

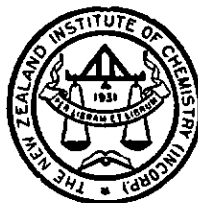
JOURNAL OF THE NEW ZEALAND
INSTITUTE OF CHEMISTRY

Vol. 29

No. 1

February

1965



ALFA-LAVAL

IS YOUR problem
FILTRATION
SEPARATION
or
HEAT EXCHANGE?



Let De-Laval's technical experience and world-wide leadership in Centrifuges and Plate Heat Exchangers be your guide.

Improve your product quality, increase process efficiency, reclaim waste, reduce floor space, cut labour cost, save time . . .

Write or phone TO-DAY!

ALFA-LAVAL (N.Z.) LTD.

70-74 Collingwood St., Hamilton, P.O. Box 430

Hamilton
Phone 40-816

Auckland
Phone 43-637

Palmerston North
Phone 87-980

Christchurch
Phone 80-986



WORLD LEADERS IN CENTRIFUGAL APPLICATIONS

JOURNAL OF THE NEW ZEALAND INSTITUTE OF CHEMISTRY

Vol. 29, No. 1

FEBRUARY, 1965

CONTENTS

	<i>Page</i>
Editorial	1
Some Aspects of Teaching Secondary School Chemistry <i>A. Sutherland</i>	2
Molecules in Magnetic Fields <i>B. R. Davis</i>	7
Radioactive Hydrogen <i>G. R. White</i>	14
International Union of Crystallography	21
Summer School for Teachers	22
Papers Read before Branches 1964	23
Royal Society Sectional Committee on Chemistry	25
Branch News and Notes	26
Council Minutes	27
Retirement: Professor J. Packer	29
Institute Prizes	30
Book Reviews	31

*Published for the New Zealand Institute of Chemistry
(Inc.), P.O. Box 250, Wellington, by*

EDITORIAL SERVICES LIMITED

9-11 Marion Street,

C.P.O. Box 6443.

Telephone 51-416.

Wellington, N.Z.

United Kingdom Advertising Representative

Walter Judd Ltd., 47 Gresham Street, London, E.C.2.

Edited by JOAN M. MATTINGLEY

P.O. Box 250, Wellington

Registrar, N.Z. Institute of Chemistry (Inc.)

D. J. Hogan, P.O. Box 1926, Christchurch, N.Z.

Employment Officer

E. S. Borthwick, Shell Oil N.Z. Ltd.,

Box 2091, Wellington.

O₂ AND CO₂ Determinations to 0.02% Accuracy

FOUR SIMPLE OPERATIONS...

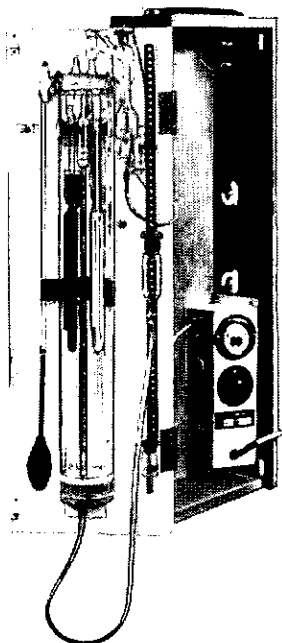
and the sample is introduced, analysed and ejected

TIME TAKEN 6 MINUTES!

MAXIMUM ACCURACY, MINIMUM FUSS!

Gallenkamp-LLOYD

with the
GAS
ANALYSER
(Patented)



DO YOU ANALYSE
RESPIRATORY GASES
FLUE GAS
EXHAUST GAS ● MINE AIR?

This analyser is now also available with the new combustion accessory for hydrogen, methane and carbon monoxide (also acetylene, nitrous oxide and other similar combustible gases).

- ★ Rapid determinations of O₂, CO₂, CO, CHO₄, H₂ and other gases such as C₂H₂ and N₂O
- ★ Accuracy about 0.02% total volume
- ★ Auto-compensated for pressure and temperature changes
- ★ Single stopcock — no leaky joints
- ★ Fully portable — easily recharged
- ★ Suitable for BS 1756 'Sampling and analysis of flue gases'

Ask for publication 635

Gallenkamp

supply the world's laboratories

TECHNICO HOUSE, CHRISTOPHER STREET, LONDON, E.C.2, ENGLAND

Our appointed agents are:—

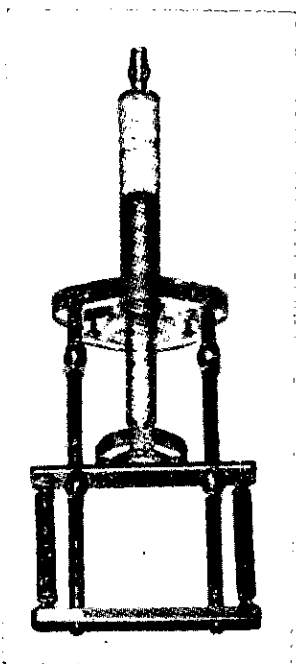
Geo. W. Wilton & Co. Ltd.,
Box 1980, Auckland. Tel. No.: 30-467
Box 367, Wellington. Tel. No.: 697-099

NEW ITEMS FOR THE LABORATORY

BB CONSTRUCTION PIPETTES

Each pipette is carefully tested and will automatically adjust itself to its volume when filled by suction. The pipettes are manufactured in all sizes from 1 to 3000 μ l and kept in stock. The tolerance is about 2% from 1-5 μ l and about 1% on sizes above 5 μ l.

D.L. SYRINGE PIPETTES



Available in sizes 1 ml, 2 ml, 5 ml,
10 ml, 20 ml and 50 ml.
Accurate instrument for measuring
liquid in routine work.
Piston and cylinder interchangeable.

CATALOGUES and prices available
on request.
Items available ex stock.

OBTAINABLE FROM:

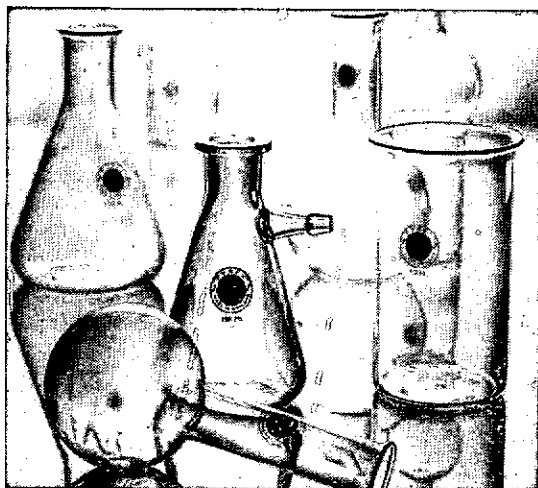
**SCIENTIFIC & LABORATORY EQUIPMENT
(N.Z.) LTD.**

P.O. Box 619, Auckland. Phone 549-235

A well aimed blow by PYREX

A machine called the Turret Chain made these: it automatically makes blownware such as flasks, beakers and other types of laboratory ware, to a very high standard of uniformity. It's the only machine of its kind in Europe. Just an example of how PYREX, the first and most important source of borasilicate glassware in this country, use the latest and best processes available. PYREX are always improving their production methods to attain even higher standards of quality. This is one good reason (among many) why everyone who is looking for quality glassware, looks for PYREX.

PYREX BEAKERS AND FLASKS are made in all practical sizes and shapes for students, routine or research work. Extremely low expansion coefficient virtually eliminates breakage from thermal shock, allows more robust construction giving greatly increased mechanical strength. High stability against attack from water and all acids (except hydrofluoric and glacial phosphoric). Therefore durable, accurate, economical, dependable, most used.



ENGLISH

PYREX

Regd. Trade Mark

LABORATORY AND SCIENTIFIC GLASS

ACCREDITED DISTRIBUTORS

Kemphorne Prosser & Co.'s N.Z. Drug Co. Ltd., P.O. Box 319, Dunedin.

National Dairy Assn. Ltd., Box 28, Wellington.
Scientific & Laboratory Equipment of N.Z. Ltd., Box 619, Auckland.

Townson & Mercer Ltd., P.O. Box 9144, Auckland.

Watson Victor Ltd., Box 1180, Wellington.

G. W. Wilton & Co. Ltd., Box 367, Wellington.

N.Z. Agents: Messrs F. O. & H. S. Hart, 9 Holland Street, Wellington, C.I.



JOURNAL OF THE NEW ZEALAND INSTITUTE OF CHEMISTRY

Vol. 29, No. 1

FEBRUARY, 1965

EDITORIAL

This issue is concerned mainly with chemistry in secondary schools*. The article on the teaching of chemistry at this level reveals problems of which most non-teachers are probably blissfully unaware. Time is the limiting factor in everything, including the school timetable. Science teachers obviously are in a very difficult situation when everything must be fitted into a short teaching period. Can a student adequately learn and understand concepts if there is no time in which to learn plenty of the facts on which the concepts are based? Is it really possible to teach a science such as chemistry at all effectively at school level? If it is part of a general science course, and all the sciences in the course must be taught like this, because of insufficient time, what is the aim of the course? And is its aim possible to attain? Can school children learn scientific attitudes without spending time on learning plenty of facts?

Mr Sutherland's article acknowledges the benefits of branch activities for the sixth formers. Branches will be encouraged to know that their efforts in this direction are worth while. Benefits, however, will not be all on one side. Non-teachers will acquire some appreciation of the difficulties of teachers and also of pupils who somehow have to cope with much more than most of us did at their age.

* The papers by Dr B. R. Davis and Mr G. R. White are based on lectures given to secondary-school pupils in Auckland.

SOME ASPECTS OF TEACHING SECONDARY SCHOOL CHEMISTRY

A. SUTHERLAND

Technical Correspondence Institute, Wellington

In New Zealand, as elsewhere, the main problem in teaching chemistry is to decide what to teach, and then how to teach it. In each branch of science, the number of workers engaged in research and the amount of material published seem to double every ten years. But a teacher cannot add more facts to his lessons. He must search for ideas round which to organize the facts he already must teach. The "how" of teaching becomes very important.

