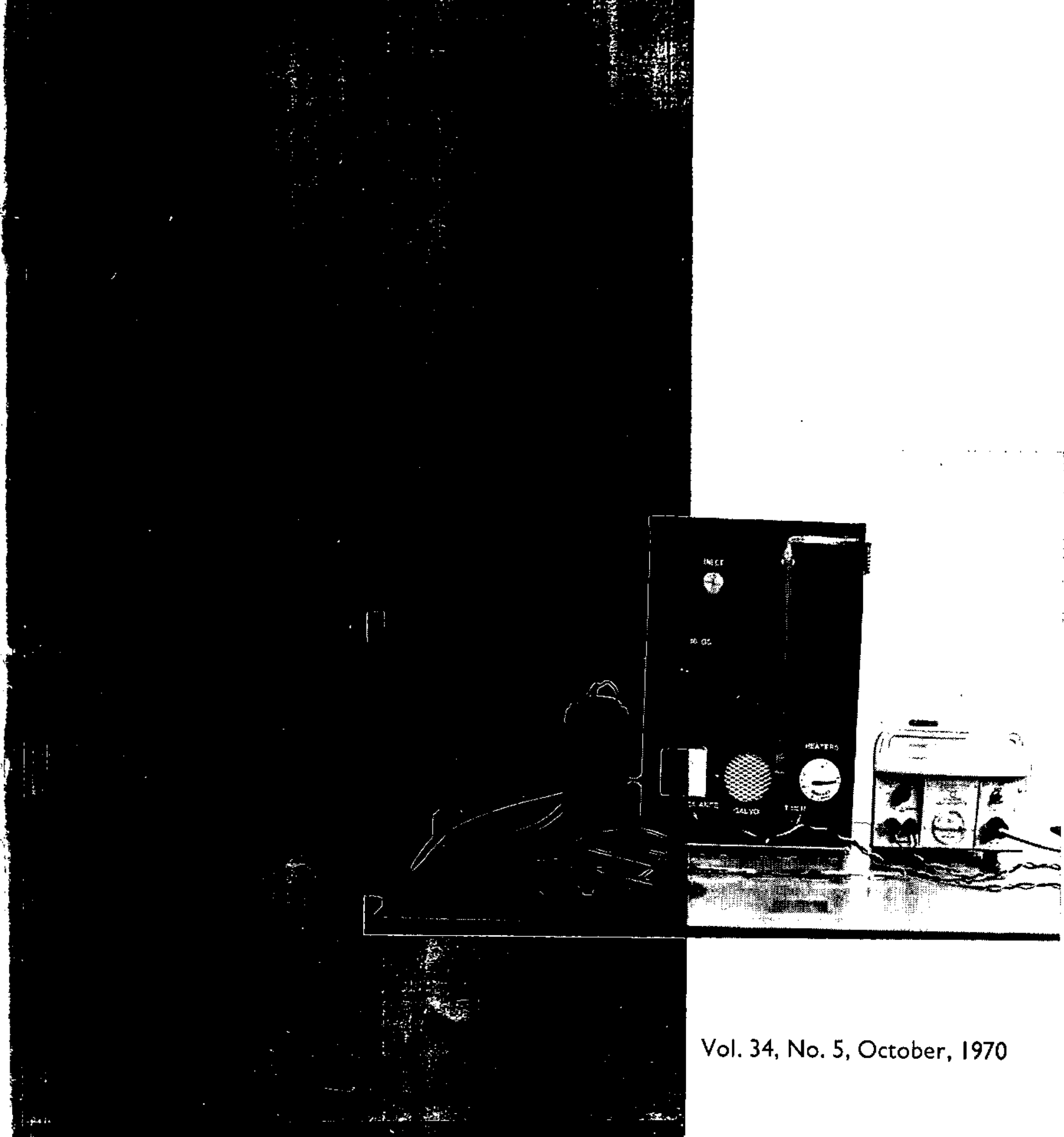
CHEMISTRY IN NEW ZEALAND

JOURNAL OF
THE NEW ZEALAND
INSTITUTE
OF CHEMISTRY



Vol. 34, No. 5, October, 1970

CHEMISTRY IN NEW ZEALAND

Journal of
The New Zealand
Institute of Chemistry

Vol. 34, No. 5, October 1970

Published bi-monthly by the New Zealand Institute of Chemistry Inc. (P.O. Box 250, Wellington)

Contents

Editor: Miss J. Mattingley, B.Sc., A.N.Z.I.C.
P.O. Box 250, Wellington.

Advertising Manager:
D. Howard, M.Sc., A.N.Z.I.C.
P.O. Box 250, Wellington.

Printed by David F. Jones Ltd., 108 Tory Street, Wellington.

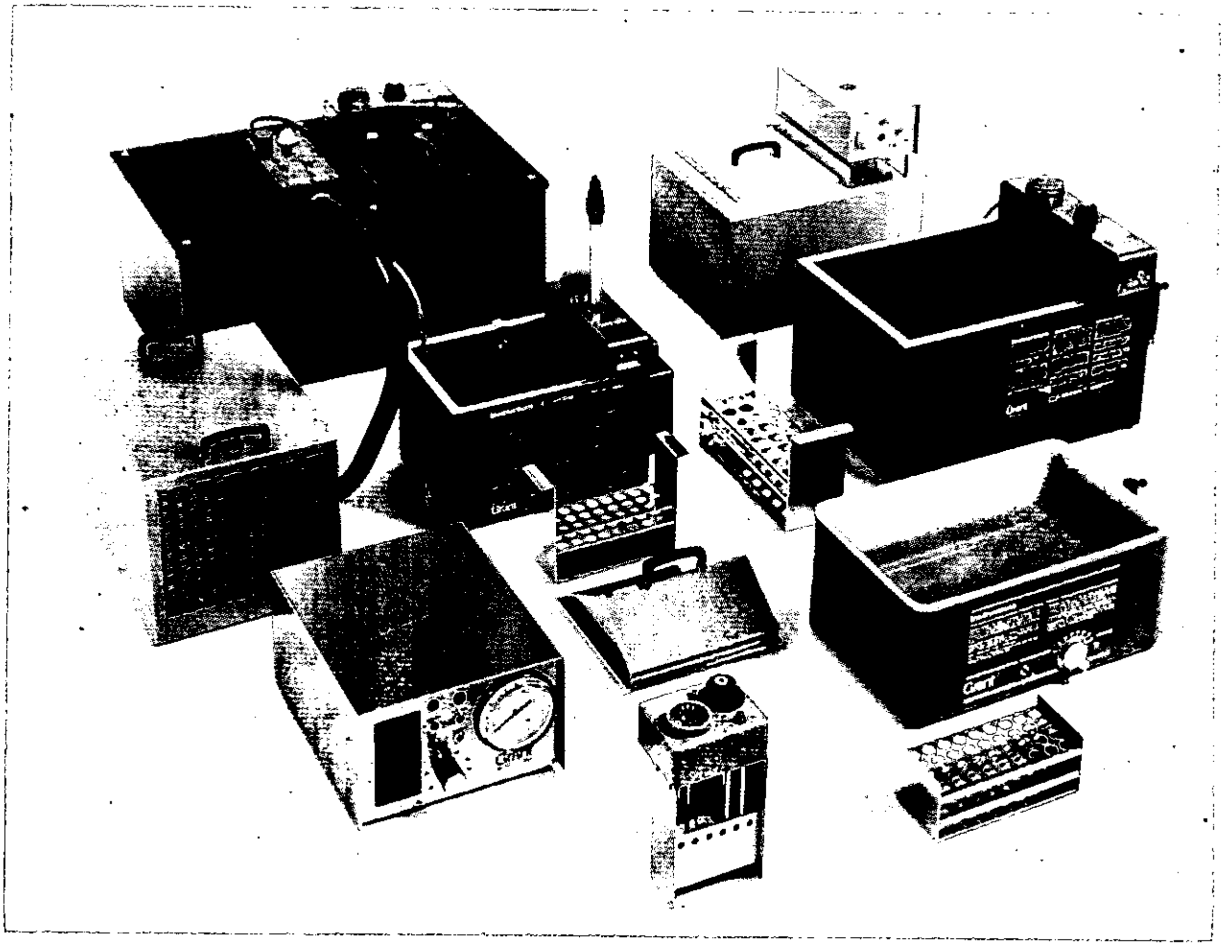
Cover photo:
Gas Chromatograph for Introductory Organic Chemistry. See page 167.

Distribution. The Registrar:
D. J. Hogan, B.Sc., A.N.Z.I.C.
P.O. Box 1926, Christchurch.

Honorary General Secretary:
Dr. E. Harvey, M.Sc., Ph.D., F.N.Z.I.C.
P.O. Box 250, Wellington.

Employment Officer:
E. S. Borthwick, M.Sc., A.R.I.C., A.N.Z.I.C.
P.O. Box 2091, Wellington.

The Journal of the N.Z. Institute of Chemistry has an audit circulation Certificate of New Zealand Advertisers. Latest audited circulation (March 1969) 1150.



They're all in the BDH Catalogue...

a range of more than 5,000 chemicals

BDH can supply almost every reagent in regular demand in laboratory practice today, as well as many developed for special applications in research and industry — reagents of the highest standards of purity and reliability.

Items of particular interest include:

'Aristar' ultra-pure chemicals: for analytical, research and industrial applications in which extreme purity is essential.

'AnalaR' analytical reagents: More than 300 guaranteed analytical reagents conforming to the recently revised 'AnalaR' specifications.

BDH Biochemicals: A comprehensive selection of high quality biochemicals and reagents including Amino acids and derivatives, enzymes and enzyme substrates, nucleotides, nucleosides and nucleic acids, carbohydrates and sugar phosphates, highly pure fatty acids and methyl esters.

Materials for chromatography and electrophoresis
Micro-analytical reagents
Organic Analytical Standards
General laboratory chemicals
Clinical reagents
Solvents for spectroscopy
Microscopical stains and sundries
Ion exchange resins
Volumetric solutions
Indicators
Test papers

If you do not already receive our monthly publication 'New Entries in the BDH Catalogue', please ask us to add your name to the mailing list.

(BDH) BDH NEW ZEALAND LIMITED,
P.O. BOX 624, PALMERSTON NORTH.

THE SHAPE AND REACTIONS OF ORGANIC MOLECULES*

M. P. Hartshorn, B.Sc., A.R.C.S., D.Phil., F.N.Z.I.C., F.R.S.N.Z.

Department of Chemistry, University of Canterbury

The foundations for modern organic chemistry were laid by Kekule in 1858 when he recognised firstly the essential tetracovalency of carbon atoms in all organic compounds, and secondly the possibilities in a structural sense of covalently bonded carbon atom chains. The shape concept was later introduced by the suggestion, more or less simultaneously in 1874 by van't Hoff in Utrecht and Le Bel in Paris, that the covalent bonds of carbon were directed towards the corners of a regular tetrahedron. This idea allowed the rationalisation, in terms of molecular structure, of Pasteur's earlier observations (1848-1860) of the optical activity of some organic molecules. Surprising as it may seem today, the tetrahedral arrangement of carbon's covalent bonds was not greeted with universal applause.

None the less there followed two significant contributions concerned with the shapes of organic molecules. First, Baeyer (1885) proposed for ring compounds the strain theory which bears his name. Briefly the theory was that, assuming the carbon skeleton of a cyclic compound existed in the shape of a planar polygon, the strain in the ring arose from the deformation of the normal tetrahedral bond angle of ~ 109.5°. Thus the strain in ring systems should decrease on going from cyclopropane to cyclopentane, and should increase again from cyclohexane onwards. This theory, as Baeyer in fact recognised, was not in accord with the marked stability of six-membered rings.

The second contribution was that of Sachse (1890) who suggested that cyclohexane could exist in two puckered forms, one rigid and symmetric (1), the other flexible and unsymmetric (2), in which the tetrahedral bond angles of carbon could be maintained. Furthermore, he recognised that for a monosubstituted derivative of the rigid form there were two patterns (3) and (4). However, to Sachse a vital part of the puckered ring concept was that these two forms (3) and (4) only interconverted on heating, and as a result the theory as a whole fell into disrepute. Considerably later Mohr (1918) attempted to revive interest in the idea of non-planar six-membered rings but at the time appeared to have little effect.

