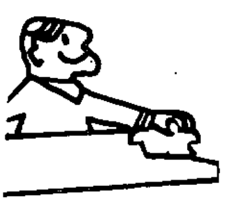
Reverse osmosis systems for water purification to "laboratory grade" standards is a relatively new method said to offer significant advantages over distillation and deionisation techniques.

Reverse osmosis is a simple separation method of producing water of a more consistent quality at a cost competitive with deionisation and much cheaper than distillation. Water is separated from dissolved solids by applying a pressure differential across a membrane which is permeable to water but not to dissolved solids.

As feed water flows over the membrane, pressure forces water through the selectively permeable walls. Quality of water produced is consistent because there is no liquid-vapour-liquid phase as in distillation.

The Millipore Corporation, USA, has produced the Milli-Ro reverse osmosis systems, further details of which are available through the NZ distributors, Smith-Biolab Ltd., Auckland.

C023 For further details, use Reader Service Card.



PRECISION DIGITAL TEMPERATURE INDICATORS

A precision digital temperature indicator operating under any ambient conditions is offered in four versions by its British manufacturers. The Series ATI 100 is suitable for industrial and laboratory use and available with a 3½-digit, 7.5mm high LED (ligh-emitting diode) or 10m high LCD (liquid-crystal display) read-out.

Either 4 wire platinum or nickel resistance sensors are employed, both using a constant current of less than 1 mA. Accuracy is ±0.1°C from -100°C to +200°C for platinum sensors and from -70°C to +170°C for nickel types; it is ±0.5°C over the -200°C to -100°C temperature range. Instruments are factory-set to comply with the sensor curve to within a maximum error of 0.05°C over the whole calibrated range.

C015 For further details, use Reader Service Card.

SPECTROPHOTOMETER

While Pye Unicam announced the SP8-200 spectrophotometer (shown on the front cover), it claimed that its performance could only be bettered by double monochromator instruments. While still adhering to the claim, the company says that the more recent introduction of the SP8-250 and its double, master holographic monochromator now provides "the ultimate in low stray light levels". Both units are available in NZ through Philips Electrical Industries of NZ Ltd.

The instruments are said to have the full range of slitwidths, scan speeds, chart expansions and other facilities expected of research performance spectrophotometers.

Despite their flexibilty, the SP8-200 and SP8-250 are described as easy to operate. Wavelengths, times, recorder offsets, factors, etc. are entered via the keyboard and its associated display while other commands are input by touch button. The microprocessor guards against invalid control settings and error conditions during operation. A keyboard lock prevents unauthorised operation.

The instruments have a high standard of photometric accuracy, achieved by a unique optical design and use of the microprocessor to perform transmission to absorbance conversion, thus eliminating the time, temperature and voltage drifts of conventional circuitry.

In scanning modes, chart/monochromator alignment is provided automatically by Pye Unicam's patented Synchrroscan feature. A baseline memory can compensate for mismatched cells and staighten the baseline to within ±0.001A. The data control module provides extra stages of microprocessor data processing for derivative scanning and integration or rate calculation modes.

The two instruments are said to have more advanced and comprehensive remote control facilities than any other UV/visible spectrophotometer. Using the output interface, at the touch of a button the setting of every control can be coded and output for recording on paper or magnetic tape. Conversely, the instrument can be set up in seconds simply by replaying the pre-recorded tape. The instruments can be connected to a computor or desktop calculator to provide further versitility.

The programme control module adds facilities for superimposed spectra, wavelength selection and timing of delayed measurements. Five selected wavelengths or a wavelength interval between readings may be entered via the keyboard. This interval may be as small as 0.1nm and can be used to obtain very accurate digital spectra for computer manipulation.

The SP8-250 includes baseline memory, programme control and output interface as standard equipment while they are optional extras for the SP8-200. Both instruments share a wide range of quick-change attachments for enzyme analysis, colour measurement, densitometry, fluorescence and many other applications.

C020 For further details, use Reader Service Card.

POLAROGRAPHY A VERSATILE ANALYTICAL TOOL

Polarography is the branch of voltammetry that investigates solution composition by reducing or oxidizing metals, organics and ions at a dropping mercury electrode (DME). In polarography a potential is applied between the DME and a reference electrode, such as a Saturated Calomel Electrode (SCE), and the resulting current is plotted versus the applied potential. This basic circuit is polarography is called a potentiostat.

The 3-electrode potentiostat is a major improvement over 2-electrode potentiostats that use only a reference and working electrode because the counter electrode allows this potentiostat to compensate for the majority of the resistance in a solution. The counter electrode does this by increasing its potential until that of reference electrode versus the working electrode is the same as the applied potential. The 3-electrode potentiostat is especially important when nonaqueous solvents are used and solution resistance is large.

The polarographic cell thus contains a reference electrode, a counter electrode of an inert material like Pt, Au or Carbon and a working electrode. For polarography the working electrode is always the DME. The DME, has advantages over other electrode materials that have made it the most versatile electrode material for electrochemists. It consists of narrow bore capillary through which Hg flows and exits in the forms of droplets. Each droplet presents a completely new electrode to the solution, which means there is no past history or poisoning of the electrode to affect the measurement being made. The high hydrogen over potential of mercury allows one to make measurements in 1 M acids at potentials that are 500-800 mV more negative than is possible with other electrode materials. Finally, one can determine metals, ions and organics, which may be either oxidized or reduced at the DME.