How to teach chemistry is influenced by the age of the pupil, his intelligence, his aim in life, and the preparation he may have had before he joined a chemistry class. It is important to note that many students of chemistry in post-primary schools will not go on to become professional chemists. This fact is not always given due attention by some in university circles whose aim seems to be to introduce a system of teaching designed to turn out useful university lecturers.

Table 1 shows the number of students taking chemistry in post-primary schools. Table 2 shows the number of first-year fifth-form students taking other science subjects.

TABLE 1: NUMBERS OF POST-PRIMARY STUDENTS IN NEW ZEALAND SCHOOLS TAKING CHEMISTRY AT JULY 1, 1963

<i>Form</i>	<i>Boys</i>	<i>Girls</i>
III	4	2
IV	130	63
V first year	2,202	598
V others	518	126
VI without U.E.	3,110	990
VI with U.E.	1,190	262
Totals	7,154	2,041
Combined total:		9,195

TABLE 2: NUMBERS OF FIRST YEAR FIFTH-FORM STUDENTS TAKING SUBJECTS OTHER THAN CHEMISTRY AT JULY 1, 1963

	<i>Boys</i>	<i>Girls</i>
English	13,442	12,479
General science	7,001	4,728
Biology	2,493	4,980
Human biology	29	873
Electricity	465	5
Physics	2,277	204

One of the ironies of chemistry teaching in most schools is that, at a time when lengthy conferences are being held frequently to see what can be added to existing chemistry courses, teachers are concerned mainly with finding sufficient time to teach what is already in those courses. Still, the situation is not yet as awkward in chemistry as it is in physics. There, the student is expected to master the contents of a multi-page textbook and digest the contents of twenty-two paperbacks, all in thirty-five weeks. By the time he has read these, a sixth-former must have little time left in which to do his paper work for physics, let alone the amount of steady reading he must do for English as well.

Usually, to complete the present chemistry syllabus, a teacher is given six periods a week, each of forty minutes. Generally, at least one-third of this time will be spent in practical work. Ideally, the student should do practical work alone. Sometimes, because of overcrowding in the laboratory, or shortage of apparatus and materials, two or more work together on each experiment. One teacher, Mr O. L. Gilmore, Senior Lecturer in Science in the Post-primary Section of the Auckland Teachers' College, has described the effect of shortage of time on the teaching of chemistry. His words were directed towards helping teachers cope with a long and detailed syllabus. "The time factor demands streamlined teaching at high pressure, a minimum of laboratory work which must be very efficiently organized . . . this means, regrettably, doing only one experiment when you feel like doing two; using experiments which establish principles rather than those which establish techniques. Unless the class is bright . . . [allow them to] . . . do simplified experiments and *explain* more advanced methods."

Despite the fact that little time can be spared to dwell on the significance of the ideas they are putting before their students, many teachers do give them every chance to acquire an understanding of the subject they are studying. Chemistry is not easy to teach. Any industrial chemist who has tried to get his point of view across to a company executive lacking training in science will appreciate the task of the teacher who is trying to explain the concept of solubility product to a student who is not ready to admit the importance of the concept.

Chemistry as taught in some areas has given rise to the belief that the present syllabus and the factual approach must be changed. Certain teachers with their eyes on overseas practices have begun to organize their material so

that it is possible to thread the facts of chemistry on certain guiding ideas. Two approaches have developed in the United States — the CBA (Chemical Bond Approach) chemistry course and the CHEM (Chemical Education Materials) Study course. The CBA project, directed by Professor Laurence Strong, of Earlham College, Indiana, arose from a meeting in Oregon of chemistry teachers who discussed the planning of an introductory chemistry course. They agreed that any such course should have a clearly recognized central theme, and that a logical central theme would be "chemical bonds". It was asserted that "... it is the chemical bond which distinguishes chemistry from related disciplines. The making and breaking of these links is chemistry." With the support of the National Science Foundation, textbooks, teachers' guides and laboratory books have been written. Dr D. G. Chisman summarized the course thus: "The CBA course attempts to give students a preliminary understanding of what chemistry is, rather than an encyclopaedic collection of chemical reactions and laboratory techniques. Since conceptual schemes are important in chemistry, the organization of the course is based strongly on conceptual models, which are introduced as logical devices based on a set of convenient assumptions. Particular attention is given to three such models: structure, kinetic theory and energy.

"In the development of a structural approach to chemistry, electrons are assumed to behave as if they were spherical charge-clouds, which by the action of electrostatic forces arrange themselves in patterns. The relationships may be simulated by the way real spheres can be arranged. Geometrical relationships governing the packaging together of spheres can be used to help visualise the arrangement of electrical forces within atoms and molecules. The charge-cloud model does not deal adequately with energy relations. A more convenient electron orbital model is therefore developed to discuss energy relationships, at least qualitatively. Through these two structural models the students gain some idea of the success and limitations of each."

The CHEM Study project was developed by a committee appointed by the American Chemical Society, in 1959, to study the possibility of revising high school chemistry. It is directed by Professor J. A. Campbell, Harvey Mudd College, Claremont, California. The course aims to build up certain concepts which can be applied to chemical phenomena so as to explain them. The point stressed is that chemistry is an

experimental science, and the text is integrated into the laboratory experiments. Chemistry is presented in terms of the atomic and molecular structure of matter. Chemical concepts in terms of atomic theory and energy changes are developed. The course is concerned with energy, rates of reaction, equilibria, acids and bases, oxidation and reduction. Certain elements are studied in relation to the Periodic Table. As with the CBA project, there are a teachers' guide and a laboratory manual in addition to a students' textbook.

One commendable object of CHEM is "to diminish the current separation between scientists and teachers in the understanding of science". While scientists have been breaking new ground and basing their work on certain new ways of thinking, teachers, too often, have been presenting old, tired ideas to their students. How much, for instance, of the new startling developments in petroleum chemistry is made known to sixth-formers or, for that matter, to university students?

Both projects emphasize the experimental approach to study, and both have been fairly extensively followed in different parts of the United States. As teachers have gained experience with these teaching programmes, they have reported their ideas for improvement to the organizing committees who have revised where it was thought necessary. The two courses are still being revised.

The CHEM Study course has been examined by officers of the N.Z. Department of Education and seems to have its official sanction. Last year, in a number of schools, sixth-formers have been taught by this method. It could well be that this year many more schools will adopt the CHEM course of study. A hasty decision to do so might well be a mistake. The sponsors of CHEM make no claim that they have a superior method of teaching chemistry, or that students taught by their system are better taught than students by other systems. New Zealand teachers should be permitted to examine and try out other methods, despite the fact that CHEM is perhaps the easiest to try because films and other teaching aids are available at no cost.

Some teachers feel that the present CHEM stresses the concepts of chemistry to the exclusion of facts about chemicals. Applied chemistry is not given sufficient treatment. If a chemistry course is to give an understanding of the importance of chemistry in the affairs of men, then something of the industrial side of chemistry must be revealed to students. Mr S. P. Chambers, Chairman of Imperial Chemical Industries Limited, touched on this point

when delivering the Chuter Ede Lecture in June, 1964, to the National Union of Teachers in England. Referring to his visit to the Soviet Union he said, "I went into classes at higher levels and found what, in my judgement, were good standards of teaching and a down-to-earth relationship of this teaching to the needs of everyday life. The teaching of chemistry as a general subject to all pupils was excellent and taken further than in British schools; it was related to the chemical industry and, as in other subjects, there was always the background of the needs and purposes of the community as a whole."

Members of the Institute know how much chemistry can be learned outside a schoolroom. Through their educational activities, they can play a part in advancing the study of chemistry in New Zealand. Already, some members have given their time and energy to organizing and delivering lectures for chemistry students. Others have used their positions in government departments and industry to arrange visits by students to laboratories and factories. These visits are important events for students, and often bring home to the individual student some point that he has failed to grasp when it was presented to him by his teacher.

MOLECULES IN MAGNETIC FIELDS

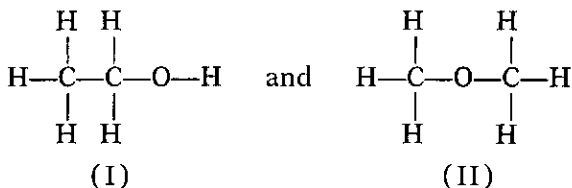
B. R. DAVIS

*Lecturer, Chemistry Department, University
of Auckland*

A very fundamental problem in chemistry — that of molecular structure — is as old as chemistry itself. Certainly since Dalton put forward his atomic theory at the beginning of the last century, chemists have been intent on determining the way in which these atoms are combined into molecules.

The examples given here will be taken from among the compounds of carbon — that is, the field of organic chemistry, because it is a field in which structural investigation has recently been aided very considerably by a number of new physical techniques — one of which will be described in some detail.

It is just over a century since the German chemist, Kekule, proposed that carbon possessed four valencies. How was this theory used to elucidate molecular structure? First, it was necessary to find the relative weights of the elements present in the compound and thus, by knowing the atomic weight, to find the relative numbers of the different atoms in the molecule; that is, the empirical formula. Then it was necessary to determine the molecular weight to arrive at the molecular formula. To take a very simple example — a liquid obtainable from natural sources of boiling point 78°C, was found to contain carbon, hydrogen, and oxygen atoms in the ratio 2:6:1. A molecular weight determination showed that the molecular formula was C₂H₆O and, assuming that carbon had four valencies, oxygen two, and hydrogen one, it is possible to write down two, and only two, structures.



The problem was then a chemical one — to determine the structural formula of the liquid. The products of reaction with sodium, with hydrogen bromide, and with sulphuric

acid, all indicate that the compound has the structural formula (I).

Chemists have been seeking methods which will give information accurately, quickly, and with as small a sample as possible. Methods that do not involve the destruction of the sample are of particular value.

The most recent of these techniques is that of nuclear magnetic resonance spectroscopy. This can be considered chiefly as applied to the hydrogen atom — this is the simplest atom, and more compounds contain hydrogen than any other element. Essentially all organic compounds contain hydrogen.

