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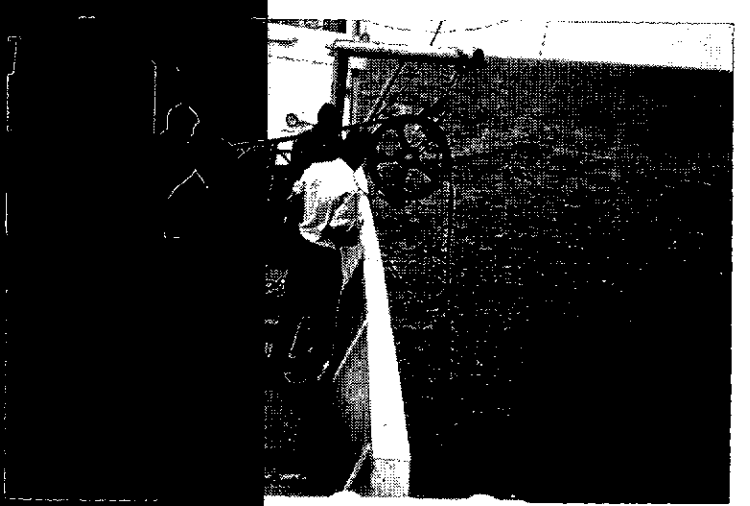

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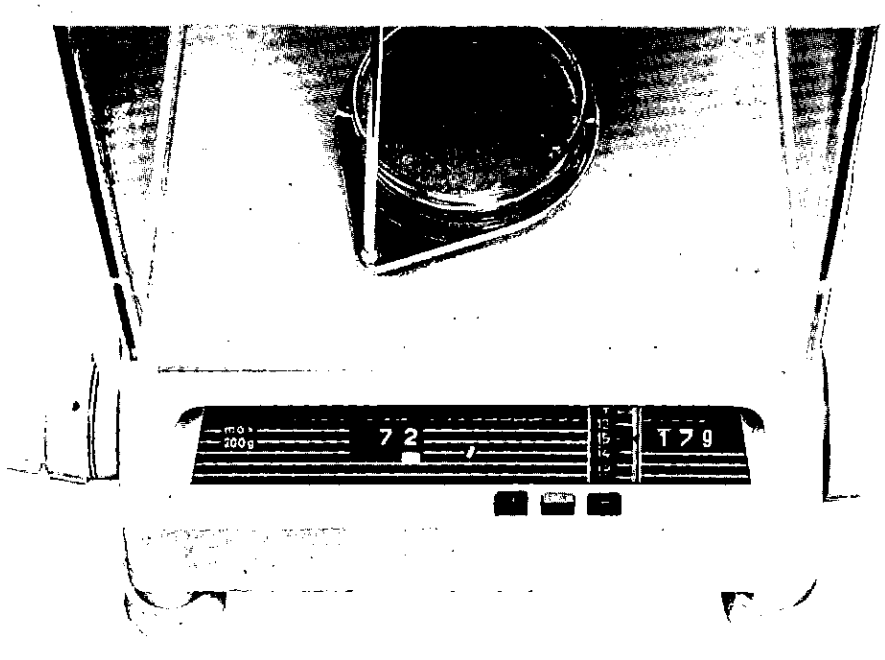

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CHEMISTRY IN NEW ZEALAND

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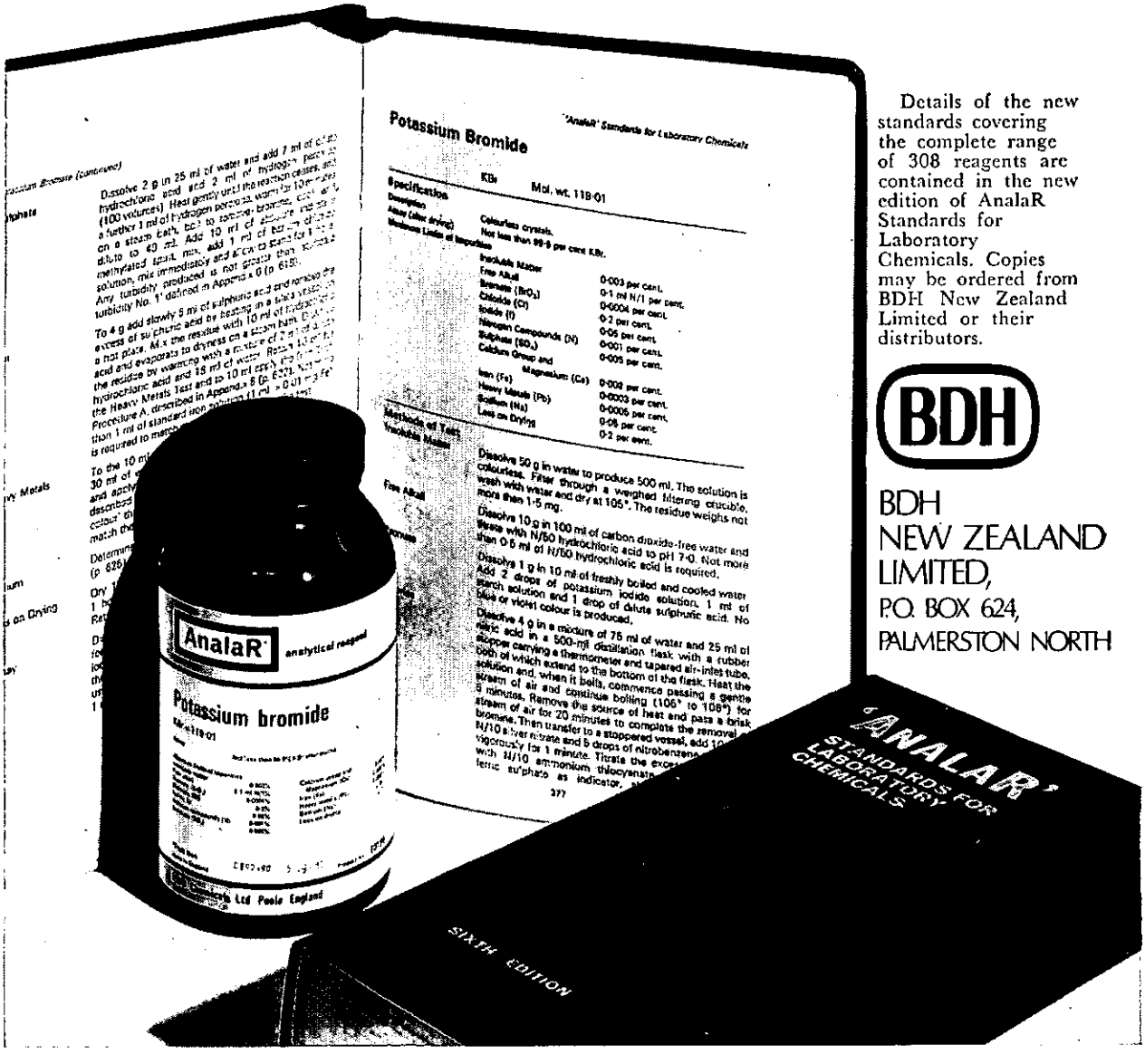