Sample Applications

Pulp and Paper Manufacture: Can be used in the analysis of constituents of kraft liquors with the aim of developing new processes, improving existing processes and quality control.

Food Industries: Apart from trace elements in foods (see below) analysis of vitamins, additives such as BHA, BHT Propyl gallate, EDTA and Tocopherols can be analysed by polarography. Toxic substances such as pesticides, nitrosamines and residual monomers from plastic containers all fall within the techniques analytical range.

Plastics and Polymers: Analyses in this area of industry illustrate the capability of polarography to deal with organic substances. The list includes most components of plastic and polymer production from monomers and polyesters, through initiators and accelerators to chain transfer agents, stabilisers and antioxidants.

Petroleum: Of topical interest in NZ is the ability to analyse sulphur in LPG. Other analyses in petroleum include aromatic sulphides, thiophenes and lead in nickel catalysts. Compounds in petroleum naphtha are also within the range of polarography.

Cost

Instrument packages for polarography range in price from $1800 for manually operated single sample analyser without recording facilities to $11,500 for a fully automated multiple sample unit with full recording hardware. So why is polarography not a more widely used technique? One reason is that although polarography is not new, the technology to implement it successfully is. Thus, many chemists who are aware of polarography are only familiar with the old hardware which was bulky and awkward to use.

Another is the wide variety of analytical techniques available to the chemist and for a long time polarography has been overlooked.

Whatever the reasons, the time is now right for chemists in research and production who have analytical problems to solve to consider polarography as a solution. It offers sensitivity and versatility at very low cost.

C024 For further details, use Reader Service Card.

BRANCH NEWS

Auckland

The March meeting of the branch was addressed by **Associate-Prof. A.F.M. Barton** Murdoch University, Australia. Prof. Barton provided an overview of resource recycling and recovery on a global scale, detailed some processes now in use overseas in the area of metals recovery, and ended with a close look at NZ's participation in the field. While awarding high marks for efforts in glass recycling, he concluded that many other areas of resource recovery could be profitably considered. The meeting ended in a lively discussion on the use of old tyres for the establishment of artificial reefs in estuaries.

* * *

Claims that NZ's current energy problems resulted from a worldwide political crisis and that this country had little to show for its efforts in energy conservation since 1973 added fuel to a lively seminar in Auckland in late April.

Venue was the Auckland Branch's annual graduands' function at Auckland University, which attracted a strong attendance of members, recent chemistry graduands and senior University and Technical Institute students.

Entitled "Liquid fuels and alternatives" a panel chaired by **Prof. A.L. Tichener**, School fo Engineering, and comprising the Minister of Energy (or should it be "for Energy"?) **Mr. W.E. Birch, Dr. G. Harris**, executive officer, NZ Energy Research & Development Committee and **Mr. D. Peace**, technical officer, Gas Association of NZ, backgrounded the current problems, cutlined current moves to ease it and discussed possible solutions.

Mr Birch, who appears reasonably comfortable in his currently "hot seat", reacted quickly to Mr Peace's criticism of past Government policy, admitting a degree of irritation over questions such as the fate of pipes stored at New Plymouth for the past two years. However, he noted that Government advisers, notably the Liquid Fuels Trust Board and the NZERDC, had that day been given 4 months to make firm recommendations regarding which major avenue Government should pursue towards the production of synthetic gasoline. He forecast that the transition from oil to alternative fuels would be slow, possibly 30-40 years, and that Middle East suppliers would pitch their oil prices just below those of alternative fuels.

Dr Harris detailed current trials being carried out with CNG and methanol as vehicle fuels, noting that the main difficulties were organisational and institutional, rather than technical. Mr Peace, (as might be expected) suggested that CNG offered much promise as a vehicle fuel, noting that the Auckland Gas Co. Ltd. already had a CNG-fuelled fleet on the road which had notched up over 1 million km to date. He believed there were some areas, like air and sea transportation, where liquid hydrocarbon fuels would be difficult to replace.

Options the Government is considering, apart from CNG and LPG already in use, include synthetic methanol, synthetic petrol, coal and biomass conversion. If necessary, said Mr Birch, each of these on its own could provide NZ's total needs and, in some instances, leave a surplus for export.

Branch News (Cont)

Chelsea Visit

Chemists are often exhorted to look to fields other than their own; the Auckland Industrial Group is doing something about it.

In early April — and despite the dampening effects of continuous heavy rain — a large turnout assembled at NZ Sugar Co. Ltd's Chelsea refinery to uncover the mysteries of keeping this country sweet.

Group chairman John Yolland expressed his satisfaction at the turnout and hoped it augured well for the Group's future.

In an interesting 2-hr session the visitors saw a film on Queensland sugar production, scaled high metal walkways and groped their way through dark alleys following the product's progress from store through to despatch.

And the overwhelming "sweet smell of success" carried a pervasive molasses - like aroma into every nook and cranny of the rambling structure — not to mention the rink-like surface of sugar-ingrained concrete!