At this point interest turned towards the shapes of non-cyclic compounds. In classical bonding theory there is postulated no barrier to rotation, for example, about the covalent C-C bond in ethane. During the late 1920's and early 1930's investigations of the physical properties of simple organic molecules led to speculation concerning energy barriers to rotation about C-C bonds. These culminated with the report by Kemp and Pitzer (1936)

	Cyclopropane	cyclobutane	cyclopentane	cyclohexane	cycloheptane
assumed internal C-C-C	60°	90°	108°	120°	128.5°
deviation from 109.5°	—49.5°	—19.5°	—1.5°	+10.5°	+19°

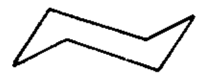
* Based on Chairman's Address to the Canterbury Branch, March 1970.

that the heat capacity and entropy of ethane could be reconciled with calculations based on statistical mechanics provided that an energy barrier to rotation about the central C-C bond was introduced. The suggestion was that the eclipsed form (5) had a higher energy (~ 3 k.cal.mole^{-1}) than the staggered form (6). The origin of this energy barrier is still not known; for ethane van der Waals repulsive interactions between hydrogen atoms on the neighbouring carbon atoms would only account for some 360 cal.mole^{-1}.

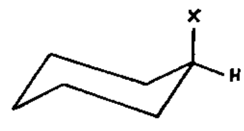
Acceptance of the Sachse-Mohr theory of puckered cyclohexane rings had remained sporadic and was limited to descriptions of molecular shape, e.g. by Haworth for carbohydrates. However, gradually during the period 1928-1947 many workers, but outstandingly Hassel, obtained physical evidence for the chair shape of cyclohexane, including the distinction between *axial* (7) and *equatorial* (8) bonds. It was also found that the substituent in monosubstituted cyclohexanes appeared to exist exclusively in the equatorial situation (4).

What is the origin of this marked preference shown by a substituent for the equatorial orientation? For the butane molecule it has been estimated that the *skew* or *gauche* form (9) has a higher energy (*ca.* 0.9 k.cal.mole^{-1}) than the *anti* form (10). Inspection of projection diagrams for methylcyclohexane reveals that for the axial-methyl structure (12) two skew-butane structural features are present which are not found in the equatorial-methyl structure (11). Using this argument it may be estimated that the equatorial-methyl structure (11) will be the more stable by about 1.8 k.cal.mole^{-1}, and that at 25° about 95 percent of the molecules of methylcyclohexane will be in this conformation.

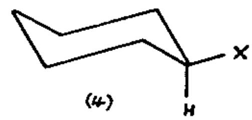
For *cis*-dimethylcyclohexane, the diaxial structure (14) has four skew-butane structural features and, in addition, a van der Waals non-bonded repulsive interaction between the methyl groups. None of these destabilising features are present in the diequatorial structure (13), which is estimated to


(1)

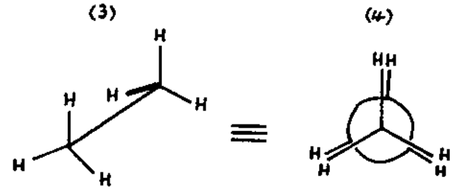

(2)

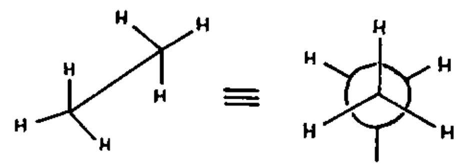


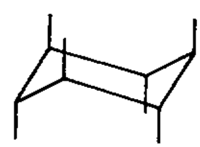
(3)



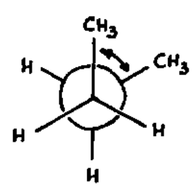
(4)


(5)

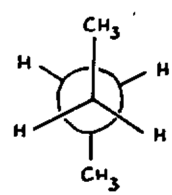

(6)


(7)

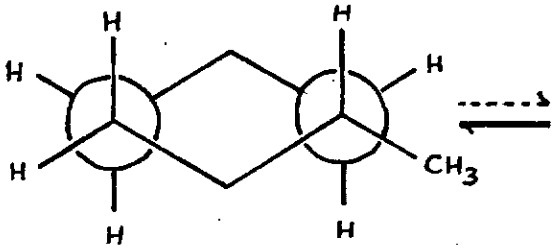

(8)



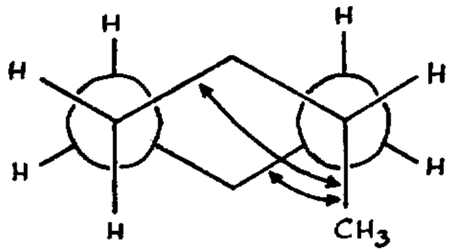
(9)



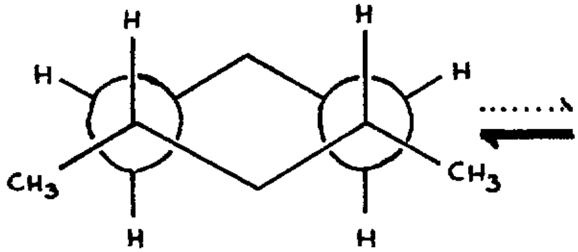
(10)



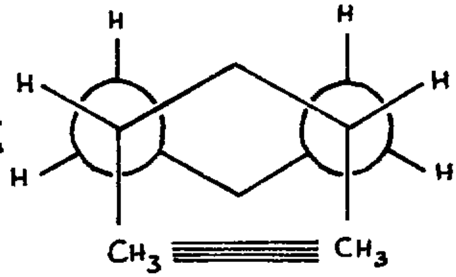
(11)



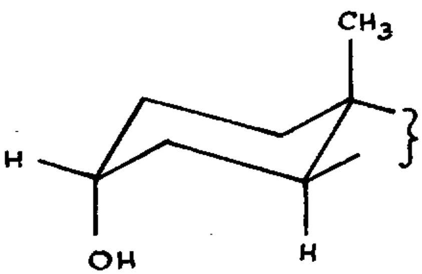
(12)



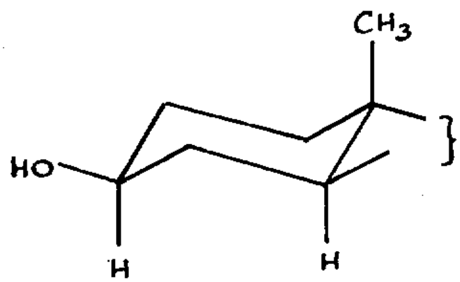
(13)



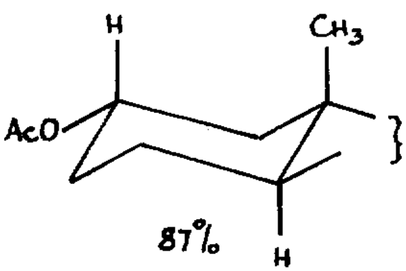
(14)



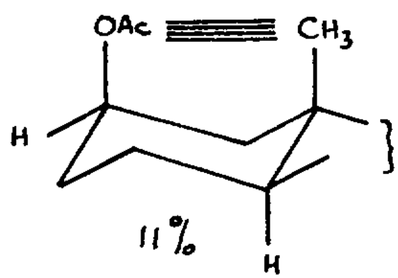
(15)



(16)



(17)



(18)

be the more stable, preferred (99.99 percent) form by about 5.4 k.cal.mole^{-1}.

The major advance came in 1950 when Barton rationalised the relative stability and rates of reaction of cyclohexane derivatives *in terms* of a preferred conformation or molecular shape. For example, the position of equilibrium for the base-catalysed equilibrium of 3α-hydroxy-(15; axial) and 3β-hydroxy-(16; equatorial) steroids favours the more stable equatorial alcohol (16). Also, the extent of hydrolysis of the two acetates (17) and (18) reveals the marked effect of the rate of a reaction on molecular shape, the more hindered axial acetate (18) reacting more slowly.

These represent just two illustrations of the mass of data, unrelated before 1950, which now forms a consistent pattern through the application of the principles of conformational analysis. The impact of conformational analysis on organic chemistry, both for cyclic and non-cyclic compounds, is underlined by the recent award of the Nobel Prize for Chemistry, jointly to D. H. R. Barton and O. Hassel.

OBITUARY

Mr Desmond Fitzsimons

Desmond Fitzsimons, B.Sc., A.N.Z.I.C., M.I.F.S.T.(N.Z.), was born at Palmerston North in 1920 and educated at St. Patrick's College, Wellington, and Victoria College where he graduated B.Sc. in 1948.

After a short period with Salmond and Spraggon Limited, he joined Lever Bros. Limited, Petone, where he became Chief Chemist. In 1956 he took up a post in the laboratory at Abels Limited, Auckland, and was appointed Works Manager in 1960.

In 1969 he became seriously ill with leukaemia but recovered sufficiently to return to work as Development Manager where he made a very significant contribution to the technical side of the firm's work. He made a brave fight against ill health but died on 10 August 1970.

Des Fitzsimons was widely respected by all who knew him and worked with him. He showed a sense of humour and had gifts of friendship and leadership which will be greatly missed.

He leaves a widow and three children to whom we extend our sympathy.

S. Brooker.

ISEC '71

The International Solvent Extraction Conference will take place in the Hague, the Netherlands, during the period 18-24 April 1971. The emphasis of the Conference will be on liquid-liquid extraction of both inorganic and organic substances, including basic principles and practical applications. The meeting is expected to review significant new research work, to learn of successful process applications and to discuss equipment now in use or in course of development.

The Working Party on Distillation, Absorption and Extraction of the European Federation of Chemical Engineering is participating. Professor R. Spence, C.B.E., F.R.S., has accepted the position of President of the Conference, and Dr Ir. A. Klinkenberg that of Vice-president.

Over 200 papers covering the whole spectrum of subject matter have been offered. Manuscripts will be submitted to referees and a Selection Committee to ensure a balanced programme of high quality. There will be a number of technical visits both during and immediately following the Conference to industrial establishments concerned with solvent extraction.

The Second Information Circular on the Conference is now available. Copies may be obtained from ISEC '71, 14 Belgrave Square, London, S.W.1., United Kingdom.

A SIMPLE GAS CHROMATOGRAPH FOR INTRODUCTORY ORGANIC CHEMISTRY

By *B. W. Cox*, Chemistry Department, University of Canterbury, and

A. H. Wooff, B.Sc., Dip.Ind.Chem., Christchurch Boys' High School

Gas Liquid Chromatography (G.L.C.) is one of the most widely used analytical techniques in chemical analysis. Chromatography is not a new technique, having been first employed by Ramsey in 1905 to separate mixtures of gases and vapours.

The design criteria for the gas chromatograph about to be described were as follows:

(1) All components should be readily available in New Zealand.
(2) The instrument should be capable of being used with reasonably cheap syringes.
(3) It should be easily maintained.
(4) The design should be rugged and able to withstand reasonably rough usage.
(5) It should use a cheap and safe carrier gas.
(6) It should perform useful separations.

Fig. 1 is a block diagram showing the general layout of the various components. The incoming carrier gas flows past the reference detector to a point where a sample may be injected. The sample mixes with the carrier gas and is forced on to the column packing. The components of the sample are now selectively separated by the stationary phase and each component is eluted past the sample detector. The reference and sample detectors (Fig. 2) form two arms of a Wheatstone bridge which is balanced by a wire-wound "balance" potentiometer situated on the front panel. The various sample components passing the sample detector produce an "out of balance" signal which can be visually displayed on a galvanometer (or recorder if available).

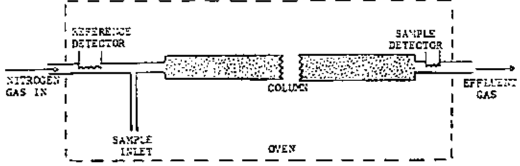


FIG. 1.

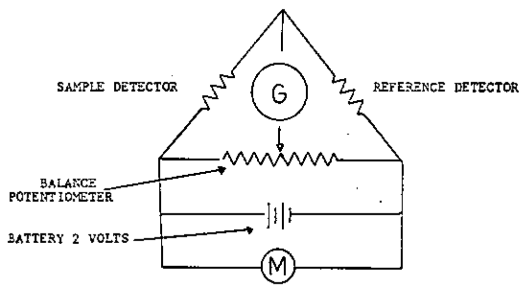


FIG. 2.

Construction Details

In the following paragraphs we will attempt to cover in detail some of the more important constructional details.

Detectors

The detectors chosen were model aeroplane 'Glo-Plugs',[1] the coiled filaments of which act as very sensitive thermal conductivity detectors. They are readily obtainable and cost about 70 cents each. Experience has shown that detectors last for several hundred injections and we have rarely found it necessary to change more than the sample detector, and that infrequently. The Glo-plugs require about 2 volts for satisfactory operation and an accumulator is necessary because of the substantial current drain; a small accumulator such as the Exide D.F.P. battery costing about $4.00 is quite adequate. Other accumulators such as car batteries can be used if they are on hand, but D.C. power supplies are not recommended as the residual ripple adversely affects the detector. The battery should be recharged when the indicated voltage on the meter (Fig. 1) falls below 1.7 volts.

Oven

The oven is heated by two 150 watt and one 75 watt electric light bulbs controlled by a simmerstat. No attempt has ben made to insulate the oven as this would substantially increase the cost of the instrument. Working temperatures of 180°c have been achieved with ease, and temperature stability is good over all ranges. A mercury thermometer with a range of 0 to 250°c is used as a temperature indicator. As can be seen from Fig. 1 both detectors, the inlet assembly and the column are enclosed in the oven.

