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Chemistry in new zealand

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EDITORIAL

SO WHAT'S NORMAL?

In his address to the Auckland Branch AGM, Dr Jim Sprott complained that normalities and equivalents were no longer taught in schools and universities, despite their widespread use in industrial laboratories.

The pedagogical arguments are familiar to most of us, but essentially they come down to the excuse that normalities are too confusing. I recently, however, came across a rather dramatic counter example. In the 3rd edition of Vogel's Textbook of Quantitative Inorganic Analysis, page 71 gives a titration curve for 100ml of 0.1N Na_2CO_3 with 0.1N HCl, showing two equivalence points at 50 and 100ml of acid added. Confused? Turn to page 255 of the 4th edition where Arthur Israel's modern successors have updated the treatment to molarities. Confusion now reigns supreme, however, as the titration of 100ml of 0.1 M sodium carbonate with 0.1 M hydrochloric acid again boasts two equivalence points at 50 and 100ml of acid added.

In acid-base systems, I tend to agree with the sceptics who claim that normalities offer little advantage and just clutter up the place. In redox systems, however, the normality/equivalence system has some definite advantages. Take the determination of dissolved oxygen in water as an example. The moles and molarity approach to the Winkler method was set out very clearly in CHEM NZ Number 8, March 1980. After listing the equations involved, the article states:

"From equations (4) (5) (8) (9) and (10) *it is possible* to derive the expression moles O_2/moles $S_2O_3^{2-}$ = 1/4"

(my italics). Sure it's possible, you need only to be able to write five half reactions and have the ability to say under your breath "2 moles thiosulphate react with 1 mole iodine, and since 1 mole of iodine is produced from 2 moles Mn^{3+} ......". How much simpler to say that the number of equivalents of thiosulphate equals the number of equivalents of oxygen and remember one half reaction: $O_2 + 2H_2O + 4e \rightarrow 4OH^-$

The point is not, should we start teaching equivalents and normalities again, but is it right that we should a remove a topic from a syllabus mainly because it is difficult to teach?

Chemistry teaching needs more input from practising chemists in terms of what is required of chemists outside the inbred ivory towers! I am not advocating handing over the complete control of our chemisty syllabi to the industrial chemists. Teaching involves skills just as intricate as the techniques of analytical chemistry or research and development, but chemical education is too important to be left only to lecturers, teachers and tutors.

Tony Herd.

PEOPLE

DR RAY W. BAILEY

DR E.W. VIVIAN

Dr Ashley Wilson, past chairman of the NZIC's Auckland branch, has been appointed general manager of Kinleith Industries. Currently executive officer, corporate development of NZ Forest Products Ltd, Dr Wilson takes up his new post on May 1.

The Medical Research Council's Toxicology Research Unit in Dunedin has been restuctured and streamlined. It is now geared primarily for work of national importance with two permanent professional staff and three technicians under the leadership of *Assoc Prof Ralph Edwards*. Prof Edwards took over on the retirement of *Prof Garth McQueen*. *Dr Don Ferry*, also of the Toxicology Unit, attended a meeting of the Australasian Society for Clinical and Experimental Pharmacologists in Sydney in December and the Australia and New Zealand Environmental Mutagens Society conference in Auckland in February.

Dr E.W. (Bill) Vivian, Director ot tne Leather and Shoe Research Associate for 17 years, retired recently and *Tony Passman* has taken over the reins of LASRA.

After six years experience in a tannery laboratory, Dr Vivian was appointed research assistant at LASRA in 1947. In 1951 he was awarded the Leeds University Procter Fellowship and worked at Leeds for three years, graduating a Ph.D. His main research achievements at LASRA were the development of hide and pelt preservation methods. Quality control in industry, product specifications and technical training programmes for middle management have been his particular interests. This has necessitated him maintaining a close liaison with industry.

Dr Vivian counts his main achievement as the move from Gracefield to Palmerston North in 1973 into new custom-built laboratories that include a pilot tannery.

Dr Ray W. Bailey, Director of Applied Biochemistry Division, Palmerston North, since 1974, is retiring at the end of April. After graduating MSc at Canterbury University College, Dr Baily worked on the microbiology of butter, cheese and whey (at the Dairy Laboratory, Wallaceville, 1945-46) and on weedkillers and the composition of peat and soil organic matter (at Rukuhia Soil Research Station, Hamilton, 1946-56). He went to Birmingham University to study the biosynthesis of microbial polysaccharides, graduating Ph.D in 1955. On returning to New Zealand, he moved to the then Plant Chemistry Division of DSIR, Palmerston North where he specialised in various aspects of carbohydrate research, principally plant carbohydrates and their digestion by ruminants. His other research activities included studies on rumen bacterial and rhizobial extracellular polysaccharides, as well as the biosynthesis of plant polysaccharides from nucleotide sugars and chemotaxonomic aspects of plant carbohydrates. He has published 120 papers, two books and edited, with Dr G.W. Butler, a three volume book on the "Chemistry and Biochemistry of Herbage". In 1974 he was awarded a D.Sc. from the University of Birmingham for a thesis based on his research at Palmerston North.

Since 1974, Dr Bailey has been responsible for developing Applied Biochemistry Division's basic research programme and also for guiding the Division into more applied aspects. Basic developments over the past 10 years include expanding molecular biology expertise in genetic engineering and related work, the biochemistry of plant-insect interactions and the composition of plant and fruit odour volatiles. Applied developments include the collection of data on food and feed composition, quality analysis of herbage cultivars and the use of tallow for energy.

In 1969 Dr Bailey was elected Fellow of the Royal Society of New Zealand and served as their International Secretary (1976-80), with responsibility for the development of relations with International Scientific Unions. He was involved with developing New Zealand scientific relations with the Peoples Republic of China and led an invited RSNZ delegation to China in 1980. He was also the Ministerial Representative on the Board of the Cawthron Institute (1974-80), the alternate delegate representing the Director-General, DSIR, on the Board of the N.Z. Dairy Research Institute (1979-83) and the DSIR representative on the Board of the Leather and Shoe Research Association (1981-83).

Dr Baily became a member of the Institute of Chemistry in 1946 and was elected Fellow in 1962. In 1962 he was Chairman for the Manawatu Branch and has been awarded the ICI Prize in 1963 and a number of research fellowships.

For his retirement, Dr Bailey plans to continue writing and counselling work in relation to food processing, with his particular interest in the history of food use in New Zealand.

Prof Ralph Holman, as well as being a guest speaker at the International Conference on Oils, Fats and Waxes and addressing several branches, addressed local branch meetings of the Orchid Society in New Plymouth and Palmerston North. He described aspects of "Fragrances and Odours in the lives and Identitites of Orchids". He described a method he developed for the analysis of floral odour from single flowers, based upon collection of the odour on oil-impregnated glass fibre followed by gas chromatographic and mass spectrometric analysis of the volatile components. A computerised method of relating odour patterns was described. Professor Holman also described a growth cabinet that he is having developed to measure the production of fragances by single flowers under various conditions. The isolation of methylanisole, a possible defense substance, from *Cypripedium* roots was also described. Professor Holman's descriptions of his activities (eg. his lying in a swamp to photograph a flower) as well as those of his associates (eg. the person who stayed up all night in a South American jungle to observe the fertilisation of a flower) showed that researchers in this field need to be resourceful and hardy!

OBITUARY

M.S. CARRIE

The Institute lost one of its prominent industrial chemists when Mr M.S. Carrie died suddenly, at the age of 73, at his home in Christchurch on 2nd January 1983.

Maxwell Stuart Carrie will always be remembered by any who had contact with him over a wide career spanning the milk, food processing and meat industries and in latter years, Water & Soil Resources. Max was always forthright in what he said and drew from this wide background knowledge to which he applied a great deal of analytical reasoning.

Max Carrie was born in Wanganui in 1910, where he attended Wanganui Technical High School and later Napier Boys High School. He graduated from Otago University M.Sc. with 1st class Honours in Chemistry in 1931 and spent the next two years on post graduate research at Otago. A subsequent colleague, Walter Whittlestone, who was a student under Max's tutorship at the time describes how he "intimidated us freshers with his learning" but "besides being an exceedingly clever student, he was a damn fine chap". These words can again be reiterated in the context of his working life for they aptly describe how Max Carrie was appreciated by those of us who knew him.

Max's industrial career began at the New Zealand Co-op Rennett Co. Ltd, Eltham in 1934 as Chief Chemist. On the outbreak of the war he joined the army, Engineers Corps, and sailed with the First Echelon to the Middle East in January 1940.

Major Carrie was demobilised in 1943 and joined the Vegetable Processing Plant at Pukekohe as Works Manager and subsequently took up the post of Production Manager for J. Wattie Canneries, Hastings. He moved into the Meat Industry in 1947 as Chemist at Hawkes Bay Farmers' Meat Co. at Hastings and in 1952, joined the Canterbury Frozen Meat Co. Ltd as Chief Chemist until he retired in 1975 as Research and Development Manager.

In his retirement, Max was an active member of the Water Resources Council and the National Water & Soil Conservation Authority right up until the time of his death.

During his time in the Meat Industry this traditional, labour dominated Industry showed the first glimmerings of technological change and Max Carrie was to the forefront promoting such change. He took a leading role in placing the fellmongering process on a scientific footing and the Fellmongers Handbook, by Carrie & Woodroffe published in 1960, is still the only comprehensive New Zealand text on the subject today.

One development noted for its technological success in an otherwise very traditional labour orientated industry can be attributed to Max Carrie's persistance and desire to promote technological progress. Along with a colleauge, he was instrumental in developing and commercialising the Slipemaster machine for removing wool from skin pieces, one must say, without the full support of this employer at the time.

Today this machine is a standard piece of equipment in all freezing works and fellmongeries and its existance typifies the contribution Max Carrie made to an industry he was fully involved in.

Of course he was involved in many of the technical groups within the Meat Industry and served on the Advisory committees of the Meat Industry Research Institute, the N.Z. Freezing Companies Association and the N.Z. Leather and Shoe Research Association. It could be fairly said that he was one of the leading chemists in the Meat Industry, a discipline he actively promoted in an Industry generally devoid of a sound technical base at the time.

Max Carrie was a strong supporter of the Institute and particularly concerned for the status of the industrial chemists within it and he campaigned vigorously for professional recognition of Institute members.

He was a long serving member of the Institute having been elected an Associate in 1936 and a Fellow in 1958.

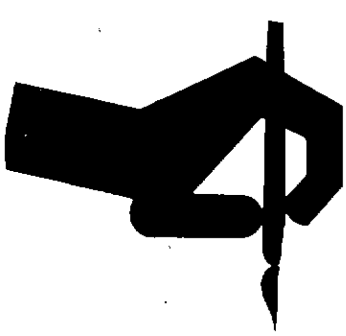
He served on the committee of the Canterbury Branch for many years, becoming Chairman in 1955 and was President of the Institute in 1966/67. He was also a Fellow of the Royal Institute of Chemistry and Associate member of the institute of Chemical Engineers.

Max's thirst for knowledge extended into a number of other fields including music and language. His scientific translations from German and Russian were always seen as a challenge and were yet another skill in his repertoire as a scientist.

As a scientific colleague one could not go much further than Max Carrie and it was most rewarding experience working under him with him. His contribution to his employer during the time I personally knew him was enormous and his judgements in his wider fields of interest always respected.

Max Carrie will long be remembered to all scientists and others who knew him.

G.M.K.



LETTERS TO THE EDITOR

Dear Sir,

I would like to draw your attention to an example of sexist language usage which occurred in an article on appointments to the NZIC council. Male appointments took the form 'Dr John ...' while female took the form Miss/Mrs Jane..., who has a PhD from X University'. I presume the female PhD has equal rights to definition in terms of qualifications as the male and equal rights to privacy in revealing marital status.

This is one example of irritating sexist language usage which occurs from time to time in the journal. I think femal scientists would appreciate a more careful screening of contents for sexist material.

Yours sincerely,
Dr Jacqueline A. Hemmingson.
Chemistry Division DSIR

Dear Sir,

I was interested and delighted to read the letter of Dr T.J. Sportt in the December, 1982 issue of Chemistry in N.Z., concerning the N.Z.C.S./BSc argument. I hope this letter is the first of many concerning this topic which has been the subject of discussion in almost every Industrial Laboratory for many years.

Yours faithfully

J.C. Wallaart
Chemist
NZ Aluminium Smelters Ltd.

The Disposal of Toxic Wastes by Incineration

N.H.C. Abbott and B.W.L. Graham
Department of Health
Auckland

Nick Abbott - Combustion Engineer for the Department of Health, is attached to the Northern Region Laboratory and is mainly involved with the Air Pollution Control section. He graduated B.Sc (Mech. Eng.) from the City University, London, in 1969 and then took a position with BCURA Ltd as an Engineer assisting with research on fluidised combustion, pulverised coal flames and gasification of coal. After some additional experience with the development of oil and gas central heating boilers he emigrated to New Zealand in 1976 and took a position with the Coal Research Association of New Zealand in Lower Hutt where he was involved with the design of a pulverised coal burner. In 1978 he took up his present position in Auckland.

Bruce Graham - The Chemist in the Health Department's Environmental Laboratory. He graduated M.Sc from Auckland University in 1970 and moved to the University of Waikato to do a Ph.D in organometallic chemistry, which he completed in 1973. After a year's post-doc in England he took up a position with Chemistry Division, DSIR, Wellington, working on aspects of natural gas utilisation. In 1977 he took up his present position where, as well as investigating various aspects of air pollution, he is actively involved with work in the fields of industrial hygiene and chemical hazards in general.

INTRODUCTION

The effective management of wastes is a challenge facing many industries today. A number of options are available, and these must be evaluated in terms of cost-effectiveness, potential for contamination of the environment, and conservation of our diminishing resources. Incineration is one option, particularly in the case of some toxic chemicals; and in this paper we will discuss some of the considerations involved with this process.

