

chemistry

in new zealand

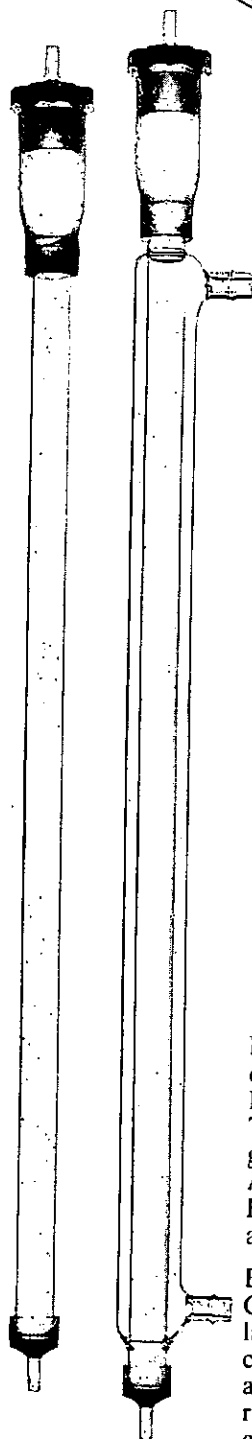


November 1975

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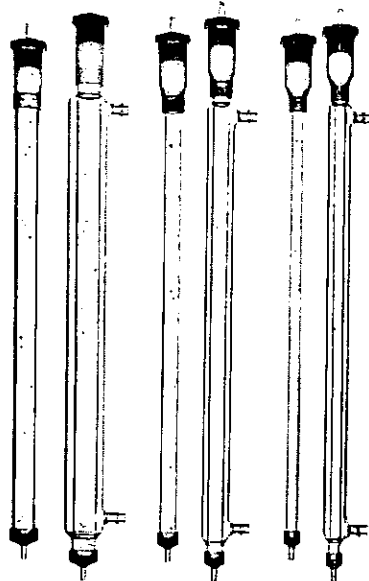
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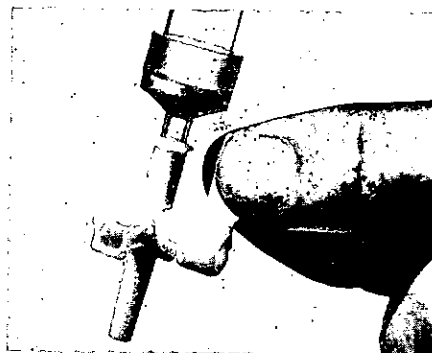
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VOLUME 39 NUMBER 4

chemistry

in new zealand

Journal of the New Zealand Institute of Chemistry

EDITOR

Joan Mattingley
P.O. Box 250 Wellington.

ADVERTISING MANAGER

R. Turner
P.O. Box 250 Wellington.

DISTRIBUTION

D. J. Hogan
P.O. Box 1926 Christchurch.

BRANCH EDITORS:

Auckland
Dr. J. E. Packer
Chemistry Dept.,
University of Auckland

Waikato
Dr. P. C. Molan
Ruakura Agricultural Centre

Manawatu
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Wool Research Organisation of N.Z.
Christchurch

Otago
Dr. B. M. Peake
Chemistry Dept., University of Otago
Dunedin

HON. GENERAL SECRETARY, NZIC
Professor W. E. Harvey
P.O. Box 250 Wellington.

EMPLOYMENT OFFICER NZIC
L. Stonyer
P.O. Box 250, Wellington.

Printed by David F. Jones Ltd.,
Wellington.

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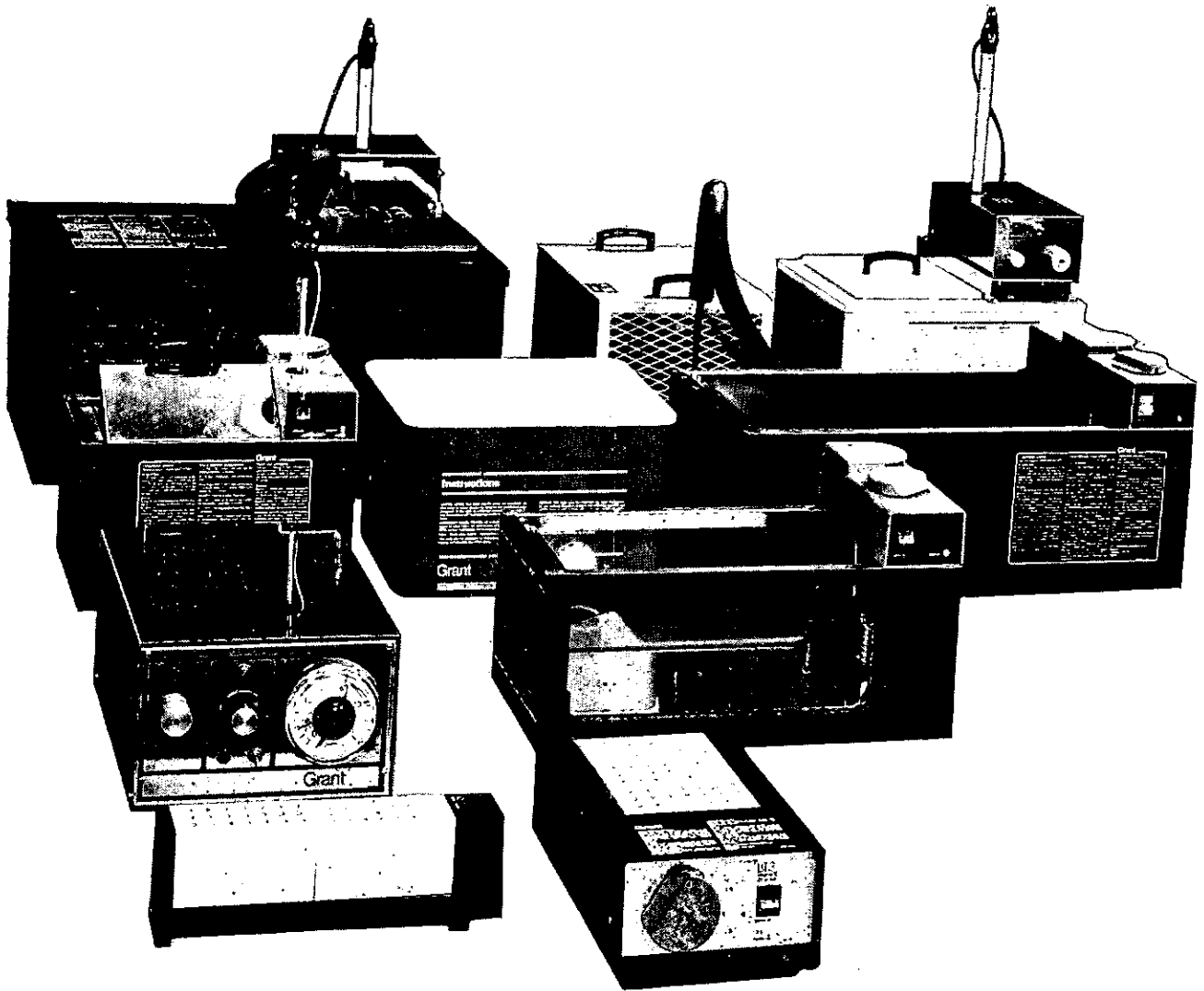
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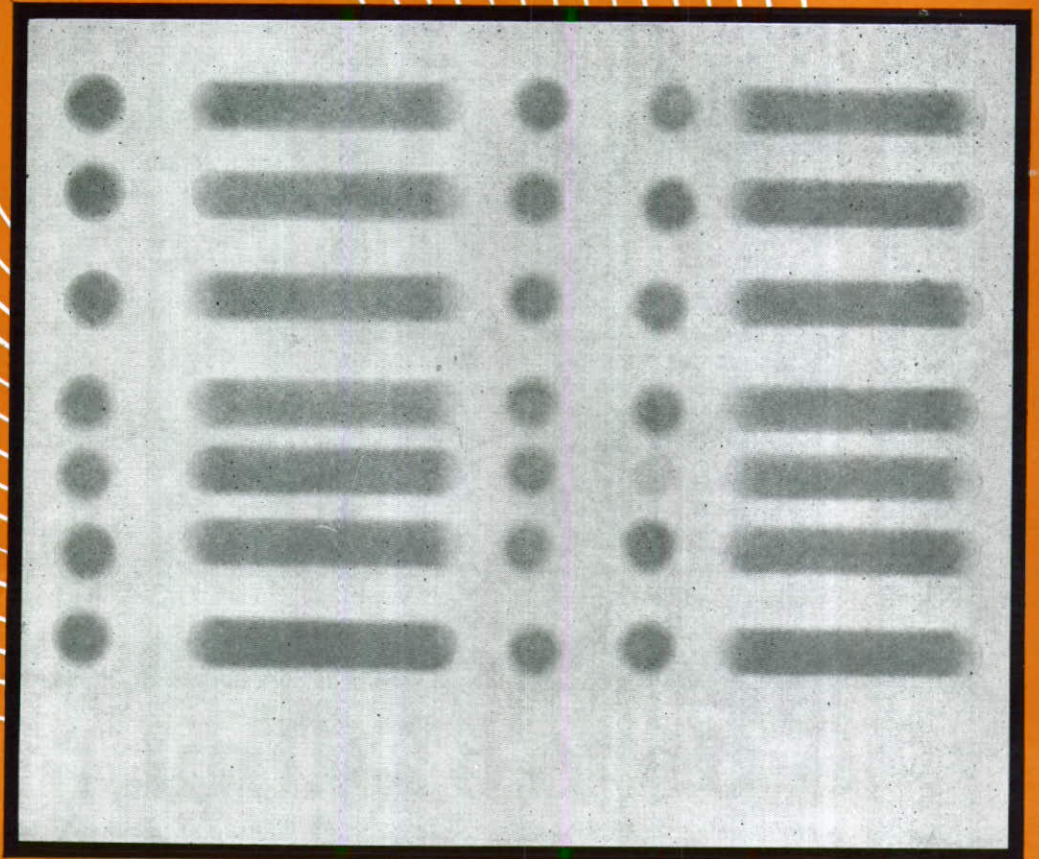
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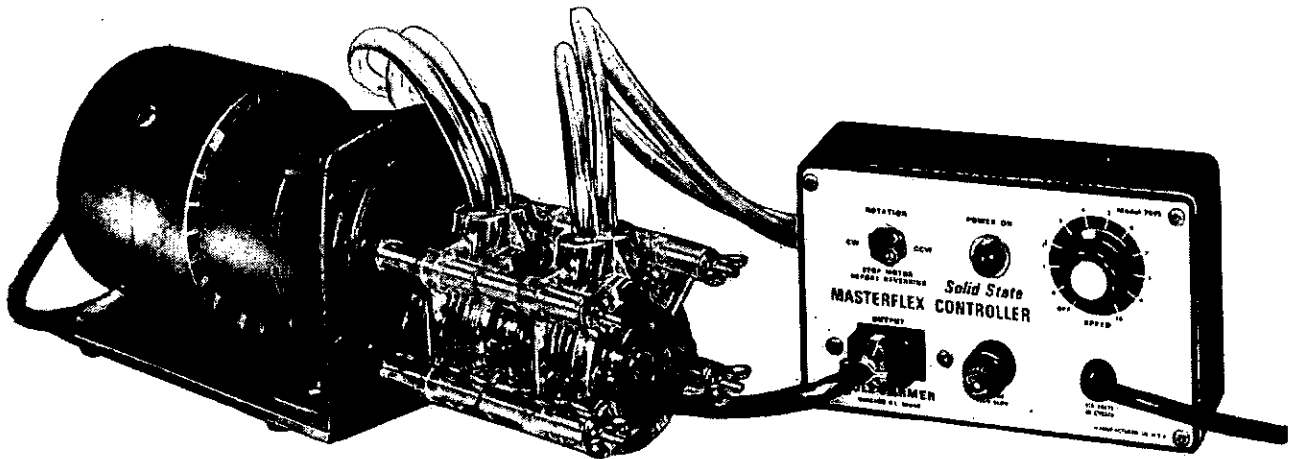
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L. H. BRIGGS MEMORIAL LECTURE

By R. C. Cambie.

G

I deem it a particular honour to have been asked to deliver this lecture and I thank Professor Batt and his Organising Committee for giving me this opportunity to speak about my good friend Bob Briggs. While my association with Briggs was for only 20 years, and many here will have known him much longer than I did, nevertheless ours was a day to day working relationship which was somewhat unique—I was first his student, then his colleague, and finally as you might say, his boss.

It is very appropriate that the Briggs Memorial Lecture should be delivered here in Palmerston North. In 1928 after he had graduated M.Sc. with Honours in organic chemistry at Auckland University, Briggs was awarded a New Zealand National Research Scholarship. However, he resigned this award in favour of a Sir James Gunson Scholarship for research in Dairy Science at Massey Agricultural College. This was a period when the Dairy Research Institute was being formed under the Directorship of Professor W. Riddet who was Logan Campbell Professor of Agriculture at Massey Agricultural College. Briggs thus became the first research student at Massey when the old science building was officially opened in 1930. In all he spent over a year at Massey working on the autoxidation of butterfat before he moved on to Oxford University to study for his D. Phil.

In a memorial service to Bob Briggs which was held in St Davids Church in Auckland shortly after his death, the Reverend O. Baragwanath said that Bob Briggs' life had been exemplified by "honesty, humility and humour." He couldn't have chosen three better adjectives and I hope to highlight one or two of these characteristics during this talk.

Briggs' achievements have been amply described in obituaries by Professor de la Mare (in *Chemistry in Britain*) and Mr Stan Brooker (in *Chemistry in New Zealand*), and in one by myself which is to appear in the *Proceedings of the Royal Society of New Zealand*, and I don't intend to deal at any length on his personal honours and achievements. But rather I would like to talk a little about his chemistry and describe some of the joys which he gained from his subject.

First I would like to tell you about some of the things which he did that will never appear in any record of achievement. It is not commonly known for example that in 1956 he was invited by the Swedish Royal Academy of Science to nominate a candidate for the 1957 Nobel Prize in Chemistry. Now I don't know how many people are asked to nominate Nobel Prizewinners, but my guess is that it's not too many, and it's not an honour that comes

to many New Zealanders. In going through his papers I found that he had nominated R. B. Woodward, anticipating by some 8 years the actual award of the Nobel Prize to Professor Woodward.

Another fact not generally known is that as far back as 1958 Briggs was nominated for Fellowship of the Royal Society, England. He had of course by then been President of the Royal Society of New Zealand, was shortly to be President of the New Zealand Institute of Chemistry, and had won both the Hector Medal and the I.C.I. Prize, the chief research medals of each of these bodies. Nevertheless, when one realises that in order to earn nomination one must be nominated by at least three Fellows of the Royal Society, and with the knowledge that at the time only one living New Zealander was a Fellow, it says a great deal for the international reputation that Briggs had built up with his researches on natural products.

Another little known fact was that he was "runner-up" on no less than two occasions for the Walter Burfitt Prize awarded by the Royal Society of New South Wales for research in all sciences over a five year period preceeding the award. And again I don't think that I am divulging any confidences when I tell you that, had he lived, he was to have been awarded an Honorary D.Sc. from the University of Auckland in 1975.

In his distinguished career he had many firsts. For example he was the first Lecturer at Auckland to be appointed an examiner for the University of New Zealand. Prior to 1933 only professors were permitted to examine for degree examinations, lecturers being considered to be unqualified for such a task. The professors received 5/- per script but there was some variation in terms—if the examiner passed all of the students he received another 10/-. One of Briggs' colleagues in the Arts Faculty actually refused appointment as an examiner since he believed that lecturers should be kept poor to make them work hard so that one day they might become Professors. Soon after, there was a general increase in university salaries but the fees for examinations were taken away. Briggs commented how quickly the lecturers became competent at examining after this.

On the human side it may not be generally known that he had a profound love of animals, particularly dogs—if he saw a dog he just had to pat it. This habit had an unfortunate outcome in 1961 when he and Mrs Briggs were visiting Shri Lanka (or Ceylon as it was then known). On being invited to the home of a chemical colleague he bent down to pet his host's dog and was promptly bitten rather badly on the face. The wound required a number of stitches and Briggs carried the scar there-

after. We found out later that the dog was a guard dog and had been trained to attack strangers who approached it.

The question that probably everyone would like to have answered about Bob Briggs is why someone with such illustrious sounding forenames as Lindsay Heathcote should have been called Bob. I must confess that it wasn't until after his death that I learnt where it came from, and only then by asking the one person who might know, Mrs Briggs. It appears that of all people, his mother was the initiator of the nickname, and the reason for it was that as a youngster "he just looked like a Bob". I suspect however that it really had something to do with a shock of red hair which he sported until he started to lose some up top in later years.

As a student Bob Briggs could have been commonly described as somewhat of a wag. He loved a practical joke and partook in many student affairs. In preparing this address I managed to find a couple of quotes relating to his student days. He was a brilliant student, and the first quote is from the 1928 issue of *Kiwi*, the official magazine of the Auckland University College Students' Association. It was customary in those days to give a quote after each graduand in the list of graduates for the year. Under his name in the list of M.Sc. graduands was the Shakespearean quote:—

"This fellow's wise enough to play the fool
And to do that well craves a kind of wit."

The 1927 quote when he graduated B.Sc. was in similar vein

"A stout man who tries to hide his extreme
cleaverness under the make-up of a fool"

—Gibbs.

However, a further quote is somewhat more original and appeared in a 1929 *Craccum*, the weekly Students magazine, after the 1929 Easter Tournament held that year in Christchurch.

"Bob Briggs has oft been a leader
A Field Club excursions-heart bleeder!
But the Christchurch air
Reflected his hair

When he came to the hall with young Freda."
I haven't been able to find out who Freda was, but no doubt she was something of a smasher.

Bob Briggs' chemistry was that of an explorer, and the New Zealand bush was both his collecting ground and his laboratory. He had three field tests which he would carry out in his exploration of the N.Z. bush:—first he would smell the crushed leaves of a plant for its essential oil, then taste the leaves and other parts of the plant for the presence of alkaloids, and finally look at the cut bark to see if it contained a colouring matter. In later excursions he also used another simple test—this was to crush the leaves, keep them in his pocket and observe them again later. Black areas along the lines where the leaf has been bruised are often an indication of the class of natural compound which Briggs himself gave a name to, namely the *irridoids*. Many of these compounds occur as glycosides which

undergo enzymic hydrolysis when the cells are broken, forming black polymers on aerial oxidation, thereby accounting for the black areas. Most of Briggs' work in this area centred around a compound called asperuloside for which he deduced the structure, and which he showed was present in most native *Coprosma* species.