Among items of interest, the visitors learned that:

- sugar is a favoured element of soil mixes for commercially grown mushrooms.
- the Chelsea plant can store up to 4 months' supply of NZ's total sugar needs.
- that Cuba is a supply source, when our traditional suppliers, Australia or Fiji, cannot meet demand.

WAIKATO

Stan Brooker, editor, Chemistry in NZ, entertained the March meeting with a lively lecture entitled "Meat Fats as food; a senior citizen looks back." In April, **Dr. Peter Robinson** spoke on research developments in the area of Fatty Acids and Cystic Fibrosis, in which a chemical approach to medical research has clearly been very successful. Peter, who moved to Waikato Technical Institute after 6 years' research in the Auckland Medical School's paediatrics department, leaves in May to take up a 2-year fellowship at the Welsh National Medical School in Cardiff. Funded by the Cystic Fibrosis Foundation, UK, the fellowship is for research towards a cure for the fatal disease.

Manawatu

The 1978 ICI Medal was presented to **Dr. Graeme B. Russell** by **Mr John Willimott**, executive director, ICI (NZ) Ltd, at the March meeting. Dr Russell, the 30th recipient of this prize, is well known for his investigation of compounds that possess high insect activity in native flora.

Prof. Howard A. Morris, Department of Food Science and Nutrition, Universtiy of Minnesota, St Paul, addressed the meeting on the subject of "Regulatory Impact in Product Development". Prof. Morris described the US Government regulatory problems that he encountered in the marketing of cheeses that were prepared from modified moulds, "low fat" butters and cheeses and the incorporation of the antibiotic Pimaricine in cheese.

Branch prizes for the 300 levels at Massey University were presented by **Prof. W.E. (Ted) Harvey** to **Messrs S. Dyke** (Chemistry) and **P. Calder** (Biochemistry) at the April meeting. Prof. Harvey gave the Presidential Address on the subject of "Scientists in Administration". He described the valuable contributions to society by scientists who have been appointed to top administrative positions in private industry, government to top administractive positions in private industry, government research organisations and the universities. Prof. Harvey considered that the challenge of the job was the main factor in the movement of scientists from the bench to a desk, rather than an increase in salary or power over their fellow-workers. This movement has important implications for the Institute as many of these scientist-administrators have given it valuable service. A vote of thanks was presented by **Prof. G.N. Malcolm** (President 1976-7).

On March 17, 120 sixth and seventh form chemistry students from colleges within and surrounding the Manawatu, attended a morning programme on "Polymers - Natural and Synthetic". This meeting was organised by **Mr. R.G. Mathews** (Freyberg High School, Palmerston North) and **Dr. A.M. Brodie** (Department of Chemistry, Biochemistry & Biophysics, Massey University) and the practical classes were assisted by lecturers from the Chemistry Department, Massey University. The programme opened with a lecture by **Prof. G.N. Malcolm**, who described the composition of various important polymers, how they are formed and the reason for their differing physical properties. The meeting then divided into 3 groups to prepare samples of the polymers nylon 6,10, a phenolic resin (similar to Bakelite), a urea-formaldehyde resin and a synthetic rubber. By this programme, many of the student participants were introduced to the Institute and the University. It was a public relations success for both organisations and other programmes should be considered by future committees.

Wellington

The April meeting involved an open evening at the Chemistry Department, Victoria University, and the presentation of the 1978 NZIC student prizes in Chemistry and Biochemistry. After the presentation of prizes by the Branch Chairman (Chemistry 300; **Mr. D. MacFarlane** and **Mr. B. Williamson**; Biochemistry 200; No award; Chemistry 100: **Mrs. R. Ainsworth** and **Mr. I. Angus**), **Prof. James Duncan** gave a brief outline of the research programmes in the Department. The members and guests were then able to tour the facilities and discuss individual projects with staff members and research students. An innovation in the 1979 programme has been an informal gathering of members for a casual meal prior to the meeting.

1979 SUBSCRIPTIONS

A centralised subscription collecting system and an incentive discount for prompt payment have been introduced by the Institute this year so that its finances can be more carefully serviced. The moves follow consultations between the NZIC Council and branch committees.

The annual subscription has been raised $2, but this will be discounted on all subscriptions paid before August 31.

Members will receive their new notices, together with change of address forms during May/June.

The Institute's financial year is May 1-April 30; branches often have a different period (October 1-September 30 is common) and varying local subscriptions (from $1-$3).

The new system will assist in the collation of these periods and help cash flow; it is being administered by the Registrar with the assistance of Mrs N.E. Wignall, Administrative Secretary, so that subscription collection will not be a burden on branch treasurers.

A steadily rising "Subscriptions in arrears" item has been appearing in the Institute's annual accounts — currently it stand at over $4000, representing over 200 members (or 1 in every 6!). In an effort to overcome this, members are offered the $2 discount if 1979 subscriptions are paid before August 31.

Branches will receive their subscriptions at regular intervals during the year.

Members are urged to pay their subscriptions early; any queries should be directed to the Registrar, Box 1926, Christchurch.