Flow Meter

A simple bulb-operated soap bubble flow meter is installed in the carrier gas exhaust line and mounted on the front panel for ease of operation.

Attenuator

This is useful when a galvanometer is used as a read-out device because overloading of the galvanometer is a common difficulty. The attenuation is fixed and reduces the signal by 30 percent.

Septums

The silicone-rubber septum mounted on the front panel allows a sample to be injected into a gas-tight system. Provided that the syringe needle is sharp, at least 50 injections can be performed before replacement of the septum is necessary. Replacement is simple.

Carrier Gas

Running costs, availability and safety limited the choice of carrier gas to nitrogen. Flow rates are low and one could expect a small 75 cu. ft. cylinder to last a school for at least a term. A standard oxygen/nitrogen regulator must be used on the cylinder to reduce the cylinder pressure to the low value required for the gas chromatograph. A gauge is not necessary and suitable gaugeless regulators can be obtained from New Zealand Industrial Gases Ltd. for about $14.00.

Columns

The standard column supplied with the instrument is a 4ft. long $\frac{5}{16}$" O.D. copper tube filled with "Celite" coated with 15 percent of silicone oil M.S. 550. "Celite" is a diatomaceous earth marketed by British Drug Houses Ltd.; the silicone oil is manufactured by Midland Silicones Ltd. The M.S. 500 column is a good general purpose one which can be used with a wide range of compounds. Stationary phases are available in bewildering variety, but virtually any compound likely to be encountered in school work can be handled by one of the readily available general purpose columns.

Syringes

There can be no doubt that the conventional G.L.C. syringe is the most convenient and positive method of injecting small samples into a gas chromatograph, but it was recognised that many schools might not be in a position to pay for this type of syringe. Thus an all glass tuberculin syringe of 250 or 500 microlitre capacity and costing about $1.50 was used for most of the development work. With practice, injections of 10 microlitres can be consistently made with this type of syringe. Replacement needles (Luer fitting) are only about 5 cents each. The syringe has drawbacks but with a little practice these can be overcome.

Using the Gas Chromatograph

With regard to the last of the design criteria listed above — that the instrument should perform useful separations — the only simple and relatively inexpensive gas chromatographs of which we were aware seemed to have been designed principally to enable the technique of gas chromatography to be demonstrated, and little thought appeared to have been given to making use of it.

This aspect we regarded as the most important of all, and a great deal of work was therefore done on selecting suitable column packings; it was also responsible for the decision to incorporate an oven, as it quickly became apparent that few interesting separations can be achieved at room temperature.

Looking back, it seems fair to say that the instrument that resulted from this work has met the requirements laid down at the outset, and that these requirements were reasonable ones. We could perhaps have been less insistent on the importance of the cheap syringe. Experience has shown that the very much dearer 10 microlitre syringe is satisfactorily durable if it is properly handled, while the extra cost involved is more than compensated for by the great convenience of being able to vary the sample size readily and reproducibly with the consequent possibility of doing some accurate quantitative work.

The availability to schools of an instrument such as this is important for a number of reasons. Firstly, it makes possible an interesting study of the chemistry of hydrocarbons in a way that has never been possible before. Secondly, it allows the detection and identification of minor reaction products which arise for interesting and important reasons: for example, the formation of cyclohexene in the preparation of cyclohexyl bromide from cyclohexanol when elimination becomes a significant competitor of substitution. And thirdly and perhaps most importantly, by its very use one is confronted with things that previously were either not known or perhaps simply underestimated or ignored. One can for example, show just how little simple distillation accomplishes when the boiling points of the components of a mixture are close to one another. Again, in a sample of n-butanol one finds a minor component with a retention time the same as that of isobutanol; this not only draws attention to the existence of these isomeric alcohols but raises the question as to whether the methods by which n-butanol is manufactured make it likely that it would contain a small quantity of the iso-alcohol.

The experiment described below was designed specifically for this instrument and is included as an example of the type of work made possible by it.

Experiment

A common method of preparing alkenes is by the catalytic dehydration of alcohols. Thus ethylene may be produced from ethanol, either in a vapour phase reaction over a solid catalyst such as alumina or in the liquid phase in the presence of sulphuric acid; but whereas ethanol can give rise to only one dehydration product ethylene, pentan-2-ol can yield pent-1-ene, pent-2-ene, and possibly a mixture of the two.

$$\underset{\text{pentan-2-ol}}{CH_3.CH_2.CH_2CHOH.CH_3} \longrightarrow$$

$$\underset{\text{pent-1-ene}}{CH_3.CH_2.CH_2CH = CH_2}$$

and/or

$$\underset{\text{pent-2-ene}}{CH_3.CH_2.CH = CHCH_3}$$

At the outset the pupil has no reason for anticipating that either of the products is more likely than the other, and it is therefore both interesting and important to be able to show (Fig. 3) that, in fact, the pent-2-ene predominates. This discovery, and for the pupils it can be made a genuine discovery, is probably best treated simply as an experimental result, there being no need to endeavour to explain it at school level. What is however equally interesting and a good deal more surprising, is that if pentan-1-ol (n-pentanol) is dehydrated under similar, though

FIG. 3.

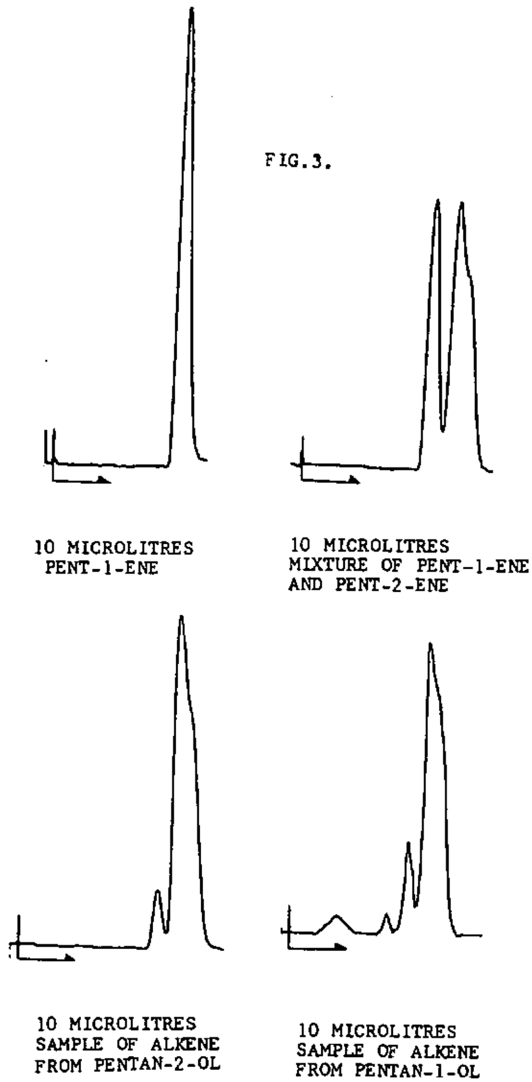
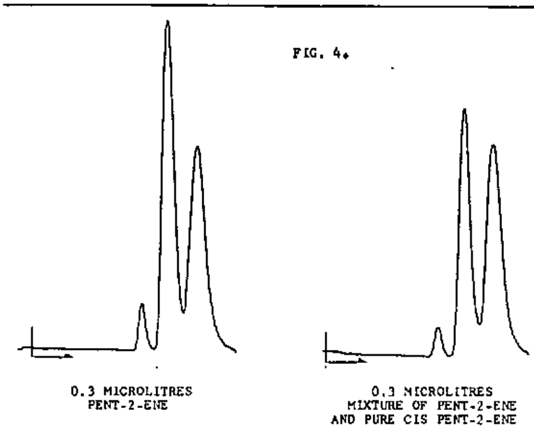


FIG. 4.



necessarily more severe, conditions the distribution of isomers is very little different from that obtained from the secondary alcohol (Fig 3).

The results in Fig. 3 were obtained by injecting the samples on to an M.S. 500 column at room temperature, this being one of the few useful separations which can be obtained without heating the column.

Note that for this type of experiment one must first show that the retention times of the possible products are sufficiently different that separation is possible. Once this has been established, the sample itself is injected. It will be noted that the shape of the pent-2-ene peaks (Fig. 3) is that characteristic of two unresolved components. This may reasonably be attributed to the fact that pent-2-ene exhibits cis-trans isomerism. Confirmation of this assumption may be obtained, again at room temperature, using a 10ft. x $\frac{1}{8}$″ diameter column packed with 10 percent XF1150 on Chromosorb P, the support prior to coating having been treated with 1 percent silver nitrate. The results are shown in Fig. 4.

The ratio of the peak areas in the product distilled from pentan-2-ol is 1.25 (trans) : 1 (cis).

Other experiments have been designed using a wide variety of hydrocarbons, alcohols, ethers, esters, ketones and alkyl halides.

An instrument based on the above design is now in commercial production in New Zealand.

The authors would be happy to receive and answer enquiries concerning the chromatograph.

Acknowledgement

We would like to express our thanks to Mr. R. H. Nokes for his work in manufacturing the components from which this instrument was constructed.

Reference

1. Herbener, R. E. J. Chem. Ed. *41*, 1964.

ENVIRONMENTAL POLLUTION

The Auckland Branch presented a Symposium on 12th May on the subject of *Environmental Pollution*. The Branch Chairman Dr J. Rogers presided, and 142 Fellows, Associates, Local Members and visitors were present. The audience included the Mayor of Auckland, Mr D. M. Robinson, members of the Clean Air Society of Australia and New Zealand and delegates to the Water Conference 1970. A panel of four invited speakers addressed the meeting, and a general discussion followed. A condensed account of each address is given below, together with a brief summary of the discussion.

Enjoyment of our Surroundings

Mr O. H. Keys, Government Analyst, Auckland

I deliberately use the simple English of the title and avoid the use of some of the emotive words about our environment that are so common today. I refuse to say "individuals have become socio-economically involved in an environmental situation"—we merely want to live in clean, unspoiled surroundings as long as possible. The word "enjoyment" carries with it the legal principle of a person enjoying or having the full benefits of the place where he lives. There is an obligation to keep dangerous things from entering a neighbour's property, thereby interfering with the neighbour's basic right to enjoy his surroundings; this can cause a conflict of interest because a person releasing something into the neighbourhood also has his own right to use and enjoy his own property and facilities. It seems obvious that no person should be permitted to ride rough-shod over a community in this respect.

The question of pollution has become very emotive in recent years and one observes that it can even become an obsession and a political band-wagon. I want to make only little use of the word "pollution", plead for the wise management of our surroundings and refer to the changes brought about by the results of man's scientific inventiveness.

The time has probably arrived when we need some type of comprehensive legislation to deal with our total physical environment. We have good food laws; we have legislation about water and air pollution; we have even recently seen the establishment of an Anti-litter Council; it is an offence to throw broken glass on road-sides or beaches. We have administration of air pollution by the Department of Health; water by Health, Marine and Ministry of Works; Anti-litter by Department of Internal Affairs—and so on. Is this the best way to meet the challenge of today and the future?

Our Food and Drug Act provides that no person shall sell any food that is unsound or unfit for human consumption or contains anything harmful, dangerous or offensive. Among detailed regulations for purity and quality of food, there are provisions regarding food which is (and note these words!) "dirtied, tainted, unwholesome, contaminated or deteriorated". We are in fact now tainting and contaminating our surroundings; there is growing danger of further insult to our conditions of living.

The Health Act, Section V, on *air pollution* refers to chemical inspectors and chemical works, fertiliser works and sulphuric acid works; the Air Pollution Regulations under it refer to acid, lead and superphosphate works. Noxious or offensive gases must not escape to the air, or must be rendered harmless; the best practicable means to achieve this must be used. There are also the Smoke Regulations to control emissions of smoke and provision for smoke inspectors to be appointed by local authorities.

For water, the legislation is broader in its scope. The Health Act refers to prevention of pollution of waters so as to be injurious to health. The Waters Pollution Act goes much further and makes it an offence to permit the entry to any waters of a poisonous or noxious pollutant, or any matter that endangers health or welfare or obstructs the public in the enjoyment of its common rights. *Waters* include rivers, lakes, bays, harbours, etc., and underground waters. *Pollute* means to contaminate or change the condition so as to be detrimental to persons, animals, birds and fish. A Pollution Advisory Council is set up, mainly to advise the Minister who is the Minister of Marine.

It is clear that the scope and intention of the law on water pollution is much wider than for air pollution and comparable to the law for pure food. The full effects of the more recent water conservation legislation have yet to be seen.