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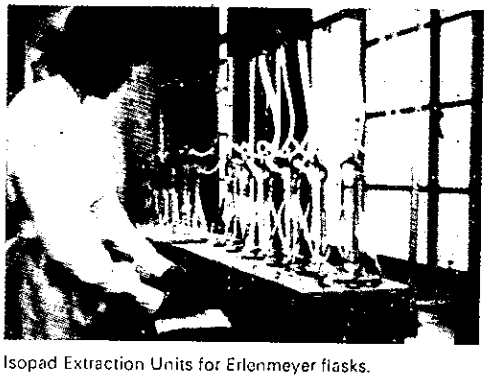

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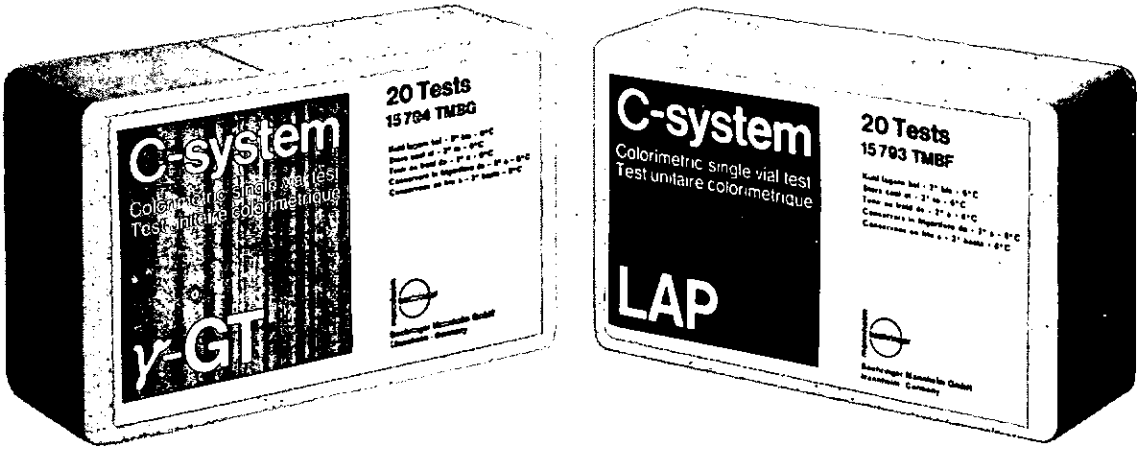

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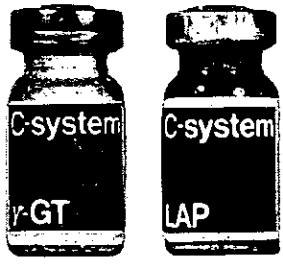

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LAKE ERIE — TO BE OR NOT TO BE

by C. W. Childs, Ph.D.
Soil Bureau,
Department of Scientific and Industrial Research,
Lower Hutt

Whether 'tis nobler in the mind to suffer
The slings and arrows of outrageous fortune,
Or to take arms against a sea of troubles,
And by opposing end them?—Hamlet

Lake Erie is the smallest of the North American Great Lakes both in volume and average depth, and the second smallest in area (see Table). Except for Lake Erie, the deepest parts of all the Great Lakes lie well below sea level.

A very high concentration of human population exists around the shore of Erie, particularly near the head of the lake where the mighty industrial network of Sarnia-Windsor-Detroit-Toledo-Cleveland is located. The population of the Lake Erie basin in 1971 is about twelve million people. One measure of the human activity around each of the Great Lakes is the B.O.D. (biochemical oxygen demand) discharge from communities. The B.O.D. is a measure of the rate at which dissolved oxygen is drawn upon during the process of waste degradation. The values shown in Table I are the sums of the B.O.D. discharges by cities, on or close to each of the lakes, discharging in excess of half a million kilograms per year.[1] It is not surprising when its size and waste load are considered that Erie is the Great Lake most seriously affected by human activities. In the last twenty to thirty years it has declined markedly as a recreational asset, and the fishing industry has been severly affected. Few people deny that the sword of Damocles hangs over Lake Erie today, and there are those who say that it has already fallen into its (hardly sparkling) waters.

Chemical pollution of waters falls into two classes—firstly, toxic effects due to mercury (from which Erie has already suffered), cadmium, pesticides and the like, and secondly, the effects of overfertilisation by nutrients such as phosphorus and nitrogen. The cause of the first is usually more easily controlled than the cause of the second, and it is the enormous addition of nutrients by man leading to a very rapid rate of eutrophication that is the main threat to the survival of Lake Erie.