Waste materials arise in a variety of ways in industry, and may be in the form of solids, liquids or gases, or mixtures of these. The waste streams may simply be process by-products (e.g. contaminated solvents, off-gases) or off-specification products; they may arise from spillages or contamination of product materials, they may result from discontinued product lines; or they may be associated with deterioration of processing equipment (e.g. waste transformer oil, lube oils, or heat-transfer fluids).

Ideally the first step in a waste management scheme should be to consider whether process modifications are available that would either reduce or even eliminate by-product wastes (e.g. use of solvent-free systems). Allied with this should be an evaluation of the potential for recycling of the wastes, purification and use in other ways (e.g. the new commercial process for the recovery of CO_2 from Kapuni gas), or conversion into some other useful material (e.g. sulphur recovery from SO_2). If none of the above options are viable, then the only course of action is disposal of the waste, and a decision has to be made as to the most appropriate method. In the case of toxic materials the choices may be split into four categories:

solidification
secured landfill
incineration
other available technologies

Solidification describes the process whereby the wastes are incorporated into an impermeable inert matrix. In most cases this would subsequently be used as landfill.

The secured landfill describes a more elaborate version of the sanitary landfills used for disposing of much of our commerical and domestic refuse. Base material on the site should be impermeable so that contamination of adjacent water supplies is avoided, and careful screening and selection of the wastes is essential. Site security and environmental monitoring would need to be maintained long after the landfill was closed.

Incineration is the third relatively universal and established treatment process for toxic materials. With developing technologies, however, a variety of other methods are, or are becoming, available, and these may better suit particular waste streams. Deep-well disposal, burial in selected geological formations, and in deep-sea bed sediments are possibilities for the future. Biological treatment processes are not generally applicable to toxic wastes, although specific examples have been reported (e.g. removal of heavy metals from liquid wastes using water hyacinths). Chemical processes have also been reported for the treatment of some specific wastes.

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GENERAL ASPECTS OF INCINERATION

Incineration as a waste disposal option offers the following advantages or potential advantages:

(i) Volume reduction, especially for bulky solids with a high combustible content..

(ii) Detoxification, especially for combustible organic materials, and pathological organisms.

(iii) Reduction of environmental effects (e.g. for odorous materials, and photoreactive organics (smog precursors).

(iv) Energy production. In many cases the system may be coupled with a heat-recovery or steam raising system.

(v) Variability of scale. Incinerators may be designed on almost any scale to cope with different waste loads.

There are, of course, disadvantages also:

(i) Cost: A well-designed incinerator may involve considerable expense, both in initial investment and in operation.

(ii) Operating problems: Variability in waste composition and the severity of the incinerator environment can result in many practical waste-handling problems, and high maintenance requirements. It has been our experience that the ability of the operator may have a significant effect on reliable incinerator operation.

(iii) Secondary environmental impacts. Combustion products may include gases such as hydrogen halides, and nitrogen and sulphur oxides; and control of fly ash and other particulate emissions may be required. Ash disposal could also be a problem.

Some particular examples are of interest here, to illustrate the problems that may occur with particular waste systems.

The combustion of wood wastes is a common disposal technique. However, if some or all of the waste has been treated with copper, chromium, and arsenic, special considerations are required. At flue gas temperatures above 200°C over 90% of the arsenic will be emitted into the atmosphere, and we have found that this may lead to contamination of the surrounding area. Below this temperature the arsenic is retained in the ash. Disposal of this material must be given careful consideration. It is not uncommon for it to be used as a weedkiller!

Recently a company made inquiries to the Department of Health concerning the incineration of tanned leather offcuts, which were contaminated with chromates. This required investigation since some chromium VI compounds are known carcinogens. However, the oxide most likely to be formed in this case is chromous oxide (Cr_2O_3) and this is considered to be relatively harmless. The company was advised to keep all ash damp to control dust (which would contain most of the chromium), and to take particular care with its subsequent disposal. Particulate emission control measures were also recommended to minimise pollution of the surrounding environment.

Wastes containing lead should also be treated with caution. For instance waste sump oil is sometimes used as a fuel, and this can be heavily contaminated with lead. In this case most of the lead would be expected to remain in the ash.

Waste materials containing sulphur or halogens may give rise to acidic, corrosive gases. Control of these emissions will almost certainly be required using, for example, a liquid scrubber. Treatment and disposal of scrubber liquor may then present itself as yet another waste management problem! The corrosive nature of these gases may also place limitation on the materials used in the construction of the incinerator, and has in the past prevented the use of any ancillary heat recovery system.

COMBUSTION PARAMETERS

In order to ensure the complete combustion of waste, operating conditions in the incinerator must be carefully arranged and then maintained:

1. Temperature

At temperatures below 600°C good combustion cannot be assured. Temperatures in the region of 800-900°C would be considered normal and some highly stable wastes may require temperatures in excess of 1100°C for total destruction.

2. Turbulence

Good mixing of waste and combustion air is an obvious necessity for efficient oxidation. This is achieved in the incinerators by providing mixing baffles, changes of direction and zones of relative high velocity.

3. Residence Time

Since the combustion process takes a finite time, the time spent actually at combustion temperature is critical. Depending on the waste, recommended residence times can vary between 0.4 s and 3 s.

4. Combustion Air

If there is insufficient air for combustion, destruction will not take place and harmful reduced compounds may also be formed. It is therefore essential that there by oxygen present in the flue gases. Too much excess oxygen will tend to lower combustion temperatures and result in incomplete combustion so a compromise must be found. Three to seven percent oxygen would be acceptable.

MONITORING OF THE COMBUSTION PARAMETERS

To ensure efficient and complete combustion full instrumentation should be provided on any toxic waste incinerator. This would include monitors for oxygen or carbon dioxide in the flue gases and temperatures of all combustion zones, and exit gases. Carbon monoxide and smoke monitors would be suitable indicators of poor combustion.

Monitoring of the feed rate and of the fuel (and waste) composition should be carried out to ensure operation within the design parameters. Furthermore, testing of the exhaust gases for emissions of the wastes, or their decomposition products, is desirable.

The normal method for obtaining residence times is to calculate the volume of the furnace and the flow of combustion gases. A simple division will give an approximated retention time. This is an obvious simplification and cannot be relied upon except as a relative guide. The more tortuous the route through the furnace the more inaccurate the figure is likely to be since turbulence and swirl has the effect of increasing the path length through the incinerator and hence the residence time.

At present we are developing a technique for the measurement of residence times. A small quantity of radioactive gas (Krypton 85) is injected into the upstream end of the furnace via a solenoid valve, which at the same time initiates a timer. When a geiger tube downstream of the combustion zone reacts to the passing activity, the timer stops, indicating the time lapse. Due to the exceptionally fast response of the micro-processor based electronics, this time lapse can be considered as being the true residence time between the injection and the detection points.

The system is operating very successfully measuring time lapse in a domestic fire flue in order to obtain flue gas velocities. Krypton 85 tracer gas is a beta particle emitter and is considered by the National Radiation Laboratory to be entirely hazard-free in this application.

INCINERATION SYSTEMS

The possibilities for different incinerator shapes appear to be limitless but the more difficult or toxic the waste becomes the more uniform is the design. The most common type of incinerator for the combustion of difficult waste is the multiple chamber incinerator. This incorporates a primary chamber where waste is burnt on a hearth, grate or in suspension and the essential secondary combustion chamber where unburnt products from the primary can be totally burnt. There are normally provisions for burners to supply additional heat if necessary and ports for the introduction of combustion air at strategic points.

Storage and feed systems for wastes must be carefully designed. Viscous liquids need to be heated to be successfully pumped and atomised in the combustion chamber. Sludges can be pumped with the appropriate equipment and solids would normally be batch-fed into the incinerator.

Incinerators in New Zealand range from Teepee, virtually an enclosed bonfire, to the complex multi-chamber, semi-pyrolysis units such as those recently installed at Auckland Airport. Cast-off engineering equipment such as boiler casings have often been converted into incinerators without due consideration to the principles involved, causing complaints from neighbours about smoke or odours. Many simple, single chamber incinerators operate very satisfactorily burning waste, such as dry wood shavings but it is a mistake to assume these units will burn any type of waste. Even the more sophisticated incinerators such as those operated by port authorities and hospital boards, will not normally achieve the temperatures or residence time required to destroy the more stable toxic wastes.

If toxic wastes are to be successfully destroyed, it is essential that the incineration system be designed to ensure that the correct operating parameters are achieved and maintained. For example, Ivon Watkins Dow operate a manufacturing plant in New Plymouth, in which chlorophenoxyacetic acid type herbicides are produced. Until recently a specially designed incinerator was used on-site to dispose of organic wastes produced in the process. This operation has now been discontinued as modifications to the manufacturing process have allowed the wastes to be recycled.

The operating parameters for the incinerator, supplied by Hygrotherm Engineering Ltd, were 1000°C at a residence time of 0.5 seconds. The organic wastes were mixed with xylene and fed into the incinerator using an atomising burner. The excess oxygen in the flue gases were typically 7%. The system was fully instrumented, and monitoring of feedstock compositions, and stack emissions indicated that a destruction efficiency of better than 99.9% was achieved.

Overseas there is a trend towards the construction of a large-scale incinerators for the contract disposal of waste from a large area. In the United States the proportion of waste disposed of in this way is estimated to be 15% and is predicted to rise to 25% by the end of the decade. Alternatively, smaller mobile incinerators can provide an on-site service.

Another option is the ocean-going incinerator ship, Vulcanus, which can receive toxic wastes from land-based industries and incinerate them at sea well away from any centres of population. There was a possibility of this ship visiting New Zealand to dispose of any stockpiled wastes but this did not eventuate.

Because of the scale of most industrial operations in New Zealand and the transportation distances involved, centralised incineration facilities are unlikely to be a viable proposition for the disposal of hazardous wastes. These waste problems must, in most cases, be overcome with the construction of small-scale systems by the industry involved. Occasionally it may be possible to find alternatives, for example, the destruction of polychlorinated biphenyls (PCB's) in a cement kiln as described by Holden *et al* (see this issue).

ACKNOWLEDGEMENT

We thank the Director-General of Health for permission to publish this paper.

A Review of Lead Hazards in the Motor Service and Repair Industry

R.V. Winchester
Northern Occupational Health Unit, Department of Health, Auckland.

Robert Winchester completed at Ph.D. in radiation chemistry at the University of Auckland in 1968. After working overseas in the fields of radiation chemistry and food irradiation he joined the Food Section of Chemistry Division, D.S.I.R. at Gracefield in 1976 to work on regulatory analysis of foodstuffs. He transferred to the Department of Health in 1980 to take up the position of Scientist in the Northern Regional Occupational Health Unit, one of three such units investigating occupational health problems in New Zealand.

INTRODUCTION

There has been much interest in recent years in the effects of lead on the human body and it is apparent that measurable effects can be found at considerably lower levels than was thought possible in the past[1,2]. Whether such "sub-clinical" effects are significant in terms of human health has not been definitely established but it is accepted that lead exposure in both the general population and in those occupationally exposed should be kept to the lowest practicable levels.

Use of lead or its compounds by workers in motor vehicle service and repair industries is perhaps more widespread than is commonly realised. In some processes, contact with lead is indirect and may not be readily apparent at first sight; and in these situations it is possible that symptoms of lead absorption which might arise could be attributed to other causes.

The handling of lead-containing powders, or the abrasion of lead, produces lead dust, while the heating of lead to well above its melting point of 330°C evolves lead fume, which is largely lead oxide. Particles of dust or fume can be absorbed into the human body by inhalation or ingestion, the route depending largely on particle size. Particles less than about 5 micrometers in diameter are absorbed directly by inhalation into the lungs, while larger particles are trapped in the nose, throat and upper respiratory system from where they are eventually swallowed and absorbed into the body via the stomach. Lead alkyls, and some other lead salts used in greases and oils, can be absorbed directly through the skin.

Descriptions of the hazards from manufacturing processes, such as motor body assembly, lead alkyl synthesis, battery making, and bearing manufacture, have been largely omitted from this review, as they are generally well-documented and protective measures are well-organised. This article is more concerned with tasks carried out by smaller numbers of workers often in unsuitable premises, where there may be little appreciation of workplace hygiene. In many cases lead is not the only hazard present, and equal risks may exist from exposure to noise, solvents, carbon monoxide and other materials.

ASSESSMENT OF DEGREE OF LEAD ABSORPTION

Rarely are workers seen showing overt clinical symptoms of lead poisoning. Lead absorption is normally monitored on a regular basis by measurement of either urinary lead, changes in one of the products of the haem cycle such as δ-aminolaevulinic acid (ALA) in urine or free erythrocyte protoporphyrin in blood, or preferably, blood lead.

Blood lead concentrations have been reported in several systems of units, the most common being micrograms per 100 millilitres of whole blood (μg/100ml), and micromoles per litre of red blood cells (μmol/l RBC). The latter unit is generally used in New Zealand at present.

An approximate conversion is:
μg of lead/100ml of whole blood = 10.4 x μmol of lead/litre of red blood cells.

The relationship is approximate as it assumes a haematocrit (red cell volume as a percentage of whole blood volume) of 50%, which is not always so.

Blood lead concentration in the normal (occupationally unexposed) adult population varies with the degree of industrial pollution. Recent studies[3,4] have shown levels of 10-15 μg/100ml in the United States and 16-20 μg/100ml in Britain. It is considered that clinical lead poisoning is extremely unlikely in a person with a blood lead level below 80 μg/100ml or 7.7 μmol/l RBC.

The New Zealand Department of Health has grouped blood lead levels into four categories[20]. Less than 3.8 μmol/l RBC (40 μg/100ml) includes the bulk of the general population, and lead workers in this category need a blood lead determination only every 12 months. The majority of lead workers are found in the range 3.8-5.7 μmol/l RBC (40-60 μg/100ml) and a blood lead estimation every three months is recommended for this group. For workers in the range 5.8-7.7 μmol/l RBC (61-80 μg/100ml) an investigation is undertaken to find the cause of the excess lead uptake and a clinical evaluation of the worker is made. Any person with a level above 7.7 μmol/l RBC (80 μg/100ml) is removed from work with lead until the blood lead concentration returns to below 5.8.