Our concern today with total quality of our surroundings is not merely with pollution of water by sewage, toxicants, nutrients and other unwanted materials, nor with air pollution by industrial and other gaseous or smoky garbage escaping into the atmosphere. The world is becoming concerned also about noise and heat pollution and the general man-made changes in our surroundings which frequently bring deterioration in living.

In the past, nature has proved capable of dealing with changes over long periods of time. The air and the oceans can absorb a great deal, but man's activity is now possibly outstripping even this absorptive capacity—in some respects to his own disadvantage. This we must guard against. Now that man manipulates his surroundings by de-forestation, by re-afforestation, by intensive farming, by vast construction works, by burning vast quantities of fossil and radioactive fuel, or by letting loose synthetic products previously unknown, there is not much time left before we or our children suffer the consequences. The adverse changes, from the purely human viewpoint, occur more rapidly than natural processes can cope with. The chemist and chemical engineer is perhaps not sufficiently aware of his capability and responsibility and the community is not yet ready to face the cost and effort of repair and prevention.

Water has generally been readily available as a convenient dumping-place or as a cheap carrier; for many activities, industrial, private or communal, a stream or river is a free conveyor-belt and a lake or shore is a bottomless pit. *This misuse of water will have to cease.*

The same applies to the air we breathe. Because the wind does not flow in confined channels like rivers, it has been all too convenient to throw our gaseous wastes into the air. Usually this mess disperses and becomes diluted over vast areas—but this cannot be relied upon in cities. Even if vastly diluted, some materials are unacceptable and indeed dangerous over any country-side. *So this misuse of the atmosphere will also have to cease.*

The rate of use of water by many industries outstrips its ready availability and in future it will be more and more necessary to re-use water. This means close technical control to high standards, sometimes adding significantly to costs. It will come to be regarded as another overhead expense like wages, interest, depreciation, etc. At times the cost of re-processing or of satisfactory disposal of effluents may become economically unacceptable; in such cases either the public will be deprived of the products of industry or find some way of preserving the surroundings in good condition.

Some years ago, the American Chemical Society adopted the slogan "Chemistry, key to better living". This is indeed the chemical era of astonishing and valuable man-made materials, created in the laboratory. We have had a golden age of engineering which is still with us, growing and still expanding man's physical control of his environment — as shown by motorways, jumbo-jets, spacecraft, telecommunications and the like. The profound effect of modern chemistry is less obvious, and not so easy for the layman, the administrator and the legislator to perceive. Whilst producing enormous benefits in food technology, medical products, industrial products upon which most other technologies now depend, the side effects, the by-products, the waste products, the residues are chemical substances, often of great activity even at high dilution. Their effects upon our lives (and of vegetable and animal life around us) are often subtle, profound and far-reaching; worse, some of them are not readily broken down by natural processes to simpler and more harmless materials. Several products of modern chemistry have had effects quite unforeseen when first synthesised. It has been estimated that some 100,000 new chemicals are discovered each year; any of these may bring great benefits or have deleterious effects.

During the past twenty years there has been an appreciation of the difference between acute and chronic toxicity. People were accustomed to think of poisons as those substances causing acute illness or perhaps even death after one or a few doses or exposures. We are now aware that many substances are capable of affecting our health and well-being in remarkably minute concentrations, either for a short time, or from cradle to the grave (this is the reason for the current interest in "additives" to foodstuffs). I need not dwell here upon cancer-producing substances or tragedies such as thalidomide; but I do want to emphasise that we were unaware of many of these sub-acute and chronic toxicities until (a) we had discovered substances previously unknown to man, and (b) means became available to demonstrate their presence, and measure their effects. It is now possible, and indeed commonplace for chemists to determine the presence of extraordinarily minute amounts of potentially dangerous or deleterious substances — for example, by chromatography. It is a problem to know how to evaluate and deal with the new knowledge we are acquiring.

I want to emphasise the accelerating rate of change in all aspects of living. Dr Ferranti recently said: "The pace is now very demanding in every respect. It needs quick decision-making. . . . All decisions that are late are wrong". Leonard Hynes in a lecture to the Society of Chemical Industry pointed out that we must learn to live in harmony with the technological explosion and concludes that we are in danger of being overwhelmed by the fruits of our scientific discoveries.

We no longer have the excuse of ignorance. Since the chemist is the person most commonly concerned first with creating and then with measurement of potentially troublesome materials, he has a large share of responsibility. I submit that he and his professional bodies should feel it a duty to assist others to devise better means by which we might all continue to enjoy the surroundings in which we live.

Air Pollution

Mr N. G. Thom, Chemical Inspector, Health Department

There has been an increase in public concern over air pollution both locally and overseas. The President of the United States of America stated that country's determination to get on top of this problem in his Address to the Nation in January this year, and this was followed almost immediately by comments by Prince Phillip who warned that more attention should be given to this problem.

In New Zealand all political parties have indicated that legislation to control pollution in New Zealand should be strengthened. A petition has recently been presented to Parliament by residents in Auckland asking for more action to preserve clean air. Opposition members have also submitted two separate bills to the House on the subject of clean air and pollution control. A subcommittee of the Board of Health has been considering changes in current legislation to more effectively control air pollution in New Zealand, and their report to the Minister of Health is imminent.

The general levels of air pollution, illustrated by ambient air monitoring in some areas of New Zealand, can be considered to be low to moderate when compared with air quality standards which have been set in many areas overseas. There is, however, an increasing trend apparent, and it is necessary to take action now to ensure that the quality of our air does not deteriorate further. Already there are areas where local sources of emissions to the atmosphere give rise to conditions unacceptable to local residents; in Auckland some have reached the stage where local authorities have taken court action against certain industries.

Contrary to popular belief, the main source of air pollution in most areas is not from industrial processes, though the fact that emissions from these are more concentrated is well established. It has been estimated that approximately 60 percent of air pollution in urban areas in U.S.A. originates from motor vehicles and domestic activity. A survey conducted by Dr C. J. Sparrow of the Geography Department, University of Auckland, for 1966 indicated that the situation is fairly similar in urban Auckland. In Christchurch domestic fires give rise to significant emissions into the atmosphere.

Air pollution legislation in New Zealand requires scheduled chemical processes to employ the "best practicable means" to control the discharge of pollution to the atmosphere, and industrial furnaces in gazetted areas to take all "reasonably practicable means" to control the emissions of smoke and dust. There is no control on domestic chimneys. The open burning of refuse and objectionable processes associated with unscheduled industry can be controlled under the nuisance sections of the Health Act 1956.

There have been criticisms of the effectiveness of legislation that requires the use of the "best practicable means" or "all reasonably practicable means" when compared with, say, legislation that specifies emission standards. In fact, the application of the "best practicable means" normally involves the specifying of a satisfactory performance standard so that the approaches may not differ to the extent that may first appear. The main advantage in existing legislation is that it can keep abreast with technological advances, and has in fact meant that, as far as new scheduled industry is concerned, at least, the effective performance standards that have been set, while practicable, are very exacting when compared with those set overseas.

In New Zealand, in view of its climatic conditions and the needs of its primary industries, the disposal of waste matter via water carriage systems is fraught with particularly significant problems. Although domestic and factory wastes can be expected in time to be conveyed in piped systems for adequate treatment, animal droppings from nearly sixty million sheep, from eight-and-a-half million cattle and from over half a million pigs are going to be spread on the ground for a long time to come and much of this will be washed by rain into our receiving waters.

Not only are problems of eutrophication likely to remain with us by increasing fertilization of the inland waters, but efforts to set low values of bacterial count are likely to prove impracticable for a long time to come, especially where re-cycling of nutrients (such as in the chain of hydro-electric storage dams in the Waikato River) is not controlled. It would seem that prevention of discharge of nutrients into such waters is no more important than would be the harvesting of existing nutrients—so increasing effort should obviously be directed to methods of economic harvesting, whether by macro weed extraction, microstraining, fish cultivation or like methods.

New Zealand's affluence is still not such that it is justifiable, never mind practicable, to jump on the band-wagon of complete anti-pollution—to postulate unnecessarily stringent and hypothetically significant standards to control pollution to the extent that all known pollutants must be eliminated in each and every discharge. It is totally unfair for a person with cigarette in hand to grumble about his neighbour's garbage fire or the smoke from a factory chimney polluting his atmosphere, when he involves his fellow beings in a fantastically high expense to provide clinical services and enormous hospitals to cope with his avoidable—yet highly probable—lung cancer. At least he can reduce this risk, but he still will have to cope with his unwanteds—and be prepared to pay increasingly more for the increasing sophistication involving nutrient stripping in some cases, and certainly improved treatment in all cases.

So long as mankind continues to try to beat nature by ignoring the needs of the "natural cycle of birth, change and decay" he is going to continually increase both his present and future difficulties. Mother Nature intended that bacteria should cope with organic matter and convert its carbon to either carbon dioxide or methane, or at least to small molecular structures capable of assimilation by lower forms of life. Controlled predation is our most useful tool in waste-water treatment. The introduction of bacteriocides and weedicides, of toxic metals and inhibitory compounds such as synthetic detergents, polythenes and plastics which have no food value (and even break the teeth of our lowly friends) will leave us increasing residues of undecomposed matters, will prevent the natural decomposition of organic residues, will affect our flora and fauna, our fish and our future!

Research is, of course, called for. But please, not the research of Dynamic Inertia which many Sanitary Engineers have perfected! Morris B. Ettinger (in the Journal of Sanitary Engineering Division of the American Society of Civil Engineers, August 1965) detailed the disastrous successes which have appeared from some types of research. He points out that agricultural research has produced a wonderful surplus of things we don't need, to add to the existing stockpile of things we didn't need; that the chemist has contributed to the stockpile with narcotic economic poisons that we can hardly live without; that the automotive engineer has produced a wonderful collection of brews, potions and lubricants to ease our burdens and foul our living. But the sanitary engineer has perfected techniques which have led to an outstanding record of earnest research effort without embarrassing accomplishment. Ettinger's list comprises many techniques, including: the Platinum Bridge; the "Me Too"; the Frog Swallows the Ox; the Mathematical Doodlement; the Ivory Tower Sewer; the Grasshopper Perspective; the Cosmetic Approach. The first line of approach is to develop methods which nobody could possibly afford to use. The "Me Too" leans upon wide-scale involvement in pure hypothesis. The Frog/Ox concerns attack of infinitely large problems with infinitely small resources. The Mathematical Doodlement produces equations containing infinitely variable constants. The Ivory Tower sewer employs a one dimensional constant temperature creek populated by *E. coli* and *Colpedium* only, moving with constant velocity and containing constant pollutant. The Grasshopper Perspective relates to the provision of "Alle Tage Sontag" with never a winter's day in sight, whilst the Cosmetic Approach is even if it doesn't do much real good to the figure, a little effort is justifiable.

A strong vein of chemistry and chemical engineering runs throughout environmental science and technology. A greater awareness of legislation which is in force to control air pollution in New Zealand is required by members of our Institute. We should be able to show an informed and rational approach which is necessary to understanding and controlling our environment. The American Chemical Society has recognised such responsibility in this respect and Institute members would find some useful information in that society's book "Cleaning our Environment—The Chemical Basis for Action" which was published in 1969.

It is considered that the universities, the Institute of Chemistry and related Institutes should ensure that they keep themselves fully informed of those aspects of air pollution and its control which are within their sphere of influence. Then they can make informed comment and guide their management, the local public and all others who may reasonably expect guidance. We should be able to ensure that there is no significant deterioration in air quality in urban areas of New Zealand.

Management of Water Resources

Mr R. Hicks, Chief Chemist and Treatment Works Superintendent, Auckland Regional Authority

The management of water resources is mainly concerned with the control of pollution in lakes, streams, rivers, estuaries and even in the oceans. Amongst the theoretical ways of avoiding polluting problems in our waters are two outstanding procedures: (a) stop the clock, (b) eliminate humanity. Since the first appears impracticable and the second unlikely in the immediate future (though none of us is really sure about this!) other avenues of progress will need to be explored.

It must be recognized that Mother Nature herself is responsible for environmental changes of great significance. Only by the cooling down of the earth was it possible for life to appear, and only by ageing processes, involving nitrogen fixation, phosphate liberation and the like, was the rapid extension of all forms of life made possible. Inevitably it must appear that Mother Nature intends that advancing years will bring advancing problems. So it behoves us all to take stock of the situation and do our utmost to co-operate if we wish to prolong our stay. There can be little doubt that mankind has misused his environment to such an extent as to speed up natural ageing to the nth degree and to convert much of what could be a wonderful heritage into a rapidly declining morass.

Obviously man's first need is to understand what life is all about . . . how nature intended he should grow, develop and decay, what good rules he should live by and what care he should take in his own interests, as well as those of his progeny, to hold his environment, to overcome his mistakes of the past and to leave his world at least as fair as, if not improved from, when his desecrations first began.