Now the nucleus of the hydrogen atom is a single proton which may be considered as equivalent to a positively charged sphere, which behaves as if it were spinning, the circulation of charge giving rise to a magnetic moment. In fact, for the present purpose the nucleus may be represented as a tiny bar magnet. When this nucleus, which is being considered as acting like a small bar magnet, is placed in a magnetic field, theory says that it may take up only two possible orientations. In one, it is lined up with the field, in the other, it is lined up against the magnetic field.

The proton which is lined up with the magnetic field is in a lower energy state than the proton whose own small magnetic field is opposed to the applied magnetic field. Normal thermal vibration will tend to upset this alignment and will tend to make for a random distribution. It can, in fact, be calculated that, for average magnetic fields as used today, at room temperature there is an excess of population in the lower energy state of only 1 in 100,000. The situation may be compared to that of an assemblage of compasses on a table subjected to violent agitation. The movements of the table tend to throw the compass needles out of alignment with the earth's magnetic field, so that, on the average, only a very slight excess of the needles will actually be pointing north.

Thus, the nuclear magnets are in a magnetic field, with a small excess in a lower energy state. It should now be possible for the nuclei in the lower energy state to gain energy and be placed in the higher energy state — *i.e.*, a nucleus that is lined up with the field should be capable of receiving energy and be "flipped over" so that it is lined up against the field. Calculations show that if electromagnetic radiation is used to impart the energy, radiation is needed with a wavelength of the order of ten metres — *i.e.*, with a

frequency round thirty megacycles per second. This is in the radio-frequency range.

To use some concrete figures, if a sample of a substance containing hydrogen atoms is placed in a magnetic field of 7,000 gauss, it can be calculated that, on irradiating this sample with an r.f. source whose frequency is about 3×10^7 cycles per second, absorption of energy should occur.

Ideas such as this had developed since the late 1920s when it was suggested that the nuclear particles could be considered to possess a spin, and in 1939 a group led by Professor Rabi at Columbia University in New York showed that it was possible, when some molecules are placed in a magnetic field, to flip some of the nuclei over so that they were in a higher energy state.

From that time on, efforts were made in a number of laboratories to detect and measure the absorption of energy by nuclei in a magnetic field. An unsuccessful attempt was reported in 1942 but success came to two independent groups in the United States just after the end of the war. One group, headed by Dr Purcell, was working at Harvard University, just outside Boston. They used a piece of paraffin wax, and were quite clearly able to detect the absorption of radiation when the wax sample was placed in a magnetic field and irradiated using an r.f. source. At the same time, a group at Stanford University, near Los Angeles, led by Professor Bloch, also detected this absorption of energy by the hydrogen atoms in a sample of water. In 1952, both Purcell and Bloch were awarded a Nobel Prize in Physics for their discoveries.

In the four years following the initial discoveries, it was found that other nuclei, when placed in a magnetic field, would absorb energy. Techniques and apparatus were steadily improved and in 1951 came an important announcement from Dr Packard (one of Bloch's original group) and his co-workers.

They had placed a sample of ethyl alcohol in a magnetic field of about 7,000 gauss and had irradiated it with r.f. energy of a fixed frequency (about thirty megacycles per second). They then increased the magnetic field, coming up to the region where resonance of the six hydrogen atoms in ethyl alcohol was to be expected, and measured the absorption of energy as the field was increased. They found that, instead of getting one peak, there were in fact three peaks, when magnetic field was plotted against energy absorbed (see Fig. 1).

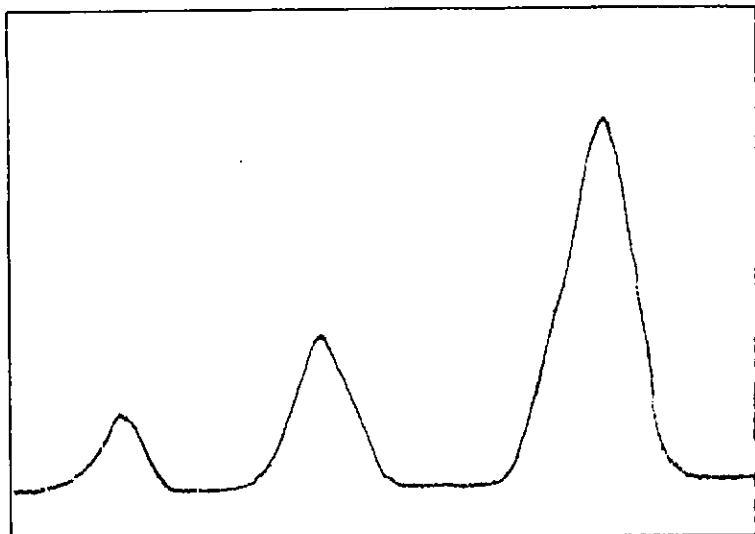
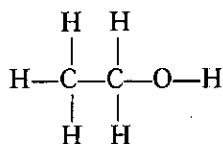


FIG. 1

It was found that the area under the peaks were in the ratio 1: 2: 3 indicating that the resonances were due to OH, CH₂, and CH₃ in



i.e., that hydrogen nuclei in different chemical environment absorbed energy at slightly different field strengths, although, in the spectrum in Fig. 1, the difference is only about five parts in a million. It can be seen, then, that measuring this absorption of energy, as the magnetic field is varied, can give important information about chemical structure. Within two years, the spectra of some dozens of organic and inorganic compounds were measured and it was soon found that chemical correlations could be made — *i.e.*, hydrogen attached to oxygen always absorbed at about the same place, and likewise specific positions could be assigned to $\text{H}-\text{C}-\text{O}$, CH_3-C , $\text{C}=\text{C}-\text{H}$, etc.

Very soon after this, the same group at Stanford that had studied the spectrum of ethyl alcohol, further improved their equipment and remeasured it. They found that with the improved techniques the spectrum appeared as in Fig. 2.

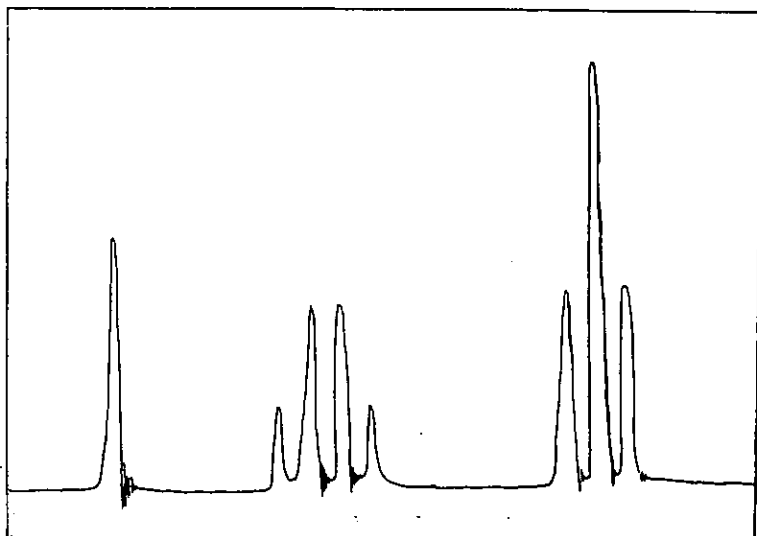
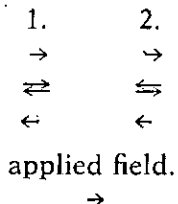


FIG. 2

Here are the same three peaks, but two of them are split further in a regular way. The bands associated with the CH_2 and CH_3 groups are still in the ratio 2: 3 but the spacing of the three components of the methyl group triplet is exactly the same as that of the quartet from the CH_2 group. Finally, the areas of the components of each multiplet are, approximately, in a simple integral ratio — *i.e.*, 1: 2: 1 for the triplet and 1: 3: 3: 1 for the quartet.

A simple explanation can be developed for these observations. Consider first the three hydrogen atoms in the methyl group. Next door there are two hydrogen atoms, each acting like a tiny bar magnet. Consider, then, the magnetic field felt by the methyl group hydrogens. They "feel" two fields — the main, strong, applied magnetic field, and a field due to the two hydrogen atoms next door. These two hydrogens can have *their* fields lined up with or opposed to the field. All the possibilities for the alignment of these two hydrogen nuclei can be listed as follows.



On the average, a quarter of the molecules will be existing with their methylene protons in each of the four spin states.

So the methyl group is "aware" of three different fields:

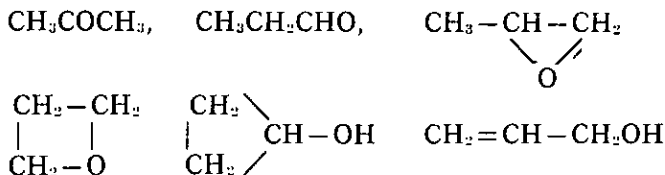
1. Applied field + 2H
2. Applied field
3. Applied field - 2H

and hence the methyl group hydrogens will absorb energy at three different values of total field strength, the intensities of the three absorption peaks being in the ratio 1: 2: 1. This explains why the methyl peak appears as a triplet. By similar reasoning, it can be shown that the three methyl hydrogens split the methylene hydrogen peak into four lines with intensity ratio 1: 3: 3: 1.

Commercial instruments enable the energy absorbed as the magnetic field is changed to be measured. The model in the Chemistry Department of the University of Auckland has an electro-magnet with a field strength of about 14,092 gauss and the sample is irradiated with an r.f. source of 60 megacycles per second. The instrument draws out a spectrum in about four minutes on a normal run and will then measure the areas under the peaks, to determine the relative numbers of hydrogen atoms in different environments. The magnetic field is varied by only a very slight amount, normally about eight parts in a million or about 0.1 gauss in 14,092. Traversing this 0.1 gauss range takes about four minutes and the spectrum is displayed on a chart twenty inches long. To change the field to zero at this rate would take over a year and require a chart over forty miles long.

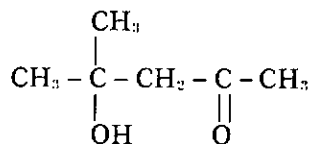
Two examples will illustrate one use to which the instrument can be put — that of simple structure determination.