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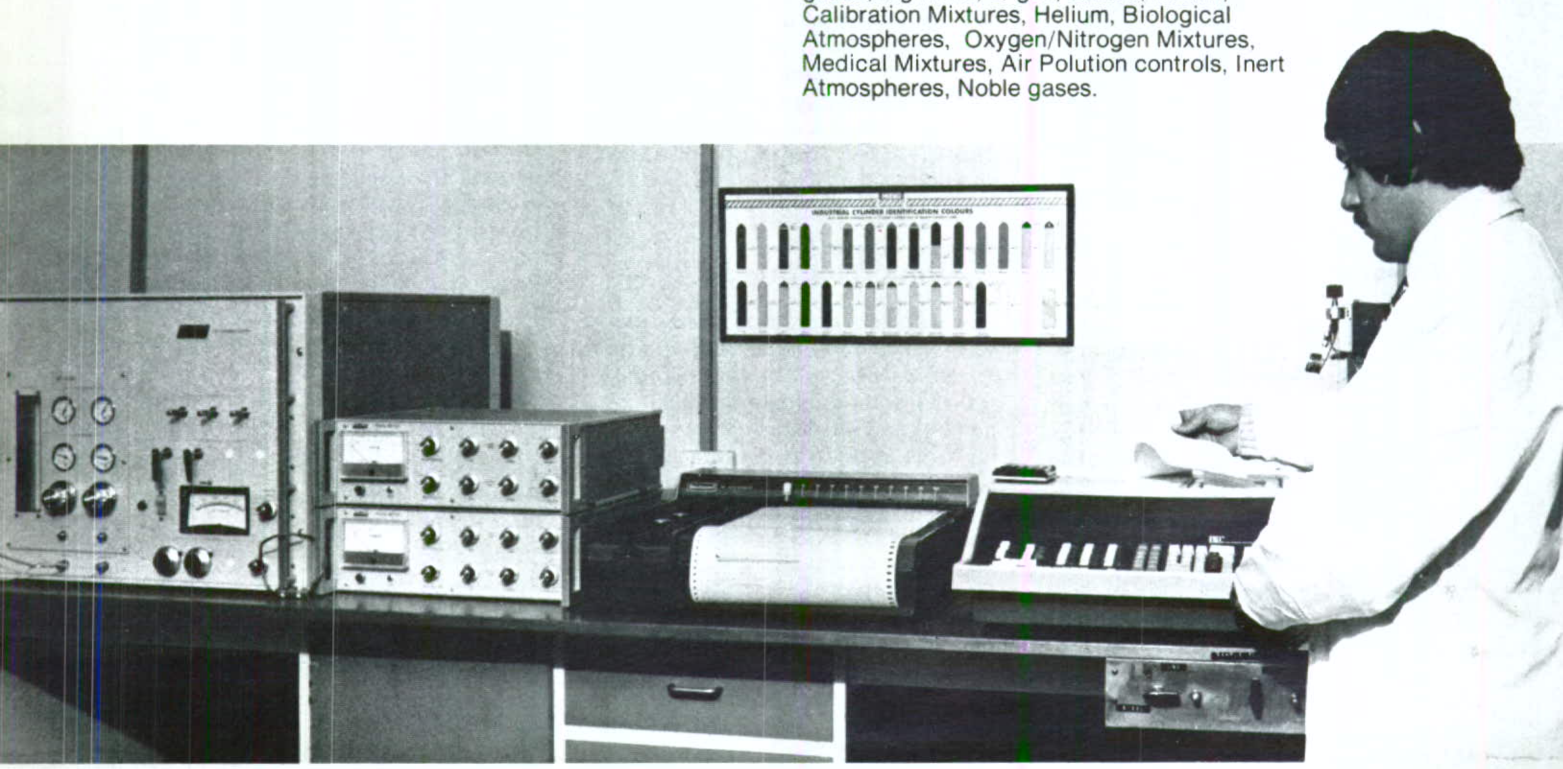

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CANTERBURY

The April meeting of the Canterbury branch was held at the Christchurch Arts' Centre. This centre now occupies the former central city campus of the University of Canterbury. The meeting was addressed by **Dr. John Campbell** of the University Physics department who gave a slide presentation on the early life and the NZ phase of the work of Lord Rutherford. After the address members were conducted through the recently completed "Rutherford's Den". The den, which occupies the basement laboratory orginally used by Rutherford as a student, has now been furnished as a museum showing "Rutherford" at work and also includes a number of interesting memorabilia. A social function and supper followed. Noteworthy guests included **Stan Brooker** of "Chemistry in NZ" fame.

The May branch meeting was adress by **Geoff Page**, Industrial Processing Division, DSIR, who spoke on the corrosion of metals.

Our Man In Dunedin

Stuart G. Gray, Otago Branch Editor, and member of the Council Publications Sub-committee, was born in Fairlie in 1950, and educated at James Hargest High School, Invercargill, and Otago University, where he graduated B.Sc. (Hons). In 1972, he joined Fletcher Industries, Dunedin, as Chief Chemist, and last year became Operations Manager for Fletcher Agriculture. He is interested in golf, squash and tramping, while his wife is a keen member of the local Toastmistresses Club.

Fletcher Agriculture's main operation in Dunedin is the crushing of locally grown linseed and rapeseed to produce the corresponding vegetable oils. These oils are further refined in their plant, and in the case of rapeseed oil are deodorised and marketed under the "Sunfield" brand for edible purposes. For some part of last year the plant was for sale as a going concern, but having received no satisfactory response, the directors withdrew the offer of sale and the plant has since been fully engaged.