Man's major pollution arises from his desire to dispose of his "unwanteds". In caveman days this was conventionally done—even without a convenience—by leaving his mess in heaps around the place and moving away when he could no longer tolerate the sight—or smell—of his residues. As more mankind appeared, it became less easy to merely push off himself, so he pushed off his mess into the nearest lake, river, stream or creek and hoped for the best. As a matter of fact, many of our kith and kin still do this, even today, although they have learned enough to know that it is more convenient to use a drain or pipe and use water conveyance, than to shovel or squeegee the stuff for many a mile! We still have many of our generation who really believe that "the solution to pollution is dilution". It might be more reasonable to postulate just the opposite! Much stuff left to lie where it is dropped will rot away without more offence than the good, old-farmyard odour or pig-pen flavour which our forefathers accepted as normal and natural.

As civilization has come and created high population densities, our aesthetic standards have altered, as well as our need for more careful control of our health standards. For the prevention of transmission of diseases such as cholera, typhoid, etc., which are known to be carried through water sources, careful control of our potable waters has become recognized as of first priority. Avoidance of pollution of water supply is part of this control. However, environmental protection requires more than avoidance of such health dangers. The W.H.O. definition that "health is a state of complete physical, mental and social well-being, not merely the absence of disease or infirmity" has become the target which the civilized world must meet.

What is needed without doubt in New Zealand is experienced approach to a big task. Pollution can be reduced to acceptable levels without crippling the economy. Even though it can't be completely stopped, it can, by experienced management, be limited and guided so that within a reasonable period of time the W.H.O. conception of health can be operable. But the longer the situation is toyed with, the more difficult is its control.

Pollution is here to stay—but please let it be managed!

Industrial Pollution

Mr W. E. Russell, Works Superintendent, N.Z. Farmers Fertiliser Co. Ltd.

Pollution is often made to appear like a struggle between the 'good guys' and the 'bad guys'—the 'good guys' seeking stiffer laws to stop the greedy 'bad guys' from poisoning the air and fouling the water. The causes of environmental pollution however, are deeply rooted in the fabric of our urban industrial society. Every organism gives off wastes—organisms have evolved to use the wastes of other organisms. But in the 20th Century the rise of man and his problems has been far too swift for this kind of evolution to keep pace. Formerly most of man's wastes were dumped into air or water to be naturally dissipated. This solution is rapidly disappearing and man's relationship to the environment presents problems not confined solely to industry. In truth, there are no 'good guys'. We are all offenders to some extent.

It is clear that it is theoretically possible to eliminate completely all industrial discharges, all harmful or offensive gases, dusts, fumes or liquids arising from industrial processes and being discharged into the atmosphere or into streams and oceans. It is equally clear that such a procedure is economically impossible and all that can be expected is that the discharge of such effluents should be limited to a tolerable degree, having regard to the overall problem, without an impossible strain on industry. There must be a tripartite compromise between: (1) the natural desire of the public to enjoy an unpolluted atmosphere; (2) the legitimate aspirations of industry to avoid unremunerative expense; (3) national, health and global rights, requirements and interests.

The most obvious way of getting rid of pollution is to prevent it from occurring in the first place. However, to return to an era of cave dwelling would solve nothing with our present world population. Competition has forced industry to improve efficiency by improvements in technology, and most impressive figures can be given showing where pollution has been spectacularly reduced. However, to some extent, these gains from technological advances have been offset by increases in both the size and number of plants necessary to meet growing world demands for energy and chemicals to fulfil man's desires for improved standards of living.

To take one particular example to illustrate improvements in technology — fifteen to twenty years ago a contact sulphuric acid plant operated with an efficiency of 94-96 percent. Over the years this conversion efficiency has been improved by better technology, until about five years ago efficiencies had reached 98.5-98.7 percent. In 1963 a German chemical manufacturer applied on a plant scale a principle of thermodynamics which had been known for over thirty years —the Chatelier principle which states that for an equilibrium reaction, removal of one of the products will result in the reaction going towards producing more of that component.

$$2SO_2 + O_2 \rightleftharpoons 2SO_3$$

This newer process is termed interpass absorption or double catalysis, and consists of removing the gases after approximately 90 percent of conversion has been achieved, and absorbing the SO_3 formed. The remaining gases are then returned after reheating to a further catalyst bed where the residual sulphur dioxide is converted and then absorbed in a second absorption tower. By this means an efficiency of 99.5-99.8 percent can be achieved. Unfortunately, in this particular instance capital expenditure for the extra plant is over 10 percent higher, and even if the higher efficiency is credited there is insufficient return to even pay the interest on the extra capital. The net result, then, if this process is adopted, is a higher cost per ton of acid produced than by a competitor's older operating plant.

Industry has for a long time mutely borne the brunt of the blame for environmental problems. Again taking the sulphuric acid industry as an example, in the United Kingdom sulphur emission from contact acid plant operation is less than 20,000 tons per annum using current operating efficiencies of 98 percent. The total sulphur emitted by the power generating industry was over one million tons in 1967—a factor of fifty. Should industry, at higher capital and operating costs to itself, reduce its contribution to sulphur air pollution by 15,000 tons, whilst publicly owned facilities continue to pour over two hundred times this pollution load into the air? It is interesting to note at this stage that air pollution due to sulphur from the combustion of fuel in the Auckland area is ten times that from chemical industry.

World literature on the subject of pollution is voluminous. Conferences, reports, research projects, the establishment of bodies to control and investigate the pollution load being daily added to the environment, a spate of tough anti-pollution laws, all add to the confusion. The first world legislation passed specifically to control air pollution was in England in 1863, mainly to reduce the discharge of hydrochloric acid gas to the atmosphere. However, the greatest single contributor to atmospheric pollution arises from the products of combustion of fuel. In U.S.A., the most highly industrialised country in the world, the estimated total load of pollutants annually fed into the atmosphere by motor vehicles, industry, power plants, space heating and refuse disposal is 140 million tons (72 million tons carbon monoxide, 13 million tons nitrogen oxides, 19 million tons of hydrocarbons and 12 million tons of particulate matter).

That the cost of pollution control for industry is considerable is seen from the 1968 Report of the British Alkali Inspector—the official body policing pollution in the U.K. About $70 million are spent annually in operating expenses and $30 million are spent annually in capital equipment to reduce air pollution. This covers such diverse fields as electricity generation (the main spender in both capital and operation costs), cement, petroleum, gas, coke ovens, lime, ceramics, iron and steel, non ferrous metals and chemical industry.

It is easy to say that no one has the right to contaminate public air. Industry is certainly playing its part to the extent that it can. The heart of the economic problem is that, for established industries, cost of control equipment has little relationship to a company's capital investment or its profitability. The harsh but unavoidable fact is that *no* method of pollution abatement will be easy, fair and equitable. Had air pollution been outlawed at the beginning of the industrial revolution, things would have been different. The economics of pollution control would have been built into the price structrue and the evolution of technology would have been greatly influenced.

These are not scientific questions, and pollution abatement is not, ultimately, a scientific problem. Technology can confront communities with choices of different processes, with choices of improved efficiencies, but the final decisions are economic ones in the communities' own hands.

Discussion

Dr A. F. Wilson (N.Z. Forest Products Ltd.) considered that there was a lack of contact between universities and industry. He suggested that university research might be directed towards development of analytical techniques to monitor pollutants in the environment. But Dr Wilson's criticism was rebutted by the activities of university scientists such as Dr C. J. Sparrow (Auckland University) who referred to his survey of pollution in the Auckland region; Dr D. J. Spedding (Auckland University) who has investigated the chemistry of sulphur dioxide pollution; and Dr G. T. Daly (Lincoln College) who described his recent work on the monitoring of atmospheric pollution by using sensitive plants. Some plant genera are much more sensitive to pollutants than animals, and the effects can be distinguished from normal plant diseases. Dr Daly has selected plant species suitable for detecting pollution under New Zealand conditions.

The Mayor, Mr D. M. Robinson, pointed out that the public is apathetic on the pollution issue, and local authorities and Government must arm themselves with effective legislation to preserve the environment. Several speakers drew attention to the fragmentary nature of present pollution laws and the difficulty of their enforcement. Mr G. G. Page emphasised that manufacturing firms must be persuaded to adopt effluent treatment procedures, and that the best way to persuade them is by financial means; they should be informed of the costs of effluent treatment from their plants. The burden of pollution control costs was a major factor in most companies, and Mr M. B. Rands (Auckland Farmers' Freezing Co.) suggested that ways must be found to turn effluent into a profitable product. Mr D. J. Gallop (Wilsons N.Z. Cement Co. Ltd.) mentioned that his firm had invested in an electrostatic precipitator costing about $500,000 and about 14,000 tons of cement dust worth $60,000 were recovered each year. Likewise, individual members of the public must be expected to pay for improvements in motor vehicle exhaust fumes and domestic rubbish fires. Dr Fish (D.S.I.R.) and Mr Thom advocated the establishment of a pollution control laboratory to carry out authoritative checks on pollution levels, but this would not remove the need for firms to monitor their own pollutant levels.

Mr Williams (Wild Life Service) stated that the pollution problem was caused basically by the unprecedented population explosion. Many of the natural ecological control mechanisms had now broken down, and mankind must consciously think in ecological terms if he is to survive on this planet. Mr K. E. Seal (Amalgamated Brick and Pipe Co. Ltd.) summed up the discussion and moved a vote of thanks to the speakers.

G. A. Wright.

IUPAC INFORMATION

A new section on Medicinal Chemistry has been incorporated in the IUPAC Division on Organic Chemistry.

IUPAC has announced a new publication *"Manual of Symbols and Terminology for Physicochemical Quantities and Units"* (the Green Book). The manual is available from Butterworths; cost £1.

An editorial preface to the publication states:

As the "Green Book" of definitive IUPAC nomenclature rules for physical chemistry, the *Manual* will find its place on the shelves of teachers, authors and editors, next to the "Red Book" and the "Blue Books" of IUPAC nomenclature rules for inorganic and for organic chemistry. It includes recommendations about the names and symbols for physicochemical quantities; a full account of the International System of Units (SI) and of other units; recommendations about numbers and about the algebraic relation of physical quantity, unit and number; a list of recommended mathematical symbols. Short chapters are devoted to symbols for chemical elements, nuclides, and particles; symbols for spectroscopy; conventions relating to galvanic cells; pH; symbols and terminology for rates of reaction. A list of the recommended values of the fundamental constants is given. None of the recommendations in the *Manual* is in conflict with those of other international standardizing bodies such as CGPM, CIPM, ISO, IEC, IUPAP, and CIE. The body of the *Manual* is expected to stand for at least ten years. It is planned, however, to attach to it from time to time Appendices on symbols and terminology for more specialized fields of physical chemistry. The first of these, on activities and related quantities, is included in the present volume.

FORTIETH ANNUAL REPORT
for the year ended 31 July 1970

Officers: President: Dr T. A. Rafter; First Vice-president: Dr W. A. McGillivray; Second Vice-president: Mr K. E. Seal. Delegates: Auckland, Dr J. Rogers; Waikato, Dr D. E. Wright; Manawatu, Dr E. Wong; Wellington, Dr P. K. Foster; Canterbury, Dr J. M. Coxon; Otago, Dr G. B. Petersen. Immediate Past President: Professor J. Vaughan. Editor: Miss J. M. Mattingley. Hon. Librarian: Mr. S. G. Brooker. Registrar: Mr D. J. Hogan. General Secretary: Professor W. E. Harvey.

Membership: During the past year the membership of the Institute has changed as follows:

New Fellows	1
Associates elected to Fellowship	12
New Associates	54
Graduate Members	15
Resignations	15
Deaths	7
Struck off	1

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

	1967	1968	1969	1970
Auckland	199	211	220	229
Waikato	49	53	55	58
Manawatu	98	95	105	108
Wellington	246	244	231	233
Otago	89	93	90	94
Overseas	92	91	114	124
	901	920	944	998

Honorary Fellows: During the year Professor L. H. Briggs and Mr. W. G. Hughson were elected as Honorary Fellows. Both are well known to members and both have given long and distinguished service to the Institute and to the profession.

It is with regret that we record the death of another Honorary Fellow, Professor N. L. Edson.

Obituary: With regret we record the deaths of the following members: Mrs K. Brown, Mr C. L. Carter, Mr F. G. Caughley, Mr S. R. J. Cotton.

Institute Prizes: The I.C.I. Prize for 1969 was awarded to Professor B. R. Davis, University of Auckland.

There were no entries for the Morcom Green-Edwards or Chemical Essay Prizes.

Conference: The 1969 Conference, held in Dunedin, was attended by approximately 200 members. The general outline of the programme had been arranged by a Council committee, with emphasis being placed on the utilisation of New Zealand resources. Dr A. J. Farnsworth of the Australian Wool Board was the guest lecturer at the Conference, and Professor H. N. Parton delivered a public lecture dealing with the life and work of Professor Mellor.