Premises where lead is used on a regular basis are required to comply with a maximum permissible concentration (Threshold Limit Value or TLV) of lead dust or fume in air of 0.15 milligrams per cubic metre averaged over an 8-hour working day. Higher concentrations are permitted for up to four brief periods per day[6]. For processes in which lead is used only intermittently it is difficult to apply such standards although they do provide some guidelines regarding the lead-in-air levels which should be attained.

DETAILS OF PROCESSES

1. Body repair work

It is perhaps fortunate that, both because of the relative expense of lead and because of technological advances in the development of fibre-glass and epoxy-resin based materials, lead is now rarely used in the repair of vehicle bodies.

Application of lead to the repair is not normally a hazardous process as the temperature to which the lead is heated is sufficient only to cause it to become "plastic" rather than to melt completely so that very little lead fume is evolved. The hazard arises from smoothing of the lead fill with electrical grinding tools.

Lead in air concentrations of up to 0.5mg/m^3 have been measured during this process in assembly plants, and work from Finland[6] showed appreciably raised blood lead levels in motor body repairers. The sanding process should preferably be isolated and the operator should use a suitable dust mask or respirator. Hand-filing or wet grinding can assist in minimising lead-in-air levels.

2. Spray Painting

The anticorrosive properties of lead-based paints have been known for many years. Much effort has been put into a search for alternatives to lead but although some satisfactory ones have been developed considerable amounts of lead pigments such as red lead and calcium plumbate are still used in anti-corrosive applications[7] and, occasionally, as paint-colouring materials. The amounts used in the motor car industry in New Zealand are difficult to assess, but do not seem to be large. Overseas work[8], suggests a degree of hazard slightly above general car repair work. Adherence to the conditions of the Spray Coating Regulations[9] should protect operators from lead hazards as well as those inherent in spray painting generally.

3. Radiator Repair

Hazards from this occupation have been recognised but may have been underestimated in the past. Work in Scandinavia based on both blood lead and zinc protoporphyrin measurements[7,10,11] has resulted in radiator repairers being placed in a high-risk category, exceeded in risk only by lead smelter and battery factory workers. Local work[12] has produced similar blood-lead results (mean 4.5 μmol/ℓ RBC, range = 3.0-7.6, n=45), with lead-in air levels of up to 0.43mg/m^3.

The hazard appears to result mainly from high temperature soldering, where gas flames of above 2000°C are used. Dust with a lead content of up to 30% is also produced by the cleaning of radiator parts with electric rotary brushes and contributes a minor part of the total contamination. Radiator work is usually carried out without any special ventilation except that from open doors and windows, and often in small, poorly constructed, and cramped premises.

The potential for high lead exposure is obviously present in this industry, and fairly close supervision, including regular blood-lead determination, is still necessary. Uptake could probably be reduced considerably by the use of local exhaust ventilation, but in many cases the cost would be prohibitive. Some radiator repairers have been able to keep their blood-lead levels down, suggesting that strict attention to work practices and hygiene should be the initial approach.

4. Petrol Sale

Allegations have often been made of a potential hazard to garage attendants from either inhalation or skin absorption of lead alkyls during filling of motor-car petrol tanks. There are on record overseas a number of cases of severe illnesses, including mental disturbances, and death resulting from poisoning by lead alkyls, but nearly all of these have been caused by exposure to the pure compound. It has generally been accepted that except in cases of deliberate abuse such as petrol "sniffing", the possibility of absorption of harmful amounts of lead alkyls from the relatively low concentrations found in petrol is very slight. Handling of pure lead alkyls is carried out in New Zealand only at the Marsden Point Oil Refinery, under strictly controlled conditions, with all transfers being carried out by pipeline. Lead alkyl levels in air measured during these operations have been negligible.

Work carried out in Australia,[13,14] while not entirely conclusive, suggests that pumping of petrol alone does not cause raised blood levels. However, evidence that lead alkyl absorption, especially at low levels, can be assessed by a blood lead measurement is also conflicting. Very high exposure to lead alkyls certainly causes raised blood lead levels[15] but workers in the lead alkyl industry are usually monitored by measurement of urinary lead[16]. Because New Zealand petrol contains a relatively high level of lead alkyls compared with many other countries, uptake of lead by garage attendants may be easier to detect than has been the case elsewhere. Further work in this field is probably desirable although it may be difficult to separate changes in blood lead concentration caused by possible exposure to lead alkyls in petrol from those caused by exposure to inorganic lead from exhaust fumes.

5. Handling of Greases and Oils

Organic lead compounds (mainly lead naphthenate) are added to some types of greases and oils, mainly to increase their resistance to high pressures, up to concentrations of around 7%. These materials are mainly used in diesel engines. A number of studies[6,8,14,19] have found raised lead levels in mechanics, and it has been suggested that one cause could be percutaneous absorption of lead from oils and greases. Persistent washing of the skin with petrol or other solvents is considered likely to promote easier passage of lead compounds through the skin and should therefore be discouraged.

Automotive oils for use in petrol-engined vehicles contain only very low concentrations of lead when new but this can increase appreciably after use as lead is taken up from worn bearings and from lead in petrol. Oils with less than 20ppm of lead initially have been found to contain up to 3500ppm (0.35%) lead after use for distances of up to 5500km[19]. No occupational health problems appear to have arisen in the handling and disposal of waste oil. It can however cause environmental problems if it is incinerated without proper pollution control equipment or disposed of in other ways which allow the lead to make its way into the environment.

6. Engine Reconditioning

Deposits formed inside petrol engines contain appreciable amounts of lead compounds. During engine reconditioning these deposits are often removed using electrical grinding tools, with the evolution of lead-containing dust. Rebuilding of engines also entails replacement of bearings, the lead content of which can be up to 75%. For older engines, where mass-produced bearings may not be readily available, new bearings are poured using molten metal and old shells. The metal is not heated to much above its melting point and tends to be 'wiped' into the shell rather than poured, hence the risk from inhalation of lead fume is low. Machining of the finished bearing produces only relatively large particles, which should not constitute an inhalation hazard. A small group of engine reconditioners were found to have blood lead levels at the upper end of the occupationally unexposed range indicating little risk from this occupation.

7. Exhaust System Repair

A relatively new innovation in New Zealand are muffler replacement shops, where a new exhaust system can be fitted to a vehicle in only a few minutes. Removal of old and often corroded exhaust systems from cars is sometimes difficult, and the old pipes are frequently cut off using oxyacetylene or oxy-gas torches.

Work by Chemisty Division, DSIR, Auckland, has shown that deposits inside old exhaust pipes can contain up to 4% lead, mainly as compounds such as lead chlorobromide and lead bromide. (These are produced by the reactions of scavenging agents such as ethylene dibromide with lead alkyls in petrol). The lead compounds are readily vapourised at the temperature of a gas torch, the boiling points being around 1000°C.

Lead-in-air levels measured in these workshops are relatively low when averaged over a working day as the cutting process occupies only a relatively small proportion of the time spent on each vehicle, but during the actual cutting, levels of up to 0.5mg/m³ over 10-15 minutes have been measured in premises in Auckland, with the operator being close to the source of the fume. Blood lead levels of up to 5.2umol/l RBC have been found in operators carrying out this work, and the use of some form of respiratory protection during gas cutting is advisable.

8. Motor Vehicle Testing Facilities

Measurements made at a Testing Station in Auckland in 1978 showed that total particulate lead (8 hour average) did not exceed 0.02mg/m³ (TLV 0.15) and total lead alkyls did not exceed 0.05mg/m³ (TLV 0.10 for tetraethyl lead, 0.15 for tetramethyl lead) with a mean of about 0.02mg/m³ or 20μg/m³.

Hence, as long as testing facilities are properly ventilated, the risk from lead is relatively low, nevertheless the possibility of absorption should be recognised. Complaints about testing stations generally focus on exhaust gas odours rather than potential lead exposure. No blood lead figures are available.

9. Battery Servicing and Repair

There is generally little risk involved in the service and repair of batteries unless the lead oxide plates are removed and subsequently allowed to dry. If this does occur, high blood lead levels can result as shown by concentrations of over 6μmol/l RBC found in some battery repairers in Auckland. Storage of cells under water and strict attention to workplace hygiene and personal cleanliness should ensure that lead uptake is minimised.

SUMMARY

Although there are a number of processes in the motor servicing and repair trades in which lead or lead-containing materials are used, in general the risk of excessive lead absorption is low. Nevertheless, as there is currently much uncertainty about the effects of low levels of lead on the human system, exposure should always be kept at the lowest practicable level. In most cases, normal personal and workplace hygiene measures are adequate, but additional precautions should be taken in the radiator repair industry against the inhalation of dust and fume, against possible fume inhalation in the exhaust repair industry, and against dust exposure in battery repair work. The dispensing of petrol by garage attendants does not appear, according to overseas work, to present any particular hazard from exposure to lead alkyls, but because of the relatively high levels of these compounds in New Zealand petrol further work on this aspect may be desirable.

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The Destruction of Poly-Chlorinated Biphenyl Waste Oils in a Cement Kiln

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Errol Hodgkinson (right) graduated B.Sc. from Otago in 1970. He is in charge of a section in the Environmental Chemistry group at the National Health Institute.

INTRODUCTION

Over the last fifteen years there have been several incidents arising from the inadequate disposal of toxic and other hazardous wastes, which have become headline news and focused attention on the potential for death and ill health inherent in the contamination of air, soil, food and water by toxic chemicals. They range from the Minamata disease episode in Japan which caused 55 deaths from methylmercury poisoning to the more recent Love Canal incident[1] where an entire housing estate built on an unmarked industrial waste site near Niagara Falls became dangerously contaminated by seepage of chemical residues. Such episodes are clear evidence that the safe disposal of industrial wastes is a matter of prime importance in protecting public health.

New Zealand has been largely free from such episodes because of our modest level of industrial activities but with the development of major industries in Southland, Taranaki, the central North Island, South Auckland and Northland, it is clear that the issue of hazardous waste management must now be faced. The Department of Health has a statutory responsibility to protect and promote public health and a particular interest in seeing that safe and effective disposal methods complying with international recommendations[2] are established. One such method, which may have important, though limited application in New Zealand, is the high-temperature incineration of non-aqueous liquid organic residues by mixing with fuel and burning them in a cement kiln. In 1982, the Department of Health conducted a full-scale trial of this method for the disposal of waste polychlorinated biphenyls (PCB's).

JUSTIFICATION FOR THIS STUDY AND NATURE OF THE PROBLEM

Poly-chlorinated biphenyls (PCB's) are ubiquitous man-made chemicals that are known to cause serious health effects on man and animals. Their safe disposal has become a problem worldwide. They are derivatives of the biphenyl compound consisting of two benzene rings linked by a single bond, and have a very stable and persistent structure. Each biphenyl has ten hydrogen atoms, and when any two or more of the ten hydrogen atoms are replaced by chlorine, a PCB is formed. PCB's are similar in structure to DDT, and share some common properties, one of which is the tendency to build up in the fat of animals through the food chain.

The main uses of PCB's are in electrical transformers and capacitors, where their great stability, low flammability and useful dielectric properties are advantageous. They are marketed under several different trade names as transformer and capacitor dielectrics in this country probably the most common being the Askarels, and Pyranol. Waste Pyranol which was the subject of this study contains 45% PCB, the remainder being trichloro and tetrachloro benzene solvents. It is a clear liquid with a final boiling point of approximately 375°C, a specific gravity of 1.44, and a flash point measured by the open cup method of 170°C.

PCB's have also been used in other products such as plastics, dye carriers in "carbonless paper", hydraulic fluids, insulating tapes, adhesives and caulking compounds, paints, and printing inks[3]. Manufacture of PCB's started in 1930 by the Monsanto company, which became the principal supplier. The company ceased production in 1977, and information compiled by the U.S. Environmental Protection Agency indicates a total production of 636,000 tonnes during this period, about 60% of which is thought to be still in use in the U.S.A. The total quantity in New Zealand is unlikely to exceed 500 tonnes, and that in storage for disposal at present probably does not exceed 100 tonnes. Unfortunately the stopping of production did not remove the problem of disposal, and the safe disposal of unwanted PCB's has become a question of international interest due to their having been detected in all living species tested so far.

Typical concentrations in human body tissues worldwide range up to 1 mg/kg of body weight[4]. The cleaner environment of New Zealand results, according to Zobel[5], in a somewhat reduced level, on average 0.35 mg/kg. Occupationally exposed men in the U.S.A. have survived with 700 mg/kg in body fat and up to 200 μg/100 ml of blood, but at this level acute symptoms and liver damage would be expected.

Humans can withstand exposure to PCB's without immediate danger or fatality and operators handling these materials for destruction should realise this in the event they come into accidental contact with them; but this knowledge must not detract from the importance of minimising personal exposure by using protective clothing and the prompt removal of all splashes of PCB's on the skin by washing with plenty of soap or detergent and warm water.

DESTRUCTION OF PCB's

High temperature incineration is the preferred method of destruction for PCB's[2], but small quantities can be safely tipped in approved landfill sites[4]. Alternative methods have been tried which involve dechlorination by combination of the chlorine atoms with sodium salts of polyethylene glycol and liberation of the original biphenyl hydrocarbon[6]. Because of the resistance to oxidation of the PCB molecule it is necessary to ensure an incineration temperature higher than can normally be found in typical commercial refuse incinerators and special facilities have often been provided.

The U.S. Environmental Protection Agency[7] has indicated that a temperature of 1100°C with 3% oxygen in the stack gas and a residence time of two seconds is the minimum to guarantee 99.9% destruction of PCB's in a conventional incineration process. Alternative conditions considered equivalent are 1500°C for 1½ seconds at 2% excess oxygen. Sabastian[8] has worked with PCB's and identified their decomposition temperature as being as low as 650°C.