University News

AUCKLAND

Dr Karl Rogers is investigating the structure and biological properties of human pituitary glycoprotein hormones and some recently discovered variant of human growth hormone in collaboration with **Drs Chapman and Brittain** and **Prof. Renwick** in the Department of Biochemistry.
The utilisation of NZ natural products is the area of research that **Dr. H. Hikichi** will study under **Prof. R.C. Cambie**, Department of Chemistry, when he arrives in NZ later this year.

A new technique has been developed by **Dr P.M. Barling** Department of Biochemistry, for labelling proteins without changing their primary structure.

Bovine parathyroid hormone has been labelled to high specific activity using a radioactive tracer. Analysis of the product by chromatographic methods showed that the structure had remained unaltered. The method developed by Dr Barling is clearly of wide potential application to the labelling of other peptides and proteins so that their structure, chemistry and biological properties can be studied.

Further tests showed that there was no loss of biological activity or changes in immunochemical characteristics.

WAIKATO

A visiting lecturer for the academic year is **Dr. John Miller**, University of Essex. Dr Miller will be continuing with his research interests in theoretical and organometallic chemistry during his stay, as well as teaching in spectroscopy and inorganic chemistry. Another visitor here on leave until August is **Dr. Bob Prosser** who holds joint appointments at Melbourne State College, where he is a Senior Lecturer in chemistry, and at the University of Melbourne, where he is responsible for administration of the B.Sc. Ed. degree. A similar degree is planned for the Waikato College of Teacher Education and Bob is looking into its development, as well as being involved in some first and second year teaching in the Chemistry Department.
Dr. Kaiser Jamil of the Centre for Cellular and Molecular Biology of the Regional Research Laboratory, Hyderabad, India, recently visited the Biochemistry Department and gave a seminar on the work of her group on antibacterial proteins in bull semen.

Available to the Hamilton public during the second term is an introductory course in chemistry put on by the Chemistry Department through the Continuing Education Centre and entitled — you guessed it — "Chemistry in the World Around Us."

Massey

An honorary Doctorate of Science was awarded to **Mr. L.W.N. Fitch**, founder of Tasman Vaccine Laboratory Ltd at Massey's graduation ceremony.
Dr. Ken Whittle, Palmerston North Technical Institute, is taking 3 months' industrial refresher leave from July.
He will be visiting several companies and research laboratories in the North Island.

Victoria University

Members of the University at the recent ACS/JCS Congress in Honolulu include **Dr. Ted Harvey**, **Prof. Neil Curtis**, and **Dr. David Weatherburn**. The latter two addressed the Inorganic Division on "Some Hexa-azacyclopentadecadiene and Heza-azacycloheadecatetraene Complexes of Nickel (II) and Copper (II)" and "Acid Decomposition Reactions of Copper (II) triazamacrocyclic Complexes." respectively.

Miss Karen Knedler, a Junior Lecturer in the Chemistry Department has been awarded the McKee Trust Postgraduate Scholarship in Geology for her studies on the geochemistry of iron metalliferous and other marine sediments. The emolument will be used to attend the general assemblies of the International Association for the Physical Sciences of the Ocean, International Union of Geology and Geophysics, to be held in Canberra later this year.

Wellington Polytechnic

Ian Bradshaw has joined the Polytechnic Staff and will endeavour to teach some 60 nursing students nursing-biased chemistry.

University of Canterbury

Recent visitors who have given seminars in the Chemistry Department have included **Prof. Dan Trivich**, Wayne State University (Photovoltaic cells); **Prof. Alan Bond**, Deakin University, Geelong (Modern Electrochemical Techniques); **Dr. Brian Halton**, Victoria University (Cyclohexatriene) and the ubiquitous) **Stan**

News From Govt. Departments

DSIR — Chemistry Division:

Dr. P.B. Udy recently left the Division to join the Pest Destruction Council in Wanganui, and an experienced glassblower from Britain, **Mr. K. Holden**, has recently joined the Division. **Dr. H.P. Rothbaum** and **D. W. Giggenbach** are at present overseas on short visits to USA and Europe, and to geothermal projects in the Phillipines, respectively, while **Dr. K. Markham** is spending 15 months working with **Prof. J. Harborne** at the University of Reading. **Mrs C. Brown** of the Forensic Section has recently returned after a year's leave overseas.

Dr. L.J. Porter attended the ACS/-JCS Congress in Honolulu and presented a paper entitled "The Structure of Polymeric Proanthocyanins" to the Cellulose-Organic combined sectional meeting.

DSIR, Applied Biochemistry Division

At the 1979 Pacific Chemical Congress in Honolulu, Hawaii (April 1-6) **Dr Geoff Lane** presented a paper with **Drs. R.A. Skipp** (Plant Diseases Division) and **O.R.W. Sutherland** (Entomology Division) on "Lupin Isoflavonoids with Antifungal and Insect Feeding Deterrent Activity".

Dr. R.T.J. Clarke attended an Organisation of Economic Co-operation and Development meeting in Paris, May 7-12. The meeting considered aspects of nitrogen fixation.

DSIR, Plant Physiology Division

Ms Heather Wright, a Commonwealth Scholar from the Botany Department, Edinburgh University, is working with **Dr. C. Roger Slack** on the "Pathway of Synthesis of Erucic Acid in Rapeseed".