A compound, acetone, has formula C_3H_6O . The spectrum consists of a single peak — *i.e.*, all six hydrogens are equivalent. On normal valency considerations, a number of structures can be written:



However, it is immediately clear that only one structure contains six equivalent hydrogen atoms — CH_3COCH_3 .

On treatment with base, acetone is converted into a dimer, $C_6H_{12}O_2$. Its spectrum consists of four peaks, none of which is split by interaction, or coupling, of adjacent hydrogens. The area under the peaks are in the ratio 1: 2: 3: 6 — *i.e.*, the twelve hydrogens are in four different environments, no two are on adjacent carbon atoms, and within each environment all the protons are equivalent. By using empirical correlations with known compounds, it can be suggested that the one proton peak is due to O—H, the two and three proton peaks to $-CO-CH_2$ and $-CO-CH_3$ and the six proton peak to two gem. methyl groups. Further, it can be proposed that the group H—C—O is absent. Fitting these fragments together, the structure arrived at is:



Such spectra can give a wealth of information about molecular structure and stereochemistry and, in fact, a recent book on the subject states, "No modern laboratory for carrying out research in organic chemistry can be regarded as complete if it lacks an NMR spectrometer". The field is one that is developing amazingly quickly — in the period 1945 to 1960 the resolution obtainable improved by a factor of about 100,000, while books on the subject published only five years ago now contain serious inadequacies. This field is just one in which co-operation between physicists, chemists, and instrument manufacturers has made for enormous advances in our knowledge of the world around us.

RADIOACTIVE HYDROGEN

G. R. WHITE

*Lecturer, Chemistry Department, University
of Auckland*

Of the three isotopes of hydrogen, ^1H , ^2H and ^3H , only one (tritium — ^3H) is radioactive, and it is this isotope that will be dealt with here.

Isotopes of an element differ with respect to the number of neutrons in the nucleus. Generally, when the number of neutrons is roughly equal to the number of protons, a stable nucleus is formed, except that at a higher atomic number a somewhat greater number of neutrons is required (see Fig. 1).

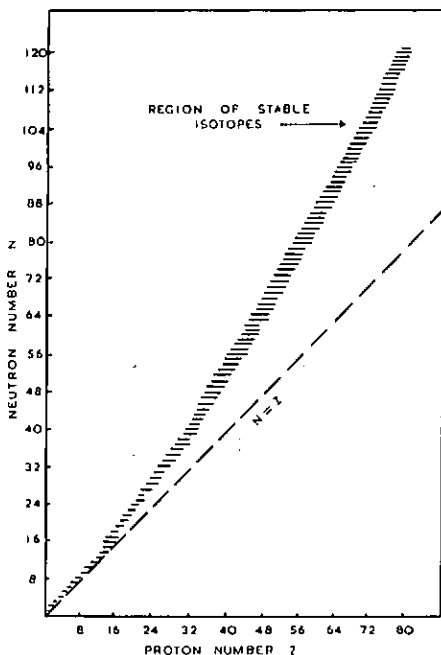
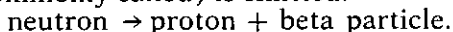


FIG. 1

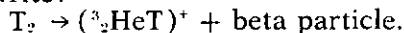
Where there are too few or too many neutrons, the nucleus is found to be unstable, the isotope is said to be radioactive, and a nuclear reaction takes place with the liberation of radiation to produce a more stable nucleus. Some radioactive isotopes emit alpha radiation, an alpha particle being a helium-4 nucleus (two protons and two

neutrons). High energy electromagnetic radiation of very short wavelength, termed gamma radiation, is often associated with the release of these alpha particles.

Most radioisotopes (including radioactive hydrogen, tritium) have an excess of neutrons and a more stable nucleus is obtained by the conversion of a neutron into a proton. In this process an electron (or a beta particle as it is more commonly called) is emitted.



The tritium nucleus consists of two neutrons and one proton, so that an atom of tritium which "decays" in this way would form an atom of helium-3. Remembering that tritium, like stable hydrogen, exists as a diatomic molecule (T_2) we can write:



The beta particles emitted have a range of energy (see Fig. 2) up to a particular maximum (E_{max}) which varies from one beta emitter to another (see Table 1).

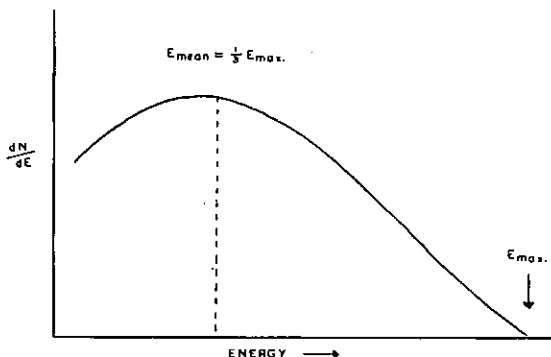


FIG. 2

It can be seen that the tritium E_{max} is very much lower than that for carbon-14, an isotope which is normally regarded as a "soft" (low energy) beta emitter. The extremely low energy of this beta radiation presents some problems in the detection of tritium but does make this radioisotope relatively safe to handle.

TABLE 1

Isotope	E_{max} (million electron volts)			
${}^{32}_{15}\text{P}$	1.71
${}^{14}_6\text{C}$	0.155
${}^3_1\text{H}$	0.0185

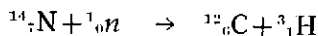
The most common forms of detector used in radioisotope work is the Geiger counter. This comprises a cylindrical container, with an anode wire suspended at the centre, filled with argon gas (and a trace of ethyl alcohol) which is enclosed by a mica window. Normally, impinging radiation enters through the mica window, ionizes the argon, and the resulting electrons are accelerated by an applied voltage of about 1,500 volts between the wire (anode) and the wall (cathode). Further ionization is produced by these accelerating electrons on their passage to the anode and the resulting "electron avalanche" produces a pulse which is used to operate a counting device. Unfortunately, the conventional Geiger tube cannot be used for the detection of tritium because the low energy beta particles are unable to penetrate even the thinnest of mica windows. Even in air their maximum range is only about 1 mm. However, it is possible to modify a Geiger counter by removing the mica window and continuously passing argon or helium through the detector and over the sample. Such windowless gas flow Geiger counters can be used for detecting beta radiation from solid samples containing tritium atoms.

A more common method of tritium assay involves the use of a liquid scintillator. The sample, containing tritium atoms, is dissolved in a suitable solvent together with some material (*e.g.*, anthracene) which produces small scintillations when bombarded with radiation. This solution is then placed in a silica cell on top of a photomultiplier tube which "sees" the scintillations and converts them into pulses which are amplified and used to operate a counter.

It should be noted that decay is a random process and for reliable estimates of activity it is necessary to measure the time taken to reach a relatively large number of counts.

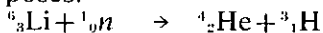
The decay rate of any radioisotope is conveniently measured by the "half-life" or the time taken for half of a given number of atoms to decay (see Fig. 3). Each radioisotope has a characteristic half-life which may be a few thousandths of a second in some cases, or thousands of years in others. Tritium and carbon-14 have half-lives of $12\frac{1}{2}$ years and 5,568 years respectively.

Tritium does occur naturally in very small quantities, being produced in the upper atmosphere by neutron bombardment of nitrogen.



However, large quantities of tritium are produced artificially for weapons research by neutron irradiation of

lithium-6 and this provides the main source of tritium for experimental purposes.



Tritium gas can be obtained carrier-free at a cost of about 15s. a curie (1 curie = 3×10^{10} disintegrations per second); 2 ml of pure T_2 gas at N.T.P. corresponding to about 5 curies.

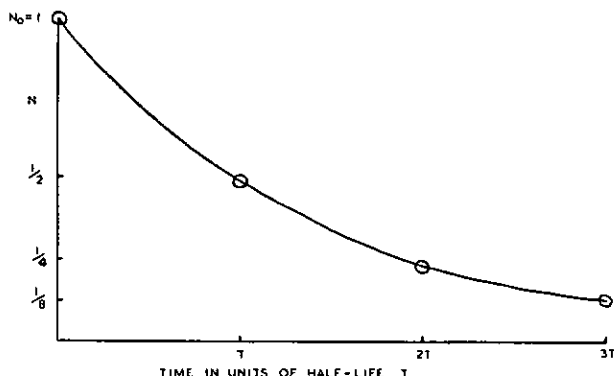
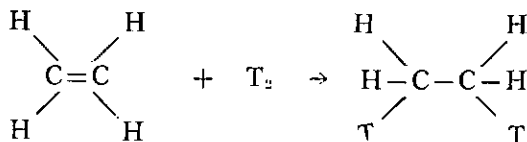


FIG. 3

One of the main uses of radioisotopes is in tracer experiments where a given chemical compound is "tagged" or "labelled" by incorporating radioactive atoms into some of the molecules. The path of this labelled material can then be followed with the use of a radiation detector. Since there are more compounds of hydrogen than of any other element, one would expect tritium-labelled material to be widely used in tracer studies.

There are many ways of making tritium-labelled compounds. It would, for instance, be a simple matter to synthesize tritiated ethane by reacting ethylene with tritium gas.



Other methods such as catalytic exchange and biosynthesis can be used. In 1957 it was found that, by exposing hydrogen-containing material to pure tritium gas for several days, some of the normal hydrogens are replaced by tritium atoms. These molecules remain tagged when the tritium gas is removed. This tritium gas exposure method therefore provides a simple and rapid way of producing tritium-

labelled compounds and many chemists have made extensive use of the method in the last few years.

It has been found, however, that the beta radiation extensively damages the material under study during the exposure process and in most cases a large number of highly labelled radiation products are produced. Recent work has emphasized the importance of checking the purity of the tritiated material.