One process that has been used with demonstrated success for PCB destruction in Canada and the U.S.A is cement manufacture[9,10]. Although the process offers the dual advantages of high operating temperatures and the absorption of any acid byproducts by the cement clinker, it has not become generally adopted yet. For this reason the Department of Health decided to repeat the North American experiments using a cement kiln in the Nelson province. While it was clear from the literature that the process incorporates adequate safeguards against the uncontrolled dispersal of PCB, a site meeting was held between management and union employees and representatives of the Department of Health and the Commission for the Environment, to explain the departments' proposals. In addition, at the suggestion of the Commissioner for the Environment, an independent evaluation was carried out by the Cawthron Institute, Nelson[11].

KILN DETAILS, TEMPERATURES AND SOLIDS RESIDENCE TIME

The rotary kiln used operates on the semi dry process producing about 32 t of cement clinker per hour for a pulverised coal consumption of 4.1 t per hour using a pre-drying section or lepol grate (see Figure 1). The pre-dried nodules of raw feed material after partial calcining in the lepol grate enter the cool end of the downwards sloping kiln. The rotary section is 48 m long and about 3.2 m in diameter allowing for refractory lining.

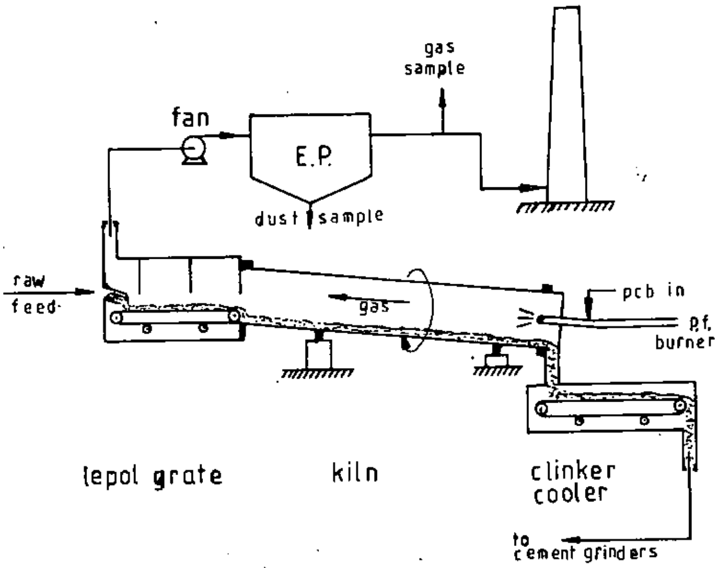

FIG 1 KILN DETAILS

The gas flow is countercurrent. At the flame burst or burner end the temperature is estimated to be between 1700 and 2100°C,[10,12] in the gas phase, and up to 1550°C on the surface of the clinker at the same point[13]. Gas temperatures fall to between 1000 and 1100°C at the lepol grate end, where the partly calcined nodules of raw material enter the kiln at about 900 to 1000°C.

The solids transit time to traverse the length of the kiln is about 1½ hours, and the "kiln filling" factor about 17% of the cross sectional area[14], resulting in a free volume of 282 m^3 for the gaseous products of combustion to flow through before entering the lepol grate at the cooler end of the kiln.

MATERIALS BURNT, MEASUREMENTS AND SAMPLES TAKEN

A total of about 4.5 t of waste Pyranol was collected on site at the Golden Bay cement works at Tarakohe in Nelson province, and burnt during May and June 1982. The oil was contained in 20 x 200 litre used drums all having been certified in sound condition and free from leaks on dispatch by road to the site.

The drums were transported to the kiln from storage on pallets by a fork lift for injection of the PCB into the pulverised coal feed pipe to the burner via a small gear pump at a rate up to 75 kg/hr the maximum capacity of the available pump at the time. When empty the drums were rinsed out with 10 of diesel oil which was subsequently pumped into the kiln for burning in the same way. The empty rinsed drums, estimated to contain a few grams of PCB, were then crushed flat and dumped in the works landfill tip.

No special conditions were required for the kiln operation during the injection and burning of the PCB, the object of the experiment being to demonstrate that typical conditions for the formation of a satisfactory clinker quality are adequate to ensure complete destruction of the PCB.

Gas samples were taken after the electrostatic precipitator before discharge from the stack for determination of any PCB residue in the exhaust gases. Samples of flue dust were also taken from the electrostatic precipitator for solvent extraction and determination of PCB residues. No samples of cement clinker were taken, as it is clear that no organic compound could survive prolonged contact with the clinker at temperatures in excess of 1500°C[8].

PCB INJECTION RATE, AND KILN GAS RESIDENCE TIME

The PCB injection rate was limited to 75 kg/hr by the capacity of the injection pump available for the test burn. This quantity represents PCB vapour flow in the kiln of 0.01% of total gas volume. Consequently a substantial increase in PCB burning rate (even 10 fold) would have a negligible affect on gas residence time and the severity of destruction in the kiln.

Gas residence times in the kiln after correcting for the average temperature, a clinker filling factor, the evolution of CO_2 during clinker formation, water content, fuel and excess air, gave 3.76 seconds. These residence times were for typical operating conditions at the time of the burn when the temperatures were normal for the production of a satisfactory cement clinker. Under these conditions the severity was well in excess of the EPA recommendations for 99.9% destruction of PCB's. Details have been omitted for space reasons but are obtainable from the authors.

ANALYSIS OF PCB'S IN FLUE GAS AND FLUE DUST SAMPLES

Sampling Equipment and Gas Chromatography

The sampling train, as shown in Figure 2, consisted of an inlet filter, two water-filled bubblers, a florisil sorbent tube, a pump and meters.

The columns used were glass 1.5 m x 4 mm and 0.5 m x 4 mm packed with 100/120 chromosorb WHP with a liquid phase of 1.5% OV-17/1.95% QF1. This was fitted to a Pye Unicam GCV gas chromatograph equipped with a ^{63}Ni electron capture detector. The column temperature was 210°C with the detector and injection port held at 250°C. Detector current was typically set at 10 and range at 64. The output from the amplifier was fed to a Spectra Physics minigrator.

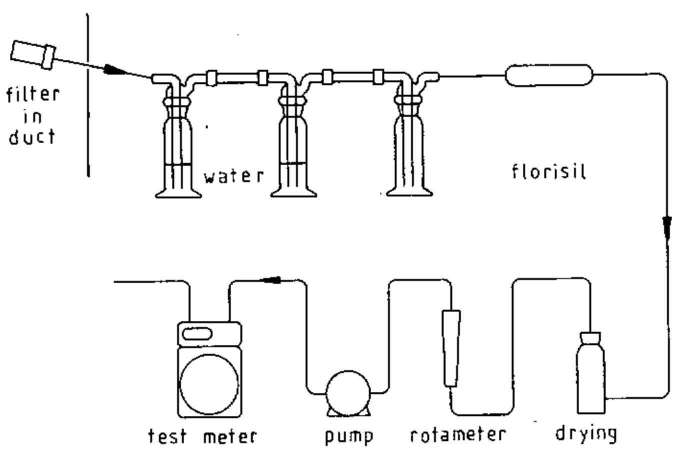

FIG 2 SAMPLING TRAIN

COLLECTION AND ANALYSIS

The sampling train was run for 90 minute periods at a rate of 5 l /min, the total volume of air being measured on a dry test meter. Between runs the inlet filter and the florisil trap were replaced, the bubbler contents decanted into glass bottles, and the entire collection system washed first with acetone then hexane into another glass bottle.

Samples were prepared for chromatography by extracting into hexane — the florisil by Soxhlet extraction, the water and washings by liquid/liquid partition. After drying with sodium sulphate and sulphuric acid cleanup, combined hexane extracts were made up to a final volume of 25 ml. The inline probe filter and samples collected from the kiln exhaust electrostatic precipitator were also Soxhlet extracted and treated similarly but kept separate. At this stage the samples were chromatographed and compared with traces produced from Pyranol and standard Arochlors.

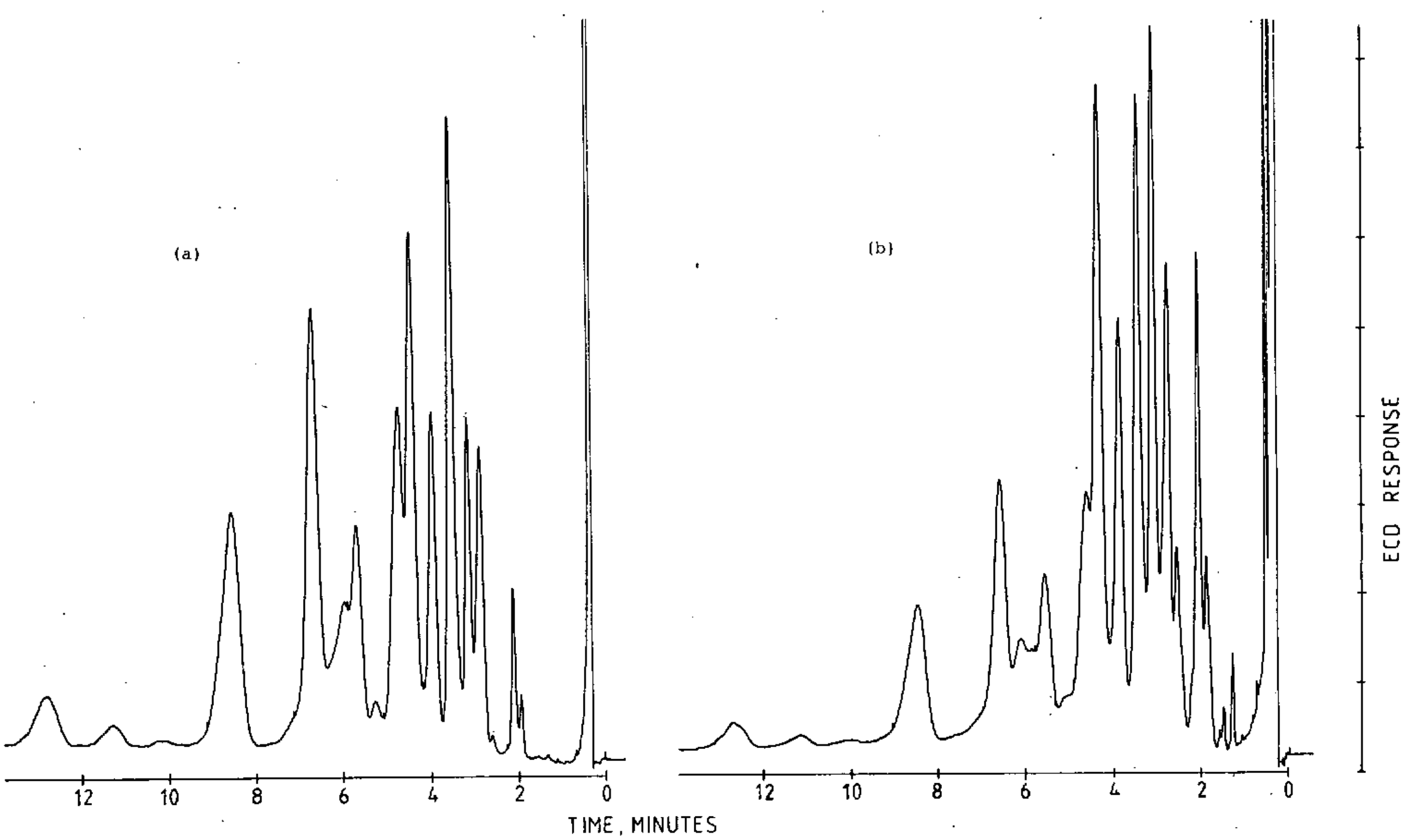

FIG 3 Chromatograms of Arochlor standard (a) and Pyranol sample used in the destruction trials (b)

A 5 ml aliquot was removed for perchlorination[15]. It was evaporated to dryness in a 10 ml vial under a gentle flow of nitrogen — 0.2 ml of antimony pentachloride added and the mixture heated for two hours at 160°C under pressure.

The tube was then cooled to room temperature and 2 ml of 50% hydrochloric acid added to destroy excess antimony pentachloride. Extraction was then facilitated with 5 x 1 ml portions of hexane with the extracts being dried by passing through micro columns of sodium sulphate. The final volume was adjusted to 5 ml in a standard flask. Comparision was made between the perchlorinated product and a standard of decachlorobiphenyl (DCB) made up in hexane.

The overall efficiency of the method was evaluated by spiking the first bubbler in the sampling train with PCB (Arochlor 1254) and proceeding with a dummy sampling run followed by an analysis of the individual train components. Results are given in Table 1. Overall recovery as DCB was 74%. Previously the perchlorination step efficiency was found to be 88%.

Table 1 Recovery of Arochlor 1254

	Initial wt of Arochlor 1254, μg	Final wt of DCB, μg	Recalculated* wt of Arochlor 1254, μg
1st bubbler	100	99	64
2nd bubbler		8.7	5.7
florisil		6.2	4.0
TOTAL	100		73.7

*using $\frac{\text{MW of Arochlor 1254}}{\text{MW of DCB}} = 0.65$

According to Armour[16].

RESULTS

Analysis of the hexane extracts before perchlorination showed no detectable concentrations of Pyranol. The chromatograms contained peaks from lighter compounds but no peaks corresponding to those on the Pyranol standard trace. Similarly no PCB residues were found in the electrostatic precipitator dust or the probe filter.

The perchlorinated samples did contain a small peak corresponding to DCB but this was also present in samples collected from the stack before PCB addition. It is assumed that a biphenyl compound was being liberated in the cool end of the kiln from the water in the feed stock, an effect noted by Lauber[10].

Using the perchlorination results, and assuming the DCB peak originates from the added Pyranol with the detection limit of 1×10^{-6}g for this method, a combustion efficiency greater than 99.999% can be inferred. This will correspond to less than 0.5g of PCB per hour emitted from the exhaust chimney stack.