In its early life a lake usually contains clear water which contains very small quantities of dissolved materials and which supports very little plant and animal growth. This state is termed oligotrophic. As time passes soils and plant material are carried in by rivers and the lake is able to support an increasing amount of life. The water becomes less pure in the chemical sense, and contains more of the trace elements and nutrients required for life. Eventually there will be sufficient nutrients to permit the formation of large blooms of algae—the most obvious sign of a eutrophic lake. Algae are the primitive aquatic plants often present as green or brown slime around sewage outfalls and in stagnant farm ponds. Algal blooms are said to occur when there is greater than about ten cubic centimetres of phytoplankton per cubic metre of water.[2]

Eventually deposition will proceed to the extent that the lake becomes a swamp. The process from oligotrophy to eutrophy is called eutrophication and usually occurs over many hundreds or thousands of years, but in a number of lakes man's activities have rapidly speeded up the process. The term 'cultural eutrophication' is sometimes used for that part of the process due to man. Lake Erie in 1971 is a rapidly aging eutrophic lake.

Of particular importance is the element phosphorus which is considered to be the limiting nutrient for algal growth and hence one of the controlling factors in the eutrophication of Erie. Many elements are required for algal growth. Carbon, nitrogen, phosphorus, hydrogen and oxygen may be classified as major nutrients, while several others including manganese, iron and silicon are required in small quantities. The determination of the limiting nutrient for a lake is a complex problem and in the case of Erie both carbon and phosphorus were proposed. The question has almost certainly been decided in favour of phosphorus as the element which most often limits algal growth in Erie but the evidence and arguments leading to this view make entertaining reading.[3]

A description of the physical characteristics of Lake Erie is helpful to the discussion that follows (see Figure). The lake is long and narrow and possesses three distinct basins—the shallow western basin which receives the outflow from Lake Huron via the St Clair and Detroit Rivers, the central basin (largest of the three) and the relatively deep eastern basin which feeds the Niagara River. During winter the lake is not stratified and is usually ice-covered to a large extent. In summer the water in the central basin separates into two distinct layers. The warmer epilimnion overlies the colder hypolimnion and insulates it from the atmosphere. There is a distinct boundary, called the thermocline, between the two layers; the temperature difference is usually of the order of 10°C. Typically the hypolimnion is two to three metres thick and the epilimnion about seventeen metres thick. The annual flow through the lake is one third of the volume of the lake. The western basin never develops a hypolimnion but the eastern basin has a deep stable one.

For many summers past, algal blooms have regularly occurred in the surface waters of the central basin of Erie. Their growth is spurred by the large quantities of nutrients present in the water. Each bloom lasts a few days before the algae sink from the surface waters and cover the lake bottom with a mat perhaps two centimetres thick. This huge amount of organic matter soon begins to decay and the oxygen used in the process is drawn from the waters of the hypolimnion. Since these waters are sealed from contact with air by the warmer upper layer, the oxygen is not replenished. Successive blooms lead to a marked depletion in the oxygen concentration in the hypolimnion. In recent years (since about 1960[4]) the oxygen concentration has gone virtually to zero each summer, in which case the hypolimnion is said to be anoxic.

The effects of the bloom and decay process are several. Besides fouling large areas of the lake surface, masses of algae wash up on beaches and rot there. Today only a few brave people swim in Erie. Algae clog water intakes and foul the spawning beds of fish. There has been a marked effect on the fish population. Generally, Lake Erie has become unsuitable for the more desirable and once plentiful types of fish such as whitefish, trout, salmon and pike, and most of the catch today consists of less desirable types like smelt and perch. Undoubtedly the lamprey which gained access to the lakes above Ontario when canals were built between Erie and Ontario has also contributed to the change.

Algal blooms tend to occur mostly near the head of the central basin and reflect the greater discharge of nutrients in the western basin—Cleveland area than elsewhere. The net movement of water down the lake carries

nutrients and algae into the central basin and it is in the sediments there that there has been a large accumulation of nutrients. Phosphorus has probably been precipitated in the form of metal phosphates or become adsorbed on sediments. It remains there, virtually fixed and unavailable to growth in the lake, as long as oxygen remains in the overlying water. However, when anoxic conditions occur in the hypolimnion there is a substantial regeneration of nutrients back to soluble forms. These changes, occuring in the central basin of Erie, were followed in detail during the summer of 1970 by a team of limnologists from government agencies in both Canada and the U.S.A. The following description is based on papers presented at the Fourteenth Conference on Great Lakes Research held in Toronto in February, 1971[5]:

A massive algal bloom occurred in the central basin of Lake Erie during the last week of July 1970, and this had two obvious effects. Firstly, the phosphate concentration was reduced to almost undetectable levels in approximately eighty per cent. of the surface waters of the basin, and secondly the bloom caused a layer of sedimented algae about two centimetres thick to be laid down on about seventy per cent of the basin floor. This bloom and subsequent others caused anoxic conditions in the hypolimnion which were first observed in mid-August and probably lasted until the loss of stratification about two months later. The rate of phosphorus regeneration from the sediments was found to be about eleven times greater under anoxic conditions than it was under oxygenated conditions. Under oxygenated conditions the amount of phosphorus released from the sediments was about one quarter of that deposited in the fresh algal material, but under anoxic conditions the amount released was greater than could be accounted for only by the decay of the algal material. Thus under anoxic conditions the central basin becomes a producer of, rather than a fixer or remover of, soluble phosphate. Subsequent checks during the winter of 1970/71 indicated that most of the phosphorus regenerated under anoxic conditions remained in solution after the autumn loss of stratification.

It sems that Lake Erie is probably close to a condition of self-fertilisation where large quantities of phosphorus would be utilised over and over again in algal production. If this is the case, then an extremely rapid decline in the lake's condition can be expected. But even if self-fertilisation does not occur, the present discharge of nutrients into the lake is sufficient to ensure its deterioration. If the deterioration is to be slowed and perhaps even halted, it seems essential that the amount of nutrients fed to the lake be markedly reduced to the extent that anoxic conditions do not occur in the hypolimnion, and preferably further to the extent that fish and other aquatic life in the hypolimnion are not affected by lack of oxygen.