One of the most valuable analytical tools available to the chemist for this task is the gas-liquid chromatograph. A glass column (say, 4 ft long and $\frac{1}{2}$ in. in diameter) is packed with particles of firebrick which have silicone oil or some other suitable stationary phase adsorbed on their surface. Any organic vapours carried through this packed column by a suitable carrier gas (*e.g.*, argon) are held back to varying degrees by the stationary phase and are eluted from the column at different retention times. Each individual component in a mixture of compounds can be identi-

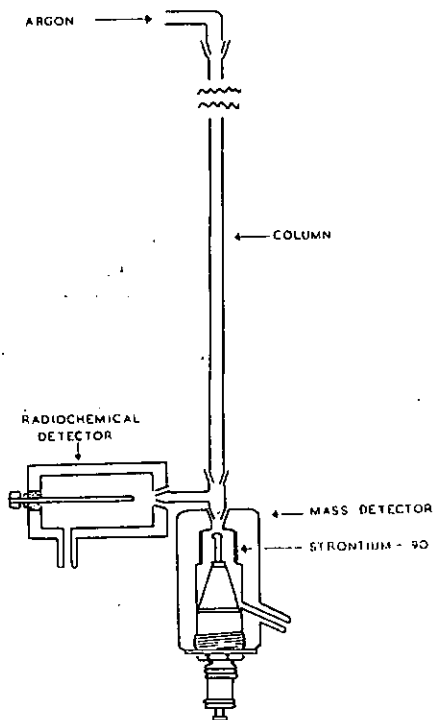


FIG. 4

fied by its retention time on a particular column under carefully controlled conditions.

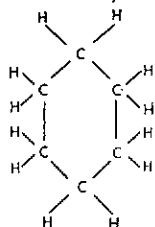
The gas stream carrying the various mixture components is then passed through two detectors (see Fig. 4). The "mass detector" simply measures the relative amount of each component flushed from the column. Some detectors utilize the differences in thermal conductivity of the various components but the more sensitive detectors make use of radiation from a suitable source. The strontium ionization detector, for instance, employs a strontium-90 source whose beta particles produce excited argon atoms in the body of the detector between the central anode and the wall. Any organic material passing through the detector is ionized by the excited argon atoms, since the first excitation potential of argon is considerably higher than the ionization potentials of most organic compounds. Variations in the ionization current are then used to produce peaks on a chart recorder.

The second detector, the "radioactivity detector", measures the radioactivity associated with each chemical component eluted from the column. One suitable detector is the "ionization chamber" which is very similar to a Geiger tube except that a much lower voltage is used and, instead of pulses being produced, a small ionization current is plotted on a recorder chart.

The two detectors therefore enable:

- (a) a normal chemical analysis of the material which has been labelled
- (b) a radiochemical analysis showing the activity associated with each chemical component.

At Auckland University we have been interested in the tritium-labelling of cyclohexane, a cyclic alkane



Samples of cyclohexane were exposed to T_2 gas at atmospheric pressure for a few days. Small aliquots of labelled material (about 10^{-3} ml) were then injected into the gas-liquid chromatograph with both detectors attached. The mass detector indicated that after tritiation the cyclohexane was still of high purity in the normal chemical sense. Even

at high sensitivity only a single peak corresponding to the retention time of cyclohexane was recorded.

However, the radioactivity plot showed a large number of peaks at either side of the parent cyclohexane (see Fig. 5) which indicated that much of the tritium had been incor-

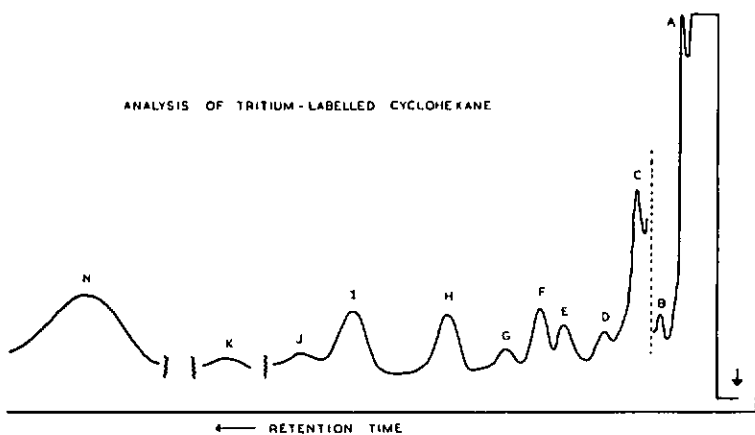


FIG. 5

porated in radiation by-products which must be present in only trace amounts since they failed to show on the mass plot. Most of these components have been identified, some of which are as follows:

A	<i>n</i> -butane	G	<i>n</i> -hexane
B	2-methylbutane	H	methylcyclopentane
C	<i>n</i> -pentane	I	cyclohexane
D	2,2-dimethylbutane	J	cyclohexene
E	2-methylpentane	K	methylcyclohexane
F	3-methylpentane	N	ethylcyclohexane

Thus, in this work normal chemical analysis is not enough, since trace impurities may be present which contain a large proportion of the tritium incorporated in the sample. Such radiochemically impure material would give misleading results if used in tracer studies. Although these trace impurities detract from this method of tritium labelling, it is possible that their presence will lead to a clearer understanding of the way in which organic material behaves when exposed to radiation.

INTERNATIONAL UNION OF CRYSTALLOGRAPHY

World Directory of Crystallographers

The Sixth General Assembly of the Union approved the publication of a third edition of the *World Directory of Crystallographers* after the second edition, which appeared in 1960, has become out-of-date.

It is intended that, as for the previous edition, the collection of the biographical information for the third edition again be carried out by national sub-editors. Questionnaires will therefore be distributed by, and should be returned to these sub-editors.

As crystallography is an essential part of many fundamental and applied scientific applications, it is difficult to give a precise statement on what the qualifications of a person should be for inclusion in the *Directory*. The Executive Committee has suggested that for inclusion a person should be a member of a national crystallographic organization, or have published on a crystallographic subject, or be a graduate student in the field of crystallography. Of course, these qualifications should not be considered as strict rules and in many cases one should judge for himself if his name should be listed in the *Directory*. The term "crystallographic" should, of course, be understood in its widest sense.

Readers of this notice whose names ought to be included but who have not yet received a questionnaire, are requested to write to Dr D. Hall, Chemistry Department, University of Auckland.

* * *

ANZAAS CONGRESS

The 38th Congress of the Australian and New Zealand Association for the Advancement of Science is to be held in Hobart, Tasmania, from August 16 to 20, 1965. A full range of technical papers is being planned by each of the sixteen sections. Early enrolment, well before July 1, 1965, is requested.

SUMMER SCHOOL FOR TEACHERS

A new phase of in-service training for chemistry teachers from all parts of the South Island, as well as for three from Fiji, began in Christchurch on January 19, when a ten-day summer school in chemistry opened in the Department of Chemistry of the University of Canterbury.

The purpose of the refresher course was to stimulate teachers and bring to their notice some of the most recent theories of chemistry. The idea for the school came originally from members of the Canterbury Science Teachers' Association. The course was organized by the staff of the University of Canterbury, in association with the Teachers' Refresher Course Committee, with Professor J. Packer as Course Chairman.

The Department of Education assisted with the travel expenses of teachers, and the cost of accommodation was met by donations from a number of industrial organizations. In this latter respect, the University was following the example of Australia, where similar schools have been financed almost wholly by industry.

Because of limited facilities, it was not possible to accept all the applications for attendance received. It was very encouraging to see such a measure of interest by teachers who at that time were enjoying their summer holidays.

"Structure and Reactivity" was the theme of the course. In the mornings, the staff of the Department of Chemistry lectured on such topics as bonding and structure, energy and equilibrium, and structure-reactivity problems. In the afternoons, workshops were held to provide opportunities to consider more closely related lecture material and its relevance to teaching.

The Chancellor of the University (Mr C. H. Perkins) officially opened the school and the Mayor (Mr George Manning) welcomed the teachers to Christchurch. Mr R. U. Roy represented the senior inspector of post-primary schools.

Twenty of the visiting teachers were housed at Warwick House, a University hall of residence. This was the informal meeting place where course members became acquainted with each other on the opening night and subsequently met for lunch and film evenings.

N.Z. CERTIFICATE IN SCIENCE

Passes in Chemistry Option

In 1963, the first students completed their examinations for the New Zealand Certificate in Science, Chemistry Option. The successful candidates were:

Mr P. F. Thompson, Howick.
Mr R. G. Ditchburn, Wellington.
Mr W. R. Owers, Lower Hutt.
Mr H. A. Polack, Wainui-o-mata.
Mr D. W. Rolls, Wellington.

These are the first certificates to be awarded in science, and the Institute, which has throughout encouraged the development of these courses in chemistry, extends congratulations to these students. Congratulations are due also to the Technicians Certification Authority, which has organized the courses and examinations, on these first products of its efforts to improve the status of chemistry technicians.

PAPERS READ BEFORE BRANCHES, 1964

AUCKLAND

Engineering research at Cambridge (*Professor P. N. Danckwerts*)
Chemistry, boating, and a trip around the world (*Assoc. Professor A. L. Odell*)

Plant kinins (*Dr D. S. Leatham*)

Margarine (*Mr S. G. Brooker*)

The theory of resonance in chemistry (*Professor C. A. Coulson*)

Symposium on chemistry teaching (*Mr. K. R. Buckley, Mr H. S. Maston, Mr R. A. Scott*)

Phosphatic fertilizers (*Mr P. J. Gallaher*)

Through space under steam and sail (*Dr T. P. Cotter*)

Mass spectrometry in chemical structure problems (*Dr J. S. Shannon*)

The scope of food technology (*Professor J. K. Scott*)

WAIKATO

Meat tenderness (*Dr R. H. Locker, Dr C. L. Davey, Dr B. B. March*).