SUMMARY

Observations of gas flow, composition and temperature on a rotary cement kiln indicate that the conditions for 99.9% destruction of PCB's recommended by the EPA are met in normal operation by a generous margin. Analysis by gas chromotography of flue gas and flue dust samples taken during the injection of waste PCB into the fuel stream indicate a level of destruction in excess of 99.999%.

CONCLUSIONS

The use of cement kilns for the destruction of PCB's is an effective and safe practice which deserves to be exploited for the disposal of these, and probably other, chlorinated hydrocarbons.

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Mr Bill Taylor	-	Works Manager Tarakohe Works
Mr Laurie Wederell	-	President Employees Union, Tarakohe.

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THE OXIDES OF NITROGEN AS DOMESTIC AIR POLLUTANTS

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In recent years the adverse health effects of air pollution have led to the regulation in many countries of emissions of particulate and gaseous pollutants, and the setting of standards for various compounds in outdoor air. However, until recently, the effects of exposure to air pollutants in an indoor environment have been largely neglected. The potential importance of the indoor environment to total pollutant exposure can be seen from the observation that most of the population of industrial nations spends between sixty and ninety percent of its time indoors [1,2] and that pollutants frequently reach concentrations indoors that are higher than ambient outdoor levels [3], especially in buildings with poor ventilation.

Indoor air quality depends upon a number of interrelated factors, including outdoor pollutant concentrations, building permeability, meteorological conditions, the nature of the ventilation system, and the generation of air pollutants indoors[4,5]. Smoking and the use of gas fired appliances are the major sources of domestic indoor air pollutants. However, in modern dwellings in cold climates where energy conservation is important, the ventilation rate is frequently reduced to a very low level which may increase the significance of other, less commonly recognised pollutants.

Examples[6] would be the emission of organic vapours from paint, varnishes, carpets, cleaning materials, and adhesives used in furniture construction and chip-board wallboarding[7]. An interesting historical case is the speculation that Napoleon's death on St. Helena resulted from the inhalation of arsenic volatilised from wallpaper[8]. In some parts of the world, the emission of radioactive radon gas (and its daughters) from building materials such as concrete, brick, and stone is important; the opinion of the Building Research Association of New Zealand (BRANZ) is that this phenomenon is not of any great concern in New Zealand (G.R. Hughes, personal communication).

Smoking contributes substantially to indoor air pollution. In the presence of cigarette smoke, many nonsmokers experience eye and throat irritation, headache, and coughing; children, persons with cardiovascular and respiratory complaints, and wearers of contact lenses can suffer particularly acute symptoms. Among the noxious species discharged in tobacco smoke are particulates, carbon monoxide, oxides of nitrogen, and polycyclic aromatic hydrocarbons[9], with levels of each depending upon the cigarette and type of filter. In un-aged tobacco smoke, nitric oxide has been found to be present at levels of between 400 and 900 ppm by volume, with nitrogen dioxide present in only trace amounts[10].

The concentration of oxides of nitrogen, NO_x, is usually defined as the sum of the concentrations of nitric oxide (NO) and nitrogen dioxide (NO_2). These are the only nitrogen oxides present in significant amounts in the atmosphere and which have potentially adverse health effects. Once liberated to the atmosphere, nitric oxide is gradually oxidised to nitrogen dioxide, the rate depending upon conditions.

The other major domestic source of recognised air pollutants (in addition to smoking) is the use of gas fired appliances, especially for cooking, oxides of nitrogen and carbon monoxide being the main species of concern.

Indoor levels of oxides of nitrogen have been shown to correlate closely with the use of gas burning appliances[3, 11-14]; representative is a study undertaken in the winter of 1978 in Gainesville, Florida, in which Palmes *et al*[13] demonstrated the effect of using unvented gas fired stoves and heaters on nitrogen dioxide levels at various locations within a dwelling. In residences where such appliances were not used, NO_2 concentrations were uniformly low in all rooms, at around 3 ppb by volume; as the number of appliances was increased, so did the level of NO_2 found throughout the residence, whether or not the particular room contained a gas fired appliance.

For example, homes containing an unvented gas stove in the kitchen and an unvented gas heater in another room yielded time-averaged NO_2 concentrations of 152 and 155 ppb by volume respectively, with an average level of 83 ppb in a room containing no gas appliance. These levels are approximately equal to or above the U.S. Primary Air Quality Standard (which applies to outdoor air) for NO_2 of 50 ppb as an annual average. Studies on the levels of oxides of nitrogen in kitchens of dwellings using gas for cooking show high peak values (up to 2.4 ppm NO_x[11]) and rapid fluctuations coinciding with gas stove usage, kitchen ventilation having a substantial effect on the overall NO_x levels.

Considering the now-widespread use of natural gas in this country, these observations have significant local importance.

As might be expected, the use of gas stoves in enclosed spaces such as are found in caravans and boats leads to quite high levels of oxides of nitrogen; a recent New Zealand Standard[15] recognises this. Work done in New Zealand on the use of a liquefied petroleum gas-fired stove in a caravan[16] showed that NO_x accumulated rapidly following burner ignition to reach equilibrium concentrations of 1-10 ppm within 40 minutes, depending upon ventilation and sampling position; it was shown that to be effective in the confined space of a caravan, ventilation needed to be of a flow-through nature. The proportion of NO_x existing as NO_2 was found to be in the vicinity of 10-15% by volume.

While it is usually accepted that nitric oxide is the primary oxide of nitrogen resulting from combustion, it has been found by some authors[11,16] that nitrogen dioxide constitutes a substantial fraction of the total oxides of nitrogen, in the range of 24-58% by volume in one study[11]. In the past some authors have failed to distinguish between NO and NO_2 so that the detailed implications of their work are not always clear.

The levels of oxides of nitrogen discussed here do not constitute an acute toxicity hazard, but may constitute a chronic health risk. Current knowledge of the effects of chronic exposure to nitrogen dioxide is limited, due to the slow onset of damage. Even less is known about nitric oxide, which is usually considered to have about one quarter to one fifth the chronic toxicity of nitrogen dioxide.

Nitrogen dioxide primarily affects the respiratory system, with effects which can be related to the concentration and duration of exposure. In animal studies, effects of nitrogen dioxide exposure have been shown[17] to include changes in pulmonary function and morphology, increased susceptibility to respiratory infections, decreased growth rate, alteration to the immune response, changes in reproductive function, delay in conditioned reflexes of the central nervous system, and depression of physical activity. Controlled studies in man are limited to short term exposures, but have shown the functional changes to the respiratory system of healthy subjects occur at concentrations which correspond to the peak values found in areas where unvented gas appliances are being used. Considering these results, plus those from epidemiological studies, the WHO Task Group on Environmental Health Criteria for Oxides of Nitrogen suggested[17] an exposure limit "consistent with the protection of public health" of 0.10-0.17 ppm nitrogen dioxide for a maximum one hour exposure at a frequency of not more than once per month. This could be expected to be exceeded in many homes.

Concluding, it appears that in New Zealand the major sources of indoor air pollution are tobacco smoking and the use of gas fired appliances in inadequately ventilated situations, although very little work has been done locally. Although ventilation is often associated with draughts and heat loss, the use of a well designed draught-free system is necessary if the potential problems described in this paper are to be minimised.

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1983 NZIC ANNUAL CONFERENCE – HAMILTON, 23-26 AUGUST

Because of the special nature of the previous two conferences (Jubilee in Auckland and 'mini' in Dunedin), a large, general conference is planned for 1983, with broad 'grass roots' appeal. papers are being called from all areas of chemistry. Although the conference does not have a specific theme, certain topics are being given prominence. The important field of analytical chemistry will receive more detailed attention in the areas of atomic spectroscopy, mass-spectrometry of biomolecules and advances in immunological based assays and separations. The chemistry and biochemistry of plant and microbial toxins will be covered with special emphasis on their role in animal diseases and insect control. The advances being made in bio-inorganic structure analysis will be reviewed with emphasis on some of the remarkable computer aided 3-D models being developed from crystallographic data. The need for a review of our science education system is recognised by the provision of a full day Education Symposium.

For the first time, the NZ Soil Science Society will be joining the NZIC. This reflects the general importance of chemistry to soil science and the specific contributions chemists are making to agricultural science in the Waikato region. Environmental chemistry will also be featured in a symposium in conjunction with the NZ Water Pollution Committee.

Although the Biochemical Society has joined the Microbiological Society for a May meeting, joint sessions are planned also for the August conference. Two major topics to be covered are protein biochemistry and calcium control. Both these subjects have links to Waikato based industries of edible protein production and the artificial insemination of cattle. Opportunity will also be given for presentation of results in other areas of mammalian biochemistry not covered in the May meeting.

Six overseas speakers have been invited to give plenary lectures to the full conference. Their talks will introduce the more specialised sessions following and will also serve the very important function of broadening the outlook of NZ chemists.

UNIVERSITY NEWS

AUCKLAND

As part of the recognition of the Centenary of the University donations have been solicited for a Foundation, the funds of which are to be used to bring scholars to the University in 1983, preferably over the period 6-9 May, when the main observances will be held. The initial target for the Foundation of $500,000 has been well exceeded. In the Chemistry Department, we will have *Prof. H.C. Brown* of Purdue University, Indiana, who has been awarded the Nobel Prize for his work on hydroboration — reactions with boron in organic chemistry. He will be in Auckland from 30 March to 19 April.

Other Chemistry visitors are *Prof. George Kennedy* from the Colorado School of Mines, *Dr. W.P. Griffith* of Imperial College, London, and Dr. Steve Riethmuller from the Virginia Military Institute.

Miss Susan Russell, Head of Science, Kelston Girls' High School, has a visiting teacher fellowhip for 1983. She will be attached to Stage 1 teaching, and she is doing a project on 6th and 7th form and stage I students' understanding of stochiometry, symbolism and equations.

MASSEY

Dr. John S. Ayres, Chemistry, Biochemistry and Biophysics Department, received a research grant from the Development Finance Corporation for the development of ion exchange and affinity celluloses. *Dr. Len K. Blackwell* of the same Department has been awarded a research grant for the development of an oestrogen test kit for the detection of ovulation in humans.

Prof. J.W. Robinson, from Louisiana State University, recently presented a seminar to the Department of Chemistry, Biochemistry and Biophysics on "Acid Rain and its Effect on the Environment". Professor Robinson described many problems that arose during his analyses of compounds from the environment. Some of the compounds could lead to the formation of acid rain. The effect of increased acidity on the release of toxic ions (eg. some forms of aluminium) and thus on aquatic life was also described.

During a visit to the above Department, *Dr. M.I. Gurr* described work in the Nutrition Department, National Institute for Research in Dairying, University of Reading, U.K., on the effect of dietary fibre on glucose metabolism. Using pigs as the model for humans, they were unable to demonstrate any effect of the fibre model, guar gum, on rates of movement of digesta. The improved glucose tolerance was believed to be due to a diluting effect of water associated with the guar gum. He also described work on derivatives of lactose which had properties similar to guar gum.

VICTORIA

Ms Janet Burns and *Ms Karin Knedler* presented papers at the Pacific Science Congress in Dunedin in February.

Ms J. Burns, in conjunction with the V.U.W. Centre for Continuing Education, organised two Chemistry Seminars for Senior School Chemistry teachers in November and December.

This year *Prof. John Tomlinson* returns to full-time teaching after three years as Deputy Vice-Chancellor.

Dr John Craig has been on study leave in Australia at the Australian Wine Research Institute at Glen Osmond and at C.S.I.R.O. in Sydney.

Prof. R.U. Lemieux, from the University of Alberta, has been a visitor in the department since December 1982.

CANTERBURY

Dr Ward Robinson is currently overseas for 12 months visiting Europe and the United States and *Dr John Blunt* is in Australia for six months.

Dr Chris Easton has been appointed lecturer in organic chemistry. He completed his Ph.D at Adelaide University and completed post-doctoral studies at Harvard. His major interest lies in the field of biosynthesis of penicillin-like molecules.

A recent visitor to the chemistry department was Dr M. Reubin. (Institute of Technology Haifa, Israel). His major interests are in the field of photochemistry.

Prof. E. Fischer is currently in the department on leave from Weizmann Institute Israel.

LINCOLN

Dr Alistair Campbell of the Department of Soil Science returned in mid February from six months sabbatical leave spent working at the Institut fur Bodenkunde Technische Universitat Munchen with Prof. Dr Udo Schwertmann. He studied the application of differential x-ray diffraction to the identification and properties of iron oxides in New Zealand soils and in placic soil horizons from New Zealand, Europe and the United Kingdom. The technique was also used to evaluate the effectiveness of selective dissolution techniques in studying iron minerals in soils.

OTAGO

In the Chemistry Department, *Prof. Arthur D. Campbell* became Mellor Professor and Head of Department on 1st February replacing *Prof Ted Corbett* who has retired after long service. Prof. Corbett will continue to research in the Department. *Dr David V. Fenby* was invited to speak at a Gordon Conference in California. His topic was concerned with the Chemistry and Physics of Isotopes.

Dr. A.J. McQuillan returned recently from leave spent at the California Institute of Technology and the University of York. He has been engaged in Raman spectroscopy at electrode surfaces.

Dr. Murray Vickers attended the 7th Australian Coal Hydrogenation Workshop and visited institutions engaged in coal research while in Australia. *John Billcliff*, Head of Science at Otago Boys High School, has been awarded a teaching fellowship and will be working this year in the Chemistry Department.

Dr Phillip Lindsay has now taken a post at Invermay Agricultural Research Centre, *Dr Peter Dawson* has moved to the I.C.I. Research Laboratories, Wellington, and graduate student *Michael Liddell* is now working for his Ph.D. on cluster chemistry with *Prof Ron Dixon* at Monash University.

Assoc Prof Brian Robinson will shortly visit the U.S.A. and Europe and attend the Leeds-Sheffield International Organometallic Conference in Sheffield.