The relationship between the phosphorus discharge into Lake Erie and the summer oxygen depletion in the hypolimnion has been explored.[4] It indicates that anoxic conditions in the hypolimnion in late summer would just be avoided if the 1970 phosphorus discharge was cut by just over a half to the level of discharge in about 1955. For sufficient oxygen to remain in the hypolimnion to maintain fish and other aquatic life at the end of summer, the 1970 phosphorus discharge would have to be cut by something like eighty per cent, and this would correspond to the level of discharge in about 1930.

Of the discharge of phosphorus into Erie about seventy per cent comes from municipal sewage. Detergents contribute about two-thirds of this (nearly half of the total discharge) and excrement about one-third. About fifteen per cent is accounted for by agricultural runoff, and about ten per cent comes from urban runoff and industrial wastes. Present municipal sewage treatment around Lake Erie and the other Great Lakes is limited, almost exclusively to primary, and

sometimes secondary, stages and is aimed at reducing B.O.D. and bacterial content. Primary treatment involves the removal of solids from the waste, while secondary treatment is an accelerated process of degradation. Both of these treatments allow nutrients to pass to discharge.

The governments of Canada and the U.S.A., spurred by public pressure, have become increasingly concerned in recent years with the problems of eutrophication in the Great Lakes. The Canadians, having recognised phosphorus as a major factor and detergents as the chief single source, have limited the phosphorus content of laundry detergents to twenty per cent as phosphorus pentoxide and have set a target, not yet a law, of five per cent as phosphorus pentoxide by the end of 1972. Also, plans are under way to provide better sewage treatment facilities which would include nutrient removal stages. These will remove nutrients from other sources besides detergents, but their development is limited by expense, time, and the difficulty of supplying small communities and rural areas with the necessary facilities.

The U.S.A. government refrained from limiting phosphorus in detergents by law, though some states and cities in that country passed their own laws on detergent phosphorus limits. At the height of the anti-phosphorus period (about mid-1970) the word 'phosphate' to the layman was probably synonymous with 'arsenic', 'mercury,' and 'DDT'. Detergent manufacturers, foreseeing the death knell of sodium tripolyphosphate as a detergent ingredient, searched frantically for replacements of comparable cost and effectiveness. Sodium nitrilotriacetate was a chief contender, as it was being used in detergents in Sweden. Borates, carbonates, silicates and citrates were also in the race.

Nitrilotriacetate came under question in late 1970 because of the ability (comparable to that of EDTA) to complex metal-ions and hence affect their distribution in various systems. This view was apparently confirmed by an investigation of the effects of feeding nitrilotriacetate together with cadmium or methyl-mercury salts to rats and mice, and the U.S.A. government in December 1970 recommended that the development of nitrilotriacetate as a detergent ingredient be halted pending further investigations. Later research by one of the large detergent makers suggested that nitrilotriacetate may be carcinogenic. None of the other substitutes appear to be entirely satisfactory. It was rumoured that several washes with citrate detergents caused clothes to become quite stiff. Environmentalists wanted assurance that any phosphate replacement would be less harmful than phosphate itself. Since phosphates are plentiful in nature and their chief crime is merely that they act as nutrients, this was a difficult requirement to meet.

In 1971 there has been a swing back from substitutes to phosphates. In September the U.S.A. government advised their public that use of non-phosphate detergents is potentially dangerous. They now plan to identify areas which have eutrophication problems due to phosphorus, and to provide phosphorus removal facilities in those places. It seems that phosphate-based detergents will remain at least in the U.S.A. At present an agreement between Canada and the U.S.A. on financing better sewage treatment facilities in the Great Lakes basin is being negotiated. What the fate of Lake Erie (and subsequently Ontario and Michigan) will be is uncertain. Whether nutrient removal from discharges can be achieved and whether that is enough to halve the rapid ageing, are questions that only time can answer with certainty.

A note on the New Zealand situation is probably appropriate. Phosphate-based laundry detergents are used to only a very small extent in this country. The market is still dominated by traditional soap powders and bars. From a lake eutrophication view this is fortunate, since soaps provide neither nitrogen nor phosphorus on degradation. Nevertheless some New Zealand lakes, including Lake Rotorua, are showing clear

signs of advanced eutrophication. Detergents aside, it is human excrement and agricultural runoff of fertilisers and animal waste that probably contribute most to cultural eutrophication. Types of sources somewhat special to New Zealand are fertilisers (aerial application may be particularly relevant) and waste from holiday homes around the lakes.

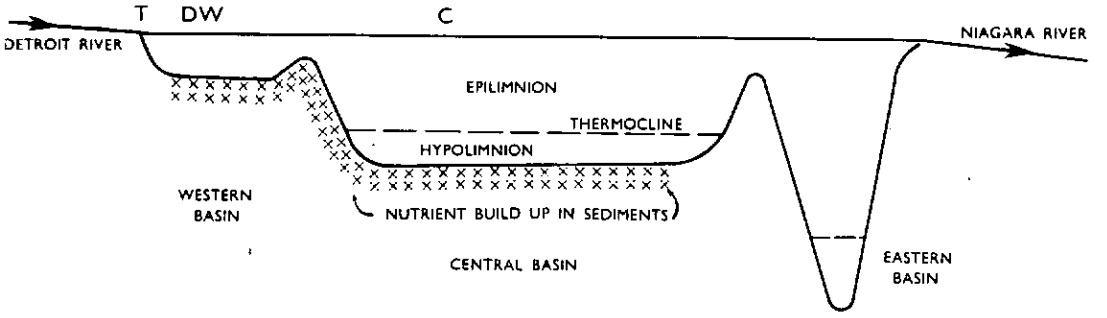

Figure 1. Profile of Lake Erie, not to scale.
Approximate positions of cities: T, Toledo; D, Detroit; W, Windsor; C, Cleveland.
The thermocline in the central basin is present only in the summer.

TABLE I

Lake	Superior	Michigan	Huron	Erie	Ontario
Area Sq. Kilometres	82,000	58,000	60,000	26,000	19,000
Average Depth Metres	148	84	59	18	86
Volume Cu. Kilometres	12,100	5,000	3,400	500	1,600
B.O.D. Input $\times 10^{-6}$ Kilograms/Year	2	16	3	29	16

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[2] Technical Bulletin No. 26, Inland Waters Branch, Dept. of Energy, Mines and Resources, Ottawa, Canada. (1970).