A series of pre-conference symposia organised by specialist groups were well attended and proved popular.

Financially, the conference realised a surplus of $143.

Publications: Joan Mattingley has continued as Editor of the Journal during the year under review. The Journal has continued to expand with an increase in both material for publication and advertising. Thanks to the increasing support of advertisers and the efforts of the Advertising Manager, Mr D. G. Howard, it has been possible to keep the net cost of the Journal close to that of previous years.

A new list of members was published late in 1969 thanks to the efforts of Mr J. S. Pollard who served as Editor.

A publicity brochure outlining the activities of the Institute and giving information about the grades of membership was published recently, thereby completing a project initiated by the Otago Branch.

With the co-operation and assistance of the Department of Education, the Canterbury Branch has arranged for the preparation of a series of special articles written by members for distribution to secondary schools, thereby continuing the tradition, developed in recent years, that the Institute, both at branch level and as a central organisation, should do all in its power to foster the teaching of chemistry, especially at sixth and seventh form levels, in the schools.

Salary Survey: During the year a salary survey was undertaken by a committee under Dr P. K. Foster and with the co-operation of Dr J. H. Darwin of the Applied Mathematics Division of D.S.I.R. This continued the general policy of the Institute, which has conducted salary surveys at regular intervals for a number of years.

Grades of Membership: During the year Council decided to increase the qualifying period of practical experience required following graduation before entry to the Associateship. At the same time a new class of membership — Graduate Membership — was introduced to provide a transition between graduation and the Associateship. Graduate Membership, which carries many but not all of the privileges of Associateship at a lower subscription, is to be regarded solely as a temporary status within the Institute and is not intended as a grade of membership open to those with lesser academic qualifications than are required to qualify for the Associateship.

The Council, in making these changes, was desirous of bringing the N.Z.I.C. requirements for membership more in line with those of similar bodies overseas and in particular the R.I.C. and the R.A.C.I.

The Institute Council resolved not to introduce a grade of Licenciate for those with academic qualifications lower than those required for Graduate membership, and attention is now focussed on the desirability or otherwise of retaining the route to Graduate Membership and Associateship by examination.

Overseas Visitors: The year has seen a number of visits by chemists from overseas sponsored by the Institute.

Professor F. G. A. Stone and his family toured the country following a visit to Australia in 1969, and in 1970 Professor P. J. Randle visited both Australia and New Zealand from Australia as guest lecturer of the 1969 Conference.

We were privileged during the year to receive a visit from the officers of the Chemical Society (London) who came here following the I.U.P.A.C. Conference in Australia. A one-day symposium was arranged largely by the Chemical Society's representative in New Zealand, Professor S. N. Slater, and Professor C. A. Coulson delivered a lecture in the evening following a dinner and the formal admission of Fellows to the Chemical Society. During the visit the officers of the Institute held a series of valuable informal discussions with the Chemical Society officers covering matters of mutual interest.

Also during the year Mr. Philip J. Corbett, a Vice-president of the R.I.C. was entertained by the officers of the Institute during his brief visit to Wellington.

Specialist Groups: A number of specialist groups are now well established within the framework of the Institute and, although their activities vary, several have undertaken the production of regular newsletters to keep their members informed of news and developments in their areas of special interest. Specialist groups have assumed increasing responsibility for the planning and organisation of specialist sessions at the annual conference.

Royal Society Matters: The Institute continues to be well represented on Committees of and associated with the Royal Society of New Zealand. The Council has continued to press the R.S.N.Z. to consider for election to the fellowship, members of the Institute whose contribution to the profession has been in administration rather than research.

The National Committee for Chemistry, with Professor J. Packer as chairman and Professor C. J. Wilkins as secretary has met during the year and has maintained valuable contact with I.U.P.A.C.

Finance: The Balance Sheet for the year ending 30 April 1970 reveals an excess of income over expenditure of $2141.94 compared with $152 for the previous year. This most satisfactory result has been achieved by holding total administration expenses to approximately $100 less than in 1969, by affecting a saving of approximately $100 in the net cost of the Journal and by the absence from the accounts this year of the item of $1000 spent on the "Careers in Chemistry" publication. The auditors comment that "the Balance Sheet of the Institute shows considerable financial strength."

Thanks: It is a pleasure to express thanks to the many individuals, committees and organisations who have assisted the Institute and its Council throughout the year.

For and on behalf of the Council.

T. A. RAFTER, *President.*
W. E. HARVEY, *General Secretary.*

BRANCH NOTES

AUCKLAND

Personal

Professor P. B. D. de la Mare has been elected Fellow of the Royal Society of New Zealand.

Emeritus Professor L. H. Briggs has been made Honorary Fellow of the Institute.

Mr. J. C. Hawthorn has been appointed General Manager of Formica (N.Z.) Ltd.

Mr. R. W. Olliff, University of Auckland, has left for a period of study leave at Oxford University.

Mr. A. C. Kennett, Chemistry Division, D.S.I.R., has been elected President of the Australasian Corrosion Association (N.Z. Branch).

Mr. K. J. Osborne, Manager of A. G. Healing and Co. Ltd., recently gave a paper on *"Electroplating"* to the Australasian Corrosion Association.

Mr. R. D. Hoyle will shortly leave the N.Z. Fertiliser Manufacturers Research Association and take up the position of Assistant Chemical Inspector, Department of Health, Christchurch.

Dr. A. J. Easteal has returned to the University of Auckland after two years' special leave spent at Purdue University, Indiana, where he worked on the physical chemistry of ionic liquids with Professor C. A. Angell.

Presidential Address

The retiring President, Dr. T. A. Rafter, addressed the branch on *"Isotopic Biogeochemistry"* on 4th August. Dr. Rafter discussed the development of isotopic techniques at the Institute of Nuclear Sciences, and the application of sulphur isotope ratios to the study of mineralisation processes. A vote of thanks was moved by Mr. G. S. Lambert, a former colleague in the Dominion Laboratory.

Visit to New Zealand Steel Ltd.

About 70 branch members visited the Glenbrook steel mill on 2nd September. The party was addressed by Dr N. T. Evans, Technical Services Manager, and then inspected the ironsand reduction kiln, the electric furnaces for steel production, and the steel strip galvanising plant.

University of Auckland

A chemistry dinner held on 13th August was attended by over 100 senior students, research workers and staff. The guest speaker was Dr. I. K. Walker, Director, Chemistry Division, D.S.I.R., who spoke on *"Chemists and the Economy"*. Dr. Walker described how academic research by Dr. R. A. Robinson on the thermodynamic properties of aqueous solutions had a direct bearing on later investigations by D.S.I.R. scientists on the production of salt at Lake Grassmere.

MANAWATU

Applied Biochemistry Division

Dr. G. Butler is travelling abroad for 2½ months, visiting laboratories in the U.S.A., Canada, Ireland, Great Britain and Sweden, with programmes which relate to those being carried out by Applied Biochemistry Division.

Dr. E. Hove has joined the staff of Applied Biochemistry Division. Dr. Hove has had a fruitful career in nutritional biochemistry especially in the fields of vitamin E and antioxidants, food toxins and in protein chemistry. He is currently particularly interested in the possible nutritional value of phospho-proteins. His previous position was Acting-Head, Bureau of Nutrition, Food and Drug Administration, Washington.

Dr. P. J. Peterson has returned from a period of study leave spent at University College, London, with Professor L. Fowden, where he followed up his interests in the biochemistry of non-protein amino acids in plants. Dr. Peterson also attended Conferences in Microbiology in Prague and Natural Products in Paris and visited some U.S. laboratories.

Dr. B. A. Tapper has returned from a period of study leave spent at University of California, Davis, with Professor E. Conn. He continued research on the biochemistry of cyanoglucosides and glucoisolates in plants and also spent three months at the Prairie Regional Laboratory, Saskatoon.

N.Z. Dairy Research Institute

Mr. R. M. Aird has resigned from his position at the N.Z.D.R.I. to take up a position with the Rangitaiki Plains Dairy Company.

Mr. D. W. King has resigned from his position as Chief Engineer at the N.Z.D.R.I. to take up a position with the N.Z. Dairy Board in Wellington.

Dr. W. A. McGillivray, Dr. P. S. Robertson, Dr. W. B. Sanderson, Dr. R. M. Dolby and Mr. D. W. King will be travelling to Melbourne early in October to take part in the annual meeting of the International Dairy Federation. Together with Dr. R. C. Lawrence, Dr. L. E. Pearce, Dr. L. K. Creanor, Mr. R. S. Jebson and Mr. B. Le Heron, they will be travelling to Sydney for the International Dairy Congress which is held every four years. This is the first time that it has been held in the Southern Hemisphere. It is anticipated that a large number of the delegates will visit New Zealand.

WELLINGTON

Chemistry Division

In August Dr E. C. Potter of the C.S.I.R.O. Division of Mineral Chemistry in Sydney gave an interesting lecture on ilmenite processing.

Miss Yuksel Gurleyik recently arrived at Chemistry Division from Turkey. She had been awarded a United Nations Fellowship to study geothermal chemistry in New Zealand for a period of three to four months.

Dr D. F. S. Natusch who was awarded a 1970 Fulbright Senior Travelling Fellowship left in August to take up a teaching position for one year at the University of Illinois, Urbana. In Urbana he will work with Professor H. S. Gutowsky in furthering his studies in Nuclear Magnetic Resonance and its application to biological systems. Dr Natusch also plans to spend three months studying aspects of Air Pollution at the National Centre for Atmospheric Research, Boulder, Colorado, before returning to New Zealand late in 1971.

Mr W. R. Braithwaite of the Metals Section of Chemistry Division is spending three months in Chile advising the Chilean Government on corrosion problems associated with the United Nations Geothermal Project.

Dr A. J. Ellis who leads the Geochemistry Section at Chemistry Division left at the end of August on a 10-week trip to Japan, U.S.S.R., Europe, United Kingdom, U.S.A., Canada and Mexico. He is delivering a paper at the Geothermal Symposium in Japan and is also attending the United Nations Geothermal Conference in Italy.

Soil Bureau

Dr B. K. G. Theng has recently joined the Soil Physical Chemistry Section from the Chemical Research Laboratories, C.S.I.R.O., Melbourne. Dr Theng gained a Ph.D. from the University of Adelaide in 1964, where he held a Colombo Plan Fellowship. He then held a Research Scholarship in Soil Chemistry at the University of Western Australia from 1964 to 1966, and a Post-Doctoral position with Professor Uytterhoeven at the University of Leuven, Belgium, from 1966 to 1968.

Dr P. C. Rankin, a graduate of V.U.W. will be returning to New Zealand early in 1971 from a post-doctoral position in the United States to join the Soil Physical Chemistry Section. At the moment he is working in the Human Nutrition Section at the U.S. Department of Agriculture centre in Beltsville, Maryland.

Chemistry Department, V.U.W.

Dr A. G. Freeman has recently returned to the Chemistry Department after spending a period of refresher leave with Professor D. W. J. Cruickshank's group at Manchester University. The major part of his leave was spent on crystal chemical studies of tetrahedral oxyanion compounds.

OTAGO

A combined meeting was held with the Invercargill Branch N.Z.I.C. at the Southland Museum on 1st May, when Dr. D. F. Nelson, D.S.I.R., spoke on "Science in the Investigation of crime". The content of the lecture, as well as the exhibits proved of considerable interest to those who attended—among whom were members of the police force.

Excellent attendances marked this year's Sixth Form Lectures which were delivered by Professor F. N. Fastier, "The Chemistry of Medicine" and Associate Professor A. D. Campbell, "Some Aspects of Modern Analytical Chemistry".

Dr. Michael Spiro, Imperial College, London, is at present in the Chemistry Department as Visiting Mellor Professor.

On leave at the Pharmacy School, University of Sydney, is Mr. R. McKeown (Pharmocology Department). Associate Professor A. D. Campbell is at present indulging in a three-month flying "jaunt" through Germany, Austria, Czechoslovakia, Switzerland, U.K., U.S.A., Thailand and Malaysia.

A recent promotion in the Chemistry Department is Dr. B. H. Robinson to Senior Lecturer in Inorganic Chemistry.

Dr. R. M. Carr will be departing in November for a year in the United Kingdom where he will divide his time between the Rothamsted Experimental Station (Pedology) and the Manchester University Geochemistry Laboratories. Dr. C. G. Pope will be at Bristol University during the same period, while Dr. M. R. Grimmett will take up a Nuffield Fellowship with Dr. K. Schofield at Exeter University, where he hopes to study some reaction kinetics in the heterocyclic field.

Royal Society of New Zealand

National Committee for Chemistry

Memorandum for Members

The following publications have been received.

Addendum to Comptes Rendus; XXV Conference — Lists Committee members, Company Associates, etc.

Codata Newsletter, May 1970 — International Council for Scientific Unions, Committee on Data for Science and Technoolgy.