He had originally investigated the *Coprosma* species for their anthraquinones, isolating a variety of hydroxylated derivatives. Some of these were excellent mordant dyes and some, such as morindone from *Coprosma australis*, were obtained in a yield as high as 20% of the dry weight of the bark. Bob Briggs had a deep appreciation of the aesthetic side of chemistry and he derived great joy out of crystallizing compounds, a joy which was often transmitted to his students. He loved coloured compounds and I well remember an occasion a few years back when I asked him to turn on a demonstration of dyestuffs and dyeing to a group of 3rd year students. The enthusiasm which he transferred to the students resulted in things getting a little out of hand, and we all had gaily coloured lab coats for the rest of the year.

One of his first chemical problems concerned the "Sodum Apple" *Solanum sodomaeum*, an introduced plant in New Zealand, which he investigated in 1936. His interest had apparently been aroused during his early plant-testing days when he had accidentally swallowed some of the green fruit and had nearly vomited on the spot. A library search revealed that an Italian chemist Oddo had already isolated a glycosidic alkaloid, solasonine, from the plant and had recorded that the latter was a protoplasmic poison and a potent haemolytic agent. These were properties which were hardly likely to lead to its use in medicine and investigation of the *Solanum* genus of over 1000 species, had consequently lapsed.

Briggs showed that solasonine could also be obtained from the endemic species *Solanum aviculare* (N.Z. Poroporo). On hydrolysis solasonine gives the aglycone solasodine. Briggs deduced the structure of solasodine and that it was the nitrogen analogue of diosgenine. Diosgenin is the compound originally isolated by Russell Marker from Mexican yams. Marker converted it into the valuable steroidal hormone progesterone, and at the time of his discovery produced 2 kilograms of progesterone, in a little over a month, with a market value at the time of \$160,000. Like diosgenin, solasodine can also be converted into progesterone in approximately the same yield. Hundreds of *Solanum* species have now been investigated around the world, particularly by Klaus Schreiber, a good friend of Briggs, in East Germany. The preferred species for yield is *Solanum laciniatum* which is closely related to *Solanum aviculare*, and which is grown extensively in East Europe and Russia as a source of progesterone. So, from a simple curious observation, why is a Sodum apple bitter, a large industry has now been established. Briggs always believed that we should examine plants for their intrinsic interest and not just from prior knowledge of any

story since it exemplified his philosophy perfectly. medicinal value, and he often used to relate this. Knowing that he realised the potential of the *Solanum* alkaloids, I once queried him why he did not push the *Solanum* work in our Department a lot harder. He replied that he preferred to be a prospector rather than a miner, and he also expressed the hope that there would always be enough prospectors to go over the next hill leaving others to mine what had already been discovered.

Briggs also maintained that it sometimes paid to be ignorant. He told the story of a time during the last war when there was a serious outbreak of food poisoning in a public works camp, where the affected men were violently ill and had to be hospitalised. The cause was poisoned honey and one of his former students, Dr M. D. Sutherland, was assigned the task of isolating the poisonous principle. In discussing the matter with Briggs, the latter suggested that he should look for tutin in the honey, a very poisonous compound from an endemic plant *Coriaria arborea*, the Native "tutu". Sutherland devised an analytical scheme for its isolation from honey, but instead of obtaining tutin with a molecular formula $C_{15}H_{18}O_6$, he isolated a closely related compound with a formula $C_{15}H_{18}O_7$. Thinking that the original investigator of the plant had missed this related compound Sutherland again investigated the plant, including the flowers, but could isolate only the original tutin. Later, he was able to prepare from the poisoned honey sufficient material for a biological test on animals when it was found that the related compound (now called mellitoxin) also had the same type of biological activity as tutin. No other plant in New Zealand, to their knowledge, contained the same type of compound, and so almost in sight of the solution, the problem was temporarily shelved. However, the results were forwarded to the apiary inspectors, one of whom observed in the late summer that the tutu plant was infested with a sap-sucking aphid *Scolypopa australia*. This ingested the tutin in the sap, oxidized it in its body and excreted it as honeydew, which was promptly collected by the bees. An investigation of the honeydew soon showed the presence of mellitoxin. As I said earlier Briggs drew a moral from this story, viz. that it sometimes pays to be ignorant. If he had been an entymologist or a botanist, he would have known that bees do not collect nectar from a tutu plant, so that his original suggestion to look for tutin had, no scientific foundation.

An area in which he carried out early research was with the alkaloids from N.Z. *Sophora* species. These studies were in fact some of the earliest chemotaxonomic studies carried out in this country, and predated many subsequent studies by other workers. From an examination of the alkaloids of the seeds of a *Sophora* species which he found at Anawhata on the West Coast near Auckland he was able to suggest that it was a new species, and in related work to suggest that a Chatham Island species was not new. In more recent unpublished work he showed that the woods of the N.Z. *Sophora*

species also contain 3-hydroxy-8,9-methylene-dioxypterocarpan, a phytoalexin or fungus-inhibiting compound which can be produced by a plant after it has been infected with fungal spores.

Senecio species also attracted his attention—the first one which he examined, *Senecio kirkii* gave a new alkaloid which he called senkirkine. However, it took some 15 years from the time of its first reporting until the full structure was solved in 1965, and then only after NMR techniques had been brought to bear on the problem. Briggs was intensely interested in the application of physical techniques for the identification of organic compounds, and he made significant contributions especially in the fields of infrared and ultraviolet spectroscopy. He was one of the earliest of organic chemists in New Zealand to see the potential of techniques such as ORD, NMR, and mass spectrometry and he used them wherever possible. In later years he showed an amazing ability to keep abreast of modern techniques and shortly before his death he was undergoing a crash course on orbital symmetry and the Woodward-Hoffman rules.

One of the most impressive things about Briggs' work was the scope and diversity of the natural products which he investigated. Without a doubt he had "green fingers" when it came to choosing a native species to examine—almost every plant which he did examine led to the exciting find of a new compound. In the time available I can do no more than mention his work on the isolation, structure proof, and synthesis, of the flavonoids of *Melicope simplex* and *Melicope ternata*—work which earned him a reputation as a world authority on flavonoid compounds.

His work on lignans, including his structure proof of mateiresinol from *Podocarpus spicatus* (Matai) and the identification of the lignan cycloolivil from *Gymneiaea (Olea) cunninghamii* (Maire) were amongst his early work when he returned to N.Z. from Oxford where he had studied under the late Sir Robert Robinson.

Essential oils played a large part in his research interests. Over the years he investigated a wide range of essential oils, from that of *Macropiper excelsum* (Kawakawa) which gave among others the painkilling myristicin which is related to eugenol (from oil of cloves), to the oils from most of the N.Z. conifers. He was proud of his work on leptospermone, a compound of novel structure which he isolated from the essential oil of *Leptospermum scoparium* (the common Manuka) and which had properties similar to the synthetic insecticide valerone. About 15 years ago he had embarked on a re-examination of many of these essential oils by gas-liquid chromatography. Commercial instruments were not readily available at the time and I well remember the home-made monster which virtually filled our whole research laboratory until I finally got a hacksaw and sawed it down the middle.

Briggs' investigations of essential oils led on to another of his major interests, the diterpene hydrocarbons, which were readily obtained from the

essential oils of our major conifers. Compounds like phyllocladene and kaurene came in for a lot of study, with a natural progression to his series of investigations of the diterpenoid constituents of the heartwoods.

In 1961 he instigated a programme of research into the metabolites of fungi. Some of the outstanding contributions in this field were the solving of the structure of pithomycolide from *Pithomyces chartarum*, the fungus which causes facial eczema, the structures of three isarolides from a new *Isaria* species, and valsarin and deoxyvalsarin from *Valsaria rubricosa*. Even his old love the anthraquinones, this time in the form of dimers, were to turn up in *Endothia* species which he investigated.

One of his last works was on the colouring matters of *Dianella intermedia* which was carried out in part by one who was to be his future daughter-in-law while she was a research assistant within our Department.

Briggs was a keen photographer. In this talk, with the exception of the first two, I have used only slides which he himself prepared for his own lectures. His love of the flora comes through in his excellent photographs of some of the species which I have mentioned. I approach the end of this talk by show-

ing you some of his slides* of other N.Z. species some of which he investigated:—

Hoheria lyallii (Mountain lacebark);
Sophora microphylla (Kowhai);
Vitex lucens (Puriri);
Leptospermum scoparium (Manuka);
Pimelia species (N.Z. Daphne);
Clianthus puniceus (Kaka Beak);
Hebe speciosa (N.Z. Veronica);
Pittosporum crassifolium (Karo);
Pomaderris elliptica (Kumerahou);
Meterosideros excelsa (Pohutukawa).

In all of what I have said I have told you little about the man himself. Briggs' greatest characteristic was, I think, summed up most explicitly by Professor de la Mare during his acceptance speech for a bronze plaque which was presented to Auckland University by the Auckland Branch of the N.Z.I.C. in July of this year, to mark the contribution of Bob Briggs to the Institute. de la Mare said that Briggs "cared for people". It was precisely this care which had such a profound influence on the many students who passed through his classes.

*These slides were of considerable technical merit—an impressive showing of the beauty of N.Z. flora—Ed.

IUPAC NEWS

NOMENCLATURE OF CAROTENOIDS

Although IUPAC issued "Rules of Nomenclature of Carotenoids" as early as in 1947 and later in 1951, many subsequent developments in the carotenoid field have resulted in situations that are not now covered adequately. For example, the number of known naturally occurring carotenoids has increased from some 80 to about 300. Since 1965 the IUPAC Commission on Nomenclature of Organic Chemistry and the IUPAC-IUB Commission on Biochemical Nomenclature have been engaged in revising the Rules. The updated recommendations were first issued in 1972 as Tentative Nomenclature Appendix No. 19 to IUPAC *Information Bulletin* and were widely circulated throughout the world for comment. The present Rules (approved 1974) have been published after the two Commissions had taken into consideration the comments so received.

The 13 Rules cover the following:

Class of compound; The stem name; Specific names—end group designations; Numbering of carotenoid hydrocarbons; Nor carotenoids and seco carotenoids; Changes in hydrogenation level; Oxygenated derivatives; Numbering of oxygenated derivatives; *retro* Nomenclature; Apo nomenclature; Higher carotenoids; Stereo-chemistry; Trivial names.

An Appendix gives a listing of naturally occurring carotenoids having trivial names with their systematic names and structures.

Published in *Pure and Applied Chemistry*, Vol. 41, No. 3 (1975) and available as a reprint (approx. 28 pages), price US\$3.00 (£1.00) surface post or US\$4.00 (£1.33) airmail from IUPAC Secretariat, Bank Court Chambers, 2-3 Pound Way, Cowley Centre, Oxford OX4 3YF, UK.

NEW APPENDICES ON PROVISIONAL NOMENCLATURE, SYMBOLS, UNITS AND STANDARDS

Four more Nomenclature Appendices to the IUPAC *Information Bulletin*, whose titles are given below, are scheduled for publication in September 1975. These Appendices are obtainable free of charge from the IUPAC Secretariat, Bank Court Chambers, 2-3 Pound Way, Cowley Centre, Oxford OX4 3YF, UK.

- No. 45 List of Trivial Names and Synonyms (for Substances Used in Analytical Chemistry)
- No. 46 Nomenclature of α Amino Acids
- No. 47 Nomenclature of Tocopherols and Related Compounds
- No. 48 Nomenclature of Peptide Hormones

CHEMISTRY IN NEW ZEALAND

By F. G. Soper

I feel much honoured in being invited as one of your Guest Lecturers to talk at this Conference on Chemistry in New Zealand. It was suggested that I should review New Zealand Chemistry over the last 30 or 40 years. I thought of putting my emphasis on the earlier years because as you know I have not been active in Chemistry since I moved into administration and suffered the chemical change that my friend and successor Professor Parton refers to as the Soper degradation.

But now I realise that it is expected that I should also speculate about the future. Nevertheless, it will help if I remind you of what has happened in recent years and this may provide a basis for extrapolation. So let me refer to Chemistry in New Zealand just prior to the war and give an impression of its very great development in recent years. I will mention some of the activities that New Zealand chemists engaged in during the war, for not only has little reference ever been made to them, but also such activities provided in many cases a beneficial experience in industrial chemistry.

First let me try to give you a flavour of the New Zealand University Chemistry Departments and their staff. When I arrived in 1936 I was taken to Victoria College where Easterfield had done so much to secure the recognition of the idea that research was of university importance. There I met Professor Easterfield's successor, Professor P. W. Robertson. On my journey south I met Dr J. Packer, later to be Professor, and Dr H. N. Parton, and initiated a long and stimulating friendship with them both. Professor Denham I had already met in London where he was on leave. So on to Dunedin and the University of Otago to follow my predecessor, the late Professor J. K. Inglis.

Professor Inglis had been a New Zealander, as were the other Professors of Chemistry, and had had postgraduate experience at Edinburgh, then at Leipzig under Oswald, and at University College, London under Ramsay, before going to Reading and returning to New Zealand in 1912. Professor Denham had had postgraduate experience at Liverpool under Donnan, at Heidelberg with Bredig and then taken charge of chemistry at Brisbane. The President of our Institute in 1936 and 1937 was Professor F. P. Worley who had had experience in London under Professor H. E. Armstrong, that stimulating rebel who refused to accept the ionic theory. Professor Robertson, a Rhodes Scholar, had experience after

Oxford, at Leipzig under Hantzsch, held posts at Rangoon and then at Imperial College, London, before returning here. New colleagues were also to include Drs L. H. Briggs and R. A. Robinson at Auckland and Mr A. D. Monro at Victoria and Mr C. L. Carter at Otago. These were the University staff who influenced and inspired the thinking of so many New Zealand chemists. Chemistry Departments more than other university departments tended to be staffed by New Zealanders obtaining their undergraduate training here and then pursuing research in overseas universities before returning. The system worked well.

Let us not forget some of the non-academic staff. University chemistry owes much to its technical staff. I think particularly of Otago and its Mr G. Gilbert, who among his many duties, was the lecture room demonstrator for our first year lectures which were extensively illustrated. I admired particularly his skills in handling gases which had been acquired by Professor Inglis and Sir William Ramsay and passed on to Mr Gilbert.

In all, the academic staff in Chemistry in the four centres in 1936 numbered 12, three at each centre. This year, 1975, the number is 152 including the biochemistry and biophysics staff at Massey University, but not including the biochemistry staff at other centres. This expansion is an indication of what has happened to university chemistry in 40 years.

It may also be of interest to note that in 1936 all science departments at Otago, and probably elsewhere in New Zealand, existed on meagre allocations of finance. We spent in that year about £300. Soon after I arrived the University of Otago Council made a special grant to the department and we were able to purchase Beilstein's *Organische Chemie* and a Bunge microbalance. The Department at Otago has been active in the field of the chemistry of New Zealand natural products and had published 20 papers from 1923 to 1934, mostly in the *Journal of the Society of Chemical Industry*. Further progress in this field would depend on the development of microchemical analysis, so Mr C. L. Carter undertook this work and devoted himself to acquiring the necessary techniques. Microchemistry was expanded under Dr T. S. Main in 1950 and 1951, and when he left the administration and continuing development was taken over by Dr (now Professor) A. D. Campbell. The microchemical unit at Otago

has for many years performed a national service and is being used by all the New Zealand Universities and by some Government research departments. The number of samples analysed was 448 in 1958 and reached 1500 to 1800 annually in the 1970's—a 4-fold increase in the last 15 years.

Part of the University Council's special grant was spent on a Bellingham and Stanley u.v. spectrograph with rotating sector, which was time-consuming to operate but allowed some useful research to be done. These minor additions to equipment, minor by today's standards, were landmarks. After the war, in 1947 a Beckman u.v. spectrograph—that sturdy workhorse of so many laboratories today—was acquired and a Perkin Elmer i.r. spectrograph in 1949. This equipment was probably typical of several chemical departments.

For active and continuous research in the universities research students are necessary, and few students can continue without some financial support. It is in the extent of such support that a great change has occurred. In the 1930's and 40's there were two Fellowships available for research in chemistry at Otago. These were the John Edmond Research Fellowship (annual value £200) and the Duffus Lubecki Scholarship (value £160). At Victoria there was the Jacob Joseph Research Scholarship. Four Research Scholarships (value £100) could also be awarded annually on a national basis by the Council of S.I.R. These are only examples, but throughout the universities and for all disciplines the total number of fellowships was low. In contrast in 1971 and 1972 the number of postgraduate scholarships awarded by the University Grants Committee was 355, each of \$2000 per annum. There were also 12 post-doctoral Fellowships at \$3000, 35 Commonwealth Scholarships at \$2500 plus free passage, with others making a grand total of 434.

Outside the university, there was a chemical industry appropriate to an agricultural and pastoral community. There was also at Edendale in Southland a most efficient factory for production of lactose, where Mr D. F. Sandys-Wunsch was Managing Director.

These were the exciting years for chemists working on soil fertility. New Zealand and Australia had come to recognise that on some soils plants and animals failed to thrive. B. C. Aston had presented a paper on the subject to the British Association in 1926, but the announcement of cobalt as a necessary trace element was first made by Marston and by Filmer and Underwood in Australia. I think it is a fair claim that it was the New Zealand chemists in the Cawthron Institute, in the Department of Scientific and Industrial Research and in the Department of Agriculture who established the convincing proof that in areas of bush sickness an actual deficiency of cobalt occurred in the soils, in the pasture and in the animal organs.

I have mentioned this well known cobalt deficiency story because it has had an enormous effect

on establishing the importance of scientific research in New Zealand. It affected the thinking of the man in the street and of successive Governments, for the simple reason that the benefits in this case were obvious and easily evaluated. The benefits of research even when considerable are not always easily evaluated. C. P. Mackie in *N.Z. Official Year Book 1967* records that in the Rotorua-Taupo area where, until the late 1930's, stock would not flourish because of bush sickness, the same land in the 1960's supported 146,000 beef cattle, 77,000 dairy cattle and 1 million sheep, and that the export value of livestock products from this area was now approximately \$10 million per annum.

New Zealand chemists played an important part in the discovery of other essential trace elements, but this is not the place to dwell on that story in which the Cawthron Institute under Sir Theodore Rigg played an important part. One of the centres of chemical activity, then as now, was the Dominion Laboratory (now the Chemistry Division of the Department of S. and I.R.). A most useful record of its work was published in 1965 entitled "*One Hundred Years of Chemical Research*". An indication of the increased tempo of chemical work is that up to 1954 the number of published papers for the 90 year period was 429; for the 10 year period, 1955 to 1964 the number was practically the same, 412, almost as many in that 10 years as in the preceding 90.

Some of the papers in the list of published work interest the most academic of chemists—work on New Zealand natural products, high temperature high pressure work in geochemistry, the spontaneous ignition of pie wool and the work of Dr I. K. Walker. I could also instance the cooperative effort with the Chemical Engineering Department of Canterbury University on salt manufacture at Grasmere where evaporation is now based on dry winds rather than solar heat; this has increased production by many hundred percent. Is there not room for more cooperative strategic research between universities and government research establishments without damaging University freedom and autonomy?