[3] J. R. Vallentyne, Canadian Research and Development, May-June, 36, (1970); and references therein.

[4] M. Gilbertson and H. H. Dobson, Proceedings of the 14th Conference on Great Lakes Research, Toronto, (1971). In press.

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NOTES ON 1971 SALARY SURVEY (Vol. 35, No. 3 June, 1971)

The salary survey is already months out of date with the rapid changes in salary, so there seems little point in pursuing it in detail. However some interesting generalities have arisen. These are not tested for significance but they appear reasonable.

The analysis-cum-correlation was run separately for each of the three employment groups, Industry, Government and University. On age alone, it appeared that starting salaries were higher in industry, but unless senior administrative positions were reached, were lower above age 45.

Much more interesting is the percentage of variance explained (R^2) and the effect on R^2 of omitting one variable at a time from the analysis. The following table results:—

Variable Omitted	Industry	Government Employment	University Group
None	51	72	74
Age	40	28	52
Quality of Primary Degree	48	68	72
Ph.D. or not	47	61	73
Major Function	28	67	63

The following appear reasonable deductions which do not conflict with what one hears:—

(a) Government and University salaries are more predictable by the simple model analysis than industry (cf 72 and 74 with 51).

(b) Age is most important in Government and least important in industry. (cf decreases in R^2 between first two lines).

(c) Major function is most important in industry.

Combining (b) and (c) it is apparent that industry pays more for the type of work done than for the age of the person doing it. It would also appear reasonable from (a) that industry considers unquantifiable characteristics, or characteristics which do not correlate with age and qualification, as more important in determining remuneration; e.g. ability to handle labour and unions.

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OBITUARY

F. H. G. Johnstone

Mr. F. H. G. (Johnny) Johnstone formerly Chemist to the Dominion Yeast Co. Ltd., Christchurch died recently in Christchurch. He was Secretary of the Canterbury branch from 1942-53 and Chairman in 1954. During most of this time he was Canterbury delegate and when most branches were represented by Wellington proxies he managed regularly to combine business with business and represented Canterbury's interests personally. He still frequently attended branch meetings and was last seen at the A.G.M. just two weeks before his death.

ALLOPHANE—ITS STRUCTURE AND POSSIBLE USES

by N. B. Milestone

Chemistry Department, University of Waikato.

(Winning Student Paper, N.Z.I.C. Conference, August 1971)

The subject of my research for my doctorate has been to propose a theory for the structure of allophane and to investigate possible uses for it.

The term allophane was originally used in 1816 by Stronmeyer and Hausman to describe material found in the cracks of rocks in Germany. It was a colourless amorphous material which lost water on standing to change from a "glassy" state to an "earthy" one—hence the name allophane from the Greek words "allos" meaning "other" and "phainin" meaning "appearance".

The occurrence of allophane in New Zealand was suggested by Henderson and Ongley in 1923 as appearing in a soil derived from volcanic ash near Mairoa. Taylor in 1933 observed further deposits in a study of ash showers in the central North Island. Ross and Kerr in America described the properties of geological allophane found in Europe and America in 1934. But it was not until 1952 that any detailed study of allophane derived from volcanic ash was made by Fieldes and his co-workers.

Allophane is an aluminosilicate clay that is amorphous and difficult to estimate quantitatively in samples. It has a distinctive differential thermal analysis pattern, and loses more water on heating than do other clays such as kaolinite.

It was recognised by Fieldes and his coworkers that allophane made up the major proportion of the clay in the yellow-brown loams and yellow-brown pumice soils in the North Island derived from volcanic ashes. A weathering scheme was proposed by Fieldes as shown below.

Glass → Allophane → Halloysite → Metahalloysite → Kaolinite

Figure 1 shows the principal ash showers of the central North Island. The youngest ashes shown are Ngauruhoe and Tarawera showers which are no older than 100 years. Kaharoa ash is about 1000 years old and Taupo ash about 2000 years old. The weathering of these ashes has not progressed very far, and although there is little clay in the soil, what is there is allophane. The Tirau-Waihi ashes are about 30,000 years old and the Egmont ashes less than 15,000 years old. Much weathering has taken place and there is about 30% allophane in the subsoil. The oldest shower here, Hamilton-Mairoa, is at least 44,000 years old. There has been extensive weathering in this region, and some soils can contain up to 75% allophane. In many places in this region crystalline clays such as halloysite and kaolinite are present with the allophane. In the areas covered by the Tirau, Egmont and Hamilton ashes there are many millions of tons of allophane which may lie in beds up to 30 feet thick.

The allophane extracted from these deposits is yellow-orange in colour, due to iron impurities which may be removed chemically.

It has been suggested that allophane-like aluminosilicates, can be formed from weathered material other than glass in the volcanic ash. Feldspars in which the aluminium and