Visitors to the Department have included *Dr Michael Spiro* of Imperial College, London, who lectured on heterogeneous catalysis in solution. *Dr M.R. Snow* of the University of Adelaide gave a seminar during his visit entitled, "Redox of cobalt (III) complexes by electrochemistry and molecular mechanics". *Prof Bill Cullen* of the University of British Columbia also visited and discussed his latest work on homogeneous catalysis.

J.W. Robinson of Louisianna State University lectured on Speciation of Metal Toxins during his stay. A little later, *Prof George H. Kennedy* from the Colorado School of Mines, and on his way to work at the University of Auckland, visited and gave a seminar titled "Filiform Corrosion — Animal, Vegetable or Mineral". *Mrs Rosalyn Watkinson* from the Water and Soil Division of the Ministry of Works, Hamilton, also visited the Chemistry Department in February to study methods of trace metal analysis in river and sea water with *Prof A.D. Campbell* and *Dr Keith Hunter*.

New hardware in the Chemistry Department includes a Nicolet Fourier-transform Infra-red Spectrometer, and a third Apple II computer system. The third computer will be devoted entirely to research, leaving the other two available for teaching. The computers are used extensively in Applied and Physical Chemistry programmes in the Department.

Chemistry Department staff have been engaged in an extensive revision of the Intermediate Chemistry course. This was required primarily to meet the needs of the Medical School. *Dr Barrie Peake* has had his teach-yourself introduction to Applesoft Basic computer programming published by John McIndoe Ltd.

The first-year student roll in Chemistry has increased this year by approximately 25% over numbers enrolled in 1982.

Continued Page 39

COUNCIL NEWS

Council at its meeting in Wellington on 18 February approved the following changes to the register.

Fellowship:
Brown, Desmond Goble, M.Sc. Chem Industries (NZ) Ltd. Pakuranga. (Chief Chemist).
Churchman, Gordon John, B.Sc (Hons) Ph.D. (Otago). Soil Bureau, DSIR. Lower Hutt. (Scientist).
Parry, David Anthony Dougall, B.Sc Ph.D. D.Sc. (Lond). Dept. of Chemistry, Biochem. & Biophysics, Massey University. P.N. (Reader).

Membership:
Barker, Miles Anthony, M.Sc. Dip.Ed. Te Puke High School. (H.O.D. Science).
Blackett, Barry Neville, B.Sc. (Hons) Ph.D (Cantuar). B.P. Chemicals (NZ) Ltd., Wellington. (Development Chemist).
Blattner, Regine, Dip.Chem. (Bassel) Ph.D (Well). Victoria University of Wgtn. (Building Res. Assn. Post Doctoral Fellow).
Friar, Murray John, M.Sc. (Massey). Chemicals Manufacturing Co. Petone. (Chief Chemist).
Grinsted, Martin James, B.Sc. (Hons) (Bristol) PGCE (Brunel) D.Phil. (Waikato). C.I.T. Trentham P.O. (Tutor in Chemistry).
Hughey, David Paul, B.Sc. Associated British Cables Ltd., Christchurch. (Works Chemist).
Searle, Philip Lee, NZCS. M.Sc. (Reading) Soil Bureau, DSIR., Lower Hutt. (Scientist).
Stratton, Gregory Charles, M.Sc. (Auck). N.Z. Farmers' Fertilizer Co. Ltd., Auckland. (Chemist).

Graduate Members to Membership:
Bradley, Mark Philip, B.Sc. Dip.Sc. Ph.D. (Otago). Howard Hughes Medical Institute, Nashville, Tn. U.S.A. (Research Associate).
Brockett, Gary, B.Sc. A.H.I. Roofing Ltd., Auckland. (Coatings Chemist).
Coll, Richard Kevin, B.Sc. Empire Rubber Mills Ltd., Christchurch. (Chemist).
Geursen, Arie, M.Sc. Dip.Sc. (Otago). Dept. of Biochemistry, University of Otago. Dunedin. (Scientific Officer).
Haines, Stephen Roy, B.Sc. (Hons) (Well). Chemistry Dept. Victoria University of Wgtn. (Ph.D. Student).
Olivecrona, Lloyd Malcolm, B.Sc. (Hons) (Well). W.R. Grace & Co. Ltd., Porirua. (Plant Chemist).
Phillipps, Maurice Wayne, M.Sc. (Otago). Pacific Steel Ltd., Auckland. (Works Chemist).
Slater, Robert Mark, M.Sc. (Auck). Caxton Printing Works, Manurewa. (Development Chemist).
White, Belinda Mary, B.Sc. N.Z. Farmers' Fertilizer Co. Ltd. Auckland. (Development Chemist).

Associate Member to Membership:
Calvert, David John, NZCS. Assoc. NZIC. Chemistry Dept., University of Auckland. (Technical Officer).

Graduate Member to Associate Membership:
Wong, Henry Kang Hiang, M.Sc. (Massey). N.Z. Forest Products Ltd., Auckland. (Technical Officer).

Technician Member to Associate Membership:
Brokenshire, Geoffrey Colin, NZCS. Merck Sharp & Dohme NZ Ltd., Auckland. (Quality Control Chemist).

Graduate Membership:
Chambers, Mark Vernon, B.Sc. (Hons) (Cantuar). Chemistry Dept., University of Canterbury. (Ph.D. Student).
Freitag, Susan Anne, B.Sc. (Hons) (Well). Ministry of Works & Development, Lower Hutt. (Scientist)
Hawkes, Peter David, B.Sc. (Hons) (Cantuar). Colgate-Palmolive (NZ) Ltd., Petone, (Plant Chemist).
Jacobsen, David Roy, B.Sc. Chemistry Dept., Victoria University of Wgtn. (M.Sc. Student).
Low, Mrs. Suat Lin, B.Sc. (Hons) (Otago). P.O. Box 4041 Nelson.
Purchase, Nigel Garth, B.Sc. (Hons) (Cantuar). Chemistry Dept., University of Canterbury. (Ph.D Student).
Readman, Jennifer Mary, B.Sc. (Hons) (Cantuar). Chemistry Dept., University of Canterbury. (Ph.D. Student).
Severn, Wayne Bruce, B.Sc. Chemistry Dept., Victoria University of Wgtn. (Student).
Sutton, Kevin Howard, B.Sc. (Hons) (Cantuar). Chemistry Dept., University of Canterbury. (Ph.D. Student)
Thakurdas, Andrew Rattan, B.Sc. (Hons) (Otago). 61 Owairaka Ave. Mt Albert. Auckland.
Vannoort, Richard William, B.Sc. (Hons) (Cantuar). Chemistry Dept., University of Canterbury. (Ph.D. Student).
White, Jonathan Michael, B.Sc. (Hons) (Cantuar). Chemistry Dept., University of Canterbury. (Ph.D. Student).

Technician Membership:
Blakie, Donald James, NZCS. Cadbury Schweppes Hudson Ltd., Dunedin. (Senior Technician).
Leech, Wayne Frederick, NZCS. Veterinary Ethicals Ltd., Auckland. (Production Manager).

Deaths:
Carrie, M.S. Hon. Fellow, Canterbury.
Hicks, R. Auckland.
McCombs, Sir T.H. Hon.Fellow, Canterbury.
Monro, Professor A.D. Hon.Fellow, Wellington.
Wood, H.J. Wellington.
Wright, N.L. Auckland.

Resignations:
Cradwick, P.D.
Pitt, M.A. Wellington.
Fergusson, Miss L. Canterbury.
Tarrant, P.A. Auckland.
Constable, J.R. Overseas.

Life Membership:
Gapper, H.R. Auckland.
McDonald, D.F. Waikato.
Adams, D.B. Wellington.
Bruce, L.W. Wellington.
Hurst, F. Wellington.
Hebden, W.H. Wellington.
Kennerley, R.A. Wellington.
Pastelidis, D. Wellington.
Penhale, H.R. Wellington.
Todd, H.J. Wellington.
Martin, C.G. Canterbury.

Struck Off:
Chung, A. Auckland.
Cochrane, M.C. Auckland.
Laus, A.I. Auckland.
Weatherall, D.A. Auckland.
Collins, G.A. Waikato.
Gregg, R.C. Waikato.
Connolly, R.S. Wellington.
Turner, J. Wellington.
Brown, G.A. Canterbury.
Owen, M.C. Canterbury.
Burstein, G.T. Overseas.
Heatherbell, D.A. Overseas.
Williams, D.E. Overseas.

BRANCH NEWS

AUCKLAND

The branch held two meetings in February, with addresses by *Prof. J.W. Robinson* of Louisiana State University, and *Dr. L.H. (Bert) Princen* of the U.S. Department of Agriculture, Illinois.

Prof. Robinson spoke on The Effects of Acid Rain, describing methodology and results to date from research conducted by his group into this problem in Louisiana.

Dr Princen gave a review of the work of the Northern Regional Research Centre in Peoria, into the search for plants suitable for development as crops for the production of various chemical intermediates (e.g. fatty acids).

Both talks were well received, with Dr. Princen's talk in particular providing some food for thought on potential developments in this country. One would not be surprised to shortly find the Railways Corporation being approached regarding the harvesting of their extensive crops of fennel, for the production of a number of industrial chemicals.

WAIKATO

Prof. Ralph T. Holman, Executive Director of the Hormel Institute in Austin, Minnesota visited the Ruakura Agricultural Research Centre in Hamilton after the International Conference on Oils, Fats and Waxes where he was a guest speaker. Prof. Holman addressed a seminar at Ruakura on "The Effect of Partially Hydrogenated Fats upon the Metabolism of Polyunsaturated Acids". Partially hydrogenated oils contain a wide range of octadecenoate isomers, each of which is metabolised differently from its closely related isomers. These isomers are precursors of unusual dienoic acids which may be converted in to prostaglandins of unusual structure, interfere with the normal metabolism of polyunsaturated fatty acids or be deposited in tissue lipids.

MANAWATU

Prof. Robert G. Ackman, Canadian Institute of Fisheries Technology, addressed the first Branch meeting for 1983 on, "Aspects of Fat and Oil Research in Canada". He discussed Canadian research work for their Fisheries Industries, in particular the deterioration of fish on being landed from the trawlers. The relationships between the fatty acid composition of fish oils rich in glycerol-based lipids and human health was also discussed.

Dr Henry Fales, National Heart, Lung and Blood Institute, N.I.H., Maryland, U.S.A recently visited Applied Biochemistry Division of the D.S.I.R. and presented a seminar on the application of ^{252}Cf plasma desorption mass spectrometry. This technique is used for obtaining molecular ions from very large organic compounds.

WELLINGTON

Prof. Ralph Holman, University of Minnesota addressed the Wellington Branch on "The Mechanism of Polyunsaturated Lipids".

He described the biochemical transformations that oleate, linoleate and linolenate undergo to produce families of polyunsaturated acids, some members of which are eventually converted into prostaglandins. Dietary deficiencies of linoleic and linolenic acids and metabolic deficiencies caused by genetic and other naturally occurring diseases in humans, as well as experimentally induced diseases in animals, can affect the polyunsaturated acid patterns of tissue and serum lipids. Professor Holman described several human diseases that he showed to be associated with metabolic abnormalities in the metabolism of polyunsaturated fatty acids.

CANTERBURY

The February branch meeting was addressed by *Prof. J.W. Robinson* of Louisiana State University who spoke on acid rain. Prof. Robinson described the methods and problems associated with the measurement of rain pH levels and discussed the causes and effects on aquatic life of acid rain in the Baton Rouge area, where pH levels as low as 3.3 have been recorded.

OTAGO

An International Conference on the Biology of Deer Production was organised by a committee which inluded *Ken Drew* and *Peter Fennessy* from Invermay Agriculture Research Centre and *Ian Forrester* from the University. This was a "world first", proved highly successful, and attracted several papers of chemical-biochemical interest. Topics included for example, seasonal profiles of plasma testerosterone, and growth hormone levels recorded from some stags in New Zealand.

Fletcher Fishing Ltd. have recently opened a new laboratory in Dunedin associated with their fish packing plant. Work is currently under way on fats from the orange roughy. Mainland Products Ltd. have introduced a new closed-vat method of cheese manufacture at their factories in Temuka, Stirling and Edenvale. Finally, the Liquigas Dunedin LPG Bulk Depot is under construction on reclaimed land near the mouth of the Water of Leith on Otago Harbour. Thirteen 100 tonne storage tanks will be buried in consolidated sand. They will be charged with LPG brought to Dunedin from Taranaki by the 1000 tonne coastal tanker, and LPG will be distributed from the Depot by road and rail.

Stan Winter, of the Southland Co-op Phosphate Co., Awarua, presented a paper at the 7th Research Symposium of the Fertiliser Manufacturers Research Association. His paper dealt with the production of high-solubility phosphate in superphosphate fertiliser made from rock of high aluminium and iron content.

On the schools scene, *Mrs. Rae Duff*, Senior Chemistry Teacher at Moreau College has been elected President of the Otago Science Teachers Association. *Andrew Innes*, Chemistry Teacher at Columba College, is now Independent School's Representative on the University Entrance Revision Committee for 6th-form Chemistry. Finally, *Michael McMillian*, until recently Head of Science at Aranui High School, Christchurch, has moved to Dunedin to take up a position in the inspectorate.

UNIVERSITY NEWS

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Otago continued

Prof Roger Short, F.R.S., visited the Biochemistry Department and gave a lecture titled "Lactation as a Reproductive Strategy", and met members of 'Reproduction Otago' — a group of scientists from the University and Invermay Agricultural Research Centre engaged in the study of reproduction. *Dr David Horrobin* from Efanol Research Laboratories, Nova Scotia, also visited after attending the International Conference on Oils, Fats and Waxes in Auckland, and gave a lecture on essential fatty acids, and "Efanol" — a natural source of γ-linolenic acid from "Evening Primrose Oil" for the treatment of essential fatty-acid deficiency states.