Some reference should also be made to the formation about this time of research institutes and research associations which have considerably expanded the number of openings for chemists. The Dairy Research Institute was established in 1927, the Wheat Research Institute in 1928. The New Zealand Wool Manufacturers' Research Association was founded in 1937 and later amalgamated with the New Zealand Wool Research Organisation. There I had a personal contact for, on its formation in 1937, the research laboratory was established initially in the Chemistry Department of Otago University and the staff appointed visited the woollen mills and advised on problems, particularly on the scouring of wool and on anti-shrink treatments. It is noteworthy that the export of scoured wool has increased nearly 10-fold in the

last 30 to 40 years; in 1973 it was approximately 95,000 tons, value \$152 million. With the present improved scouring methods and recovery of lanoline it is likely to increase still further.

In 1939, not unexpectedly, the war came. This time the threat of war to New Zealand was much closer than in 1914. The comment has been made that if the 1914-18 war was the war of the chemists the Second World War was the war of the physicists. Nevertheless chemists were still much concerned with the old problems common to all wars—the problems of supply.

There had been some pre-war planning and some stockpiling of essential commodities, having regard to New Zealand's role in the event of war as a food supplier. But as J.V.T. Baker in his book *"War Economy"* part of *"The New Zealand People at War"*, reports "in the main New Zealand's economic pre-war planning was characterised by considerable discussion and many recommendations but very little action". Stockpiling did not extend to munitions although it was clear that New Zealand might have to manufacture her own, because her traditional suppliers would be concerned with their own needs. In the final result New Zealand did produce quantities of hand grenades and trench mortar bombs plus fuses, but the explosives had to be imported. There was, however, a multitude of suggestions for home production of explosives. One enthusiastic suggestion was to use toluene from the Taranaki oil-wells and locally produced nitric acid to give T.N.T. Some of us who knew how long it took Britain in the 1914-18 war to produce service explosives considered such a project was not practicable in a country far less advanced industrially than Britain in 1914.

But, on the other hand, New Zealand had available trained chemists, and across the Tasman Australia had an expanding explosives industry already in operation and was in need of chemists. So it was arranged through the activities of the Defence Science Committee to transfer New Zealand chemists to Australia. Cabinet agreed to make available up to 40 and eventually 32 went over, some in late 1940 and others in 1941 and 1942. The quality of those who went received much favourable comment from Australia, and most returned with benefits to New Zealand through their industrial experience. Moreover, our cooperation with Australia ensured the supply of service explosives and allowed munitions assembly to proceed in New Zealand, an operation with which Dr V. Armstrong was associated.

Apart from our chemists working in Australia, there were our chemists here in New Zealand in the universities, in the Department of Scientific and Industrial Research and in the Department of Agriculture who were anxious to help where they could in addition to their normal duties. So a Chemical Panel of the Defence Science Committee was set up to advise on matters relating to the supply of

chemicals and where the chemist could assist in meeting the various shortages, and in helping to solve the various problems raised by the armed services, the National Service Department and the Ministry of Supply. The panel had Mr N. A. Marris, and later Mr J. A. D. Nash of the D.S.I.R. as Secretary. Members were Dr Marsden, Mr R. L. Andrew as Director of the Dominion Laboratory, Dr J. C. Andrews, Professor Denham (whose place was later taken by Professor Packer), Captain J. Melville, of the Plant Chemistry Laboratory (as Army Representative), and myself as Chairman.

Among the projects undertaken by the Chemical Panel was one concerned with defence against the use of war gases. This involved working out of methods of identifying war gases, provision of necessary equipment and the instruction of Gas Identification Officers. Courses for the latter were held in the Dominion Laboratory under the direction of Dr Briggs and Mr G. Chamberlain. Then, in the event of attack the nature of the attack could be authenticated, and casualties could receive appropriate treatment. Samples of all of the common war gases were made in the universities and the Dominion Laboratory, including its Auckland Branch. These were used for training purposes in the making up of smelling sets. Auckland University Chemistry Department also produced quantities of detector dye used in gas detector paint, and at Otago the late L. G. Neubauer of the Dominion Laboratory, assisted by Lewis Baker, produced supplies of war gas antidote.

Gas masks for the civilian population were manufactured in quantity. Dr Annett took charge of the factory, and the testing of samples of the finished product was carried out at Canterbury University College under the supervision of Professor Packer. In particular the absorptive capacity of the activated charcoal, both locally produced and imported, was under continuous review. Fortunately, none of the expertise which was developed was required in the long run, but precautions, like many others in war time, had to be taken.

Another wartime service requirement was smoke for concealment in both attack and defence. Smoke bombs were produced in an Auckland factory under the direction of the late Dr J. C. Andrews; chlor-sulphonic acid was produced at the Kempthorne Prosser Fertiliser Works in Dunedin; research was done into other possible production. The Dunedin work involved the preliminary production of oleum using the contact process. A vanadium catalyst was not available, so a platinum catalyst was used instead. A number of young graduates were concerned with this work, particularly Mr D. G. Murdoch, and cooperated with the Works Manager Mr P. Rouse.

There was no lack of projects. Large crystals of Rochelle salt were required by the Navy for their sonar equipment. This production was undertaken at Otago University by Mr Lewis Baker; some mas-

sive and magnificent crystals were produced utilising a thermostatically controlled room with an automatically adjusted thermoregulator causing very gradual lowering of room temperature. Dr Parton at Canterbury worked out the details for efficient conversion of sodium chlorate into the potassium salt when 2 tons of the latter was urgently required by the Ministry of Supply. This conversion was undertaken at various university centres. Everybody was relieved to see the product dried, boxed and delivered without untoward happenings.

Medicinal plants were being grown by the D.S.I.R. and evaluated in the Dominion Laboratory. These included *Digitalis purpurea*, *Datura stramonium*, *Belladonna* and *Hyoscyamus*. This venture was successful in making up for the deficit in the country, and for supplying the English market. During the 1914-18 war morphine had been processed from opium confiscated under the anti-drug laws. This processing had been done by Professor Easterfield. Dr S. N. Slater carried the work out during the Second World War. The alkaloidal constituents of New Zealand ergot were determined by Dr C. H. Hassall, and their chemical assay by Drs W. A. McGillivray and W. S. Metcalf.

This account of chemical projects undertaken up and down the country is far from complete, but it may give an indication of the many activities in progress, and I should like to acknowledge the invaluable assistance of Mr J. A. D. Nash in compiling this brief account. Looking back on it all after 30 years, I realise that these activities may not have added much to human knowledge, but those war-time precautions which were necessary were efficiently taken. In the main it was activity in the realm of supply. We did what we could. What remains in my memory is the willingness of all New Zealand chemists to engage in whatever tasks would assist the national effort, even if on occasions those tasks had only small chemical content.

Important activities were occurring in industry, and in its 1943 report the Department of Industries and Commerce referred to new industries of that year. These included dehydration of food, and the production of linsed oil and fish liver oils. In 1944-45 the Marine Department reported that over half a million lbs of fish livers were processed and 20,000 gallons of oil produced. (Some New Zealand fish oils are very much richer than cod liver oil in vitamins A and D, particularly in A.) About this time, agar was produced on a semi-commercial scale from seaweeds by the Dominion Laboratory, tested overseas and then manufactured by the Davis Gelatine Company.

All these industries required chemical control. Dr Dixon, in F. R. Callaghan's *Science in New Zealand* (1957) mentions that in 1928 there were 37 chemists in industry; in 1957 this number had increased to some 200 in various industrial groups. This increase reflects a number of influences. One of them was the New Zealand realisation during

the war years of the importance of the industrial chemist. The war undoubtedly stimulated thought in new industries in New Zealand. Many of these, particularly the food industries, required chemists and, indeed, chemists with a wider training. In 1941 the New Zealand University recognised this and approved courses in Biochemistry, Physiology and Bacteriology as units in a Science degree. These were to count for degree purposes as Stage II units and were first offered at the University of Otago, where there already existed courses in these subjects for medical students.

A course in Applied Chemistry was approved by the University of New Zealand in 1945 and was made immediately available at Auckland, Canterbury and Otago. Chemical Engineering as a B.E. Chem. degree had been approved the previous year in 1944. Both Applied Chemistry and Chemical Engineering had been of special interest to the late Professor Denham and the introduction of these subjects as University courses owes much to his interest and influence.

It is popular to accuse the Universities of being ivory towers but I should like to affirm that University policies do respond to national needs.

Post-war the universities did not return to pre-war conditions but instead to increased numbers of students and duplication of classes. Research expanded—this was necessary at that time to achieve a proper balance.

After both the 1914-18 war and the 1939-45 war the desirability of encouraging research within the Universities was recognised; the Ph.D. research degree was instituted by the University of New Zealand after the first war but was withdrawn after a short interval. Following much activity behind the scenes, particularly by the science members of the Academic Board it was re-introduced after the second war in 1946. This encouraged research in the universities, and provided valuable stimulus, training and experience. There was also encouragement by more generous provision of postgraduate scholarships and increasing grants for research from the University of New Zealand Research Committee. This Committee was replaced when the separate universities were established, by the University Grants Research Committee which last year dispensed grants, mainly for equipment, amounting to nearly \$3/4 million.

The result has been the formation of strong schools of research throughout the universities, but not, in my opinion, so strong that the balance between teaching and research has been upset. What are the main streams? There are strong schools in X-ray crystal structure work; good strategic research in sequential analysis of polypeptides and their synthesis; the use of entropy changes in shedding light on physical and chemical processes; the study of reaction mechanisms including very fast reactions; organo-metallic compounds in biological problems; macromolecules; the con-

tinuing work on the natural products of New Zealand, with present day emphasis on the conversion, including micro-biological transformation, of the more readily accessible products to compounds of commercial value: also the high precision mass spectragraphic work which, for example, has so greatly assisted the study of dothistromin, the toxin causing disease in *Pinus radiata*. There are others too, making a colourful variety of first class research.

I could spend time in reminding you of the rapid way chemical techniques have changed in this post war period, but this has already been done in Professor Vaughan's eloquent Packer Memorial Lecture in 1973 and in Dr Ellis's address to the 12th Science Congress in 1972 on Trends in Modern Chemistry in New Zealand. I cannot add to what has already been so well expressed except to highlight what has happened to the techniques used in the first step in so many chemical investigations, namely the separation of a pure substance from mixtures. The great step forward was chromatography, in particular partition chromatography.

Usually benefits flow from pure research into industrial research and thence into industry. Rarely does the flow of benefits occur in the opposite direction, from industrially financed research into pure research. This is what occurred in partition chromatography, the great contribution of Martin and Synge. Synge was awarded a Research Scholarship at Cambridge by the International Wool Secretariat, which obtains its funds from the wool growers of Australia, New Zealand and South Africa. Synge was concerned with finding a method of separating the amino acids which result from the hydrolysis of wool. Collaboration with Martin resulted in combining two techniques, chromatography and solvent-solvent distribution. The results were published in 1941 when both were at the Wool Industries Research Association in Leeds. Paper chromatography was described by Consdon, Gordon and Martin in 1944; gas liquid chromatography by James and Martin followed in 1952. In that year Martin and Synge were awarded a Nobel Prize. Dr Synge came out to New Zealand and worked with Dr E. P. White at Ruakura Animal Research Station on the chromatographic separation of ether extracts from the fungus *Sporidesmium bakeri* which causes facial exzema. They isolated the toxic substance, characterised it and gave it the name sporidesmin. This was published in 1959. From the point of view of the wool growers, who had supported Synge earlier on, this was bread cast upon the waters returning after many days.

The onward march of gas liquid chromatography has been dependent on improved detection and identification of the successive substances issuing with the carrier gas. The use of this sensitive tool is now widespread. It is of special practical value to this food exporting country in its use in the

investigation of food flavours. A present wish is to link the issuing gas with a mass spectograph which is an ideal detector, but I doubt if it is justifiable from the expense point of view, except in special cases.

Outside the research laboratories the range of industries having strong chemical content has been steadily increasing. The paper pulp industry for example at Kinleith; two metal producing centres, iron and steel at Glenbrook (based on indigeneous iron sand from which steel billets were first produced in 1969) and an aluminium industry since 1971 at Bluff (based on indigeneous hydro electric power). With metals, salt, natural gas and electric power all available we are now much nearer, nationally, to the possibility of a more balanced economy.

No reference to the last 40 years of Chemistry in New Zealand would be complete if our N.Z. Institute of Chemistry and its Journal were not mentioned. The membership of the Institute has steadily increased from just over 100 in 1935 to over 1200 in the 1973 list of members. Its Conferences have been valuable and stimulating. I well remember the first well attended Conference which occurred just after the war. Dr J. C. Andrews was President and the Conference was held in this city. As membership of the Institute has steadily increased the importance, size and prestige of its Journal has advanced under a succession of distinguished editors. First O. H. Keys, then H. N. Parton, followed by S. G. Brooker, G. M. Wallace, W. A. McGillivray, N. T. Clare and now Miss J. Mattingley. The Journal has played a most important part in holding together those engaged in the profession of chemistry and giving them a sense of unity. We are all, I am sure, most grateful.

It has been a remarkable 40 years, remarkable in the development and use of sophisticated equipment and new analytical methods. A chemist in the 1930's would feel like a stranger if he returned to the laboratory of today. But there are dangers, in the midst of all these advances, if we lose contact with our classical techniques. Those who practice chemistry need practical skills beyond the ability to press a button and read a scale.

There is an obvious increasing demand for the techniques of chemistry in the fields of biology, particularly techniques of analysis, but there is much in such work that also needs some depth of chemical knowledge. Already in the teaching of chemistry in advanced courses more specialisation is being provided, allowing the student to progress either to the physico-mathematical side or to the biological side. But I still believe in a common core in the training of all chemists. Let us not lose our sense of chemical history.

In this brief summary I am very conscious too of many omissions, but time is relentless.

SCIENCE, SOCIETY AND THE STATE

by C. L. Davey

An important emphasis given this Conference has been to examine the achievements in New Zealand Chemistry over the years. It is a moment of pause, and as such it must also be a moment in which to give thought to the future of New Zealand science and the society it purports to serve.

Like most countries New Zealand is not escaping from the economic and social agonies besetting the world. Indeed New Zealand, more than most western countries, is at a time of dilemma and is needing more than most to determine new directions. The need arises through our severance from historical associations irrevocably made with Britain's entry into Europe and our being cast into Asia. Like all psychotics we have become practised in the art of self deception when describing our dilemmas. However diagnosis and proper therapy are essential if we are to establish the good, secure and prosperous society we are all seeking.

A society in confusion as ours, leads to incessant self examination. While this can become tedious, it is an essential step in the process of clarification. You will therefore excuse me if I add my personal view. I will exclude all mention of the Institute and its affairs since the achievements and failures through the year will duly be exposed at the Annual General Meeting and in the Institute Journal.

We all recognize the importance and inevitability of Britain's joining Europe. The most compelling argument in favour of the move has largely been lost in the confusion of the event. Britain as an industrial unit of some 60 million people is not considered large enough to exist as a thriving entity in effective competition with larger and developing industrial countries. Britain needs a large home market to support and test new technology by which she survives. Without such a buffer she can not thrive.

We in New Zealand should surely be asking the question—If Britain needs to belong to such an entity for survival, by the same argument how can New Zealand prosper as a small, unattached, isolated, European nation of 3 million people in Asia, half the world from its heritage? It is by posing such a question that the seriousness of our dilemma becomes exposed. It is a national habit to belittle idealism and only to seek solutions that are pragmatically possible. This latter is the politician's way. I make no excuse for my own idealism since extravagant solutions will be needed for solving pressing problems.

I will examine as examples three areas of our functioning which have a considerable technical base, land usage, energy usage and the organization of New Zealand science. My premise is that in these three areas, as is the case in many others, a longer, more cohesive view than we habitually consider necessary, is needed for this country's harmonious salvation.

I have cast around for an existing example that might convince us that a courageous approach to the ideal is possible. I have drawn on the experience of Norway. It chose not to enter the European Community, is bent on finding its own solutions and salvations, is ethnically similar to us, lives largely from its renewable resources, and above all is bent on creating a civilized way of living.

Land use

For our continued wellbeing, efficient agriculture will be the basis of the economy for generations. Agriculture is our living force. Without it we would not thrive. The overlying objective of any policy on land use is that agriculture (in which I include indigenous and exotic forestry) remains pre-eminent in our economy. At present we appear to be moving towards large-scale subsidizing of agriculture. Although a case can be made for limited and controlled subsidizing to produce from otherwise unprofitable areas, one has to remember that such a transfusion is only possible if fiscal blood is available from other production. In New Zealand it is not.

The rapid, logarithmic phase of agricultural development in New Zealand has passed, and only special, cost-intensive, ordered agriculture can reap further returns. Temperate-climate agriculture is globally very competitive and our margins of advantage have begun to shrink. As soon as countries such as the Argentine solve their political dilemmas, vast, virgin areas will be brought into efficient and cheap production of the same luxury items we produce. France, twice our size and many more times more arable, is likely to organize its agriculture to produce the lamb we have created for the British market. Yet we muddle through without long-term targets.

I cannot but highlight our lack of forethought in the senselessness of city growth in New Zealand and incursions of such growth on our agriculture. Our aspiration for a quarter acre of suburbia has been replaced by our desire for 10 acres on the

city's edge. Hamilton is a city approaching 100,000 in population. It lies centrally in the Waikato basin which, if we believe the city guides, with its animals is the most intensely populated region of this earth. It is a city which exists to service the farming industry. The flat productive Waikato basin is approximately 270,000 ha. Hamilton city occupies 3-4% of the basin. However the city with its cluster of 10 acre plots and consequent fragmented farm land makes up approximately 25%. Recent local county rulings have increased the subdividable limit to 50 acres, which may or may not be an economic unit.

Hastings is a modest improvement. The policy is to protect the strictly-limited but highly-productive Heretaunga plains from urban sprawl. It is achieved by limiting city growth to well-defined unproductive iron gate gravels following old river courses. The policy is being rigorously maintained and suburbs following land-type demarkations take on unusual shapes. Urban development is only allowed within city boundaries. Ten-acre subdivisions are permitted but unless they are proven economic units, housing on them is not.

While the spreading city eats us out of productive land, our enlarging population eats us out of an export income. With a population of three million we eat one-third of the meat we produce and one-quarter of the dairy produce. At double our population, all else being equal, we will live on twice as much and live on half our present export income. This will happen on present projections in 35 years time, and if all goes to plan, when our Maui gas reserves dry up. Such a possibility is more than just a theoretical calculation. It has been, and still is, one of the crippling dilemmas of certain South American countries. Britain's European entry and our resulting dilemma are largely problems of agriculture. We need an active land policy which of course some would consider we already have.

Remodelling of land systems has largely been at the basis of political and economic reorganization in Europe this century. There, it is recognized that the weakest kind of land protection is that which prohibits subdivision of individual plots below a certain size. The administrative machinery is not adequate to enforce such rules in badly fragmented areas, as evidenced particularly in the peasant agriculture of Portugal. Think then of the Waikato and other parts of New Zealand. Again, in Sweden a centuries-old tradition encouraged clearance of indigenous forest to increase freehold. In the middle of last century it was realized that the system served as a cover for the penetration of private forestry enterprise into the public domain, and the law was changed to prevent it. What then of our non-renewable beech forests and our incapacity to learn from history. New Zealand needs an active land policy that goes deeper and far beyond our present concepts.