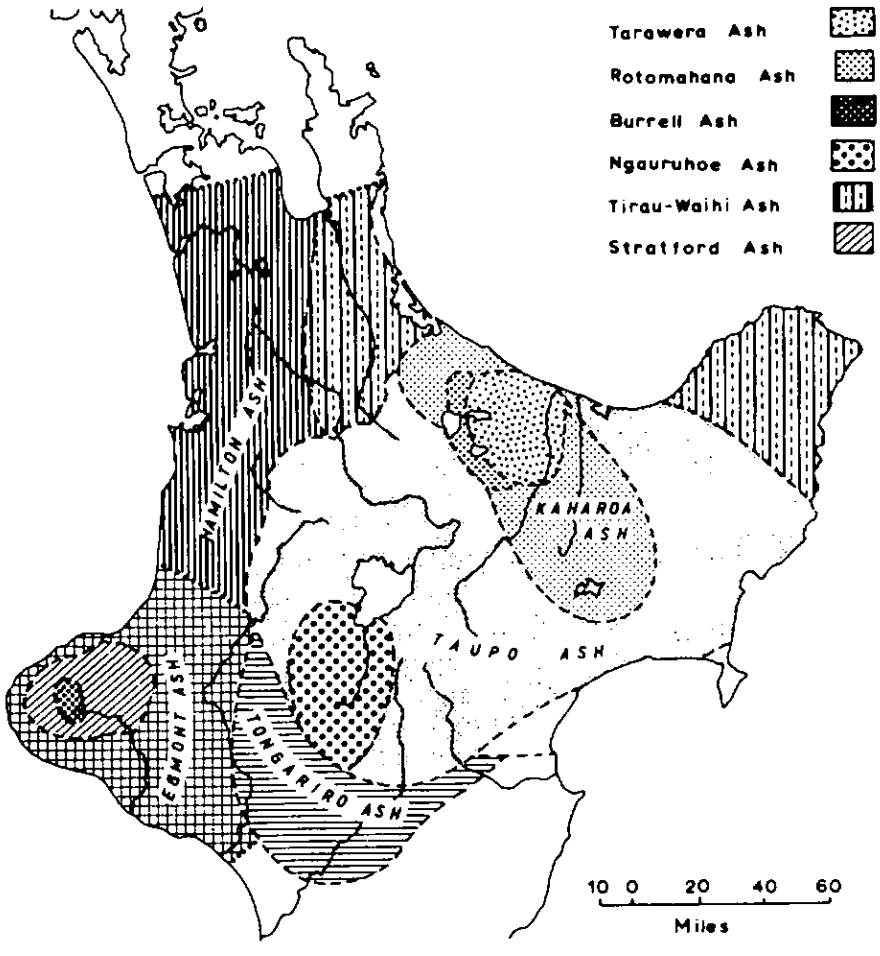

Fig. 1. Principal ash showers of the North Island.

silicon atoms have a disordered arrangement cannot weather to form regular mica-like minerals and the weathered products appear as allophane.

Minerals can also be reduced to a disordered state by grinding, frost action or similar treatment. Provided that the rate of recombination to form crystalline products is slow, the products of the mechanical treatment will remain as allophane. These conditions are found in subsoils under forests and at high altitudes where the temperature is low and there is a high rainfall.

Figure 2 shows the high country soils of the South Island. Up to 10% allophane is found in the high country yellow-brown earths formed from weathering of greywacke and schist. The allophane from these soils contains less iron and is much less red in colour than from those of the North Island.

The lack of X-ray diffraction data means that there is no easy way of identifying allophane, and in fact it has long been thought, outside of New Zealand and Japan, to occur only infrequently and to be of little importance. However, papers are now appearing

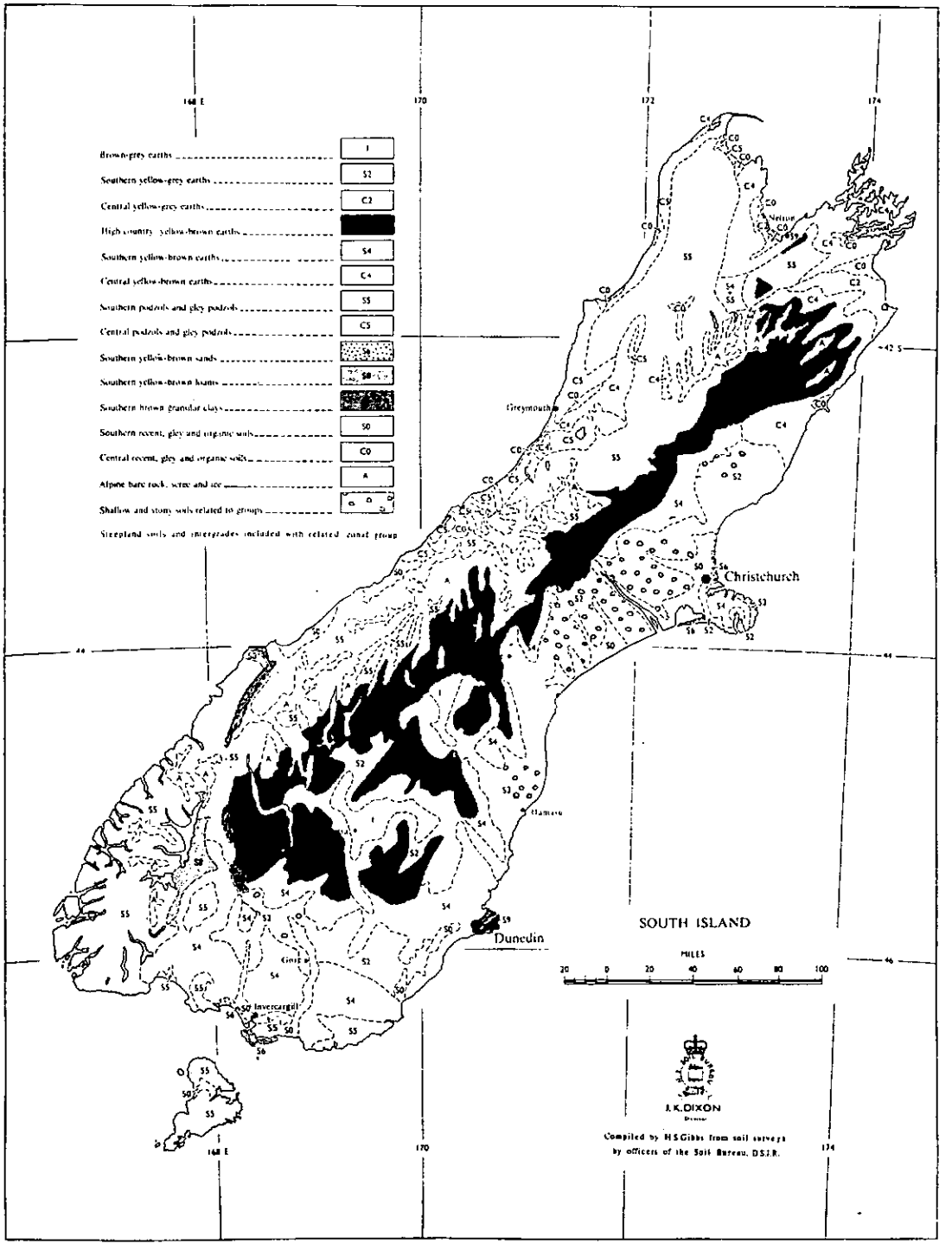

Fig. 2. Soils of the South Island. High country yellow-brown earths in black.

citing the occurrence of allophane throughout the world especially where there has been recent volcanic activity.