Pure and Applied Chemistry, Vol. 20, No. 4, 1960. (This will be filed at Royal Society Office, Wellington.)

C. J. Williams, Secretary,
National Committee for Chemistry,
29th September, 1970.

BOOK REVIEWS

Thermochemical Kinetics, by S. W. Benson, published by John Wiley and Sons, New York, 1968, 223 pages. Price (Aust.) $10.45.

The book's subtitle, "Methods for the Estimation of Thermochemical Data and Rate Parameters", summarises the contents adequately. A major problem confronting kineticists initiating studies of a new reaction is—how fast will it go and for how long can I follow it? The solution kineticist has little more than intuition to guide him, and the reviewer recalls making elaborate arrangements to study a reaction which he guessed would have a half-life of about 20 seconds at 0°c, only to find that the half-life was two weeks at 75°c!

The basic theory of gas phase reaction rates is better developed than that for solutions, but even for simple reactions of doubtful utility, computer-calculated semi-empirical potential eenrgy surfaces are required. The resulting rate parameters still leave much to be desired. Benson's monograph now provides the gas kineticist with methods based on slide-rule calculations and tabulated data whereby estimates of rate data may be made.

The basic method involves estimation, using the principles of group additivity of thermochemical properties, of the thermochemical properties of initial and transition states of gas phase reactions involving reasonably complex molecules, and use of the pseudo-thermodynamic theory of absolute reaction rates. The first two chapters comprise revision material on equilibria, kinetics and methods for estimating the thermochemical properties of real molecules. They lead logically into a discussion of the properties of the experimentally inaccessible activated complex. Calculation of rate constants via Arrhenius A- factors and energies of activation for reasonably complex reactions follows, and while methods for estimating the latter quantities leaves something to be desired, the same can be said for modern elaborate quantum calculations.

In Chapter IV such estimates are applied to the analysis of complex reaction systems, with chain reactions receiving major attention. An extremely valuable appendix brings together from a wide variety of sources group contributions to enthalpies, entropies and specific heats, thermochemical data for simple organic and inorganic molecules, and data useful for statistical mechanical calculations.

The book is a personal account of estimation techniques largely developed by the author himself, and the list of references to other work is short. The material is organised in a coherent and logical fashion. A particularly useful feature is the incorporation of worked examples at appropriate points in the text. Although the book would be of most use to graduate students and teachers of physical chemistry and to chemical engineers interested in homogeneous gas phase reactions, an advanced undergraduate should have little difficulty in following this unusual but useful exposition of rate theory.

The scientific standing of the author and this presentation of his work lend authority to the treatment. The book is a fitting companion to Benson's monumental treatise of 1960—"The Foundations of Chemical Kinetics" which is by no means outdated today. D. J. McLennan.

Aromatic Character and Aromaticity. By G. M. Badger, Cambridge University Press, London, 1969, viii + 133 pp., 14 x 22 cm, U.K. 35/-, U.S. $6.00 (Paperback, U.K. 12/-, U.S. $1.95).

Aromaticity is a field which has evoked considerable interest in the last few years and is one in which considerable advances have been made. Although, this monograph is intended for students in the final year of their undergraduate chemistry or for those beginning graduate work, it can be recommended to all students who require an insight into the subject. The material is not covered in great depth and only general references to the most important topics are given, but the book is written by an authority in the field and he succeeds admirably in introducing the subject of aromaticity in a simple and readable manner.

The book has only four chapters. The first is an introduction which summarizes the physical evidence for the structure of benzene followed by a wave mechanical picture of its electronic structrue. Polycyclic aromatic hydrocarbons and aromatic heterocycles are then discussed and the chapter ends with yet another definition of aromaticity—one which is more comprehensively and more carefully phrased than in most text books.

Chapter 2 describes some consequences of aromaticity and deals with bond lengths, resonance energies, electronic absorption spectra, and induced ring currents. The third chapter examines non-benzenoid hydrocarbons from the point of view of Huckel's rule and ranges over compounds from the 2π system to the 30π system, while the fourth chapter is concerned with more complex systems including the fulvenes, metallocenes and bicyclic and tricyclic systems.

In such a concise treatment it has not been possible to expand on any particular aspect but in the reviewers opinion it is a pity that the terms "homoaromatic" and "antiaromatic" are not introduced or considered. Also some of the more unusual heterocycles such as borazole and the phosphonitrilic halides might well have deserved comment. Nevertheless, the aim of the book has been amply achieved in this monograph which is well presented and is very reasonably priced.

R. C .Cambie.

1,2-Cycloaddition Reactions. The Formation of Three and Four Membered Heterocycles. By Linda L. Muller and J. Hamer. Interscience Publishers. 1967. Price Australia $15.

This book gives an account of the reactions between two species which lead to the formation of 3- and 4-membered heterocyclic ring systems. It covers the formation of rings containing 1 and 2 atoms of O, N, S and, to a lesser extent, Si, Ge, and P (except for epoxides).

The mechanism and scope of the reactions are covered, and tables of examples are given in each case. The literature has been covered through to the middle of 1965.

The authors in their preface state that the survey is aimed at being historical and comprehensive, rather than interpretative, and this appears to be the case. The compilation provides a survey of a field which has grown rapidly in recent years. Inevitably there is overlapping with other reviews and books, but to research workers interested in this somewhat specialised area, this monograph provides a useful collection of information. It is likely that major libraries will be the only buyers.

B. R. Davis.

An Introduction to Gel Chromatography, by L. Fischer. Published by North-Holland Publishing Co. Amsterdam. 1969.

This is a pocket edition of Volume I, Part II of the series 'Laboratory Techniques in Biochemistry and Molecular Biology', General Editors T. S. Work and E. Work.

This little book of approximately 230 pages deals effectively with the basic concepts of gel chromatography, various types of gels, equipment and experimental techniques. There are chapters on applications of the technique, special techniques and in the appendix lists of manufacturers of gel materials with chemical nature, molecular weight range etc. Altogether a very useful little book.

J.M.

Correction

Dr. Rogers has requested the following correction to his article Farmers, Fertilisers and Funds, *Chemistry in New Zealand 34,* No. 3, June 1970, page 90 beginning at line 5, the next two sentences should read: 'The initial capacity of the Dunedin works was 3,000 tons per annum, and in 1887 the company built New Zealand's second fertiliser plant at Westfield, Auckland, with an initial capacity of 8,000 tons. Thirty years passed before another company, New Zealand Farmers' Fertilizer, built a works in Auckland, this time (1917) with an initial capacity of 16,000 tons per annum.'

Where will you find other laboratory mantles of such high quality and low price?

Only in the Isopad catalogue

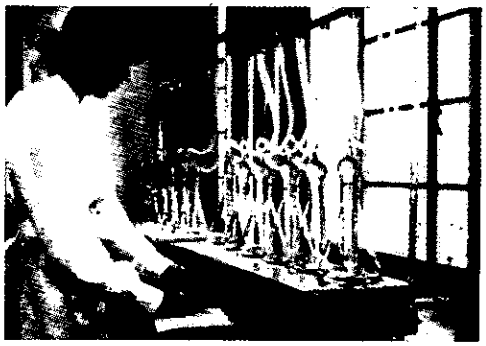
Isomantle electric heating mantles are standard equipment in thousands of laboratories all over the world. They were first introduced in 1947, and their prices have increased surprisingly little since then. Their quality remains unchallenged.

The range covers virtually every laboratory requirement. The multisize design enables one heating mantle to be used for several flask sizes, and the flameproof and completely spillage proof Isopad design for hazardous areas is being used by more and more laboratories, especially for ether and solvents. All Isomantles can be supplied with fitted energy regulators.

Isopad also supply Isomantles for funnels, beakers and mercury vapour pumps, in addition to hot plates and the laboratory version of the well-known Isotapes.

Isopad extraction units are made in banks from four to twelve positions for all Soxhlet and Kjeldahl work.

All these products are fully specified in Catalogue LM. Send for it now and for Catalogue GP, Isomantles for large glass plant.



Isopad Extraction Units for Erlenmeyer flasks.

The range of Isotapes for laboratories includes moistureproof and high temperature types.

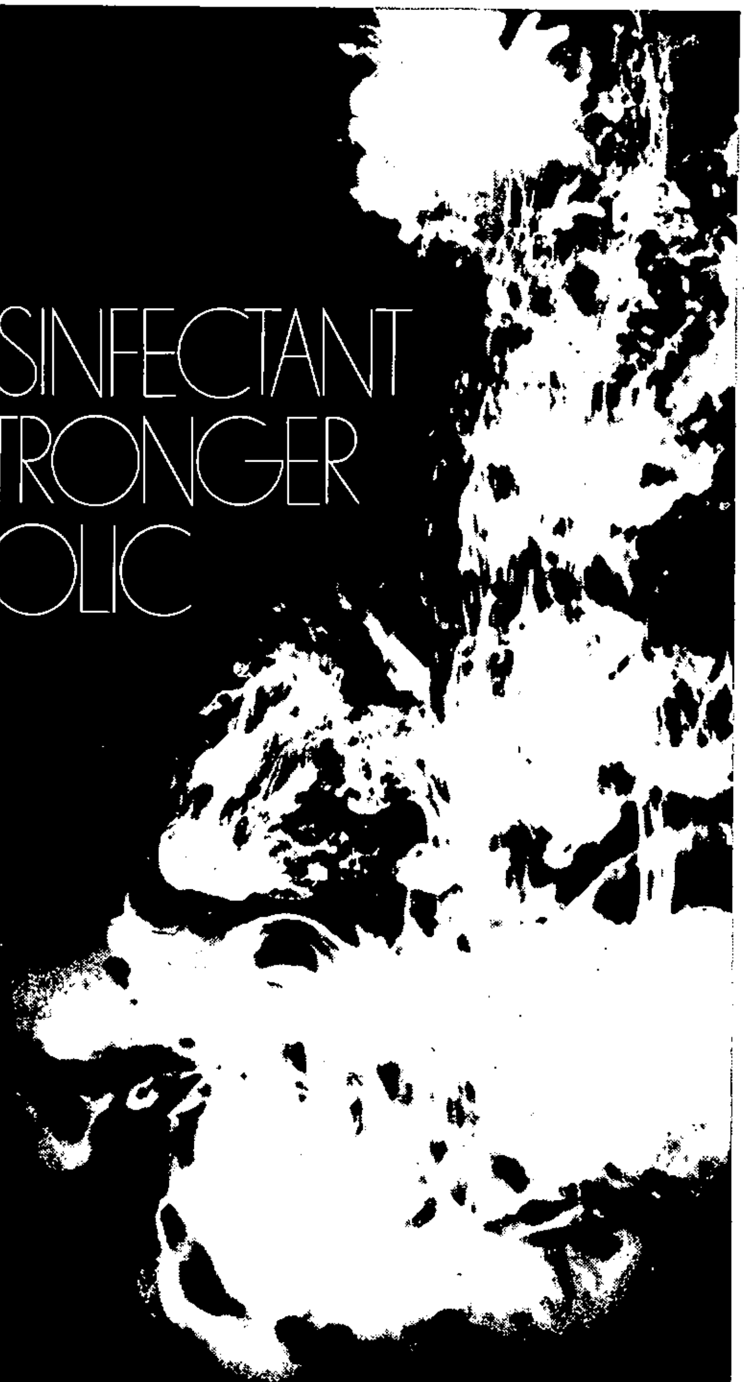
Isomantles for flasks and process vessels
Isotapes for pipes
Isodrum Heaters for all standard drums
Isopanels for any shape or surface

ISOPAD
electric surface heaters

Sole Agents
WATSON VICTOR LTD.
Head Office: 4 Adelaide Road, Wellington.
Branches: Auckland, Christchurch and Dunedin.

BIOZOL

GENERAL DISINFECTANT FIVE TIMES STRONGER THAN CARBOLIC ACID



Biozol is a powerful disinfectant, but corrosion-free and non-staining at recommended concentrations. It is equally effective for hospital, veterinary, farm, industrial, and home use.