Having done no more than highlight one small problem of land use, city and population growth, it is essential to my mind that our policies be

unified and extended to give prime recognition that our land and its productive use is the sustaining life blood of this country. In formulating policy many critical factors come to mind.

- (1) More precise zoning for agricultural use, including forestry.
- (2) Limit to population.
- (3) Agricultural diversification.
- (4) Growth and location of urban areas.
- (5) Classification of economic units.
- (6) Enlarged and co-ordinated scientific, economic, and sociological studies of agriculture.
- (7) Land ownership.

Energy usage

It has only been in the last few years that limits to resources have been seen as a real threat to social and economic vitality. It must be disconcerting to the planner that change has rarely been accurately forecast. We are suddenly confronted with our vulnerability to disturbances in the resources balance-sheet. Hence the current concern for energy. One wonders what other events wait in the wings to disturb our increasingly sensitive social and economic balance. Like most countries, New Zealand is confronted with its energy problem. It is having to devise a long-term and comprehensive energy policy which in my view hardly exists at present. The recently-created Ministry of Energy Resources, the Energy R & D Committee, and its activities, and the two impressive private conferences held on the matter are signs that we are moving towards such a realization. Dr Maiden in his report to the Second Energy Conference developed an interesting design of research scenarios as a means of moving towards a co-ordinated energy policy. Unless however the political strength exists to use the information such efforts move into history to reside with their predecessors in other fields.

An energy policy goes beyond long-term energy self-sufficiency. The national environmental impact of any long-term policy is a critical aspect of its success. Some countries have found that their energy policies are no more than monuments to the bureaucratic process. The United States gives emphasis to its industrial life in determining policy, and with the passage of their recent Energy Supply Act has lifted the moratorium on the Alaskan oil pipe-line. Sweden seems to be moving towards a tough but workable policy basis which is limitation to growth. It hopes by 1985 to have reduced the rate of increase in energy usage to 2% and zero by 1990. To the Swedes at least in their energy policy, the old adage that growth is good is being cast aside.

In New Zealand on the other hand we compartmentalize our policies. Our Electricity Department in its policies is still led by the carrot of projected demand—a demand determined amongst other things by the fact that even our isolated seaside

hamlets of city people's second houses can be hooked up to our sacred national grid. I believe the best lessons can be learned from Norway which has a well-considered policy for energy development and control. Norway is bountifully endowed with hydro energy. With the discovery of North Sea oil and gas it became an example of the Biblical assertion that 'to him that hath shall be given'. Norway has the ability to consider ahead and to produce effective policy, whereas we carry on uncommitted to a well-principled strategy by once more relying on the art of muddling through. Norwegian recognition of the need for conservation is reflected in the fact that all households have their own peak-load meters. Fifty percent of our electricity generation is used by the household. At 7820 Kwh/annum per house, it is one of the highest in the world. A 10% saving now would represent the out-put of a 250 Mw power station. I would strongly advocate domestic peak-load meters in New Zealand homes with stiff rates (x 6 as in Norway) for overuse. Such a concept would certainly extend the much needed life of Maui. Norwegian Parliamentary reports and other official publications on energy, and especially on oil and gas, are impressive and readily accessible in New Zealand. One in particular impresses me—No. 25 (1973-74)—*Petroleum Industry in Norwegian Society*. In its 125 pages it examines the implications of North Sea oil and gas to the balance and advance of Norwegian society. It looks at the environment of both sea and land, the implications to fish life, the strategies for Norwegian ownership and engagement, the effect on local communities, the rate of sensible exploitation, and so on. The State-owned Statoil Company is participating, and will I understand be responsible for exploration and development above a latitude of 62°N. At least six Norwegian Oil Companies are active in the North Sea. That country, the same size as ours, has gained the expertise to control and develop its own mammoth oil and gas resources and moves towards gaining control over landing and distribution.

In contrast, the New Zealand White Paper on the Development of the Maui Gas-field is some 300 pages of well-reasoned analysis, including a single page on the environmental impact of Maui. Hopefully more in this respect has recently come to hand and the Commissioner of the Environment will be keeping a watching eye on developments through Environmental Impact Reporting. Impact Reports are certainly a laudable concept but one I suspect which detracts from the long and overall view, through piecemeal analysis. The concept of the environmental impact report can only function successfully within the context of comprehensive policy.

It might be said that the size of Norwegian North Sea developments is of a magnitude that demands urgent and stringent policy. I have brought together the Norwegian and New Zealand energy pictures in the following Table:

TABLE 1
NORWAY AND NEW ZEALAND

I Population and Agriculture				
	Size (ha)	Population	Arable Land (ha)	
Norway	32 x 10 ⁶	4 000 000	8 x 10 ⁵	
New Zealand	28.5 x 10 ⁶	3 000 000	9 x 10 ⁵	
II Non-renewable Energy (x 10 ¹⁸ Joules)				
	Oil and			Total
	Gas	Condensate	Coal	
Norway	85	10	0.6	95.6
New Zealand	26	0.5	33	59.5
III Renewable Energy-Potential Electrical Generation (10 ¹⁸ x Joules/year)				
	Hydro	Geothermal	Total	
Norway	0.23	—	0.23	
New Zealand	0.11	0.07	0.18	

Although these figures can only be approximate in the absence of true assessments of available reserves, Norway's present per capita fossil and renewable energy resource is 20-30% greater than that of New Zealand's. It is interesting in this respect, that before Norway found oil or gas in the North Sea, 30 dry wells had already been drilled. (In the U.S. 32 000 wells are drilled annually.)

Even in today's aware and busy world, a nation's smallness and isolation are directly related to its naivety. I, with many others, unfortunately with hind-sight, feel that New Zealand did not negotiate the best of deals in its aluminium smelter. We hope we learn from experience. I am however disconcerted to discover, in contrast to Norway, how little we seem to be able to participate in searching for and developing our gas and oil. The gas resource is of the same order of size as that in Norway, and yet it is only through State finance or by a vicarious stock exchange flutter in two companies holding prospecting concessions that we are able to participate. Since we have been so proudly expert at developing geothermal energy, I would presume we could gain equal technical expertise in seeking out and developing gas and oil resources. In this respect, with new methods of seismic interpretation, the chance of successful drilling has increased five-fold. Large-scale technology can only be created through firm and long-term policy. To participate, not only financially but also technically, would add confidence and impulse to our capacities to develop large and complex industry. This in turn would force us into larger-scale and longer-term planning as has happened in Norway. It is important to realize that whatever the exploratory risk—the consumer pays in the long run.

My theme is that a co-ordinated or integrated Energy Policy for New Zealand is not only necessary, but also possible. Such a policy should have four essential elements:

- (1) Slowing energy consumption, leading to zero growth.
- (2) Increasing dependence on renewable energy resources.

- (3) Nurturing of our fossil fuels.
- (4) Integrated administration and a single control.

Organization of science

So many of Britain's institutions were contrived at a time when the country could indulge in waste at the expense of the inexhaustible resources of a supporting Empire. We have inherited such attitudes—attitudes which don't require the stringency of cohesion and the long view. The long view is a collective view and cuts across the self-interest of our much vaunted individualism. We are close to our origins. The seeds of New Zealand nationhood have hardly germinated, and self-interest still supersedes national interest in most of our minds. This is no more evident than amongst our educated. While it would be foolish of me at this Conference to criticize the quality of the scientific institutions to which I owe allegiance, I cannot help but return to my theme that, as is the case in many of our endeavours, New Zealand requires a more cohesive and long-term policy for scientific research and technical development.

I think we are sufficiently aware of the organization of Science in New Zealand and the parallel roles of the National Research Advisory Council and the University Grants Committee in planning, co-ordinating, and financing scientific research. A review of science policy under N.R.A.C. jurisdiction has recently been undertaken. The impression I gain from the Advisory Council's latest report is that the broad intention is to achieve a greater integration of science policy and economic development. This is heartening indeed. However, effective policy can only hang happily on a single skeleton. N.R.A.C. and U.G.C. jurisdiction of Scientific and Technological Research should be more firmly linked under a single policy umbrella. The 1973 report to *Nature* of New Zealand's N.R.A.C. is much less positive and claims that the legitimate requirements of academic freedom and the national interest can probably only be met satisfactorily if Government funds are provided through more than one channel.

I believe this to be an over-fastidious view and a complete abnegation of a critical principle for vital National Scientific Research, effectively embraced within a single policy. Organization is only one aspect of Science Policy. The detailed nature and direction of the research undertaken is the other. From my observations and experience there is not enough consideration given to determining the critical directions our researches should be taking in the cause of New Zealand.

From experience, and I hope wisdom, I have reached the view that ultimately a good scientist's interest expands to fill the field of research endeavour he is directed to undertake. He accepts the constrictions of science policy if the targets are true and indulge his altruism rather than his self-interest. The time is appropriate to undertake a review of scientific research policy so that clear and carefully considered directions are determined.

Within prescribed directions the whole spectrum of research from undeniably basic to pragmatically applied research should be pursued. The basic former would serve as a feed to the latter and a reinforcement to our scientific scholarships and culture. Its end product in application through other phases of research and development would be the necessary vital, technical base to New Zealand's enterprise.

For prescribed directions and wide spectrum research to flourish effectively, sensitive co-ordination will be necessary, encouraging collaboration, while limiting unnecessary duplication. Without mentioning examples, this especially occurs with certain popular areas of work initiated overseas in large scale and then taken up sometimes without conclusion in New Zealand. For a country which depends almost entirely on animal protein, fat, and cellulose, it surprises me that we have no declared national policy examining the basic nature and quality of these raw materials at all levels. While I accept pockets of excellent basic research are accruing in these fields, no cohesive policy exists to see them flower as they should, to the betterment of our scholarship and our ultimate well-being.

The muscle proteins are our greatest source of wealth and probably bring us (with attendant water, bone and fat) some \$500 million a year. Yet studies in the structure and function of muscle as a basic research endeavour, both as a field of research training of our students, and as a foundation to our meat industry, hardly exist. Only through the horizontal linking of our research endeavour amongst all institutions can such a broad and co-ordinated research prospect be contemplated. Since we live from the proceeds of proteins, then a nationally-sanctioned, co-ordinated, research programme of protein chemistry and biochemistry is also wanted in this country. By the same token, a co-ordinated programme of fats and carbohydrate research is needed.

As a young research student I became conscious of my obsessive dedication to my particular line of research. I see the same dedicated passion of creation in the eyes of our able research students, bringing order into what can so often be regarded as incomprehensibly abstruse fields of research. Aiding their training and scholarship it may be, but at the same time destroying their sense of externalized contribution to the Nation's good. Our educational system encourages individualism but of a sort which inevitably seems to indulge self-interest. Our young scientists too often see themselves as international currency surviving through self-fulfilment and gratification. These characteristics are part of the creative drive and cannot be denied. However these same young students could have been trained for higher degrees, within New Zealand, on research lying at the core of chemistry and biochemistry, yet with a New Zealand significance.

I would point out that it was the contracting muscle which spawned the biochemical discipline. The problem of muscular contraction still remains

the great unsolved mystery of biology, while characterization of the large fibrous proteins in muscle is one of the most intriguing research tasks in protein chemistry. I suspect that some of our university research relates in no way to the New Zealand scene, but was born decades past for research students in the universities of the northern hemisphere, where perhaps it once had obvious industrial significance. I am strongly of the conviction that our students should, as far as possible, gain their research training in the interests of New Zealand—in the biology behind insect control, the biochemistry of our 2-300 million opossums in an effort to identify their biological achilles heel; in the reproductive physiology of our sheep; in their genetics and general physiology, with the aim of creating a leaner animal; in the various diseases associated with our domestic animals such as brucellosis, toxoplasmosis, sarcocystis and taenia ovis, which are likely to affect importation of our meat into other countries; the physiology and psychology of domesticated deer; more active research into our fish. When designing research policies it is well to remember that fish is meat and responds to its processing environment in much the same way as the mammalian tissue. This country necessarily has world dominance in the understanding of the effect of chilling and freezing on meat quality. It would be unfortunate indeed if through not recognizing the issue, quite separate research developments arose into fish and mammalian meat.

I seem to smite at university science. Not entirely so. I sense though that it is often still too isolated in its pursuits. Some of its research directions could be replaced by equally basic, equally creative, and nationally more significant lines of endeavour. It is again my experience that the young research student, by working in a field clearly relevant to New Zealand, cements his sense of nationalism and confirms his continued allegiance to this land. New Zealand university science has made a magnificent contribution over the years, as this Conference will no doubt attest. I must admit in this election year of fiscal and social despair I am moved to ponder to what extent our various University Departments of History, Political Science, and Economics have contributed to New Zealand current political philosophies, or economic policies.

I believe it is an occupational hazard that we academics are inclined to retain a sense of detachment from the New Zealand scene. However as citizens of this land we should not be given, nor should we expect, exclusive privilege. My recent visits to university and other research institutions have convinced me that, in terms of archives, libraries and general accommodation and research facilities, we are no less endowed than the most progressive research establishments anywhere. In this situation I feel, to consolidate our affiliation to New Zealand Science, we should be prepared to recognize that we can gain our fulfilment here. To claim periodic renewal as of right through furloughs

or sabbaticals in the Northern hemisphere is a tradition we would all like to preserve. I now think this detracts from our New Zealand purpose. The concept was good sense in Colonial times, but should now be considered history. It should be replaced by an *ad hoc* system determined by merit and need.

In the Norwegian Parliamentary Report M071 "Norwegian Long-Term Programmes" the role of research is comprehensively analyzed. Over 1% of the gross national product is directed to research and development. It is obvious from the report that Norwegian research directions are sensitively and broadly laid. The importance of regarding research in an overall national perspective is recognized, and much effort is therefore given to the organization of total research activity. The dangers of over-construction and control, especially in the 4 universities that serve Norway's 4 000 000 people is clearly recognized. Attention is being given to the need for systematic follow-up and evaluation of the effects of research policy.

What prevents us from achieving the long view? In some respects the particular sort of freedom we have inherited from Britain, fiercely maintained and based on long tradition as the most liberal and sought-after freedom there is. We and Britain style our institutions on the adversary system, whether in our politics or our systems of law. All questions of conflict can be argued to the ideal conclusion from the stance of opposing views. It leads us however into a hypercritical and opposing attitude on most political and social issues, despite the fact that the best solution implies a single answer only. Thus to suggest that State ownership of land might be essential to sensible land-use policy smacks to many of impossible socialism. Our habits and conditioning say so, and yet in benign Norway, our Northern Hemisphere soul country, all land both town and country is held as a form of leasehold. Land speculation does not exist, nor does the real estate agent, since there is price control on housing. The lucrative but largely unnecessary business of conveyancing will also presumably be minimal. Our land use is different from Norway's, and the proportion of land under agriculture much greater. Some may think the social upheaval in the farming sector might be more than we can sensibly tolerate. In urban areas such a concept has much merit. The symbiosis of town and country is strong in New Zealand. Speculation in city land spreads to the country and coastline. The consequent diminished return on inordinate investments in farming make agriculture unprofitable. To convert our land to the 10-acre peasant's dream is the alternative, thinning our agricultural life-blood still further.

The sense of freedom a people feel is derived from their habits and manners which are their culture. Freedom is different for different people. We and Britain with our open-ended view of the sensation would feel constricted by the more rigid habits of Central Europe. They, however, would feel constricted by the less stated, possibly more insidious intrusions on personal freedom that we contrive.

In some respects what we have created is more debilitating to the spirit than bald control. E. M. Forster, Britain's great author and liberal in the first half of the century says in his essay on 'Liberty in England': "We're menaced by something—I might call Fabio Fascism—by the dictator spirit working quietly away behind the facade of constitutional forms, passing a little law (like the Sedition Act) here, endorsing a departmental tyranny there, emphasizing the national need of secrecy elsewhere, and whispering and cooing the so-called 'News' every evening over the wireless". With growing years I sense that the challenge to freedom and the democratic process in this country are equally subtle and incisive. We have modest libel laws although we have an Official Secrets Act, and we are gaining a Justice Department computer—for what merit I am not sure. The laws surrounding it and other personnel data collecting units will probably be the most enlightened anywhere. We have accessible politicians and a reasonably sympathetic system of law. We have a reputation for humanity, but tragically what we have lost is a sense of individual courage. Despite the fact that we are so close to our pioneers, most of us have lost the spirit to dare. It is intriguing in this respect to discover that a senior British Civil Servant, Dr Walter Marshall, Chief Scientist at the Department of Energy, can publicly decry the use of natural gas in power stations because of the mammoth conversion losses. Would the making of such a statement be encouraged here? How have we aged so quickly? To some degree it is a hazard that confronts all small and isolated communities fighting to come to balance with a new land. To some degree it is a consequence of the power of our State institutions in our lives—the quiet aura of power that unwittingly infuses the nation with a feeling of silent and sometimes disapproving authority. We are all to blame. If long-term goals are the cure, then climate for their creation is required—goals that transcend the party political scheme of things and the hazard of a changing political view every three years. Bipartisan participation in developing policies of national concern are crucial.

We build our emotive reactions on our habits. Our adversary political process is sacrosanct, yet we have the spectacle of the party whip, cutting across the personal view, and bringing ideas into party political conformity. Opposing collective views are compulsively manufactured on every issue. It leads for instance, while the country crumbles, to opposing schemes for superannuating us all in our ossifying old age. A limited vision of no risk for a young emerging country. The time has come to recast our habits to accept the long view—stringent planning in land use, effective and tough targets in energy development, sensible population control, and cohesive Research and Development policies. New Zealand has few alternatives. It could develop into a dilapidated microcosm of North America or Europe; it could form an alliance or axis with countries south of Capricorn, or in some austerity demonvital community in independence, developing its

own, much-needed culture. There are, of course, hazards in going it alone and some hazardous clouds are already appearing.

A society in isolation can become hyper-moralistic and crabbed. It seems to occur in materialistic communities in isolation such as ours. The materialist drive is ownership and consumption. It has a peculiar off-shoot; we set up temptations for the people and then make it a crime if they yield to them. Thus we approve of alcohol and shower honours on those who make it; on the other hand we disapprove if people over-indulge. We make safety-belts mandatory, so that our car smashes are safer.

New Zealand is probably the most learned country in the world yet in terms of an understanding of moral issues and responsibilities we are the most ill-educated. This year has seen a considerable and successful attack on our moral education. What a tragedy of contradiction. Many New Zealanders react against sex education for the young and would like to inhibit or even prohibit frank discussions on contraception and abortion and have said 'No' to homosexual law reform. Yet we have one of the highest illegitimacy rates, 15%, in the world. Surely we must not move in our legislation to protect ourselves from ourselves, but should move to a frank, sympathetic, and open-ended system which does not encourage Calvinist guilt. A system where people are educated, guided, trained, and encouraged to think particularly of their moral and political responsibilities. Social and moral agonies would then fall into perspective without unnatural pressure.