Minerals such as gibbsite and feldspars can be ground fine enough not to give an X-ray diffraction pattern, but can be detected by I.R. absorption peaks or differential thermal analysis. The I.R. absorption spectrum of allophane in the metal-oxygen stretching region shows a very broad intense peak centred about 1000 cm^{-1}. This is made up of several peaks since shoulders are seen with some allophane samples. This shows that in the structure of allophane there are not sufficient numbers of the same type of linkages to justify an orderly structure—in other words the structure is essentially random. This randomness is a property of allophane. Differences in allophane samples are usually due to composition rather than structure. Soil allophanes have been reported in a wide range of chemical compositions, but usually with the silicon to aluminium ratio lying between 1 and 2.

X-ray fluorescence studies using the aluminium Kα line have shown that the coordination number of aluminium in allophane is apparently five. A more detailed study has been made of aluminium coordination in amorphous aluminosilicates prepared by hydrolysing together organo-derivates of aluminium and silicon. Aluminium is tetrahedrally coordinated up to about 30% alumina. With increasing aluminium concentration, octahedral coordination increases until at 100% alumina there are no tetrahedral aluminium atoms remaining.

Wada, from Japan, has proposed a structure scheme for allophane with two end members corresponding to silicon/aluminium ratios of 1:1 and 1:2. He describes a chain type structure (Fig. 3). But this would have some order and not the randomness described by Fieldes.

The occurrence of tetrahedrally coordinated aluminium leads to a negative charge

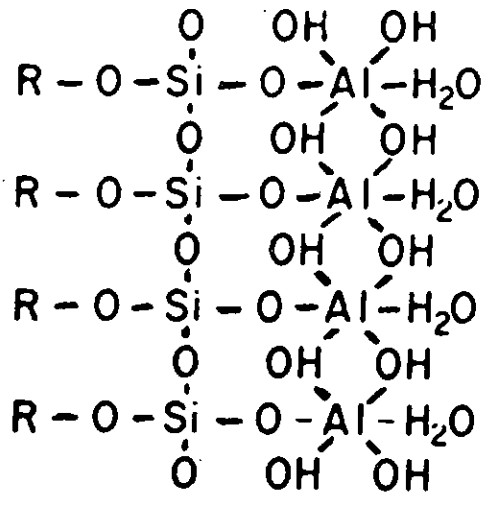

Fig. 3. Wada's allophane structure.

for each unit tetrahedron. This charge is balanced by a proton or by hydroxyalumina complexes such as $[Al(OH)_2(H_2O)]^+$ or $[Al_2(OH)_2(H_2O)_8]^{4+}$. This is the basis of a model proposed by Cloos and his co-workers in which the active tetrahedral aluminium is in a central core chemically bound to silica and randomly arranged with hydroxyalumina complexes electro-statically attached around the core.

From our work we have proposed a theory for the formation of allophane from volcanic glass (See Fig. 4).

The colloids formed from the initial weathering will be very small particles of hydrated alumina, silica and iron hydroxide. These colloids carry a charge; alumina and iron hydroxide colloids are positively charged while silica is negatively charged. These charged colloid particles are attracted together to form what we have termed a 'colloid salt'. The arrangement can be considered as something akin to a normal salt, but as the particles have different sizes a random type structure will occur. The structure is held together with electrostatic forces. This

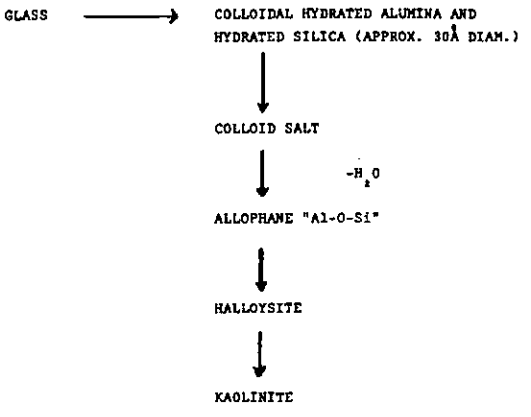

Fig. 4. Proposed theory of formation of allophane.

phenomenon would not be confined to this weathering scheme but would be important in all colloid chemistry. We have carried out experiments to investigate this 'colloid salt' to see whether it is stable or not.

If we take freshly cleaved mica and dip it into a colloid of hydrated alumina or iron hydroxide and remove it, the surface is covered with amorphous particles of the appropriate colloid which cannot be washed off. If we dip the coated mica into a colloid suspension of hydrated silica, we can put a coating of silica onto it. We can repeat this, dipping alternatively into hydrated alumina or iron hydroxide and silica, so building up a succession of layers of our 'colloid salt'. If we treat the surface with radioactive phosphate (P-32), we find an alternating pattern of uptake with iron hydroxide and silica, but an even pattern with the alumina. It appears that instead of forming the 'colloid salt' of hydrated alumina and silica we have a chemical reaction taking place between colloid particles which presents a uniform surface to the phosphate. For the hydrated iron hydroxide and silica, there are alternating layers of iron hydroxide which absorbs phosphate and silica which does not. This means that a "colloid salt" of iron hydroxide and silica is stable, whereas the 'colloid salt' of alumina and silica reacts to form allophane.