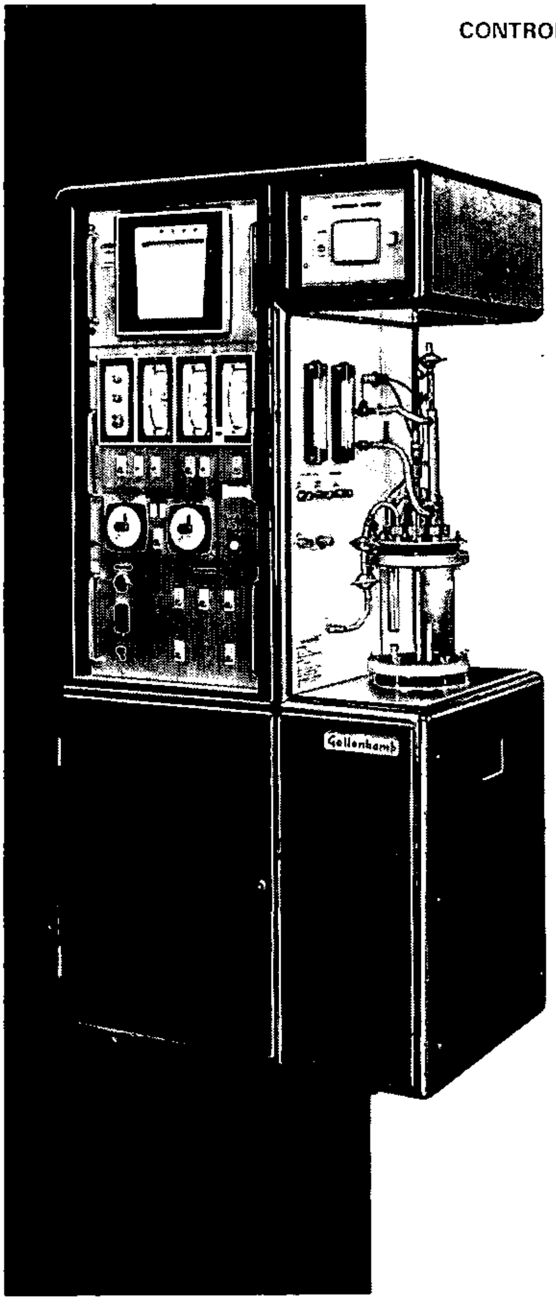
In commercial applications, where cost is an important factor, Biozol has proved particularly economical. One gallon of Biozol diluted with water, makes 20 gallons of a ready-to-use solution.

T V L

Industrial

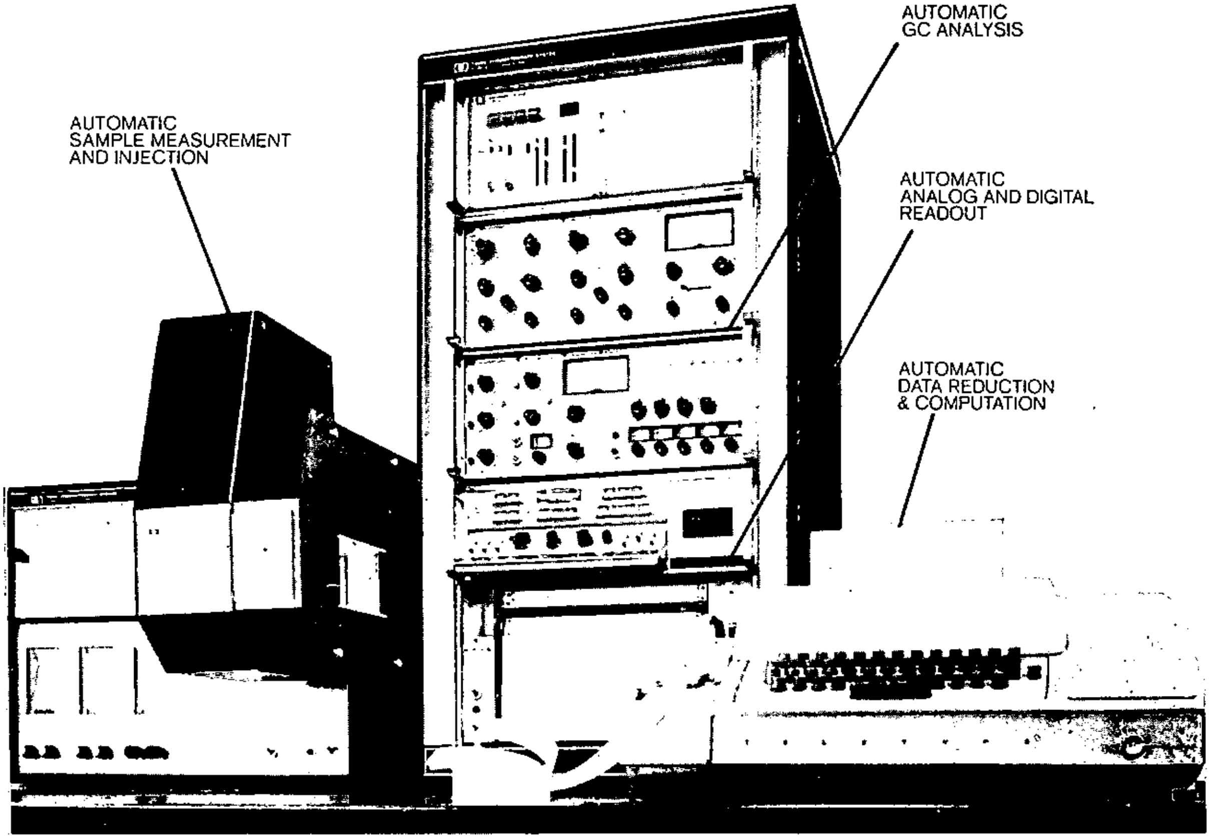
TASMAN VACCINE LABORATORY LIMITED,
WHAKATAKI STREET, UPPER HUTT.

1979.FP



The all new HP Model 7600A Chromatograph System

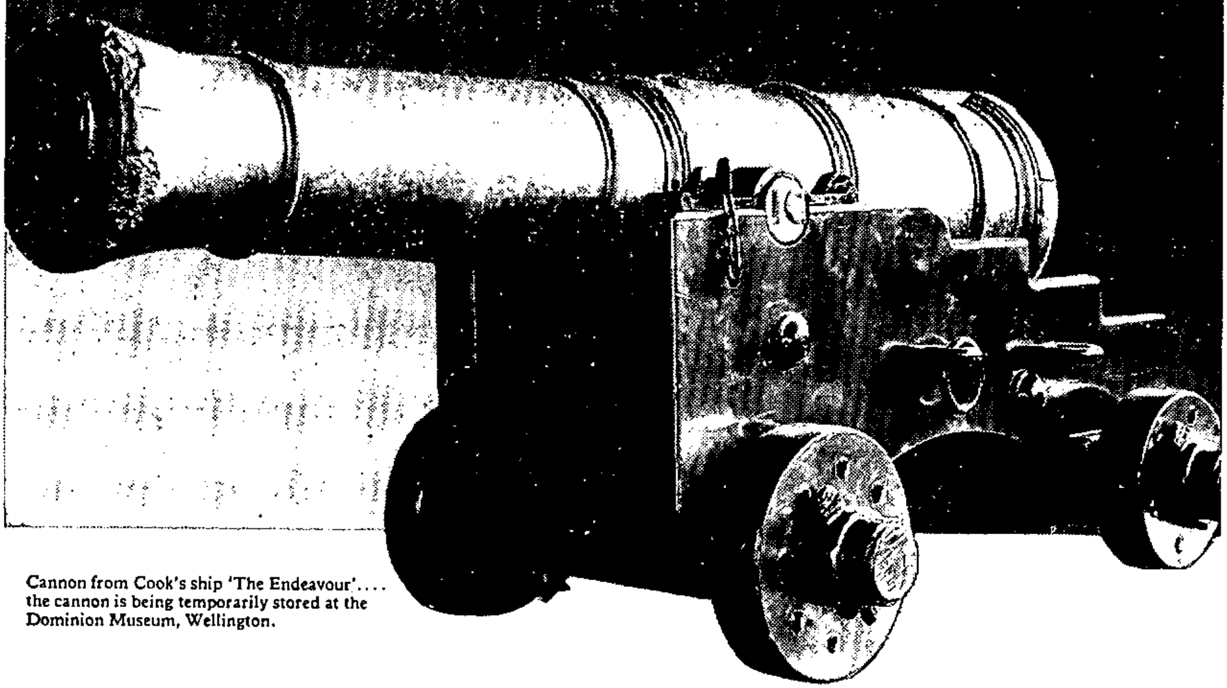
HEWLETT hp PACKARD



DENTAL & MEDICAL SUPPLY CO. LTD.

Auckland Wellington Christchurch Dunedin

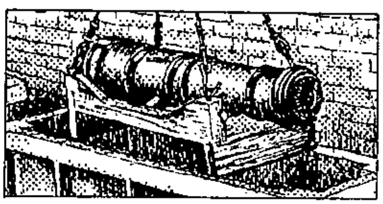
"Endeavour" sails home with long lost cannon



Cannon from Cook's ship 'The Endeavour'.... the cannon is being temporarily stored at the Dominion Museum, Wellington.

On May 5 1970 the HMNZS 'Endeavour' arrived in New Zealand carrying one of six cannon jettisoned almost 200 years ago by Captain James Cook.

It was June 11 1770 when Cook's ship 'The Endeavour' ran aground on the Barrier Reef. For two centuries these historic cannon lay on the sea bed . . . while this country achieved nationhood.



Cannon cradled in wooden tank lined with Epikote resin.

Discovered in January 1969, they were given to the Australian Defence Standards Laboratories to undergo restoration.

Epikote resins assist in historic restoration

Each cannon was cradled in a heavy wooden tank lined with Epikote resin and fibreglass cloth layers. There they remained, after removal of the coral, through various chemical processes designed to stabilise the metal and prevent further corrosion.

The tanks lined with Epikote resin were subjected to these rigours during the restoration process.

- Immersion in a solution of sodium hydroxide.
- Washings in dichromate inhibited distilled water.
- Soakings in ethyl alcohol.
- Immersion in molten wax to temperature of 212°F.

Epikote resins were chosen because they are impervious to such chemical actions.

AT WORK IN INDUSTRY

Versatile Epikote resins have the qualities of adhesion, durability, heat resistance, corrosion resistance and chemical resistance.

For further information to help you apply Epikote resins in your industry, contact Shell area offices at Auckland, Wellington or Christchurch.

*Shell registered Trade Mark

Epikote*

Shell Chemicals SHELL

114.0

Shell Oil New Zealand Limited

Staff appointments

At the end of this year Shell will be offering employment to men (or women) with degrees in Chemistry, Civil or Mechanical Engineering, Agricultural Science and Commerce. There may be also a few opportunities for graduates in other subjects, e.g. Economics, Law or Arts.

POSITIONS AVAILABLE

Most of the graduates will initially be stationed in Wellington.
Each man is appointed as soon as possible to a position best suited to his qualifications, talents and interests and he is asked to follow a planned programme to enable him to use all his knowledge and ability at an early opportunity. The work is accepted as qualifying for corporate membership of professional Institutions or Societies.

Chemists will begin in the Central Laboratory in Wellington on product development and testing, technical service, and the supervision of quality control, and may also be employed in chemicals marketing.

Engineers are responsible for design development, construction and maintenance of oil storage facilities, processing plants, buildings, pipelines and road tankers.

Agricultural Science graduates are appointed to the Shell farm trade organisation, acting as specialist advisers on the marketing, development and application of chemicals for agricultural purposes.

Commerce graduates are employed primarily in finance, where the responsibilities include quarterly accounts, treasury, taxation, credit, investment, audit, payroll, costing, budgets and management accounting.

Data Processing with a Systems 360/60 IBM computer also offers a field for graduates with the necessary aptitudes for systems analysis, programming, operational research, etc.

ADVANCEMENT

As well as specialising initially in work for which he is qualified the graduate will be trained to take a comprehensive view of Shell activities generally.

The Shell group of companies, which is international in character, scope and shareholding, is engaged in New Zealand and throughout the world in two industries, petroleum and chemicals. Both are growing in volume and complexity and show ample prospect of development in the future.

Shell Oil New Zealand Limited is staffed by New Zealanders, of whom the most able may be eligible for promotion to senior positions overseas. With individual recognition, supervision and guidance each graduate is encouraged to progress towards the most senior position he is capable of filling. His own efforts towards self development may be aided in several ways, including overseas training for the most promising men.

SALARIES

Young graduates have a special salary scale and it is Shell's policy to offer salaries and conditions of employment (including retirement benefits) at least comparable to those offered by other large firms.

VACATION EMPLOYMENT

A few vacation jobs will also be available in Wellington next summer for students now in their second to last year of a degree course in Engineering, Commerce or Chemistry. No unusual obligations are imposed but preference will be given to men seriously interested in the eventual prospect of a Shell career.

Application may be made at any time during the year but a decision will not necessarily be made until October or November.

ENQUIRIES

More detailed information is available in the booklet "A Guide to graduate employment with Shell Oil New Zealand Limited", copies of which are available from the University, or Shell Oil New Zealand Limited.

Interviews can be arranged to suit any students who may be interested.

Enquiries may be addressed to:
Personnel Manager, Shell Oil New Zealand Limited,
Shell House, The Terrace, PO Box 2091, Wellington. Telephone 45-060.

or Shell House, Albert Street, PO Box 1084, Auckland. Telephone 78-880.

or St Elmo Courts, Hereford Street, PO Box 2095, Christchurch. Telephone 62-939.

116.0