It is true we have our policy makers in land usage with the recent establishment of the Land Use Advisory Council, in energy within the Ministry of Energy Resources, and of course our Scientific Advisory bodies. It might surprise you to know that we have a planning committee co-ordinating our Education at the Tertiary level amongst our Universities, Teachers' Colleges, and Technical Institutes. However, like Jason of antiquity, the policy teeth we plant will appear from the ground as paper tigers unless we give such tigers the gnashing teeth they grew from. The example of Norway indicates the possibilities.

As a scientist talking of science, I have one recommendation to make on the matter of clear pathways of nationally-important research. Assuming present scientific structure are invulnerable to attack, our professional bodies of scientists should combine in a conference to survey our existing science and to determine in detail the scientific directions we should be taking. This should provide a detached approach which would offer ideas of extravagance and some courage, which is what New Zealand needs just now. There are hazards in such an approach—the hazard of fruitlessness. Our history is littered with unused findings of grand reports and inquiries and similar indulgences. But that is another story. Our ultimate pathways are determined by policy which is no more than an

extension of politics. We need to have faith in our expertise and enterprise and to be trained to be political beings with a strong national consciousness.

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NOTICES

PRELIMINARY NOTICE COLLOQUIUM ON TOXICOLOGY AND RELATED SUBJECTS

A meeting will be held at the Medical School, Dunedin, between Wednesday, 30th June, and Friday, 2nd July, 1976, in association with the visit of Dr Roy Goulding, Director of the Poisons Unit of the Guy's Group of Hospitals in London.

It is anticipated that the programme should cover a wide variety of clinical, laboratory and forensic aspects of toxicology, and the following headings are tentatively suggested:

MANAGEMENT OF POISONING
ANALYTICAL PROCEDURES
FORENSIC TOXICOLOGY
THERAPEUTIC MONITORING
ENVIRONMENTAL TOXICOLOGY

Dr Goulding directed the establishment of the Poisons Information Service in Great Britain and is prominently associated with collaborative development of Poisons Services in Europe.

The New Cross Hospital Poisons Unit, which is a member of the Guy's Group of Hospitals has been responsible for much original work on quantitation of drug levels in body fluids and the contribution that can be made by the laboratory to the management of poisoning.

This group has also been closely associated with the development of devices for elimination of drugs in poisoning cases.

It is hoped that there will be a very wide representation from all bodies in New Zealand with responsibilities and interests in general field of toxicology. The Working Party responsible for the organization of the Colloquium would greatly welcome an indication, at an early date, of individuals likely to attend and particularly offers of papers. Those who are interested in the Colloquium please contact

E. G. McQUEEN, PhD, FRCP, FRACP (Convener),
Department of Pharmacology,
Medical School,
P.O. Box 913,
Dunedin.

ROYAL SOCIETY OF NEW ZEALAND CENTENNIAL AWARDS FOR SECONDARY SCHOOLS

Members, particularly those who are concerned with secondary school students, are asked for support and assistance in making these Royal Society awards known.

The purpose of the Awards is to stimulate and encourage original scientific work, to recognise scientific achievement in New Zealand secondary schools. They were established in 1967 to mark the Centenary of the Royal Society of New Zealand and will be awarded annually. The Awards are available to students who expect to undertake a University degree course in New Zealand and who submit a project report by March 15th on a scientific investigation undertaken voluntarily by the student. In order to achieve the highest standard at the secondary school level it is expected that the project report will normally be submitted by March 15th of the 7th form year. However, students in lower forms are not excluded from consideration should the standard of the project report reach the designed level of excellence.

Subject to the decision of the Centennial Award Committee of the Royal Society of New Zealand:

- (1) The candidate placed first will be awarded:

The Royal Society Centennial Medal.

Books suitably engraved, to a value of not less than \$25.00. The opportunity either to visit selected institutions of scientific interest during five days of the August vacation with provision of necessary travelling and other expenses or to work for a period of two to three weeks in a selected scientific institution in the August or December vacation. During the period the award-winner will receive the necessary travelling expenses and salary at the ruling rate for vacation employees.

- (2) Up to five candidates will be awarded:

A Royal Society Centennial Merit Award Certificate. Free membership for three years of a member body of the Royal Society of New Zealand.

The opportunity to work for a period of three weeks in a selected scientific institution in the August or December vacation of the year of the award. During the period the award winners will receive the necessary travelling expenses and salary at the ruling rate for vacation employees.

Already, several potential chemists have been winners of awards, have worked in chemical institutions during their vacation and become local members of their local Branch of the N.Z.I.C.

WHERE IS SCHOOL CHEMISTRY GOING?

by T. R. Hitchings

Anyone who feels tempted to gaze into the crystal ball would do well to heed the words of Lord Halifax, "Perhaps the best way to suppose what may come is to remember what is past" If we take his advice then we may avoid the pitfall pointed out by George Santayana "Those who cannot remember the past are condemned to repeat it."

The purpose of this paper is to look into the background of the present situation to see how it came about, and to speculate very briefly on which direction school chemistry may take.

The origins of the teaching of chemistry in New Zealand are buried in the obscurity of the nineteenth century. We know that during the earlier years scientific knowledge had been integrated by the statement of four fundamental principles: in 1805 the atomic theory of Dalton; the cell concept of Schwann in 1839 followed the idea of energy from the work of Joule and William Thomson in the 1840's and 50's; finally Darwin's Theory of Evolution in 1859 and its subsequent development.

This picture of science stirred the imagination and provided an intellectually satisfying framework for thinkers both in Victorian England and here in New Zealand. The inclusion of natural history, or natural philosophy as it was also known, in the school programme was assured, especially as it was demonstrating its practical value in industry.

In those days secondary schools were mainly single sex. Chemistry and physics were taught in boys' schools; usually botany was taught in the girls' schools¹. Little is known of the prescriptions or the quality of the teaching, but some idea of the scope can be formed from expenditure records of the Government of the day.

In the report² of the Southland High Schools for 1888 we read that a chemical laboratory which had been "fully equipped" showed a total expenditure for "chemicals and appliances" of £91.11.8. In the same year Christchurch Boys' High School with its two laboratories and demonstration room expended £5.15.0 on chemicals and apparatus. Wellington College and Girls' High School were more extravagant, spending £75.3.4. Headmasters were given to

describe chemical laboratories as "well equipped". But even when allowance is made for the value of money then, such statements must be viewed with some suspicion.

The teaching of the day came in for serious criticism. Examiners in 1883 reported that in chemistry "the boys had learned the textbook rather than the subject"³. There can be little doubt that in general it was handled in a full abstract manner, from books rather than from experiment. Chemistry teaching was dominated by the classical tradition. Writing of the situation in Britain at that time, J. D. Bernal has this to say "The professional school-master almost managed to make the understanding of chemical reactions as dull and as dogmatic an affair as the reading of Virgil's Aeneid".

By 1908 the total amount of science taught in secondary schools, on the average, was about 3 hours total a week for physics, chemistry, and a little physiology⁴ for boys. For girls little except botany was taught⁵. The average stay at secondary school was 2½ years, but only 10% of children had some secondary education.

In 1912 physics and chemistry were being taken by about 2000 pupils out of a total enrolment of 5542, that is, 35%. Three years later the Inspector of Secondary Schools (T. H. Gill) was able to report "Although in a few schools, an attempt is made to teach chemistry mainly through a textbook, with occasional demonstration lessons by the teacher, in practically all endowed schools individual practical work is a conspicuous feature of the teaching."

Towards the end of the First World War the then Minister of Education (J. A. Hanan) recommended a new attitude to the teaching of science⁷. The study of general elementary science was proposed. It would be as equally suitable as the individual sciences of chemistry, physics and so on, for the first three years. This thinking, together with the view widely held in schools that chemistry was a hard subject to score well in in the University Entrance and Scholarship examinations, resulted in such a swing away from chemistry that in some large schools its teaching as a separate science was discontinued.

This trend had its opponents. The Inspector of Schools at the time (T. R. Cresswell) commented that "a reduction in the time devoted to chemistry is a retrograde step from the educational point of view and a serious loss from the national point of view"⁸.

By the mid twenties opposition to this broad treatment of science was growing rapidly. In 1934 the Auckland Secondary Schools Masters Association declared that it was impracticable. It was felt that such a subject would become a mass of scrappy details on which it would be difficult to build a course giving any training in scientific method. The following year an inquiry was instigated by the Entrance Board of the University of New Zealand⁹ on the advisability of recasting the prescriptions in sciences. The consensus of opinion from teachers seemed to be "definite branches of science preferred for examination purposes" General Elementary Science died a lingering death in the face of the hostility of a teaching body solidly content with its reliance on academic tradition.

The turning of the tables did not occur till 1944 with the publication of the famous Thomas report. It profoundly altered the pattern of science teaching, and chemistry's great rival, General Science was reborn, a subject to be taken as part of a compulsory core in the first two years at secondary school, then as an option to chemistry for the new School Certificate examination.

School Certificate

1945 saw the scope of the School Certificate chemistry prescription widened to include elements of both inorganic and organic materials so that "pupils might have a reasonable knowledge of those principles of chemistry affecting their daily lives".

The position up to the post war years is summarised in Fig. 1¹² prepared by Searle.

Problems in the sixth form resulting from pupils with the alternative background of either General Science or Chemistry became immediately apparent. Searle was able to say in 1957, "The background standard for the sixth form in the particular sciences is of course, intended to be equivalent to one year's study beyond the School Certificate level in those sciences. It is considered by many teachers to be almost impossible of attainment in one further year by the student who has taken only general science to the fifth form level." Further serious criticism of General Science was soon voiced—"the present prescription demonstrates clearly that its framers had no conception of it other than a hotch potch of other sciences, with no form of unity."¹¹

University chemists lent support to the mounting criticism. Dr H. N. Parton in his presidential address to the Canterbury Science Teachers Association¹³ said "On the last occasion on which I had the privilege of addressing this Association, I put before you the question 'Is there a General Science?' Reading again what I said at that time, I find that the question was not entirely rhetorical and I think that the answer given, the negative answer, was not unreasonable."

The School Certificate chemistry prescription, on the other hand was praised by one of the best known teachers of the day. Here is an extract from his report.

"It in particular indicates a broad approach. It shows clearly a sense of purpose and a realization of the place of chemistry at school level. Whilst adequate attention is given to the development of the concepts and principles of chemistry, it is not forgotten that chemistry is a functional factor in the

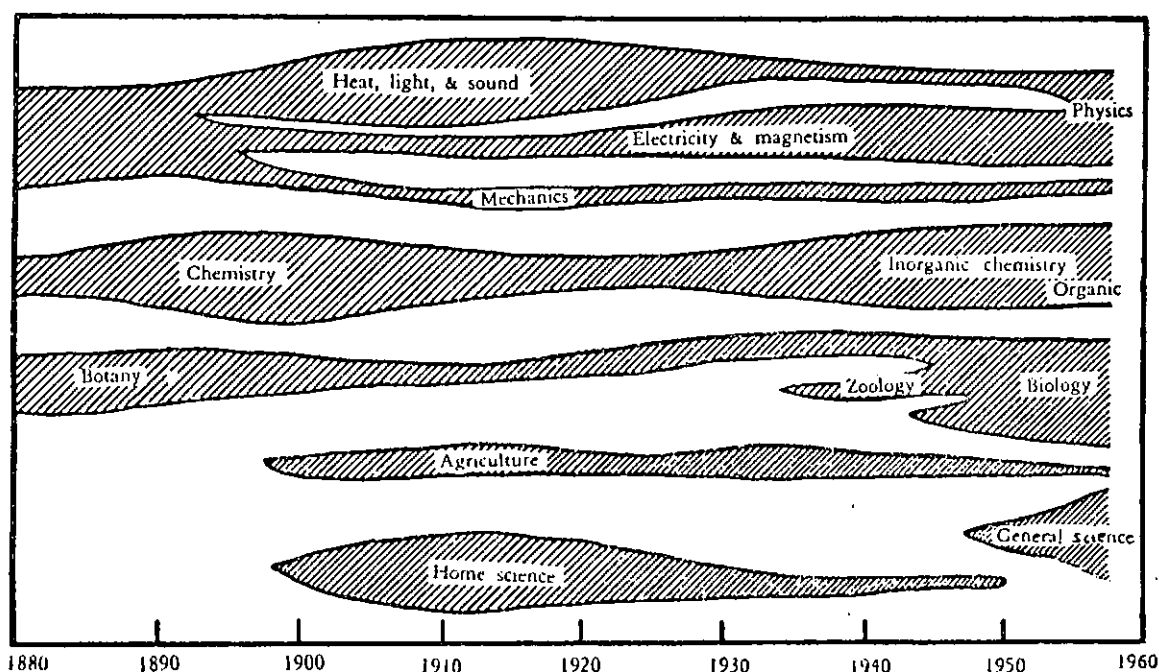


Fig. 1. The development of science in post-primary schools.

pupil's environment. The reason for the inclusion of specific topics in the syllabus is made apparent, and this results in a feeling that the whole has been inspired by a sound philosophical approach based on experience and contact with schools and pupils. For those not proceeding further in the study of the subject it provides an extensive and satisfying course. For those continuing the study of chemistry it should give a solid store of factual knowledge and a clear understanding of basic principles and fundamental concepts. In its adaptability it provides satisfactorily for the wide range in ability of the pupils who will have to follow it, and, further, it is a prescription that lends itself admirably to experimental exposition.

Criticism could with some justification be levelled at its length, and it could be urged that it has many features of a teaching syllabus rather than of an examination prescription. Its many good features, however, outweigh any such minor defects that it may possess. It stands up well to both critical investigation and to the test of experience.¹⁴

Both of the School Certificate prescriptions, in general science and chemistry, were to survive with very minor modifications for more than twenty years.

In 1964 strong pressures developed to integrate more closely the curricula of intermediate and secondary schools. On the recommendation of the Commission on Education¹⁵ a Form I to IV science programme was introduced in 1966. It sought to bring in, amongst other topics, an elementary consideration of chemical ideas such as pure substances and mixtures, elements, compounds, types of chemical change and the energy associated with chemical reactions.

The success of the scheme depended upon the effective training of intermediate school teachers who did not usually have the necessary background

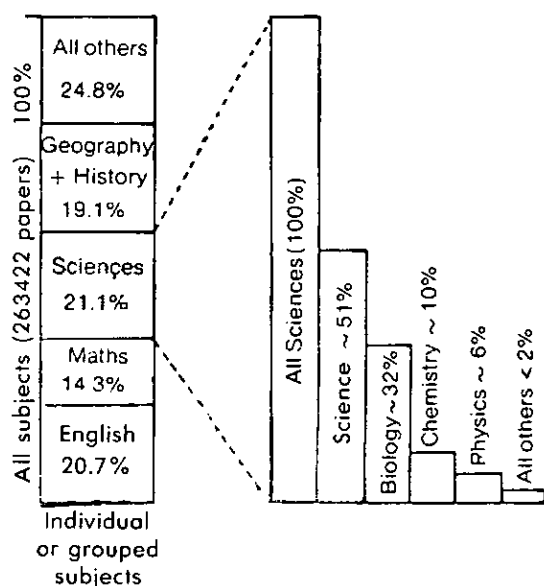


Fig. 2. S.C. 1973: ALL CANDIDATES. Numbers of papers sat in various subjects.

in science, nor the opportunity to specialise in one sector of the curriculum. In addition, fairly massive financial support to provide the equipment and facilities in intermediate and primary schools was essential. Neither of these supportive measures eventuated on a scale sufficiently worthwhile to give the new programme any chance of success. We still have, therefore, as a foundation for the years prior to the School Certificate year, a four year programme, compressed into two, and source for a great deal of dissatisfaction particularly for teachers who recognise the difficulties of those pupils without the intellectual equipment to cope with this compression.

During the late 1960's the old general science prescription for School Certificate was gradually phased out and the new prescription was called simply "Science". There was little doubt that some of the administrators able to exert a major influence upon the secondary curriculum hoped and expected to see Science replace all the individual sciences. This retarded efforts to revise the chemistry syllabus at that level. As a result, except for minor modifications and the inclusion of a preamble and statement of objectives in 1970, the original syllabus produced in 1944 survives to the present day.

Let us see what the effects of these reforms were. The last year for which a full statistical analysis is available is 1973 and these results have been reported by Strachan¹⁶ (Fig. 2). The numbers sitting chemistry are about 10%. However more than half these candidates now come from the Pacific Islands.

If we restrict our data to New Zealand school candidates, the numbers are as shown in Fig. 3.

Four fifths of all candidates take one or another science. This is shown by comparing the first and second bar. Cross hatching shows the number of candidates taking that subject and one or more other science subjects. Chemistry makes up only

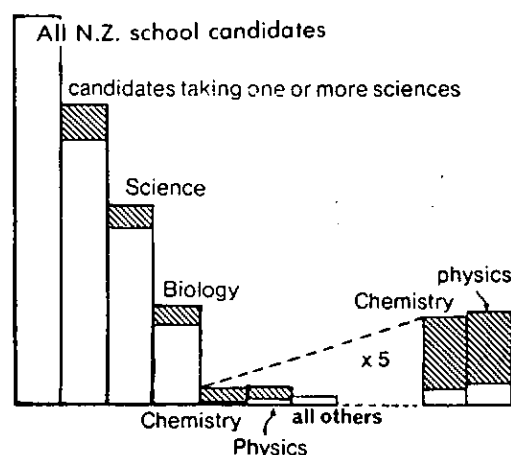


Fig. 3. S.C. 1973: ALL N.Z. SCHOOL CANDIDATES. Popularity and combinations of science subjects.

Cross hatching shows numbers of candidates taking that subject and one or more other science subject.

about 5% of the total number of candidates.

The trends are shown in Fig. 4.

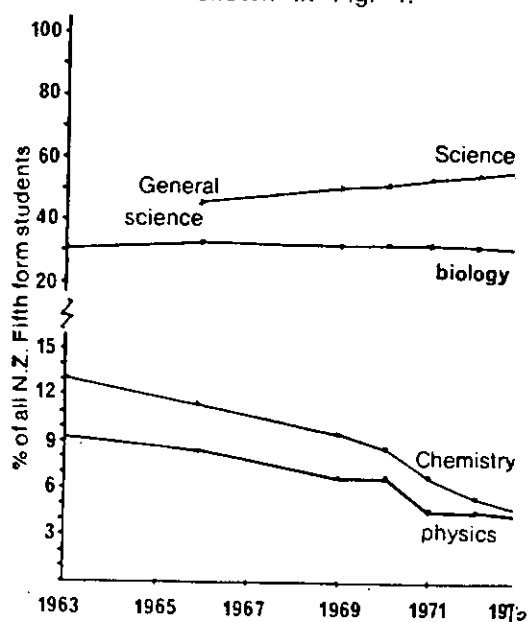


Fig. 4. ALL N.Z. FIFTH FORM STUDENTS. Trends in percentages taking science subjects.