The Pharmacy Department has a new professor and head. He is *Prof D.G. Perrier* who obtained his degrees at the University of Alberta and the State University of New York. Since 1973, he has been engaged in teaching and research in pharmacokinetics, firstly at the University of Kentucky, then at the University of Arizona. He has been head of the Department of Pharmacy practice at Arizona for the last two years.

A new lecturer in Pharmacy, *Dr C.T. Hung*, has also been appointed. Originally from Hong Kong, he comes to Otago from the Robert Gordon's Institute of Technology, Aberdeen, where he gained his degrees and trained in pharmacokinetic studies of drugs and their metabolites in humans.

In the Nutrition Department, *Dr Orville Levander* from the U.S.D.A. Nutrition Institute, Beltsville, U.S.A., has been a William Visiting Fellow. Dr. Levander works on selenium bioavailability, requirements and metabolism, and collaborated in a selenium bioavailability study during his stay.

Institute members in the Department presented papers titled "Iodine Nutrition of Man and Domestic Animals", and "Cadmium and Other Toxic Trace Elements" at the Fifteenth Pacific Science Congress held in Dunedin in February. *Dr Joan McKenzie* has been invited to participate in a Dahlen Workshop on the topic, "Changing Biochemical Cycles of Metals and Human Health" in Berlin. She will present a review paper on the bioavailability of trace elements from foodstuffs and beverages.

In the Biochemistry Department, *Prof Clive Bradbeer*, from the University of Virginia Medical School, has joined the staff as a visiting lecturer for a year. Prof. Bradbeer has worked on the mechanism of transport of vitamin B12 in micro-organisms. After an appointment as temporary lecturer during 1982, *Dr Brian Monk* has been awarded an M.R.C. Senior Fellowship for 1983. His research interest is in flagella membrane structure, function and genetic specification. *Dr Warren Tate* has returned from leave during which he worked on the architecture of the ribosome and how it functions in protein biosynthesis to read the genetic code. This work was conducted at the Max Planck Institut for Molecular Genetics in West Berlin. *Dr Mary Thompson* returned from leave at the University of Virginia where she was investigating the existence of a second messenger for insulin action.

Dr George Emerson has departed for leave at Heriot Watt University, Edinburgh, and *Dr Brian Mansfield* recently left for a postdoctoral position to study molecular-biological events of growth and differentiation with Nobel Prize winner, *Prof Dan Nathan* in the U.S.A.

Also in the Biochemistry Department, *Dr Clive Trotman* attended the Australia and New Zealand Society for Cell Biology's Conference on Differentiation and Morphogenesis at Macquarie University where he presented a paper on protein biosynthesis in isolated gastric cells. *Prof George Petersen* and *Dr Kevin Farnden* attended the combined meeting of the Eighth Nitrogen Fixation Workshop and the Fourth Biennial Meeting of the New Zealand Branch of the International Association for Plant Tissue Culture in Palmerston North. Prof Petersen was Conference After-dinner Speaker and also presented a paper on DNA sequencing. Dr. Farnden presented one paper on molecular biology of plant micro-organisms interactions, and with *Clive Ponson* and *Victor Nyoni*, another on isolation and symbiotic properties of Rhizobium C_4-dicarboxylate transport mutant. *Dr Murray Grigor* attended the International Conference on Oils, Fats and Waxes in Auckland and spoke on the effect of high fat diets on lipogenic enzymes in the rat mammary gland.

Finally, in the Textile Department, School of Home Science, *Dr. Ian Weatherall* has been re-appointed N.Z. Textile Industries Representative for 1983 on the Textile Industries Training Board.

Tom Landreth, Senior Chemist at Alliance Textiles, has been appointed Tutor for 1983, and *Dr Peter Barber* has been reappointed a member of the Standards Association of New Zealand, Committee on Textiles.

New regulations which permit one or two units from other Faculties to count towards a B.Sc. degree, are expected to increase the popularity of the Textiles Science course offered in the Faculty of Home Science.

CONFERENCES

1983 NZIC CONFERENCE

This years conference, in conjunction with the NZ Biochemical Society and the NZ soil Science Society is being held 23-26 August at the University of Waikato. See the insert in this issue for details and registration form.

Australian Science Education Research Assn.

14th Annual Conference, 19-21 May 1983, at the University of Waikato. For details write to Dr Roger Osborne, Science Education Research Unit, University of Waikato.

Australasian Corrosion Association

A special one day symposium aimed at helping manufacturing industry understand how materials such as metals, plastics, rubbers etc. break down in service will be held in Christchurch on Friday 20 May.

The symposium is entitled "Degradation of Materials" and is being jointly organised and run by specialists from the New Zealand Branch, Australasian Corrosion Association; Christchurch Industrial Division, DSIR; Auckland Industrial Division, DSIR: and the Mechanical Engineering Department, Canterbury University.

The objects are to provide a forum for South Island technical people and industry personnel to discuss ways and means of preventing and controlling the degradation of metals, plastics, rubbers and other materials commonly used in manufacturing processes and industry.

The meeting will also discuss the formation of a Christchurch Division of the Australasian Corrosion Association (New Zealand Branch).

Topics to be covered include: economics of corrosion control; metallic corrosion; degradation of plastics and rubbers; corrosion research in New Zealand; standards in corrosion engineering; a review of the international corrosion scene.

Interested participants should contact the following for more details:
Convenor:
Mr Les Boulton
Auckland Industrial Divison, DSIR
Ph. 34-116 (Auckland)

Mr Gerry Allen
Christchurch Industrial Division, DSIR
Ph. 62-369 (Christchurch)

The 7AC Symposium Secretary,
C/- AMDEL,
P.O. Box 114 Eastwood,
South Australia 5063.

OVERSEAS

Seventh Australian Symposium on Analytical Chemistry. 22-26 August 1983, Adelaide.
Contact:

6th International Symposium on Plasma Chemistry. 24-28 July 1983, Montreal.
Contact:
Prof M. Boulos,
Departement de genie chemique,
Universite de Sherbrooke,
Sherbrooke, Quebec, Canada.

9th International Congress of Heterocyclic Chemistry. 21-26 August 1983, Tokyo.
Contact:
Prof Yuichi Kanaoka, 9th ICHC,
Faculty of Pharmaceutical Sciences,
Hokkaido University,
Sapporo 060,
Japan.

International Conference on the Applications of Mossbauer Effect. 26 September - 1 October, Alma-Ata.
Contact:
Dr V. Ya. Rochev,
Institute of Chemical Physics of the Academy of Sciences of the USSR,
Ulitsa Kosygina 4,
Moscow 117334,
USSR.

Eleventh International Conference on Organometallic Chemistry. 10-14 October 1983, Pine Mountain Georgia U.S.A.
Contact:
Dr E.C. Ashby,
School of Chemistry,
Georgia Institute of Technology,
Atlanta GA 30332,
U.S.A.

D.S.I.R. AND RESEARCH INSTITUTIONS

CHEMISTRY DIVISION GRACEFIELD

G.G. Page has recently transferred to Auckland where he is continuing his studies into corrosion.

Mrs Y. Hamer (nee Van Hoogenhuyze) from the Drugs and Alcohol section of Chemistry Division, Lower Hutt has transferred to Chemistry Division, Auckland.

Ms D.K. McKay of the Drugs and Alcohol section has completed a B.Sc in Chemistry at Victoria University of Wellington. Ms McKay was recently transferred from the Technicians grading to Scientist grading.

H.J. Todd of the Spectroscopy section recently retired from Chemistry Division.

P.D. Wilson. a Technical Officer in the Forensic Section recently returned to Chemistry Division after completing M.Sc in Forensic Science at Strathclyde University in Scotland.

Dr Peta Stringer has joined the Forensic Section to work as a forensic biologist. After graduating with Ph.D in Biochemistry from La Trobe University in Melbourne Dr Stringer came to New Zealand where she taught for two years at Wairoa College before being appointed to the Chemistry Division.

Dr B.G. Weissberg has relinquished the position as section head of the Geochemistry Section. *Dr T.M. Seaward* has been appointed the new section head.

R.A. Kennerly. head of the Inorganic Materials Section retired on 9 March. *Dr D.M. Bibby* has been appointed head of the section to succeed Mr Kennerley.

Dr W.F. Giggenbach has returned to Gracefield after two and a half years secondment to the International Atomic Energy Agency in Vienna.

Dr Gillian Cooper-Driver from the University of Boston recently spent six weeks at Chemistry Division working with *Dr K.R. Markham* on fern chemotaxonomy.

CHEMISTRY DIVISION CHRISTCHURCH

Stephen Gwyn has recently resigned from the Toxicology section to undertake missionary work in Zambia.

His place has been taken by *Peter Grounds* who has transferred from the Food and Pesticide section at Gracefield.

Richard Van Oort is soon to join the staff after completing his Ph.D at the University of Canterbury.

The new building being built for Chemistry Division at Ilam is progressing and staff hope to shift to their new residence later this year.

DAIRY RESEARCH INSTITUTE

Prior to the recent International Conference on Oils, Fats and Waxes, *Dr W.W. Christie* of The Hannah Research Institute, Ayr, Scotland, visited the DRI and presented a senimar on "Fatty Acid Esterification in Adipose Tissue". Dr Christie described observed differences in triglyceride structures within and between different animals and related this to biochemical changes within cells. he then described his studies of triglyceride biosynthesis in which he used both rat tissue homogenates and preparations of intact cells.

Dr Michael Gurr (Reading), left, talking to Drs Murray Grigor (Otago), centre, and Roy Bickerstaffe (Lincoln), right, at the Fats, Oils and Waxes Conference.

PLANT MICRO-ORGANISM INTERACTIONS

Meeting on Molecular Biology of Plant Microorganism Interactions Palmerston North February 16-18.

The Eighth Nitrogen Fixation Workshop (sponsored by DSIR) and the Fourth Biennial Meeting of the New Zealand Branch of the International Association for Plant Tissue Culture held a combined scientific meeting at Massey University from Wednesday 16th February to Friday 18th February. An object of the meeting was to examine the molecular biology of plant-microorganism interactions expecially those involved in agriculture and horticulture and this topic was highlighted in a Symposium held on the first day of the meeting. Conference members were welcomed in the opening ceremony by *Dr John Robertson* Chairman of the organising committee, other members of which were *Drs Clive Ronson, Derek White* and *Dan Cohen*, DSIR, Palmerston North. Dr Robertson said that he saw this meeting of being of particular importance because it came at the beginning of a new branch of science in which genetically engineered microorganisms would be used as tools to probe mechanisms of plant development. *Dr Waters*, Vice Chancellor of Massey University, welcomed conference members to the University and spoke of the need for interaction between scientists working in the fields of molecular biology and agriculture and of his hopes to further enhance Massey's reputation as an outstanding University. *Dr Ian Shearer*, Minister of Science, officially opened the meeting and commented that the Government is very much aware of the importance of the new technology of genetic engineering and strongly supports research in biological nitrogen fixation, detection and control of plant diseases and in the development of new varieties of plants.

Topics considered at the one day symposium and in the following two days of concurrent sessions of the Nitrogen Fixation Workshop and the Plant Tissue Culture Association included the genetic manipulation of microorganisms of agricultural and horticultural importance, objectives and techniques in molecular biological studies of symbiotic nitrogen fixation and plant diseases and techniques for the genetic manipulation of plants. Keynote speakers on these topics included visitors from West Germany, France, England, United States and Australia as well as from New Zealand. Several of these speakers dealt with the problems involved in transferring techniques from research to industry with emphasis being placed on possible developments in genetic engineering and plant tissue culture techniques.

Prof George Petersen Otago University who gave the lecture at the symposium dinner said that there had been great strides in molecular biology in recent years. These advances have brought with them powerful new techniques for studying and manipulating living cells and their products. Professor Petersen said that New Zealand needs a "biological research council". Such a council should be established to support research in molecular biology and other forms of new technology in the biosciences. He said that it is vital that New Zealand should make the fullest use of this new technology and not be left far behind developments in other countries.

New Zealand scientific firms gave support to the meeting and advertised their products on poster boards.

Dr. J. Robertson

FATS OILS & WAXES

International Conference on Fats, Oils and Waxes.

This Conference, held in the Conference Centre of the University of Auckland, from 13-17 February, 1983, proved to be quite an exciting affair. It was truly international in that about one-third of the 150 delegates came from 14 overseas countries, including faraway places such as Hungary and Sweden. Judging by their comments received since, they enjoyed the intimacy of a small specialised conference as well as finding the papers of a good standard.

Although members of the Chemistry Department of the University played a prominent part in the organizing of the meeting, they were well supported by representatives from industry, D.S.I.R., M.A.F. and the Departments of Biochemistry and Medicine at the University.

An initial grant of $3000 from the Royal Society of N.Z. established the project as a going concern; it was also supported by a loan of an equal amount from the N.Z.I.C., as well as grants from the National Heart Foundation, the Nutrition Foundation, the Auckland Medical Research Foundation and the N.Z. Dairy Board. A number of businesses and other concerns also assisted in cash or kind. These funds enabled the organizers to bring several noted scientists from overseas including *Prof R.G. Ackman*, Nov Scotia, Canada; *Dr Michael Gurr*, Reading, England; *Prof H.K. Mangold*, Munster, West Germany; *Prof Sune Bergstrom*, Stockholm, Sweden (Nobel Laureate, 1982); *Dr L.A. Princen* Peoria, U.S.A.; *Prof Ralph Holman*, Minnesota, U.S.A; *Dr Mark Hegsted*, Harvard, U.S.A.; and *Dr John Craske*, Sydney. In addition, a number of well-known leaders made their own arrangements to come and made welcome contributions..

The social side was not overlooked. At the official dinner on Tuesday February 15, opportunity was taken to present an engraved silver tray to *Dr Brian Shorland*, ex-Director of the Fats Research Laboratory, Wellington, — the "guru" of New Zealand Fats scientists. At the same time the chief plenary lecturer, and the main after-dinner speaker, Prof Ackman, was presented with a white towelling hat to protect his otherwise rather sparsely covered head.