The role of carbohydrates in rumen metabolism (*Dr R. W. Bailey*)

Analysts and enzymes (*Dr D. E. Wright*)

Oriental chemistry (*Dr R. Hodges*)

Some aspects of milk composition (*Dr W. G. Whittlestone*)

The chemistry of margarine (*Mr S. G. Brooker*)

Food technology (*Prof. J. K. Scott*)

The structure of wheat flour (*Dr P. Meredith*)

MANAWATU

The biosynthesis of plant phenols (*Dr E. Wong*)

The contribution of quantum theory to chemistry (*Professor C. A. Coulson*)

Nuclear magnetic resonance spectroscopy (*Dr R. M. Golding*)

Margarine (*Mr S. G. Brooker*)

N.M.R. (*Dr J. N. Shoolery*)

Aspects of wood chemistry (*Dr J. M. Uprichard*)

Flavour formation in cheddar cheese (*Mr R. C. Lawrence*)

Mechanism of halogen substitution in systems having unsaturation
(*Professor R. M. Noyes*)

WELLINGTON

Pests, plagues and population (*Mr H. Warren Johnston*)

The theory of resonance in chemistry (*Prof. C. A. Coulson*)

Margarine (*Mr S. G. Brooker*)

- Ceramics research in New Zealand (Mellor Memorial Lecture)
(*Dr P. K. Foster*)
Detoxication mechanisms and molecular design (*Prof. J. N. Smith*)
Application of mass spectrometry in chemical structural problems
(*Dr J. S. Shannon*)

CANTERBURY

- Aspects of the work of the Dairy Research Institute (*Dr W. A. McGillivray*)
Industrial chemistry in Christchurch (*Dr B. R. Mann, Mr J. S. Pollard*)
Bread (*Mr R. W. Cavley*)
The contribution of quantum theory to chemistry (*Prof. C. A. Coulson*)
Safety in the laboratory (*Mr A. H. Horn*)
Sodium and potassium in living tissue (*Dr Phillipa Wiggins*)
X-rays, crystals, and biological structure (*Prof. D. Hall*)
Los Alamos—A different American laboratory and community
(*Dr T. P. Cotter*)
Margarine manufacture (President's Address) (*Mr S. G. Brooker*)
Ion exchange and solvent extraction in trace metal analysis (*Dr R. R. Brooks*)
Industrial development in New Zealand (Symposium)
Mineral uptake by plants (*Dr T. M. Morrison*)
Some reactions of 5-hydroxy steroids (*Dr M. P. Hartshorn*)
Mass spectrometry (*Dr J. S. Shannon*)

OTAGO

- Operation Rarotonga (*Mr L. C. Baker*)
Applications of the digital computer in chemistry (*Dr D. B. Myers*)
Contributions of the quantum theory to chemistry (*Prof. C. A. Coulson*)
Modern toxicology—Research and applications (Chairman's Address) (*Dr J. C. Dacre*)
X-rays, crystals and biological structure (*Dr D. Hall*)
Margarine (*Mr S. G. Brooker*)
Chemical industry (*Dr T. Hagyard*)
Mass spectrometry (*Dr J. S. Shannon*)
Research evening (*Messrs S. G. Wyllie, K. L. Oo and J. B. Macaskill*)
Copolymers in the textile industry (*Dr E. R. Entwistle*)

ROYAL SOCIETY SECTIONAL COMMITTEE ON CHEMISTRY

A meeting of the New Zealand Royal Society Sectional Committee on Chemistry held on August 13, 1964, was attended by Dr F. G. Soper (Chairman), Dr F. B. Shorland, Mr T. A. Rafter, Dr A. T. Johns and Mr E. S. Borthwick (deputy for Mr S. G. Brooker). Two foundation members of the Sectional Committee who are present members of the National Committee on Chemistry, Professors L. H. Briggs and H. N. Parton, also attended. The following extracts are taken from the Chairman's report on this meeting, which was made available to the Council of the Institute of Chemistry.

"The Committee discussed the inter-relations of the Sectional National Committees on Chemistry and considered that their functions are so nearly similar that one of these Committees should be abolished. It was felt that there was a danger of over-proliferation of committees at the present time, particularly in view of the establishment of the National Research Advisory Council which has set up 15 working committees. The Basic Sciences Working Party which is one of the 15 working committees will duplicate much of the work of the Sectional Committees of the Royal Society but this must be regarded as unavoidable.

"The Committee considered whether the Sectional Committee or the National Committee should be abolished and was of the opinion that the work of the Sectional Committee on Chemistry of advising the Council of the Royal Society or its officers should be allocated to the National Committee which would continue to deal, as at present, with I.U.P.A.C. matters. This recommendation appeared to the Committee to present no difficulties since both Sectional and National Committees on Chemistry report to or through the Royal Society. The elimination of one of them is regarded as highly desirable. The following resolution was unanimous:

"That the Sectional Committee for Chemistry be abolished and that the functions of this committee as set out in the N.Z. Gazette 13 April 1960, be taken over by a National Committee for Chemistry."

In discussion on the composition of the National Committee, the Sectional Committee felt that, pending changes in the Constitution of the Royal Society, the low proportional representation of chemists among Fellows of the Royal Society "... gave rise to the fear that a National Committee constituted as at present might not be as representative of New Zealand chemical opinion as it could be and the following recommendation was passed.

"The National Committee for Chemistry shall consist of four members appointed by the Council of the Royal Society and four members appointed by the Council of the N.Z. Institute of Chemistry. The Chairman of the National Committee shall be one of the members and shall be appointed by the Council of the Royal Society after consultation with the President of the N.Z. Institute of Chemistry. Members should be appointed for a three-year term and not serve for more than two consecutive terms."

Among other matters of direct interest to chemists discussed by this meeting of the Sectional Committee were:

- (1) The collection of data regarding chemists on graduation. This matter was considered as falling within the functions of the Institute of Chemistry and Dr Shorland undertook to discuss it with the Institute Council.
- (2) The supply of chemists, especially for industry. The Sectional Committee reaffirmed its opinion, expressed in the 1961 report, that the supply of chemists was considered as the most urgent problem facing the country. Specific recommendations contained in that report included expansion of the science departments of the universities, and inclusion in university courses of more applied sciences such as industrial chemistry, biochemistry and metallurgy and more technological subjects such as food, wool, woods, etc.

In its 1964 report, the Committee noted that ". . . research in the Chemistry Department of the Universities was in a healthy state but in the opinion of the present Sectional Committee there was a shortage of chemists working on New Zealand problems". The Committee further recommended ". . . that appropriate University Departments should make special efforts to bring before the attention of senior students a knowledge of the scientific problems facing this country. More use might be made of the services of heads of research divisions in Government Departments in advancing such knowledge, the object of such contacts being primarily the dissemination of information; recruitment at this stage should be a secondary consideration."

BRANCH NEWS AND NOTES

OTAGO

A dinner in honour of Dr Roy Gardner, Honorary Fellow, was held in the University Union on November 3. Dr Gardner is shortly to retire from his practice as a consulting industrial chemist and from his position as Senior Lecturer in Pharmaceutical Chemistry at the University of Otago. The dinner, organized by Dr F. N. Fastier, gave members of the Institute and the Pharmaceutical Society an opportunity to recall the distinguished service which Dr Gardner has given to the Institute and the profession of chemistry—service which has been recognized by his election to Honorary Fellowship (*Journal of the N.Z. Institute of Chemistry*, Vol. 28, p. 24, 1964). The health of Dr Gardner was proposed by Dr F. G. Soper, on behalf of the University of Otago, and supported by Mr W. P. C. Clifford, for the Otago Branch of the Pharmaceutical Society, and Dr J. C. Dacre, for the Otago Branch of the Institute.

During the year the Branch has again sponsored a series of lectures for secondary school pupils. The lecturers were Dr R. E. Corbett, Professor J. R. Robinson and Professor T. W. Walker. Professors Robinson and Walker also gave their lectures to pupils in Invercargill.

COUNCIL MINUTES**ABRIDGED MINUTES OF MEETING OF COUNCIL,
NOVEMBER 27, 1964***Present*

Professor S. R. Siemon (President, in the chair); Dr A. T. Johns (First Vice-President); Mr M. S. Carrie (Second Vice-President); Dr G. A. Nicholls (Auckland), Dr E. B. Davies (Waikato); Mr D. King (Manawatu); Dr P. P. Williams (Wellington); Mr T. A. Mitchell (Canterbury); Dr J. C. Dacre (Otago); Mr D. J. Hogan (Registrar); Dr W. E. Harvey (Secretary); Miss J. M. Mattingley (Editor).

Honoraria

Resolved: That the honorarium for the General Secretary be £60 and the honorarium for the Editor be £45.

Branch Grants

Resolved: That Branch grants be increased to £30.

Chemistry in Action

Resolved: That a grant of £30 be made to the Canterbury Branch towards the cost of *Chemistry in Action* 1964.

Examinations for Associateship

Council received a memorandum outlining the action taken by the Examinations Committee in correspondence with an applicant who wishes to present himself for examination for the Associateship. The action taken by the Committee was approved and the memorandum together with previous memoranda from the Committee was discussed at considerable length. A number of recommendations were made for forwarding to the Examinations Committee and Council agreed that a subcommittee consisting of T. A. Mitchell and Dr W. E. Harvey should meet the Examinations Committee to finalize the drafting of the Regulation.

Council considered that (1) Provision should be made for a candidate, if he so desired, to spread the examinations over two consecutive years; (2) a candidate should be permitted to substitute for one of the papers in Organic, Inorganic or Physical Chemistry a paper on a specialist subject of his own choosing approved by Council (it was agreed that the special paper must be of a high standard); (3) there should be no restriction as to age with respect to this specialist paper provision; (4) consideration be given to providing for the examination to be passed "as a whole"; (5) the practical examination should cover only those branches of the subject in which the candidate is sitting written papers; (6) all applications to be examined should be submitted in the first place to the General Secretary or the Registrar.

The Secretary reported that it seemed that it would be possible for candidates to sit the university examinations in the general papers Organic, Inorganic and Physical Chemistry, but that enquiries were still continuing about detailed arrangements.

Award of L.A.C.

Resolved: That the L.A.C. be awarded to the following: Alan John Poole, Michael Thomas Davidson, Graham Allan Cathbertson and Rewi Sepless Thompson; and that David John Calvert's certificate be endorsed with the additional subject photography.

L.A.C. Examinations

Resolved: That no examinations for the L.A.C. be held after 1965.

Sectional Committee on Chemistry, R.S.N.Z.