Over the last ten years chemistry and physics have fallen steadily while biology remains constant and science shows a steady rise in popularity.

It is interesting to speculate as to the possible reasons for such a decline.

Firstly, the change in the nature of the school population from Renwick.⁶

TABLE 2. ESTIMATED PERCENTAGE OF PRIMARY SCHOOL LEAVERS PROCEEDING TO POST-PRIMARY EDUCATION

	1900	1920	1940	1960
	(10-15)	30	63	98

By 1960, virtually all primary school children were going on to secondary school.

TABLE 3. LENGTH OF STAY AT POST-PRIMARY SCHOOL

	Percentage leaving each year			
	1920	1940	1960	1970
In first year	39	21	8	3
In second year	30	32	33	16
In third year	18	23	32	31
In fourth and later years	13	24	27	50

The percentage staying on for four or more years has continued to increase.

It must be acknowledged that one certain reason for the drop in percentage of those offering chemistry for School Certificate arises simply from an increasing proportion of less able candidates who, in

former years, did not stay long enough or present themselves for the examination.

This position could be examined by comparing the number of School Certificate candidates in chemistry as a fraction of the total population in a comparable age group whether at school or not.

Such a direct comparison is simply not possible as the data are not available in a suitable form.

Changes in the nature of the groups presenting chemistry are much more significant. The pass percentages in School Certificate papers tend to be adjusted into the region of 45-55% for all subjects. In the year 1972 this was so, with the exception of subjects clearly seen to be presented by small groups of exceptional candidates, such as Latin and Russian.

Compare chemistry and science.

A small number of extra mural candidates are not included above. Clearly those taking fifth form chemistry in New Zealand constitute an elite group and, unless special consideration were given in adjustment of the median, they are extremely vulnerable to a shift away from presenting chemistry by Island candidates, who in general, do not have a high success rate.

Form Six

At the beginning of the sixties teachers became restive with the prescription at sixth and seventh form level. These are controlled by the universities. In 1965 Sutherland in a survey of chemistry teaching¹⁷ criticised the length of the syllabuses and drew attention to the possibility of threading the facts of chemistry on to certain guiding ideas.

This idea had been developed in two high school teaching programmes in the United States, the CHEM study and CBA projects. CHEM Study was tried by a small group of schools in New Zealand in 1964, but Sutherland voiced the opinion shared by many teachers that these programmes perhaps leaned heavily on chemical concepts which were sometimes too intellectually demanding for 16/17 year olds.

A decision was made at a meeting of teachers involved in the programme that, notwithstanding the attractiveness of much of the material and its supporting films and aids, students would be better served by a major revision of the Universities Entrance and Scholarship prescriptions. These took place in 1965 and marked a turning point in chemical education.

Up till this time it was assumed that all candidates would be expected to have a background of

TABLE 4

	N.Z. Schools		Island Schools		Total	
	Number	Pass %	Number	Pass %	Number	Pass %
Chemistry						
Sitting	2 926	59.2	2 537	38.1	5 534	49.0
Science	26 737	51.8	332	12.3	27,138	51.3

School Certificate chemistry. The decision to write the new prescription assuming only a background in School Certificate General Science recognised what had been apparent for several years. That is, that most students were in schools where chemistry was not taught as a separate science until the sixth form. The reasons for this decision were practical ones. The growth of General Science and its appeal for the less able altered the statistical balance. Teachers could see, year by year, as the swing continued away from chemistry, average students succeeding less and less. The weaker ones opted for General Science with its easier pickings. In addition the claims for a broader, less specialised fifth form curriculum made General Science more educationally acceptable for those who wished to keep their options open. Only the exceptionally able could cope with a six subject School Certificate course, and for those with fewer subjects, to take chemistry meant a commitment to specialisation they generally were not prepared to make.

The second major decision made was that a *prescription*, not a *syllabus* would be prepared. As far as possible teachers would be left free to determine their own teaching sequence. This allowed as much room for individual manoeuvre as possible.

The third major break with tradition was the provision, for the first time, of a prescription which had explanatory notes to guide the depth of treatment. But probably the most radical change made was to make possible minor alterations at any time, and a major review of whole prescription after five years.

The quality of this complete restatement of what senior school chemistry should be is indicated by its survival in essential outline to the present day. In 1969 the section on macro molecules was rewritten. In 1975, after a very extensive inquiry, the prescription was rewritten in the same basic framework but with the addition of a clear statement of the objectives as an introduction.

A measure of the appeal of chemistry in form six can be made by looking at the proportion of University Entrance candidates taking it. University Entrance can be gained by passing the examination or accrediting. The combined data for 1966-1974 is as follows

TABLE 5¹⁸

Year	Sitting in Chemistry	Total	% Sitting in Chemistry
1966	6 177	14 751	41.8
1967	6 686	15 826	42.2
1968	7 700	17 802	43.2
1969	8 815	20 378	43.3
1970	9 512	22 956	41.4
1971	9 840	24 048	40.9
1972	9 778	23 839	41.0
1973	9 531	24 031	39.7
1974	9 351	25 241	37.0

In the last two years there can be seen evidence of a small decline in the numbers offering chemistry.

It may be dangerous to say this, particularly in International Women's Year, but one reason is the increasing proportion of girls in the sixth form. See Table 7.

TABLE 7

1st July	Rolls	Total Roll	Girls	%
1971	23 849	11 034	46.3
1972	25 029	11 754	47.0
1973	25 417	12 215	48.0
1974	not available

I will reconsider this factor in conjunction with Form Seven trends.

Form Seven

In 1966 the Bursaries examination was introduced. In 1970 this examination was combined with the Scholarships examination in the 5/3 system.

These two dates therefore mark changes in the type

TABLE 8

	Bursary Numbers sitting			Scholarship Numbers sitting		
	Total	Chemistry	%	Total	Chemistry	%
1966	2 998	1 729	57.6	743	534	72
1967	3 347	1 911	57.1	878	615	70
1968	3 722	2 158	58.0	996	707	71
1969	4 251	2 491	58.6	722	513	71
1970	5 141	3 305	64.3	1 112	478	43
1971	5 659	3 437	60.7	1 085	481	44
1972	5 922	3 558	60.0	1 161	535	46
1973	5 933	3 416	57.6	1 091	483	44
1974	6 185	3 477	56.2	1 173	542	46

of examination. The change in the nature of the Scholarship examination in 1970 produced an abrupt increase in the numbers sitting. Since that date there seems to be a small but definite trend away from bursary chemistry. Scholarship numbers are quite steady.

It is highly significant that, as in the sixth form, the nature of the group is changing. See Table 9.

TABLE 9

Seventh Form Roll

	Girls	Total	%
1970	2 204	6 277	35.1
1971	2 376	6 564	36.1
1972	2 487	6 860	36.2
1973	2 963	7 025	38.3
1974	2 928	7 124	41.1

The steady increase in proportion of girls will be a major factor in accounting for apparent decline in chemistry. Girls tend to select the social studies, languages and biology; increase in numbers in these courses could give the impression that a reduced proportion of seventh formers are taking chemistry. In 1973 47.3% of those taking seventh form biology in State schools were girls, with only 29% taking chemistry. About 1 in 2 of those taking biology are girls, but only slightly more than 1 in 4 are girls taking chemistry; chemistry students are simply becoming more diluted as an increasing proportion of the population enters the sixth and seventh form.

University

Beyond school the future of the graduate in chemistry as in all hard core sciences has also changed. He or she can no longer assume that a pass degree will open the door to work at the bench. This year's guide from one University states "There are indications that (the) situation is changing and that while honours or higher degrees in science will continue to lead to specialised work in the chosen subject, the pass B.Sc. degree, like the B.A. will not necessarily do so." A degree in chemistry at the pass level may be of greatest value as an indicator of general educative level rather than specialised training.

Some members of the Institute and colleagues in the United States and elsewhere are concerned about the changing output of chemistry graduates; this may be due to changing attitudes to fundamental research and to the astonishing variety of alternative courses. But I submit that this swing does not begin in the schools. Remember firstly, that professional opportunities to work at the bench are now severely limited for those with a pass degree; secondly, because of the alternatives available in relatively new, allied fields, this trend may be inevitable. Courses leading to other than a B.Sc. or B.Sc. Hons., for which Chemistry I is a prerequisite include—pharmacy, dentistry, agriculture, medicine, engineering, veterinary science, bio technology, food technology, horticulture, forestry, microbiology, human nutrition, mineral technology, optometry. The balance between those engaged in pure and applied or related fields is a dynamic one and sensitive to many factors. The influence of schools is only one of these.

Conclusions

Using this survey of the past and present as a background, it should be possible to make some assessment of the future.

The teaching of chemistry is certain to be affected by general educational changes. One of these is the increasing tendency to remain at school longer. This appears to be a major factor in what at first seems to be a decline of popularity in chemistry at School Certificate level. Simple dilution of the senior school population by the less able can create a statistical swing away. If a major aim of chemistry teachers is to produce a relatively small number of exceptionally able graduates, then this need be no cause for concern. But if there is value, or even a necessity, for elementary chemical ideas to be widely disseminated in the population, then this situation is serious. Teaching programmes designed to attract and hold the average student (and this does not only mean the pass degree candidate) and those going on to other kinds of institutions must be developed. Even further, it will be essential to encourage students whose abilities do not even enable them to reach University Entrance standards to persevere with chemistry in the sixth form. Our job is to get them into a state of chemical literacy.

This is why the acceptance of the Sixth Form Certificate by the community is vital.

Schools themselves are experiencing a general climate of change. Time honoured traditions and forms of organisation are being called into question. The ability of the adult community to predict what will be best for the young can no longer automatically be assumed. The content of knowledge has become so vast that one must ask "How much of what we have to teach is it worth bothering to know about?"

Perhaps the most explicit confrontation with tradition lies in the challenges to what has been referred to as the 'protestant ethic'. Its essential values are being increasingly challenged, and some of the pressures on secondary schools stem from this. The temptation to be resisted is that of allowing chemistry at school to become the preserve of an intellectual elite. The fabric must be strengthened throughout. It will not be either possible or desirable to put the clock back and have chemistry standing on its own as a major science below the sixth form.

One possible solution is the proposed introduction of "Physical Science" for School Certificate next year. A series of topics in chemistry and physics is to be offered to the teacher, who may choose from more than a dozen modules the ones which seem best suited to his class. It is possible that individual selection to suit particular students may also be made.

Such a system is not without its critics. Obviously the individuality of both chemistry and physics appears to be lost, the time spent is reduced, and the students who have taken such a course will be of highly variable quality in their chemical attainment. The real gain in comparison with General Science will be worthwhile increases in the time spent on both chemistry and physics, and also the possibility of taking the new "Biological Science" paper within a normal five subject course. At all levels the temptation to create a theoretical superstructure will need to be resisted. The inclusion of material on the grounds that it will be "useful next year" is no longer acceptable.

William of Ockham said many years ago "It is vain to do with more what can be done with less". In the middle years of secondary school the student is impressed but not attracted by chemical sophistication. Too much attention has been paid to chemical vocabulary. Theory and the concentration on the grammar of chemistry may destroy its fun. What remains of prime importance is what was there all along—the simple delight in changes of phase, of colour and of energy. School programmes which start from this and place the responsibility for finding out literally in the hands of the student are what we need. The teacher must curb his tongue and refrain from building a theoretical framework beyond the immediate necessity.

The lesson from the past is that the place of chemistry in the middle school has been constantly challenged. In spite of this it shows a remarkable resilience and capacity to survive. In some respects the presence of large numbers of the less academically able presents a novel situation. There is no royal road to chemistry. The way is and will remain long and require some at least of those qualities it is so perplexing to my own generation to find unfashionable. The need to attract young men and women to careers in which chemistry plays a part is plain enough.

The larger and more important issue for schools however is to ensure that members of the community as a whole are aware of the importance, and are sensitive to, the consequences of chemistry. It is to this second end that teachers, with the help of our professional colleagues outside the schools, most urgently need to address themselves. Any shift away from chemistry which may be occurring in the Universities is not paralleled in the schools. A little more constructive support in first year University classes, more attention to the causes of frustration and student inability to cope, need serious consideration by those with the responsibility. Help is a two way process. Universities would do well to exploit the experience of teachers in understanding better the kinds of creatures present-day

sixth and seventh formers are, to the mutual advantage of both the profession and the community.

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BOOK REVIEW

New Trends in Chemistry Teaching, Vol. III, UNESCO 1972, £2.5, 335 pages. (Edited for UNESCO by E. Cartwell, University of Southampton.)

This volume presents papers originally published in 1969-71, and has been prepared in close connection with IUPAC with a view to use in developing countries. It is divided into 6 sections—the periodic table; bonds and structures, energetics and kinetics, chemistry, industry and environment, nuclear science, selected topics; source book.

This could be a very useful book, but it seems a pity that the editor has apparently no clear idea who he was

producing the book for. Not only are some articles in French and some in English, which means that the majority of readers could not cope with all of them, but the articles are of very uneven standard. Some have been written for the public at large (Great Moments in Chemistry—a series of radio plays), some for educators (who would like to know what is going on in other places from general interest) and some for the use of students ranging from pre-school certificate level to university.

The third part seems the most useful for not only schools in underdeveloped countries but also for New Zealand—especially the article on corrosion of

metals and its control with a whole series of simple experiments which would be of interest to fifth and sixth form students.

Part four on nuclear science is well presented and the experiments clearly described, but it seems wrong that no safety measures are mentioned anywhere. Also this is taken from a UNESCO Chemistry Teaching Project, and to publish it again in a UNESCO publication seems rather a waste.

On the whole the topics chosen are too specialised and often too unimportant to be of much use to the readers for whom this book purports to be assembled.

D. Suuring.

ADDITION OF IODINE AZIDE TO ALKENES

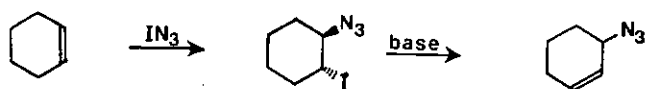
by Truis Smith-Palmer,
University of Auckland

Previous workers in our Department at Auckland have investigated the use of thallium(I) salts in organic synthesis. During this work thallium(I) azide and iodine in dichloromethane was found to add the elements of iodine azide across the double bond of cyclohexene. Hassner of the University of Colorado had previously reported that a mixture of iodine monochloride and sodium azide, usually in acetonitrile, was a stereospecific reagent for adding iodine azide to unsaturated molecules. When a comparison was made between the two reagent systems using cyclohexene as the substrate and acetonitrile as the solvent, it was found that they did not give identical results. Thus a more extensive investigation into the reaction of thallium(I) azide and iodine was begun.

Firstly, I will discuss iodine azide and several of its typical reactions, and then discuss more fully the reaction of thallium(I) azide and iodine with a steroidal, and therefore conformationally rigid, alkene.

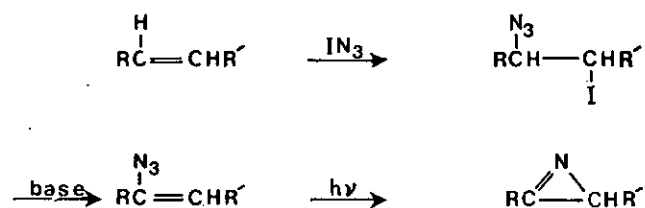
Iodine azide was first synthesized by Hantsch in 1900 by stirring an aqueous suspension of silver azide in ether with iodine. It was isolated as highly explosive, yellow crystals. Little further was done until the last 20 years or so when Hassner became interested in iodine azide as a means for stereospecifically introducing nitrogen functions into molecules. For instance, azides are useful in the generation of nitrene intermediates, and in the synthesis of a variety of heterocyclic compounds.

Elimination of hydrogen iodide from vicinal iodo azides proceeds in an anti-periplanar manner. For example, elimination of hydrogen iodide from the iodo azide formed from cyclohexene gives the allylic azide.

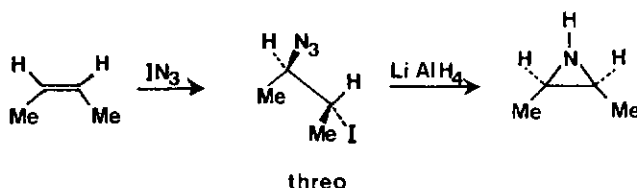


However in acyclic systems elimination of hydrogen iodide leads to vinyl azides rather than allyl

azides. Hassner also found that photolysis of vinyl azides would give a 1-azirine ring. Lithium alumin-



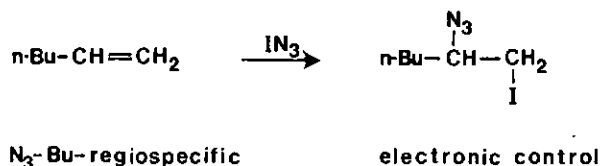
ium hydride reduction of the vicinal iodo azides themselves has been reported to be a highly stereospecific method of aziridine synthesis.



Addition of olefin to a slurry of iodine azide formed by the method of Hantsch resulted only in a black oil containing some iodohydrin. Hassner attributed this to the slow decomposition of the iodine azide in the presence of water. He developed an alternative method for the formation of iodine azide in which a solution of iodine monochloride is added dropwise to a cold slurry of sodium azide and left to stir for about 10 min. There is a colour change in acetonitrile as solvent from the orange of the iodine monochloride solution to the yellow of iodine azide. The olefin is added to the cold slurry, which is then warmed to room temperature and left to stir overnight. Iodine azide itself has never been isolated from these solutions, although its presence has been well established. The products are vicinal iodo azides, and they are formed even when the olefin is added to the filtrate from the slurry. Since sodium azide is insoluble in acetonitrile, the iodo azides cannot arise by azide ion attacking a cation derived from iodine monochloride. In the remainder of this paper the reagent formed in the above manner will be referred to as iodine azide.

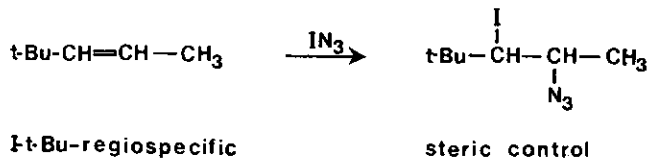
Hassner has reported that iodine azide, like iodine isocyanate, always adds stereospecifically to double

bonds to give *trans* products. However, in contrast to the addition of iodine isocyanate to 1-hexene where both primary and secondary isocyanates are obtained, the addition of iodine azide to 1-hexene gives only the secondary azide.

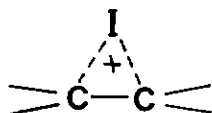


Hassner proposed the term 'regiospecific' for such reactions. For simple alkenes the two possible modes of addition of an unsymmetrical reagent to an unsymmetrical alkene are often distinguished by the terms 'Markownikov' and 'anti-Markownikov'; but when discussing alkenes such as androst-2-ene, this terminology is inadequate.