DSIR — IPD

E. Beanlands of the Industrial Processing Division, recently attended, as NZ's representative, the UNEP discussion on "Agricultural Waste Utilisation" in Bangkok. **R. Braithwaite** attended the ACS/JCS Congress in Honolulu presenting papers on "Geothermal Corrosion Processes".

D.J. Bell has been awarded a NRAC Postgraduate Fellowship for study at University College, London, and **R. Armishaw** has recently joined the Analytical Section of the Industrial Processing Division.

RUAKURA

Dr. Wattie Whittlestone, one of Ruakura's and NZ's best known and internationally recognised scientists retired recently. Dr. Whittlestone will be the subject of a special article in a later issue of the Journal. Another loss to Ruakura is **Dr. Doug Wright** who has moved to MAF head quarters in Wellington as Assistant Director-General of Agriculture. Doug's contributions to local branch affairs over the years, including assistance with organisation of the two Institute conferences, have been very valuable. Appointed by the NZIC to his place on the WTI Board of Governors is **Dr. Pat Lester.**

NZ Dairy Research Institute

Dr Peter Robertson has been appointed director. He was previously assistant director and has been acting director since early in 1978.

Dr Kevin Marshall has been appointed assistant research director. He was previously head, Whey Products Section and the Effluent Technology Section.

Peter Hobman has been appointed head, Whey Products Section. Previously he was a member of the Casein and Related Products Section.

Max Parkin has been appointed head, Effluent Technology Section. He was previously a member of that section.

Dave Munro has been appointed head, Milkfat and Butter Section. He was employed at the Bay of Plenty Co-op. Dairy Association Ltd as a chemical engineer.

Drs. R.C. Lawrence and **W.B. Sanderson** recently visited Cairo with members of the NZ Dairy Board staff to investigate the possibility of manufacturing special products similar to indigenous Egyptian dairy products. Dr Lawrence went on to Cambridge, England, to give an invited review on fermentation in milk to the Society of General Microbiology. Dr Sanderson attended a meeting of the Permanent Committee of Commission B of the International Dairy Federation in Brussels.

Drs. F.G. Martley and **K.R. Marshall** have each recently assisted NZ dairy companies in the purchase of specialised cheese and casein-making equipment by travelling to Europe with company representatives.

*** ***

We welcome to our editorial contributors Hamilton East MP (and former Ruakura researcher) Ian Shearer, who will be writing a regular column from this issue on. As a scientist (M Agr Sc from Massey, PhD from Nottingham) turned politician, he is well placed to provide an "inside" view on matters relating to the profession.

University News (Cont)

Brooker (Industrial uses of Fats and Oils).

Profs. Leon Phillips and **Cuth Wilkins** both attended the recent ACS/JCS meeting in Hawaii. Those at precent on study leave from the Chemistry departments include **Murray McEwan** who is at the Jet Propulsion Laboratory, Pasadena, California and **Jim Coxon** who is at York, England. **John Abrahamson** (Chemical Engineering) will shortly be visiting a number of institutions in USA, Britain, Germany, Israil and India.

Junior Chemical Society: The JCS has operated for several years under the sponsorship of the Canterbury Branch. The aim is to stimulate interest in chemistry among 7th form pupils in the area. This year's programme includes a seris of 4 lectures during the year, topics being:

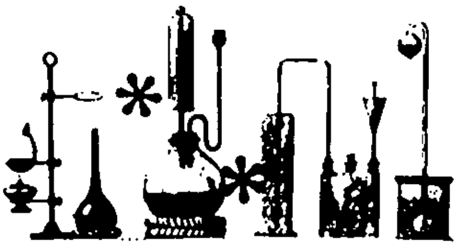
"Of Trout and Sewage" (**Dr Ken Emerson**, Montana State University)

"Chemistry for the Courts" (**Dr Bill Swallow**, DSIR, Christchurch)

"Indigenous Transport Fuels for NZ" (**Dr Brian Earl**, Chemical Eng., Univ. of Canterbury).

"Snowflakes and Symmetry, Spheres and Structure, Ice and Opals" (**Dr Ward Robinson**, Chemistry, Univ. of Canterbury)

In addition to the lectures the annual "field day" was recently held and attended by 52 students from Christchurch 7th forms. Dust samples collected from busy Christchurch streets were analysed in the schools for the lead concentrations using simple wet chemical tests. Students selected to attend the field day brought their dust samples and results to the University where **Dr Jack Fergusson** demonstrated the application of atomic absorption spectrometry for the accurate analysis of lead content. The reaction chemistry of copper was also considered in relation to the recycling of copper waste. **Dr Peter Harland** gave the students a talk on the instrumental methods employed in the department for structure determination and routine chemical analysis, followed by a tour and demonstrations of the instruments considered in the talk.



New Products, Services

NEW SCIENTIFIC SUPPLIER

From the merger of Medical Supplies and Kempthorne Prosser has come a new organisation, Kempthorne Medical Supplies, whose scientific department aims to provide NZ's scientific community with a broad coverage of world class products suitable for most situations.

Hewlett/Packard analytical equipment, Gallay washers and Wild Leitz microsdopes indicate the quality and service available in the traditional equipment area, while Morebank, Eppendoff, Nichyro, Schott and Kocklight represent a sample of the many quality consumables sold.