In a letter, Dr Shorland asked if the Institute would be prepared to assist in conducting a questionnaire to obtain information as follows:

- "(1) To survey and catalogue the chemists in respect to yearly records of graduates and their fate. The classification of chemists with respect to industry, universities, D.S.I.R., and other organizations, with subdivisions into fields of work.
- "(2) To survey and catalogue organizations and types of work concerning chemists."

It was agreed to reply to Dr Shorland to the effect that Council considered that the Manpower and Training Committee of the N.R.A.C. was probably covering the same ground and that therefore no action be taken at present.

Salary Survey

It was agreed that the Institute should conduct a salary survey as soon as possible after March 31, 1965, and that Dr R. B. Miller be asked to take charge of the survey.

Register of Members' Ages

Council declined to accept the suggestion from the Wellington Branch to keep a register of members' ages. It was pointed out that current application forms list the age of applicants.

Resignations

The resignations of J. G. Croker and R. R. White were accepted with regret.

Duties of Branch Committees in Handling Applications

There appears to have been some doubt in the mind of Branch committees about their duties in considering applications.

It was agreed that the main reason for sending applications to branches was to enable the Branch committee to comment on the personal character of the applicant and to check where possible the factual accuracy of statements made in the application especially in respect of practical experience claimed. If the Branch committee is unable to check these matters, a statement to that effect should be made. It is not, of course, the duty of the Branch committee to assess an applicant's qualifications, although the Branch committee may express an opinion if it so desires.

Conference 1964

The report of the Conference Committee was received and it was *resolved* that the Conference Committee be thanked for their efforts, and that the profit from the Conference (£83 11s. 2d.) be paid into the Overseas Visitors' Fund.

Conference 1965

Dr Dacre reported that it was proposed to hold the Conference in Dunedin, from Tuesday, August 17, to Friday, August 20, 1965. Accommodation in university halls of residence was envisaged and a conference committee was at work.

Resolved: That the sum of £20 be advanced to the Conference Committee.

W. E. HARVEY
General Secretary

RETIREMENT

PROFESSOR J. PACKER

Many former students and members of the Department of Chemistry of the University of Canterbury gathered in Christchurch on November 2, 1964, to honour Professor J. Packer on his retirement, which is effective from February 1, 1965. Professor Packer has been a member of the staff of the Department of Chemistry since 1923, and has been Head of the Department for the last twenty-one years. The function was organized by the Canterbury Branch of the New Zealand Institute of Chemistry, which has had cause to be grateful to Professor Packer on very numerous occasions since the Branch was founded.

Professor H. N. Parton, of the University of Otago, in presenting Professor Packer with an Austen Deans painting on behalf of all those "who regard him as a great teacher and a good friend", praised his fruitful collaboration with his predecessor, Professor H. G. Denham, and with Professor J. Vaughan, who is to succeed him as Head of the Department. "He is not an easy man to talk about because all that can be said about him is good. I wonder if he ever made a mistake?" Professor Parton said. He also praised the manner in which Professor Packer had built up the Department of Chemistry so that it was held in high respect by chemists everywhere, by all associated organizations in New Zealand, and particularly by the schools, with which a close understanding had been built up.

In reply, Professor Packer said that in forty-two years the Department had become a part of him, but he was confident, as he handed it over to Professor Vaughan and Dr C. J. Wilkins, that the reputation of the Department would continue to be enhanced. He also wished to express his thanks to all his former colleagues and students, whom he could not thank individually, both for their gift and for their co-operation over the years.

At other functions Professor Packer received presentations from the University of Canterbury Staff Club and from staff and research students of the Department of Chemistry. He has been elected an Emeritus Professor by the Council of the University of Canterbury, and will continue to be Chairman of the Wheat Research Committee, a co-opted member of the Research Committee of the University Grants Committee and, for part of the year, a specialist lecturer at the University of Canterbury.

Professor Packer has served on the Senate of the University of New Zealand and the Council of the University of Canterbury and on their boards and committees. His high standing in the profession was recognized by the conferring of one of the University of Canterbury's first Honorary Doctorates in 1962.

INSTITUTE PRIZES

The 1965 closing date for the three prizes awarded annually by the Institute is April 15. The regulation governing the award of these prizes was published in full in the *Journal* for April, 1959. The following descriptions indicate the main requirements:

The Chemical Essay Prize: Offered for an essay or review paper, of not more than 5,000 words, on any aspect of chemical science. The prize is open to all members and local members. Its value in recent years has been £25.

The I.C.I. Prize: This prize of £50 and a medallion has been donated by Imperial Chemical Industries (N.Z.) Ltd. It is awarded for "some major contribution to some branch of chemical science, this contribution to be judged by research work published or accepted for publication during the five years immediately preceding April 15 in the year of the award". Members may apply for the award or they may be nominated by branch committees or by individual members.

The Morcom Green, Edwards Prize: This is of £25 value and is donated by Messrs H. H. Edwards and Morcom Green. It is offered for the encouragement of original work by young chemists in pure and applied chemistry, with emphasis on applied chemistry. Applicants must be below the age of 35 years on June 1, in the year of the award. The candidate is assessed on published work.

EASTERFIELD AWARD: 1965

Applications are invited, from suitably qualified chemists, for the Easterfield Medal to be presented on behalf of the Royal Institute of Chemistry at the N.Z.I.C. Conference in August, 1965.

The conditions of the Award state that the Medal shall be awarded to a chemist under the age of 35 years at April 30, 1965, in recognition of the quality and originality of his research work. It is expected that the major portion of this research work shall be carried out in New Zealand, and the successful applicant will be required to deliver a lecture on the subject of his research at the Annual Conference of the N.Z.I.C. The Award is open to chemists whether or not they are members of the Royal Institute of Chemistry or of the N.Z. Institute of Chemistry. In addition to the Medal, a grant of £25 will be made to the successful applicant and necessary travelling expenses to and from the Conference will be refunded.

Intending applicants are reminded that applications must be in the hands of Mr I. R. C. McDonald, Corresponding Secretary, R.I.C. (Chemistry Division, D.S.I.R., P.B., Petone), by April 15, 1965.

BOOK REVIEWS

CAHIERS DE SYNTHÈSE ORGANIQUE. VOL. XI: CYCLISATION BIMOLECULAIRE MIXTE. By Jean Mathieu and André Allais. Published by Masson et Cie, Paris, 1964. 343 pages. Price 120 francs.

Volumes of this excellent compendium of methods of organic synthesis have been mentioned in the *Journal* before. This one, the second to last of the series, covers heterocyclic rings formed by the union of two different molecules, e.g., 1-methyl-quinoline from 1-amino-benzaldehyde and acetone. The literature is covered up to 1963.

This series deserves wider recognition than it has received so far outside its country of origin.

S.G.B.

IDENTIFICATION AND ANALYSIS OF SURFACE-ACTIVE AGENTS BY INFRARED AND CHEMICAL METHODS, by Dieter

Hummel (Translation by E. M. Wulkow). Published by Interscience Publishers, New York, 1964. Price £9.

To the outsider, the field of the chemistry and identification of surface-active agents is most confusing. Substances showing surface-activity vary so enormously in their chemistry that their classification is very difficult. Professor Hummel has tackled this aspect of the problem very thoroughly and provides a very good background to the general chemistry of the important surface-active substances. This is the background to his systematic approach to the identification and analysis of these materials.

The reviewer has a general interest in the problems involved in analysing detergent mixtures, but has had some difficulty in finding a concise and systematic approach to the problem. Professor Hummel has provided this and all workers in the field should be grateful to him for the tremendous effort which he has put into providing a system of analysis, and an immense collection of basic data on physical properties which includes an atlas of infra-red spectra.

The reviewer has one small reservation in connection with the systematics of Professor Hummel's approach. He has used a new term, "tenside". Every science has its own jargon and, with increasing specialization, it becomes increasingly difficult to understand workers in fields other than one's own. The significance of the word "tenside" is far from obvious, while "surfactant" is a "portmanteau" word the meaning of which is obvious.

The book appears in two volumes, the second being the *Atlas of Spectra*. They are well bound, well printed and of excellent quality paper. The many tables are clearly set out and easy to read. Anyone interested in the chemistry of surface-active agents will find this book valuable and Volume 1 provides an excellent background for the student in the field. The book is essential for anyone interested in the analysis of mixtures containing surface-active materials.

W.G.W.†

The 4th International Symposium on THE CHEMISTRY OF NATURAL PRODUCTS

This symposium will be held in Stockholm from June 26 to July 2, 1966. It is being arranged by the Swedish National Committee for Chemistry and will be sponsored by IUPAC, the International Union of Pure and Applied Chemistry.

Scientific contributions from four fields of research will be presented:

- (1) *Polysaccharides* (structural studies, and chemical and biochemical methods of novel interest).
- (2) *Structural elucidation of natural products other than macromolecular compounds* (primarily investigations of compounds of novel types and applications of new methods and techniques).
- (3) *Biosynthesis* (with emphasis on experimental studies of the biosynthesis of natural products—"secondary metabolites"—excluding macromolecular substances).
- (4) *Chemical taxonomy* (chemical contributions to biological classification and phylogenetic relations).

Invited speakers will give eight "section lectures" in the above fields, and two "plenary lectures", all to be published by IUPAC. The "section lecturers" are: (1) G. O. Aspinall and R. W. Jeanloz, (2) P. Karlson and K. Nakanishi, (3) A. R. Battersby and F. Lynen, and (4) R. Hegnauer and B. L. Turner.

The first circular may be obtained from Prof. L. H. Briggs, University of Auckland, Box 2175, Auckland, New Zealand. It will contain a card for provisional application, to be returned before April 15, 1965.

Correspondence regarding the symposium should be addressed to Dr (Mrs) G. Aulin-Erdtman, General Secretary, Natural Products Symposium, Drottning Kristinas väg 53, Stockholm O, Sweden.

Small pre-symposia are provisionally planned in Denmark—on "Naturally Occurring Sulphur Compounds"; and in Norway—on special aspects of carotenoid chemistry.