Another example of iodine azide addition is with 4,4-dimethylpent-2-ene, where the direction of addition is determined by steric control.

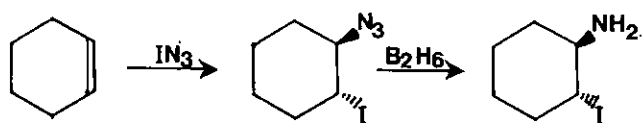


The above reactions can be explained by the intermediacy of an iodonium ion which is opened by attack from the opposite face to give a *trans* product.

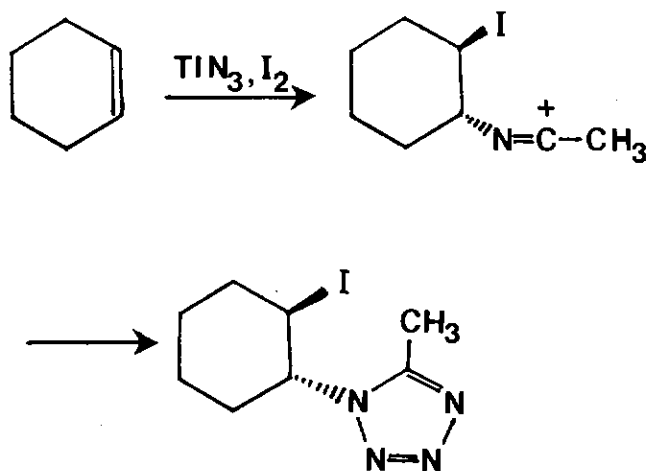


Hassner has reported that this iodonium ion is fairly stable, as even when it was possible to form a benzyl cation instead, e.g. with stilbenes, only the expected products from the iodonium ions were observed, i.e. *cis*-stilbene gave only *threo* iodo azide and *trans*-stilbene gave only *erythro* iodo azide. If a benzy cation had been formed, a mixture of *threo*- and *erythro*-iodo azide would be expected from each of these reactions.

As shown previously, iodine azide adds in high yield to cyclohexene to give the *trans* iodo azide adduct only. When reduced with diborane this product was shown to be identical with *trans*-1-amino-2-iodo cyclohexane prepared independently. We



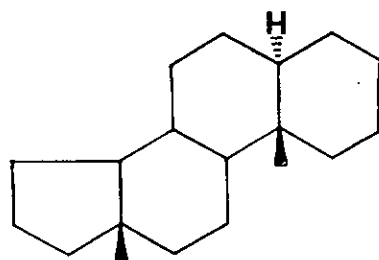
have found that this *trans* iodo azide of cyclohexene can also be formed by gradually adding a solution of iodine in dichloromethane to a stirred slurry of thallos azide in a solution of cyclohexene in dichloromethane. When acetonitrile was used as the solvent however, the major product was the solvent incorporated *trans*-iodo tetrazole. This presumably arises from a Ritter type intermediate by reaction with azide ion and subsequent cyclisation, since no reaction occurred when the iodo azide itself was treated with thallium(I) azide and acetonitrile.



Similar solvent incorporation has been reported for bromine azide.

In contrast to the case of sodium azide and iodine monochloride, in either acetonitrile or dichloromethane (where it is possible to form iodo azide adducts from a preformed, filtered mixture of the reagents) no iodo azide was formed if cyclohexene was added to a filtered mixture of thallium(I) azide and iodine in dichloromethane. When cyclohexene was treated with sodium azide and iodine in dichloromethane, no iodo azide was formed, but with acetonitrile as the solvent the iodo azide was again obtained. Thallium(I) azide thus appeared to react in a different way from sodium azide, and it was necessary for cyclohexene, thallium(I) azide and iodine all to be present in order to obtain iodo azide adducts.

To further investigate the stereospecificity of the thallium(I) azide/iodine reagent, 5 α -androst-2-ene was used as a substrate. It was chosen because

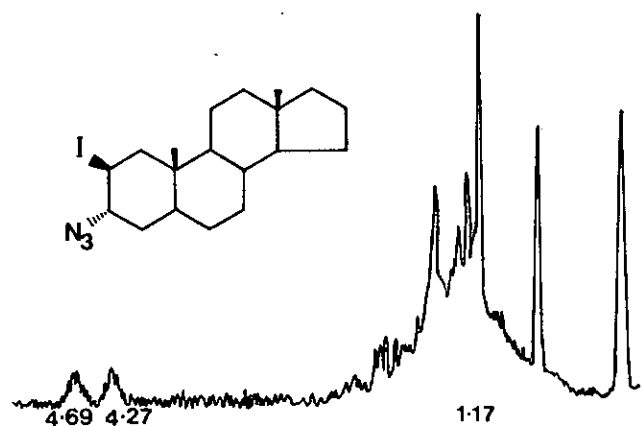
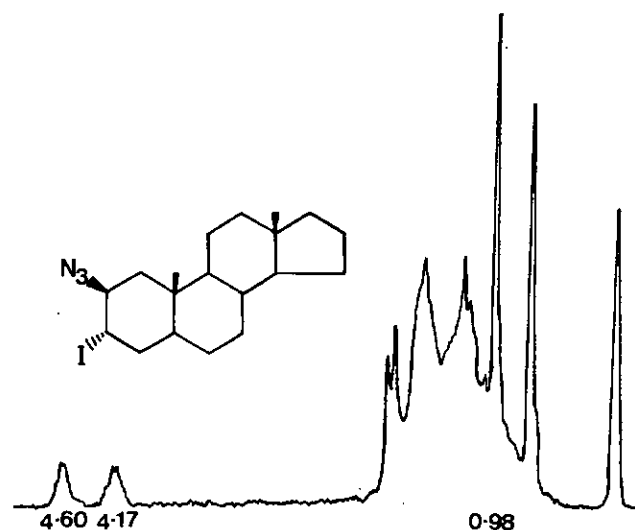
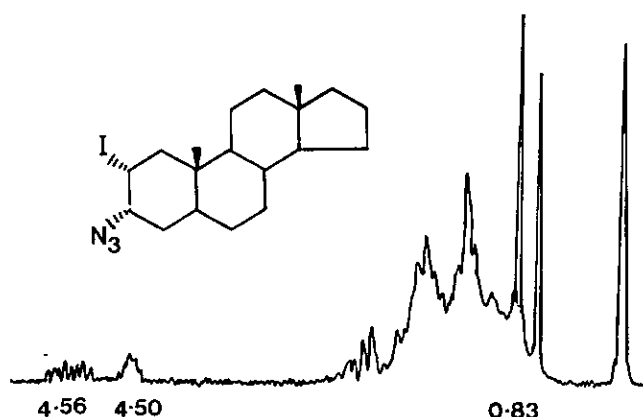


the structure is rigid compared with cyclohexene, and it has only two methyl groups and thus has a fairly simple n.m.r. spectrum. It was hoped that identification of products would be facilitated since the C-19 methyl signal is known to shift if certain substituents are present in the 2 β -position, and this shift is easily seen in the n.m.r. spectrum.

Shift (p.p.m. downfield from C-19 methyl of androstane.)

2 β -H	0.0
2 β -N ₃	0.2
2 β -I	0.4

When thallium(I) azide and iodine was reacted with androst-2-ene, three isomeric iodo azides were obtained in 90% yield. These isomers were separated by preparative thin layer chromatography using n-hexane as solvent. Elemental analysis showed they were isomeric iodo azides, and the presence of azide in each was also shown by a distinct band in the i.r. spectrum of each at 2100 cm⁻¹. See below. Two



of the isomers had similar R_f values, and these were assigned as the *trans* diaxial isomers, as in the n.m.r. spectrum of each there were two downfield proton resonances with halfwidths of about 7-8 Hz. Since equatorial protons couple less with adjacent hydrogens than axial protons, equatorial proton resonances are narrower than axial proton resonances which have a half-width of about 20Hz.

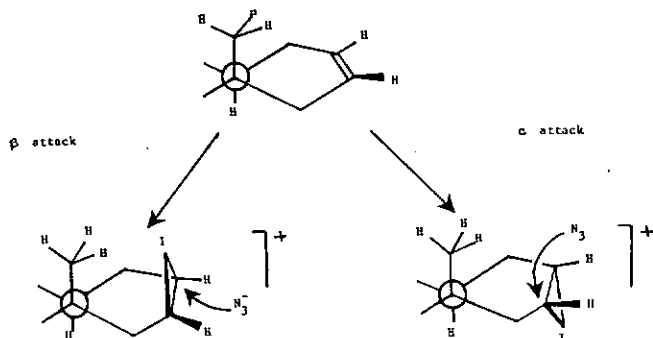
With the protons equatorial, the substituents must be in the 2 β and 3 α positions. The main isomer was the faster moving of the two and its C-19 methyl signal showed a downfield shift of approximately 0.2 p.p.m. from the C-19 signal in the parent androstane (δ 0.69). Assuming ring A is in a chair form, this is the expected shift for a 2 β -azido substituent, whereas a 2 β -iodo substituent is expected to cause a shift downfield of approximately 0.4 p.p.m. Thus the main isomer is assigned as 2 β -azido-3 α -iodo-5 α -androstane.

The C-19 methyl shift in the n.m.r. spectrum of the minor *trans* isomer was approximately 0.4 p.p.m. downfield and this isomer is thus assigned as 3 α -azido-2 β -iodo-5 α -androstane.

In the spectrum of the minor compound there were again two downfield proton resonances. How-

ever, although one had a half-width of 6Hz showing that it arises from an equatorial proton, the resonance furthest downfield had a half-width of 22Hz and must be due to an axial proton. Since the C-19 methyl showed only a downfield shift of 0.02 p.p.m. from that of the C-19 signal in androstane, no substituent can be present in the 2 β position, and thus this must be the position of the axial proton. Hassner has reported that a proton geminal to a secondary iodide resonates further downfield than a proton geminal to a secondary azide. As the axial proton resonance is furthest downfield and the axial proton is in the 2 β position, the iodine must be in the 2 α position. This isomer is therefore assigned as 3 α -azido-2 α -iodo-5 α -androstane. The ratio of *trans* 2 β -azido: *trans* 2 β -iodo: *cis* was 3:2:1. All three isomers were also obtained when 5 α -androst-2-ene was treated with sodium azide and iodine monochloride in acetonitrile: ether (1:1). The ratio of *trans* 2 β -azido: *trans* 2 β -iodo: *cis* was then 7:2:1.

Formation of the two *trans* isomers can be rationalised in terms of formation of both α - and β -iodonium ion intermediates which are then opened in a diaxial manner.



Formation of an iodonium ring α to the steroid face is more favoured for steric reasons and leads to the major product. Attack at C-3 of the α -iodonium and at C-2 of the β -iodonium ion is not favoured, since although this would ultimately lead to a diequatorial and therefore more stable conformation, the reaction would have to pass through a boat transition state.

Formation of the *cis* product is less easy to explain and requires either radical addition, the formation of a carbonium ion-like intermediate, or addition via a termolecular transition state. Radical addition of iodine azide has not been reported in acetonitrile as solvent, but Hassner has suggested

that it does occur in pentane under nitrogen. We therefore used pentane under nitrogen as the solvent for the reaction of preformed iodine azide with androst-2-ene. Although only a low yield of product was obtained, the relative amount of the *cis* compound compared with the main *trans* isomer had increased. Reacting thallium(I) azide and iodine with androst-2-ene in *n*-pentane again gave only a low yield of product, but this time the *cis* product had decreased with respect to the main *trans* product. Thus radical addition does not seem likely. With a carbonium-ion like intermediate it is difficult to explain the difference between the two reagent systems. With thallium(I) azide and iodine, the thallium must be involved in the transition state, as we have shown that iodine azide is not preformed in those reactions.

We began by showing iodine azide as a stereospecific reagent, but then gave an example where it was only stereoselective. Thallium(I) azide and iodine was shown to react via a different mechanism from sodium azide and iodine monochloride, and to be more solvent dependent. Thallium(I) azide and iodine can thus be used as an alternative to iodine azide for some reactions, but in other cases such as with acetonitrile as solvent, this leads to solvent incorporation rather than azide formation.

INTERNATIONAL UNION OF INDEPENDENT LABORATORIES DIRECTORY OF MEMBERS

The Union Internationale des Laboratoires Independents (UILI), has published a new edition of its directory drawing attention, at an international level, to the activities of its members in order to provide potential users of the members' services with a ready means of locating the most appropriate laboratory or consultant, also to promote close international co-operation between members of the national associations affiliated to UILI. The directory records the names, addresses and fields of activity of all the members, together with particulars of UILI and its national Member Associations. Copies at DM 10.00 each, are obtainable from the Secretary-General, Mr R. Herzka, Ashbourne House, Alberon Gardens, London, NW11 0BN.

UILI is an international association of private laboratories and independent consultants. Its members undertake consulting and advisory work, analysis and testing, laboratory investigations, research and development, and scientific services in forensic matters, patents, and legal problems, including expert witness.

There are national Member Associations in Belgium, Denmark, France, Germany, Great Britain, Netherlands and U.S.A. There are also a total of 13 Affiliate members in Argentina, Australia, Brazil, Canada, Israel, Malaysia, Norway, Singapore and Spain.

CONFERENCE ON INDEPENDENT CONSULTANCY SERVICES

A two-day Conference on the contributions made by independent technical research and consultancy services to industry and government, sponsored by UILI, will take place in Singapore on 28th and 29th January 1976.

Further details are available from Mr A. Herzka, Ashbourne House, Alberon Gardens, London, NW11 0BN.

THE CLEAN AIR SOCIETY OF AUSTRALIA AND NEW ZEALAND (New Zealand Branch)

The Society is offering a scholarship of up to \$1000.00 to be taken up in 1976 for an overseas study tour or project to extend qualifications and/or experience in the field of air pollution investigation and control, or for undertaking an appropriate project in the field in New Zealand. In all cases it is essential that proposals are appropriate to the New Zealand scene.

Applications, in letter form, giving full details of the applicants including qualifications and experience, and their proposals with reasons why they consider these to be of benefit to New Zealand, are to be forwarded to N. G. Thom, Secretary/Treasurer, Clean Air Society of Australia and New Zealand (New Zealand Branch), P.O. Box 56-145, Dominion Road, Auckland, before 1 November 1975.

Xth I.U.P.A.C. NATURAL PRODUCTS SYMPOSIUM

Dunedin, August 23-27, 1976

For the first time New Zealand has been invited to host an I.U.P.A.C. meeting. This will be only the second time that a Natural Products Symposium has been held in the southern hemisphere. Australia hosted the first Symposium in 1960. The Symposium can only be a success if it has the whole-hearted support of New Zealand biochemists and chemists. The Council of the N.Z.I.C. has given the lead by cancelling the 1976 Conference which was to be held in Dunedin and urging members to attend the Symposium.

While the programme will appeal especially to biochemists and organic chemists it will embrace the interests of almost all New Zealand chemists. Section F, in particular, which covers separation and analysis techniques will include ^{13}C n.m.r. spectrometry, x-ray crystallography, liquid chromatography etc., and will prove of wide general interest.

The plenary lecturers represent the most outstanding group of scientists ever invited to this country and include four Nobel Laureates. They will be backed up by 30 invited "half-hour lecturers" of almost equal distinction.

This will be a once in a lifetime opportunity for members of N.Z.I.C. to see and hear those who have been the architects of much of modern biochemistry and organic chemistry, and those who will be responsible for its advancement during the next decade. The excitement and stimulus of a meeting such as this once experienced is never forgotten. For many older members of the Institute the I.U.P.A.C. Symposium in Australia in 1960 will be remembered as a highlight in their careers.

This Symposium will open a window to New Zealand, and Institute members are urged to offer research achievements and this is an opportunity to show the world the quality of our work. The programme committee will find a place for all papers that are offered which are similar in quality to those normally presented at specialist meetings of the N.Z.I.C. Some 300 research papers are expected to be presented.

The success of this Symposium depends on you. The organising committee must have your support if it is to host this meeting with credit to New Zealand.

INVITED LECTURERS (with Topics)

Presidential Address: Sir Derek Barton "Some Aspects of Natural Product Chemistry."

Closing Address: Lord Todd

Invitations have been extended to a number of other half-hour lecturers from whom replies have not yet been received.

SECTION A:

Nucleic acids, nucleotides and related compounds. Proteins and peptides (both animal and plant). Molecular biology including enzymes and hormone receptors.

Plenary Lecturers

- H. D. Niall (Australia): "Microsequence Analysis of Biologically Active Proteins and Peptides"
- F. Sanger (U.K.): "Sequence Determination in DNA"

Half-hour lecturers

- G. G. Brownlee (U.K.): "Nucleotide Sequences in Globin and Immunoglobulin Messenger RNA"
- B. F. C. Clark (Denmark): "The Relation of Structure and Function of Transfer RNA"
- G. W. Kenner (U.K.): "Big Gastrin"
- S. A. Narang (Canada): "Total Synthesis of Lactose-Operator Gene and its Biological Studies"

SECTION B

Lipids, carbohydrates and other bio-polymers including lignins, tannins and related substances.

Plenary Lecturers

- J. Baddiley (U.K.): "Cell Wall Polymers in Gram-positive Bacteria"
- P. K. Stumpf (U.S.A.): "Biosynthesis of Fatty Acids by Plant Systems"

Half-hour lecturers

- T. Higuchi (Japan): "Metabolic Differences between Gymnosperms and Angiosperms in Biosynthesis of Lignin"
- N. K. Kochetkov (U.S.S.R.): "The Structures of O-Antigenic Polysaccharides from Shigella Species"
- K. Weinges (W. Germany): "Constitution and Significance of Naturally Occurring Dimeric and Oligomeric Procyanidins"
- L. H. Prinsen (U.S.A.):

SECTION C:

Biologically active compounds, including, hormones, antibiotics, pheromones, ecdysones and toxins. Flavour and odour chemistry.

Plenary lecturers

- J. Meinwald (U.S.A.): "Chemical Ecology: Recent Advances in the Study of Arthropod Defence and Communication Mechanisms"
- K. L. Rinehart (U.S.A.): "Progress in Studies of Antibiotic Chemistry and Biology"

Half-hour lecturers

- G. W. K. Cavill (Australia): (no title available)
- E. Hecker (W. Germany): "New Toxic, Irritant and Cocarcinogenic Diterpene Esters from Euphorbiaceae and Thymelaeaceae"

SECTION D:

Biosynthesis and biosystematics, including chemotaxonomy and Phylogeny.

Plenary lecturers

- A. R. Battersby (U.K.): "Recent Researches on the Biosynthesis of Natural Products"
- T. J. Mabry (U.S.A.): "New Applications of Chemistry to Phylogeny"

Half-hour lecturers

- A. J. Birch (Australia): "The Construction of Biosynthetic Hypothesis"
- L. Canonica (Italy): "Recent Results on the Biosynthesis of Prenyl Aromatic Compounds"
- O. R. Gottlieb (Brazil): "Secondary Plant Metabolites as Systematic Markers"
- Ch. Tamm (Switzerland): "Cytochalasins: Biosynthetic and Synthetic Studies"

SECTION E:

Structural and synthetic studies of natural products, including steroid, terpenoid, alkaloid and monosaccharide chemistry.