The scientific department offers nationwide coverage with technical specialists, general sales staff and service personnel in the main centres.

The new department's manager, Mr Bryan Mogridge, said it is aiming to provide both quality and service in all aspects of its business. It will have a policy of continually searching the world for new and improved equipment and scientific methods so that NZ can benefit from its business contacts with up to date overseas principals.

In light of this the department is sending two people, Messrs Barry Eglinton and Jim Edmonds to ACHEMA, a tri-annual science congress in Frankfurt this year to make contact with principals and bring back the latest information on the world's scientific community.

C019 For further details, use Reader Service Card.

SPECTRO CHEMICAL ANALYSER

Recently released in NZ by Advanced Electronics Ltd. is the "Plasmascan" Model 700 sequential soectro chemical analyser developed by Labtest Equipment Co., Melbourne. Its cost is said to be comparable with some of the higher priced atomic absorption instruments.

This instrument is equipped with an inductively coupled argon plasma (ICAP) source which, when coupled to a monochromator and readout, provides a versatile, sensitive analyser for liquid samples.

The plasma is formed by the interaction of RF energy with a continuous flow of suitable carrier gas (normally argon). Temperatures of around 9000°K are generated.

The introduction of the sample via a suitable nebuliser—spray chamber system into this plasma provides a very satisfactory analytical condition for the excitation and subsequent analysis of many elements.

It is claimed by the manufacturers that elements, which are difficult or impossible by atomic absorption techniques, can be measured at below 1 ppm or better. These include refractory elements as well as arsenic, selenium, phosphorous and sulphur. It is claimed that the instrument has a very wide dynamic range permitting the analysis of elements from different matrices without dilution from samples, ranging from 1 ppb to per cent in most cases.

Optional equipment is available to permit complete automation of the system as a sequential analyser for the determination of up to 10 elements per sample during an analysis period of 2 – 3 minutes.

C013 For further details, use Reader Service Card.

HPLC PACKINGS

With the current emphasis on HPLC operators packing their own columns, the Instrument Division of E I Du Pont de Nemours announces that its Zorbax microparticles are now available as bulk packings. The range includes pure silica (SIL) and three bonded phases packings ODS or C-18, C-8 and cyanopropyl (-CN).

These packings complement the extensive range of high quality packed columns already available. Packings are perfectly spherical, totally porous, of uniform size (nominally 7-8 micron diameter) and the bonded phase particles have a true monolayer of functional groups bonded via a monofunctional silane to the silica particle.

The packings are available ex stock Auckland from the NZ agents, Neill, Cropper & Co Ltd, Auckland, which can also supply information on all Du Pont instruments.

C 022 For further details, use Reader Service Card

CHEMICAL CROSSWORD
Solution to April Puzzle

M	I	L	L	I	G	R	A	M		S		P
	R		E		L			E	S	T	E	R
C	I	S	T	R	O	N		T		R		I
	S		O		B		G	R	O	O	V	E
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R			F		L	A	N	C	E	L	E	T
I		Q			I		I			S		L
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T	I	T	R	E			M		S		S	
E		Y		D	E	S	E	R	T	I	O	N

THE DU PONT LC COLUMN

Get higher resolution and repeatability with new monolayer bonded Zorbax™ columns.

DuPont has developed an innovative new line of monolayer bonded phases for Zorbax™ ODS, Zorbax™ CN and Zorbax™ C-8. This monolayer approach to bonded phases is at the forefront of packing technology utilized by leading researchers in the field.

Zorbax™ monolayer bonded phases (ODS, CN, C-8) are produced from proprietary monofunctional silanes. This technology permits close control of the chemical bonding process. The result is repeatable surface coverage, bringing you columns with the exceptional reproducibility so critical for reliable assays.

But it all starts with the particle...

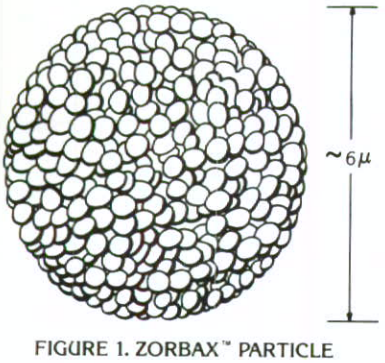


FIGURE 1. ZORBAX™ PARTICLE

Zorbax™ is not a silica gel adapted for HPLC, but a pure siliceous particle designed solely to meet the demanding needs of HPLC (Figure 1). Critical particle parameters that must be controlled for superior performance include:

- Particle size and distribution
- Pore size and distribution
- Surface area

Zorbax™ meets all these criteria through its unique patented structure. Ninety-five percent of all particles are within one micron of the nominal particle diameter (6 μm). This extremely narrow particle size distribution means very high efficiency performance without the high backpressures found with many five to six-micron packings.

The pore structure is also rigidly maintained by the inherent nature of this unique synthetic process. The packing uniformity of Zorbax™ in the column is excellent due to the uniform spherical shape and the narrow particle size distribution.

...and ends with performance.

The resolution power of the Zorbax™ ODS column is seen in a separation of polystyrene oligomers (Figure 2). This non-aqueous reversed phase (NARP) separation was achieved with only a fifteen-centimeter column. The fifteen-centimeter Zorbax™ columns provide higher efficiency than many thirty-centimeter columns of 10 μm packings and importantly are less expensive.