Besides having succeeded in organizing a conference which appears to have been successful, and a groundbreaking event in being the first of its kind in this country, the Committee hopes that it will awaken interest in fats, which have a largely unrealised potential in this country.

It is expected that proceedings of the Conference will be available later this year. Enquiries should be addressed to *S.G. Brooker* Dept. of Chemistry, University of Auckland.

New Atomic Absorption Spectrophotometer

The 902 double beam Atomic Absorption Spectrophotometer released by GBC Scientific Equipment P/L contains several novel features.

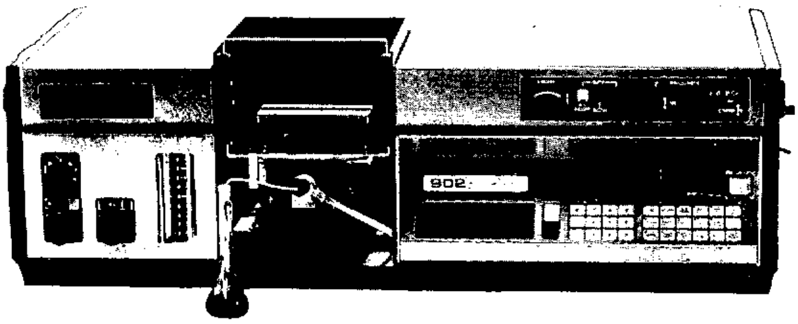
Operation of the instrument has been greatly simplified by incorporating an alpha numeric display effectively allowing the instrument to inform the operator what actions are required.

The 902 has a new feature called time expanded operation which takes a digital "snapshot" of absorbance data over a ten second period.

This snapshot is replayed in slow motion enabling ordinary chart recorders to capture transient signals occurring in graphite furnace atomizers.

With this system it is possible to time resolve the lead peak from the non atomic peak when analysing lead in 1% sodium chloride.

In addition the 902 makes more efficient use of the time available for sample beam theoretically improving signal/noise ratio by 40%.



NEW STAINLESS STEEL PUBLICATION FROM DSIR

A new DSIR publication sets out in a clear, concise manner the correct ways to use and maintain stainless steels so that they give long, trouble free service lives.

The publication stresses than an incorrect choice of metal grade, poor design or faulty fabrication and maintenance procedures could lead to rapid and sometimes catastrophic failure. Corrosion, stress or a combination of these and other factors could all cause serious problems.

The publication "Using Stainless Steel" is authored by two specialists in the fields of metallurgy and metallic corrosion.

Dr N.A. Miller heads the Engineering Materials Section of DSIR's Industrial Division in Auckland and has had considerable experience in the welding, industrial usage and failure investigation of stainless steels.

L.H. Boulton, also with the same section, specialises in industrial corrosion and the solving of manufacturing and design problems associated with this metal.

The 64 page booklet is well illustrated with detailed black and white plates and includes a selected bibliography.

Subjects covered include types of stainless steels, corrosion, selection, design, welding, cleaning and maintenance.

The authors have presented the technical material in a clear, easy to understand style and it should particularly appeal to industrial users of stainless steels. The information would also be useful to students at both university and technical institutes who are pursuing careers in engineering and manufacturing.

"Using Stainless Steel" can be purchased from Government Bookshops throughout New Zealand as well as DSIR's Science Information Division in Wellington. The price is $7.00 plus 36 cents postage. The address is DSIR, Science Information Division, P.O. Box 9741, Wellington.

USE FOUND FOR NMR

Nuclear Magnetic Resonance is being investigated by the American Food and Drug Administration as a replacement for x-rays in body scanners. Using donut shaped magnets that enclose the patient's body, the technique promises better distinctions between body tissues than is possible with x-rays.

With powerful new magnets being developed, images based on phosphorus and carbon 13 as well as hydrogen are possible future developments. Phosphorus nmr could be very useful in the diagnosis of muscular disorders.

Expensive, at a predicted minimum of $1.5 million, the technique has some disadvantages, not least for patients with pacemakers. (Proving again that nmr is not for the faint hearted).

PYE LAUNCH

PYE UNICAM LAUNCH INTO CUSTOM CHROMATOGRAPHY

Pye Unicam's industrial projects group is extending its well-known custom design service into the field of high-performance liquid chromatography.

Customised systems based on the outstanding PU 4000 family of HPLCs are now being produced from a range of standard modular packages. These systems range widely, covering applications from routine quality control right up to extended facility schemes for automatic method development.

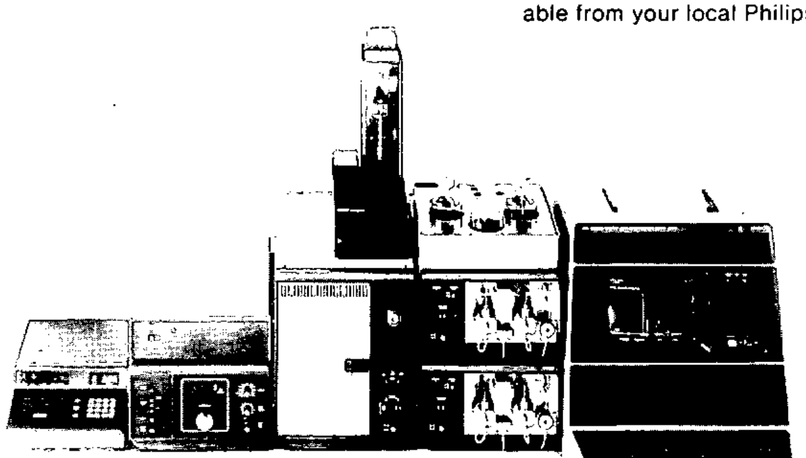
One example is an instrument for use in the pharmaceutical industry, where extensive batch production produces a high throughput of samples requiring analysis by HPLC, using various combinations of solvent, different columns and several detector wavelengths.

For this application a special isocratic version of the PU 4002 video liquid chromatograph has been produced, providing automatic selection of five solvents, high-performance pumping with automatic compensation for solvent compressibility differences, a column oven with multi-step automatic selection between up to five columns (and a by-pass line), automatic sample injection of up to 102 samples, a new UV detector which provides automatic changing of wavelength and the well-known Pye Unicam PU 4800 video chromatography control centre, supervising the entire system and providing sophisticated data handling, processing and presentation.

This particular system, which typifies a whole range of custom possibilities, provides fully automatic, completely unattended analysis of over 100 samples, each with the correct pre-programmed combination of solvent type and flow, column type and temperature, and detector wavelength. It will transform throughput in many quality control laboratories.

Automatic liquid chromatography systems for other applications such as the analysis of monomers and polymers, the degree of sulphonation of alkyl ethoxylates and the analysis of amino acids are also among Pye Unicam's recent custom-orientated designs. Their industrial projects group are anxious to be approached by users with their own specific requirements and aims.

Further technical information is available from your local Philips office.



ALPHATECH SYSTEMS LTD

ALPHATECH SYSTEMS LTD has recently taken over the complete NZ Sales operation of ANAC Ltd. All distributorships will be transferred to ALPHATECH who will undertake the warranty responsibilities associated with instrumentation installed to date. ALPHATECH SYSTEMS is a fully New Zealand owned company and has the full support of its many International Principals.

Notable among these principals is Waters Associates, world leaders in HPLC, and a well known name to New Zealand chemists. ALPHATECH will maintain the well equipped Applications Laboratory for the benefit of HPLC users as well as a large inventory of HPLC spare parts and consummables. Many new products from WATERS will further enhance this range of equipment.

ALPHATECH SYSTEMS has also recently been appointed the exclusive representative of BECKMAN INSTRUMENTS in New Zealand. Existing BECKMAN Sales, Service and Support staff from the Auckland office of BECKMAN will join ALPHATECH and Service Support will be available directly in Dunedin. The merger will allow wider service and support to be provided to customers throughout New Zealand.

In the areas of liquid chromatography, electron microscopy, spectroscopy, nuclear and health physics, radioisotopes, and electrochemistry ALPHATECH SYSTEMS has inherited a history of quality instrumentation and service.

ALPHATECH SYSTEMS will be located at:
83 WAKEFIELD ST
AUCKLAND 1
P O BOX 5565

TELEPHONES: 770-392
TELEX : 21433

For all enquiries - contact Conway Bishop or John O'Neill.

NEWS FROM KEMPTHORNE

1983 CATALOGUE FROM PRECISION SAMPLING WILL AID G.C. AND HPLC USERS

Chromatographers will discover the new 1983 catalogue invaluable as a selection guide for liquid syringes and gas syringes. Key features of each model are carefully listed and the benefits explained.

In addition to Precision Sampling's syringe range which covers from 0.01 micro litre volumes to the Magnum gas series with up to 500ml capacity, the catalogue lists replacement parts and a range of accessories such as micro-capillary valves, septum needle guides, cat whisker kit, etc.

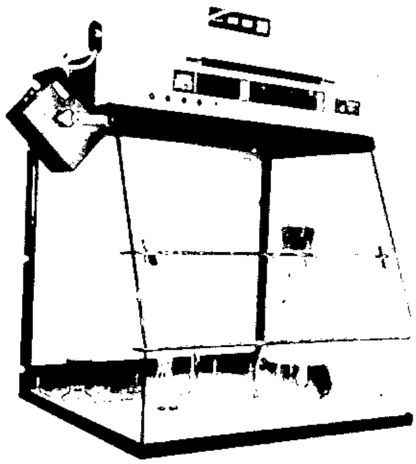
COPIES OF THIS CATALOGUE ARE AVAILABLE FROM:
KEMPTHORNE MEDICAL SUPPLIES

ERLAB FUME HOODS.
Fume Hoods Without Ducting

Erlab Captairs are recommended for the filtration of gases, vapours, toxic particles, reducing personal exposures and odour level in the laboratory. The use of the Erlab Captair is recommended for the protection of the respiratory passages and working environment of people who regularly handle toxic substances. The filtration system for toxic substances is specially designed for Erlab Captairs and is of extremely high efficiency. This filtration principle should not be confused with other commercially available systems which dilute toxic substances discharged by a low efficiency filter, in a volume of air controlled by a fan. Contrary to the air dilution system, the Erlab system guarantees that, throughout the lifetime of the filter, filtering efficiency is such that air discharged into the room no longer contains any traces of toxic substances.

Erlab cabinets are mobile, modular and completely ductless, coming in a variety of sizes and with a choice of filters.

Literature, copies of test reports and further detailed information is currently available from exclusive agents,
KEMPTHORNE MEDICAL SUPPLIES LIMITED,
P.O. Box 1234,
AUCKLAND.



New Microprocessor Controlled Gas Chromatograph from Shimadzu
MODEL GC - 9A

This new instrument from *Shimadzu* has a built-in microprocessor which ensures extremely simple operation. The Gas Chromatograph is set up and controlled via the interactive keyboard and display.

The microprocessor has storage facilities for the operational parameters of up to 10 analytical programmes, which is especially convenient for the running of practicals, or, push button operation by semi-skilled operators. It provides the capability for composing time programmes through dialogue with the system via it's display. The microprocessor also provides a self-diagnostics function. A timer is incorporated so the G.C. may be shut down when not in use and automatically warmed up for the next analysis.

The large column oven with removable main doors allows convenient access. The unique two door system ensures easy operation when employing column switching valves etc.

The oven can be temperature controlled in the multi-linear mode. Temperature controlling range is from - 100°C to 399°C in ten steps, precision ± 0.1°C. (Cryogenic accessory is required for sub-ambient operation.) Column temperature control at near ambient via ambient control valve.

There is a choice of 6 detectors available from *Shimadzu*. The GC-9A can have four detectors mounted, which can be retrofitted.

The instrument is versatile and is designed to provide a base for an automated system. Expanding as requirements change and budget allows. The optimum system would be connected to the *Shimadzu* Chromatopac CR-2AX Data Processor/Control Unit. (see other notes)

THREE NEW PRODUCTS FROM SCI • MED

New Microprocessor Controlled High Pressure Liquid Chromatograph
MODEL LC - 4A

The microprocessor controls the liquid pump, gradient system, detectors, Helium degassing, column oven, auto sampler, start signal to data processor and also provides a self-diagnostics function and safety devices against abnormal pressure and temperature. It provides storage facilities for the operational parameters for up to 10 analytical programmes. This feature is especially convenient for running routine analyses. Once the parameters are filed the instrument can be used by an inexperienced operator at the push of a button.

High performance liquid pump is compact, dual plunger reciprocating system, allowing both isocratic and gradient elution of up to three mobile phases and also step gradient elution. Choice of either constant flow or constant pressure. Permits both extremely high pressure delivery for high separation columns and also high flow rate for preparative HPLC. Incorporates a drain valve for convenient, simple solvent changeover and system purge.

The LC - 4A is designed to provide the base for an automated system in conjunction with the *Shimadzu* Data Processor C - R2AX. (see other notes)

New Chromatopac Data Processor Controller from Shimadzu
MODEL C-R2AX

The C-R2AX is not just a Data Processor, it will enhance the performance of any G.C. or H.P.L.C. It is specifically designed to be used with the *Shimadzu* GC-9A and LC-4A, although it can be used with other instruments.

It provides: Operational control of micro-computerised gas chromatograph and liquid chromatograph. Establishment of a fully automated G.C. or L.C. system using the BASIC programme of the C-R2AX. Printout (or CRT display) of instrument parameters. Presentation of temperature programme curve or gradient curve on the printer/plotter (or CRT).

Memo input via BASIC programme, annotated chromatogram with printout of component names at peak apexes, presentation of corrected baseline etc plus presentation of calculated data. Extended C-R2AX BASIC facilitates writing time programmes in BASIC programmes.

Results are printed out in format suitable for final filing. 20 k byte user memory.

Simultaneous processing and recording of output from two detectors, or, two other variables such as flow and pressure rates, with INP-R2A.

Full keyboard which is especially convenient for BASIC programming.

As with the other new products in the *Shimadzu* chromatography range the emphasis is on flexibility and customer benefit.