Plenary lecturers

- P. Deslongchamps (Canada): "Synthetic Studies Towards Ryanodine"
R. B. Woodward (U.S.A.):—Provisional

Half-hour lecturers

- S. J. Angyal (Australia): "Complexing of Sugars with Cations"
M. Fetizon (France): "Synthesis of Terpenoids with the Help of Photochemistry"
E. Fujita (Japan): "Recent Advances of the *Isodon* Diterpenoid Chemistry"
A. G. Gonzalez (Spain): "Sesquiterpenoids of Plants Endemic to Spain"
Sir E. R. H. Jones (U.K.): "Microbiological Transformations"

SECTION F:

Physical methods, including ¹³C resonance, mass spectrometry, X-ray crystallography, chromatography and new analytical techniques. Separate of macromolecules.

Plenary lecturers

- D. M. Doddrell (Australia): "Structural Application of Nuclear Spin-lattice Relaxation Times"
I. L. Karle (U.S.A.): "Molecular Formula, Configuration and Conformation by X-ray Analysis"

Half-hour lecturers

- J. Clardy (U.S.A.): "X-ray Diffraction Studies of Naturally Occurring Toxins"
D. N. Kirk (U.K.): "Developments in Chiroptical Methods"
E. Wenkert (U.S.A.): "¹³C N.m.r. Spectroscopy of Naturally Occurring Substances"

BRANCH NEWS

Auckland

The memorial plaque in honour of Professor L. H. Briggs which was presented to the University of Auckland by the Auckland Branch of the Institute was unveiled at a short ceremony on 8 August. The Pro-Chancellor, Mr G. N. T. Greenbank, spoke on behalf of the University and unveiled the plaque which is situated in the ground floor foyer of the Chemistry Department.

On 14 August an evening meeting on "Science and the law" was held, being preceded by a buffet dinner. The Rt. Hon. Sir Alfred North and Dr C. L.

Davey spoke on various aspects, followed by questions and discussion.

On 2 September, Professor R. Reiser of Texas A. and M. addressed the Branch on the subject "The interdependent and independent effects in the degree of unsaturation of diet fat, cholesterol, and phyosterols on cholesterol metabolism."

The 11 September meeting took the form of an informal tour of the New Zealand Manufacturers' Research Association at Otara. The Director Dr Rogers introduced Drs Tony Herd, Garry McSweeney and Mal White who talked on the research work being done there, and Mr Doug Jackson of New Zealand

Farmers Fertiliser Company who spoke on links between the Association and its supporting industries.

University

Two visitors have spoken in the Department: Dr John Spencer of the University of Bristol on "Synthesis and reactivity of Pt and Pd olefin complexes" and Dr Roger F. C. Brown of Monash University on "New methods of making aromatic rings".

The Chemistry Department held its annual "Research Dinner", for the third year students, research students and staff on 8 August. Professor P. B. D. de la Mare and Dr D. M. Adams spoke after the meal.

Waikato

This year's lectures in the series "Chemistry in Action" given to 6th and 7th form students from all the high schools in the region were: "The Biochemist and the Case of the Missing Factor—a Case of Mistaken Identity (Vitamin D)" given by Dr. D. Wright of the Biochemistry Section of the Ruakura Agricultural Research Centre, and "Muscles, Molecules and Movement" given by Dr. C. Devine of the Meat Industry Research Institute.

Prior to the second of these lectures the students were conducted around the Chemistry Department of the University of Waikato.

Branch Meetings

At the July branch meeting Dr. J. M. Robertson of the Chemistry Division, D.S.I.R., Auckland, gave a talk on "The gazetted analyst's role in New Zealand food law enforcement".

At the August branch meeting papers were given by research students from the Chemistry Department of the University of Waikato. M. J. Grinstead spoke on "Past climate changes from tree ring isotopic data" and G. D.

Beresford spoke on "The synthesis of 4,5-diaminopentanoic acid".

Ruakura Agricultural Research Centre

Dr. D. Wright of the Biochemistry Section attended a conference in Cairo in June organised by the International Atomic Energy Agency for research workers involved in programmes on the water requirements of tropical animals. Dr. Wright has been involved in using tritiated and deuterated water to get information on the water metabolism and requirements of sheep and cattle in New Zealand and India. The conference was attended by workers from as far north as Alaska and as far south as New Zealand, but mainly from Africa.

The Biochemistry Section has observed that high levels of zinc are able to protect animals against the action of sporedesmin. Field trials with sheep and cattle have shown zinc to protect these animals against natural outbreaks of facial eczema. The levels of zinc necessary are near to the toxic dose, so research is now proceeding into means of safely giving zinc to livestock, and also into elucidating the mechanism of this effect of zinc.

University of Waikato

Dr. L. Main departed on study leave in August to spend 9 months working at the Dyson Perrins Laboratory at Oxford on peptide synthesis.

Dr. B. K. Nicholson joined the staff as lecturer in Chemistry in September. Dr. Nicholson, whose main interests are in organometallic chemistry, has been working at the University of Sussex where he was studying the formation and identification (by e.s.r. spectroscopy) of free-radical species derived from organometallic compounds.

The Chemistry Department has purchased and installed a Uras II infra-red gas analyser for determining carbon dioxide. It will be used principally for studies on the ground waters of the Waitomo caves.

The School of Science has purchased and installed two Packard Tricarb scintillation counters. One of these, a 3-channel 100-sample instrument with external standard ratio will be used for carbon dating work. The other, a 2-channel 300-sample refrigerated instrument with external standard ratio will be used for general radio-chemical work.

Wellington

Department of Scientific and Industrial Research—Chemistry Division

Dr A. J. Ellis, Director of Chemistry Division, spent five weeks in the U.S.A., Canada, U.K. and Europe. During this visit he attended an International Association Geochemistry Symposium in Toronto, the International Union of Geodesy and Geochemistry in Grenoble and a meeting of the International Atomic Energy Agency in Pisa.

Dr G. J. Leary of the Organic Section spent two months visiting different institutions in the U.S.A., Canada, U.K. and Europe discussing recent developments in wood and natural products chemistry.

Dr P. P. Williams of the Physical Chemistry Section attended the Summer School in Crystallographic Computing in Prague and was the New Zealand delegate to the 10th Congress of the International Union of Crystallography in Amsterdam.

Chemistry Division and the Institute of Nuclear Sciences will be holding

open days on October 17 and 18. During these two days members of the public and invited guests will be able to tour the laboratories and see something of the work carried out.

Mr P. G. Sim of the Physical Chemistry Section resigned in order to study for a Ph.D. at the University of Virginia with Professor E. Sinn (formerly of Victoria University of Wellington).

New staff at Chemistry Division include:

Miss J. Mulvihill who has joined the laboratory after completing work for a Ph.D. with Professor L. F. Phillips at Canterbury University.

Dr C. J. Downes has joined the Water Laboratory after working 8 years for the CSIRO at the Baas Becking Geobiological Laboratory in Canberra.

Dr R. J. Wilcock has also joined the Water Laboratory after 2 years on a Post Doctoral Fellowship at Wright-state University in Ohio, U.S.A.

Dr D. M. Bibby has joined the Cement and Concrete Section after working 4 years at the Nuclear Physics Research

Laboratory in Witwatersrand, South Africa.

Mr A. F. Fricker has joined the Mineral Processing Section. After graduating M.Sc. from Imperial College London Mr Fricker gained wide experience in mineral processing and extraction techniques; he spent the last five years working at Otago University.

Mr E. A. Dutton who recently completed a B.E. (Chem.) at Canterbury University has joined the Chemical Engineering Section.

Victoria University of Wellington—

Dr B. Halton has returned from sabbatical leave spent in the University of Reading and visiting laboratories in U.K. and Europe. Dr J. T. Craig has left for 6 months leave at the Australian National University, Canberra.

M. D. Featherstone has commenced work on an MRC grant to study the initiation of dental caries.

C. Heath has been appointed Chairman of the University Technicians' Association.

Otago

N.Z.I.C.

Dr C. D. Stevenson of the Water Laboratory at Chemistry Division, D.S.I.R. addressed the May meeting on the topic 'Water Analysis—with a pinch of salt'.

At the June meeting, Dr B. H. Robinson of the Chemistry Department, spoke on the topic 'An Inorganic Chemist's View of Organic Chemistry and Biochemistry'.

Professor A. L. Titchener of the Chemicals and Materials Engineering Department of Auckland University addressed a joint meeting with the Institute of Engineers in July on the topic "Alcohols as Engine Fuels (or what should we put in the petrol tank when the petrol has all gone)".

A social evening was held in August at which the branch was addressed by Professor Birbeck, Professor of Human Nutrition, University of Otago on the topic "Aspects of Nutrition and Health of the Western Canadian Indian".

Dr D. Whyman of the Otago Chemistry Department addressed the September meeting on the subject 'Plasmas, Thermal Plasmas and Chemistry at High Temperatures'.

Professor J. Robinson and his wife Associate Professor M. Robinson both left at the end of May for a six month overseas visit. During this time they will attend the International Congress of Nephrology in Florence, spend three months at Cambridge, and then visit various laboratories in the U.S. as well as the National Library in Washington.

Chemistry Department

Dr L. W. Deady from the Department of Organic Chemistry, La Trobe University, Australia spent four weeks in May in the department. During this time he gave a seminar on 'Basic Methanalysis of amides'.

Dr N. S. Issacs of the Chemistry Department, University of Reading visited the department at the end of June and gave a lecture on the topic 'Thermal (2+2) Cycloadditions'.

Biochemistry Department

Dr J. Cutfield has recently joined the staff. He is a Ph.D. graduate from Chemistry Department, Auckland University. He has had four years post-Doctoral experience in the protein crystallography laboratory of Dorothy Hodgkin at Oxford University. His research interests centre around structure-function studies of proteins.

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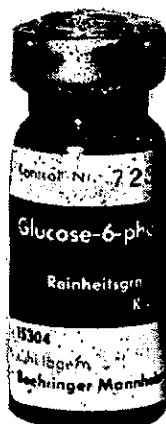
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analytical bio chemistry



For the solution of a variety of considerably complex questions, many analytical methods are employed by the biochemist. An almost classical method of analytical biochemistry came into existence from biochemistry itself, viz. the enzymatic analysis.

Enzymatic analysis means determination of metabolite concentration with the aid of enzymes, measurement of activities and study of the characteristics of enzymes in vivo and in vitro, and analysis of the control and regulatory functions within the cell and in organ metabolism.

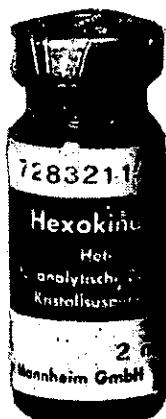
enzymology

Enzymologic research revolutionizes biology not only because of the mushrooming number of newly-discovered enzymes. To the extent to which the biologist advances into cellular regions, he will become an enzymologist; to the extent to which the enzymologist interprets biological functions of cell components enzymatically, he will become a biologist. Thus, enzymology has become one of the main pillars of all biological disciplines.



molecular biology

The research fields of protein and nucleic acid biosynthesis are nowadays lumped together – unfortunately – under the term “molecular biology.” In our program we offer enzymes, substrates, templates, primer, inhibitors and auxiliary reagents, all of which are indispensable for the study of molecular action mechanisms.



clinical chemistry

This program is noted for its search for ever more specific and predictable test methods for medical research and routine diagnosis while adhering to the rising requirements for precision and accuracy of laboratory data. On the other hand, such a program must also take into consideration the requirements for simplification and rationalization. The ideal requirement is

reached when simplification of actual labour allows, at the same time, for an increase in precision.

Our program for clinical chemistry offers numerous examples of this ideal.

food analysis

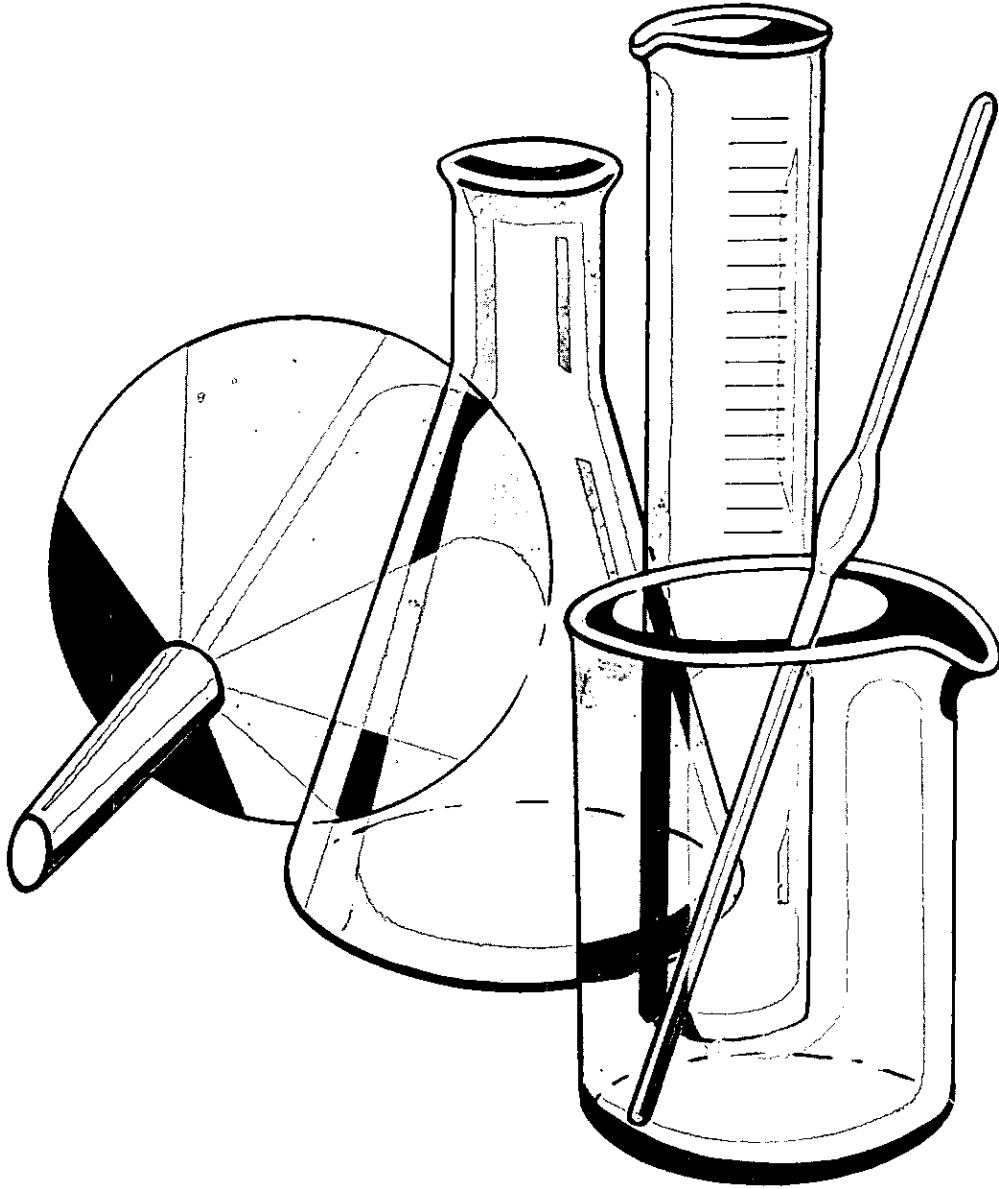
The first knowledge of biochemical processes, of the role enzymes play in them and the first experiences with enzymatic analytical methods were gained with foods. Analyses with the aid of enzymes have many advantages in food analysis: enzymatic methods are fast, safe and reproducible. The measurement of enzyme activities as a criterion of the condition of foods is supplemented more and more by enzymatic analysis of the components of foods.



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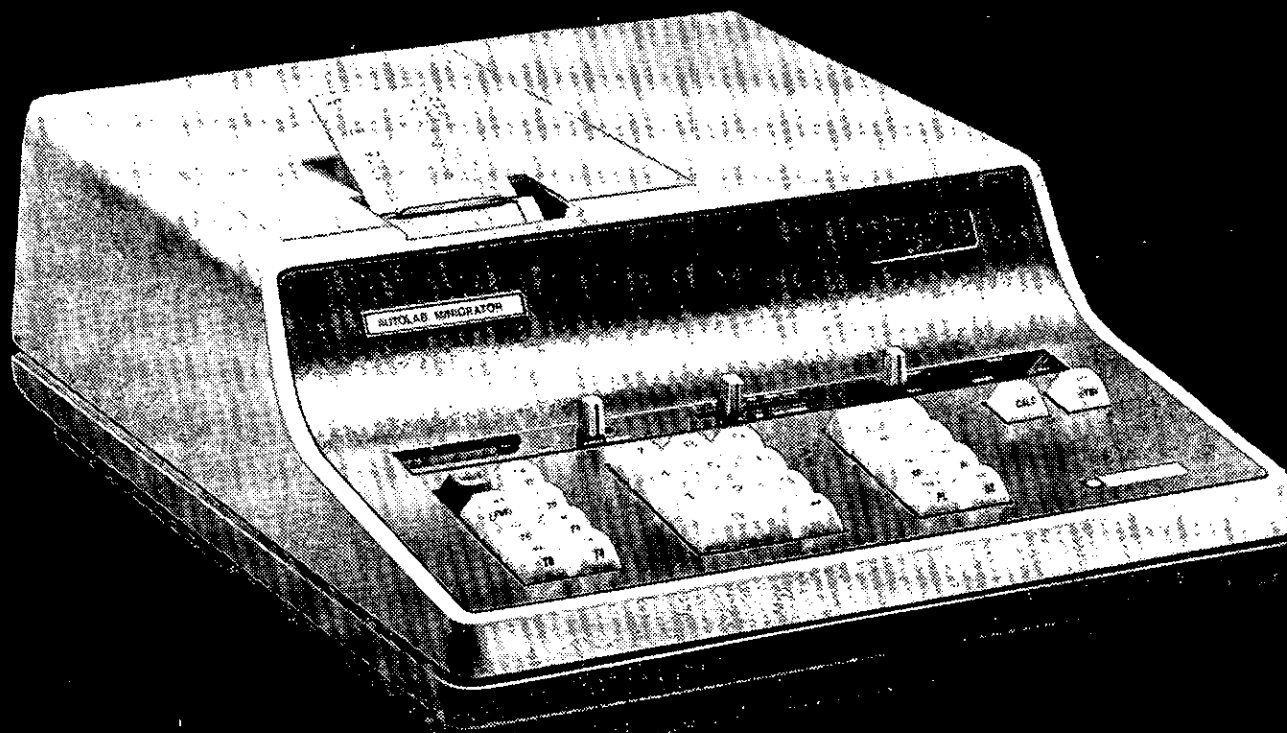


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