FIGURE 2 POLYSTYRENE 800 OLIGOMERS

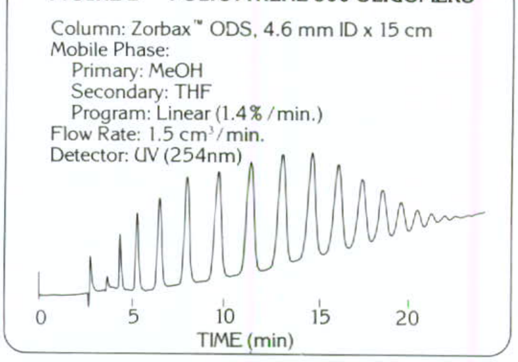
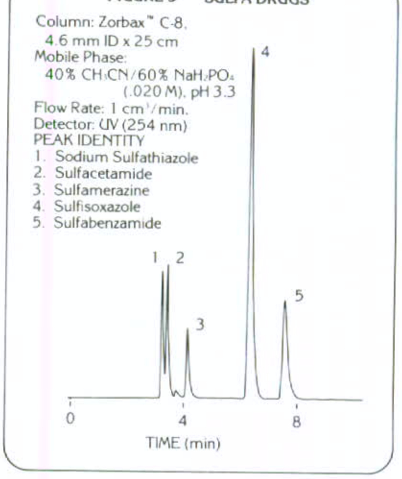


FIGURE 3 SULFA DRUGS



The new member of the DuPont packing team is Zorbax™ C-8. This reversed phase packing shows excellent selectivity for highly polar compounds including water soluble materials. A separation of some common sulfa drugs is readily obtained on Zorbax™ C-8 (Fig. 3).

DuPont Instruments is dedicated to giving you the best possible tools for your separation problems.

Make sure you receive DuPont's informative new series of column literature. Send the reader service card. Write or telephone Chemical Dept., Neill, Cropper & Co. Ltd., P.O. Box 9, Auckland. Ph: 31-049. Telex: NZ2521

Liquid Chromatography Columns

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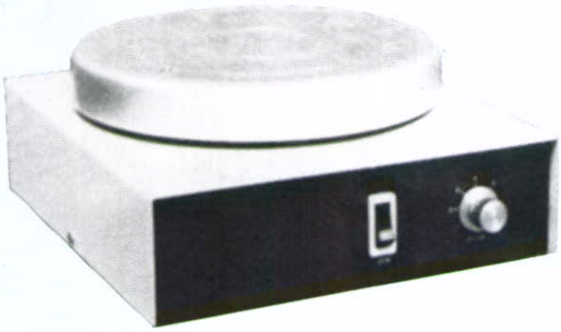
LABORATORY MAGNETIC STIRRERS — HOT-PLATES

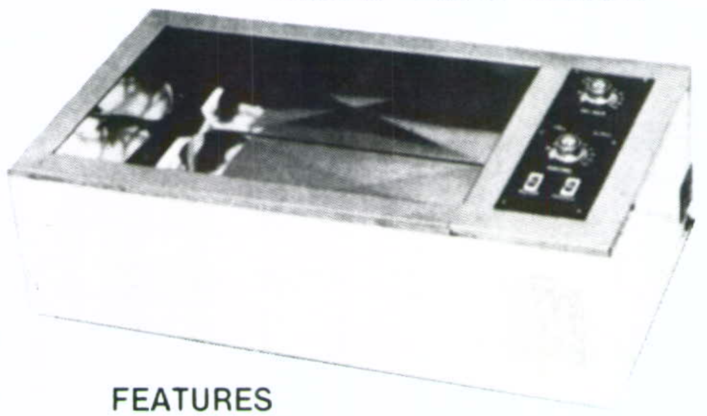


MODEL MS2000
STIRRING RANGE 10/1500 + R.P.M.

MODEL MHP 200
TEMP. RANGE 25°C/400°C
STIRRING RANGE 10/500 + R.P.M.

FEATURES

* SIMMERSTATIC CONTROL OF HEATER
* TRANSISTOR DRIVEN MOTOR
* STAINLESS STEEL MOTOR BEARINGS
* ALUMINIUM DIE CAST TOP PLATE
* ELEMENTS CAST INTO TOP
* CONTROLS PROTECTED FROM SPILLAGE
* SANDANYO COOLING RINGS
* WELL VENTILATED STEEL CASE
* ANTI CORROSIVE PAINT
* THREE RUBBER FEET FOR MAXIMUM STABILITY ON ANY SURFACE.



PRECISION WATER-BATHS

FEATURES

* WELDED STAINLESS STEEL TANK
* STEEL CASE FINISHED IN ANTI CORROSIVE PAINT
* BUILT IN CENTRIFUGAL PUMP
* SAFETY OVER-RIDE THERMOSTAT FULLY ADJUSTABLE OVER THE FULL RANGE
* FACILITY FOR FITTING A CONTACT THERMOMETER
* ELECTRONIC CONTROL
* ± 0.1° WITH PUMP ON
* AVAILABLE IN FULL RANGE OF SIZES
* AVAILABLE AS SHAKING BATHS

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