ROYAL SOCIETY OF NEW ZEALAND EXECUTIVE OFFICER

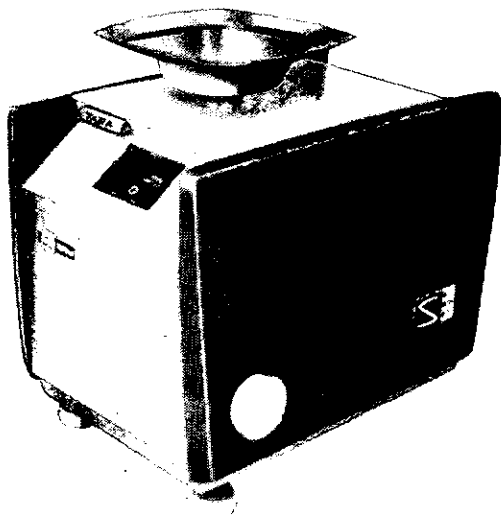
The Council of the Royal Society of New Zealand is giving consideration to the appointment of an Executive Officer, and invites any interested persons to communicate with the President (P.O. Box 368, Lower Hutt) before April 30.

The Executive Officer will be responsible to the President and Council and his duties will include administration of the Society's affairs, supervision of its staff, offices, library and records and the execution of Council policy. During the initial period the work will involve enquiries, discussions and negotiations for the acquisition of a site for the Society's headquarters in Wellington.

Applicants should hold a scientific degree and should have some experience in administration of science in New Zealand. The position is suitable for a superannuitant. Salary up to £1,500.

Toppan
Toppan
Toppan

SAUTER-TOPPAN
Series M or Series S



**THE NEW HIGH-SPEED PRECISION BALANCE WITH FREELY
ACCESSIBLE PAN FOR ANALYTICAL RANGE WEIGHING**

Available with or without taring device.

Latest Models with direct reading scale.

Example:	1,000 gm. Balance
Scale graduation	0.01 gm.
Readability	0.01 gm
Taring range	100.00 gm

For full information or catalogues contact

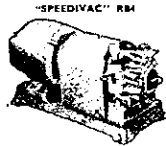
**SCIENTIFIC & LABORATORY EQUIPMENT
(N.Z.) LTD.**

P.O. Box 619

Auckland

Phone 546-235

A PERFECT COMBINATION OF VACUUM & PRESSURE

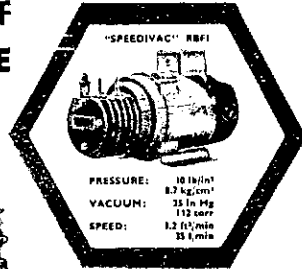


"SPEEDIVAC" RB4

PRESSURE: 15 lb/in²
(1.0 kg/cm²)

VACUUM: 25 in Hg
100 torr

SPEED: 2.6 ft³/min
78 l/min

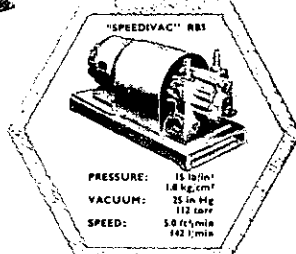


"SPEEDIVAC" RBFI

PRESSURE: 10 lb/in²
0.7 kg/cm²

VACUUM: 25 in Hg
112 torr

SPEED: 3.2 ft³/min
91 l/min

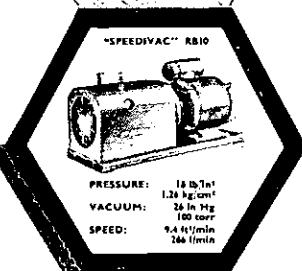


"SPEEDIVAC" RB1

PRESSURE: 15 lb/in²
1.0 kg/cm²

VACUUM: 35 in Hg
112 torr

SPEED: 5.0 ft³/min
142 l/min

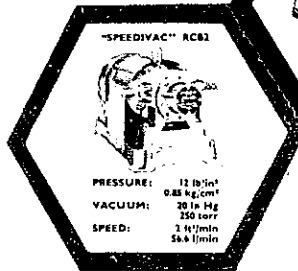


"SPEEDIVAC" RB10

PRESSURE: 18 lb/in²
1.24 kg/cm²

VACUUM: 25 in Hg
100 torr

SPEED: 9.4 ft³/min
266 l/min



"SPEEDIVAC" RCB2

PRESSURE: 12 lb/in²
0.83 kg/cm²

VACUUM: 30 in Hg
150 torr

SPEED: 2.4 ft³/min
66.6 l/min

A PERFECT COMBINATION

"SPEEDIVAC" COMBINED VACUUM AND PRESSURE PUMPS are precision engineered yet extremely robust units specially designed for continuous operation. Of particular interest is the "SPEEDIVAC" RCB2 pump which is completely oil free. It incorporates a heavily chromium plated stator, stainless steel rotor, carbon blades and end-plates, completely external bearings and is therefore ideal for handling corrosive gases. Another special combined pump is the "RECIPROTOR" an electromagnetic pump, which is completely oil free and gives a vacuum of 22 in. of mercury, pressure up to 10.7 lb/in², and speeds up to 1.77 ft³/min.

EDWARDS HIGH VACUUM LTD

REPRESENTED EXCLUSIVELY IN NEW ZEALAND

BY

GEO. W. WILTON & CO. LTD.

Box 367
WELLINGTON

Box 1980
AUCKLAND



IF you have a laboratory . . .
whether it's small or large . . .
research or industrial . . . what-
ever the size or type, the N.D.A.
can be of assistance to you.

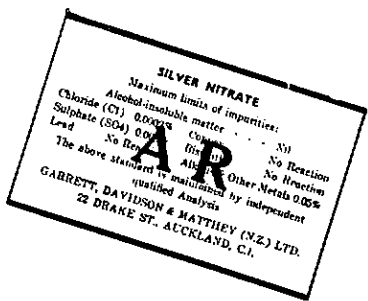
WE stock a comprehensive range
of analytical and laboratory
reagents, technical and industrial
chemicals, scientific apparatus and
laboratory equipment.

CONSULT the N.D.A. in regard
to your particular requirements.
We will be pleased to quote you on
an ex-stock or indent basis.

THE NATIONAL DAIRY ASSN. OF N.Z. LIMITED

THORNDON QUAY,
WELLINGTON.
P.O. Box 28.

BEACH ROAD,
AUCKLAND.
P.O. Box 1001.



CHEMICALS

by

Matthey, Garrett (N.Z.) Ltd.

The following chemically pure and Analytical Reagent quality "CHEMICALS" are manufactured in our laboratory to the highest "world standards"—

- SILVER NITRATE C/P.
- SILVER NITRATE A/R.
- SILVER NITRATE
DENTAL
- SILVER CYANIDE
SINGLE SALT
- SILVER SALT
(ready mix)
- SILVER IODIDE
- SILVER IODATE
- SILVER OXIDE
- GOLD METAL C/P.
- GOLD CHLORIDE

- GOLD PLATING
SOLUTION
- GOLD PLATING SALTS
- PLATINUM BLACK
- PLATINIZED
ASBESTOS
- PLATINUM CHLORIDE
- RHODIUM SOLUTION
- ELECTROLYTIC
CLEANING SALTS
- "QUALTEST" OUTFIT
(Testing precious metals)
- AMMONIA C/P.



22 Drake Street AUCKLAND P.O. Box 2073
 Telephone: 21-786 (2 Lines) Telegraphic Address: 'Rollers'

CHEMICALS in an ATOMIC AGE



B.D.H. make fine chemicals in bulk for today's new industries—the industries that represent the era of atomic energy, man-made fibres, plastics, advanced metallurgy, electronics and artificial satellites.

For the new processes of the new industries, and many new processes in older industries, B.D.H. produce by the ton chemical raw materials of the highest laboratory purity, and welcome opportunities of supplying more and more of them.

Equally B.D.H. are a major source of chemicals for all scientific purposes; analytical and micro-analytical reagents, biochemicals, indicators and stains, ion-exchangers and molecular sieves and thousands of other products reach the world's laboratories from B.D.H. at Poole.

B.D.H. Biochemicals

B.D.H. Laboratory Chemicals

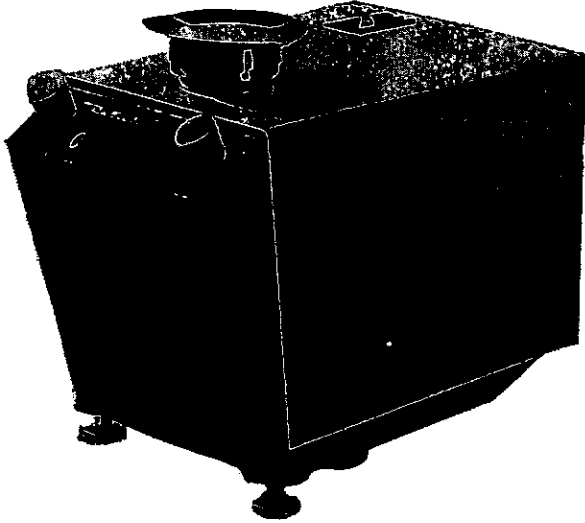
B.D.H. Fine Chemicals for Industry

are all supplied by



THE BRITISH DRUG HOUSES LTD.

B.D.H. LABORATORY CHEMICALS DIVISION · POOLE · ENGLAND



Mettler announce 3 New Precision Balances, designated P1000, P1200 and P3. Details are set out below. P Balances previously announced were: P120, Capacity 120 grams, and the P10, Capacity 10 Kilograms.

Model	P1000	P1200	P3
Weighing range	0 g to 1000 g	0 g to 1200 g	0 g to 3000 g
Taring in optical range	300 g	100 g	2500 g
Capacity	1300 g	1300 g	5500 g
Readability	0,1 g	0,01 g	0,2 g
Precision	$\pm 0,05$ g	$\pm 0,005$ g	$\pm 0,05$ g

We will gladly provide further details with literature, prices and delivery information.

Full Service facilities available from Sole New Zealand Agent

WATSON VICTOR LTD

16 The Terrace, Wellington

Also at Auckland, Christchurch and Dunedin.

"Serving Science and Medicine Since 1888".