Artificial allophanes can be prepared in two ways. Firstly by taking organoderivatives of aluminium and silicon, we can hydrolyse them together to obtain an amorphous product with the properties of allophane. Secondly we can hydrolyse the organoderivatives separately, mix the colloidal suspensions together and freeze dry them. Amorphous hydrated alumina and silica show characteristic peaks in the I.R. due to Si-O and Al-O bonds. A mixture of these two, dry ground together, still show some characteristic peaks which can be assigned either to silica or alumina. However, the I.R. spectrum of the aluminosilicate prepared in the second way shows only that of an allophanic material. This suggests to us that the free colloids will react chemically to form Si-O-Al bonds, at least when fresh. Thus allophane is a product of the chemical reaction in a "colloid salt" of alumina and silica reacting to form bonds and eliminating water.

The charge on the elementary allophane particle will probably be negative, since aluminium can be fitted into the tetrahedral environment occupied by the tetrahedral silicon. If this is so, then hydrated alumina and iron hydroxide colloids will be attracted. The iron hydroxide will now form a "colloid salt" with allophane which will account for the fact that it can be removed by mild chemical treatment. The alumina will react until all available silica particles are removed, and if there is insufficient silica will eventually crystallise and form gibbsite which is often found in separation of allophane from volcanic ash.

We are continuing our work using Fe-59 to determine the movement of iron in "colloid salts" we can prepare using allophane, silica and alumina.

New Zealand is one of the few countries in the world in which large scale deposits of allophane occur near the surface. As we saw in Figure 1 there are many millions of tons of allophane occurring in the western region of the central North Island. There may be up to 75% allophane in these deposits which can be easily separated from sand by dispersing and allowing the sand to settle out leaving an allophane suspension.

The second part of my research has been to investigate possible uses for this cheap, abundant raw material. Allophane is a good ion exchange material having both acidic and basic sites, and hence may be useful for removing materials important in causing pollution. Phosphate is fixed readily by allophane and ammonium ions readily absorbed, thus removing two elements associated with pollution. Meatworks and sewage disposal plants cause pollution. The Horotisu abattoirs north of Hamilton pour about ten tons of protein per day into the Waikato River. We are studying protein uptake on allophane in an effort to find whether allophane could be used commercially to remove protein. The protein we have used extensively so far is bovine serum albumin, which occurs in abattoir effluent.

Allophane samples were equilibrated in solutions of a known pH and then suspended in distilled water and gently stirred. A small volume of protein solution was then added and allowed to sorb onto the allophane. The concentration of protein remaining in the solution at any given time could be monitored by removing an aliquot, centrifuging and measuring its UV absorption at 282 nm. The protein concentration dropped with a typical half life of about two and one half hours. Samples were left for twenty-four hours, then a further sample of protein solution added and readings again made. This was continued until the sample was saturated with protein.

When saturated the allophane will no longer disperse even with vigorous stirring, but settles to the bottom of the flask in a

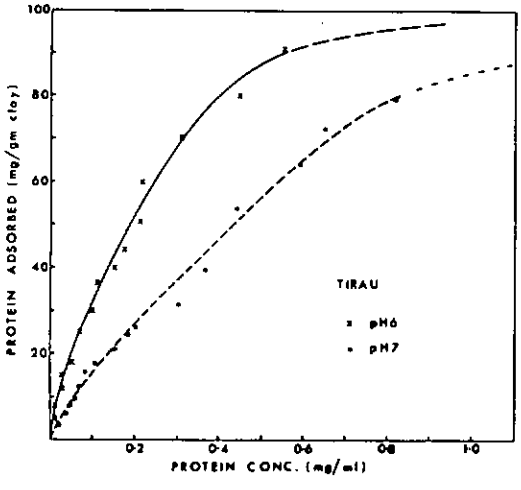

FIG.5 ADSORPTION OF BOVINE SERUM ALBUMIN ON ALLOPHANE

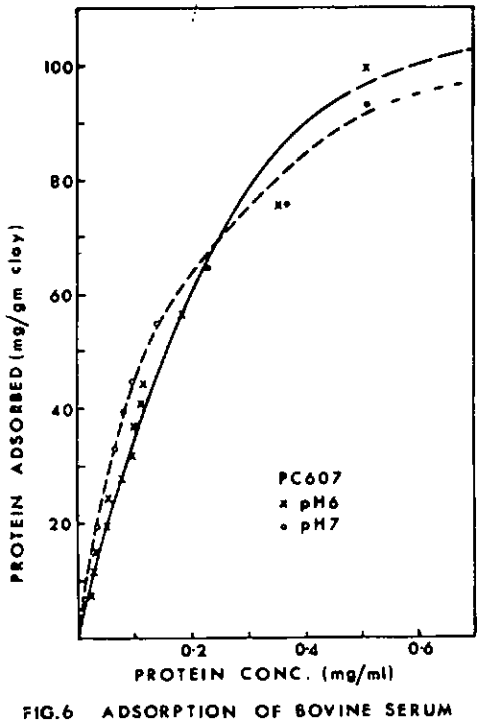

FIG.6 ADSORPTION OF BOVINE SERUM ALBUMIN ON ALLOPHANE

jelly-like mass. Allophane equilibrated at pH 4.5 or less causes immediate coagulation of the protein when added and we have not been able to measure uptake of protein below the isoelectric point for bovine serum albumin which is 4.7. The isoelectric point for allophane lies between 6 and 7 depending on the allophane used.

Fig 5 shows the absorption isotherm of bovine serum albumin on allophane separated from Tirau ash. These samples were not fully saturated, although they had the appearance of being so i.e. the clay settled to the bottom of the flask in a sticky mass. At pH greater than the isoelectric point, both the allophane and protein are negatively charged, and if the attraction is electrostatic we would expect there to be less uptake of protein at pH 7 than at pH 6 as shown.

Fig 6 shows the absorption isotherm for bovine serum albumin on allophane from sample PC 607 from a road cutting. The distinction between the pH isotherms is not as clear as for the Tirau sample, suggesting possibly the isoelectric point of PC 607 lies closer to 7 than that of Tirau. The uptake of protein, although tending to the same value, about 10% by weight, is reached at a much lower protein concentration in solution for PC 607 than for Tirau.

The relatively slow rate of absorption of protein (half-life about two and one half hours) is possibly due to a slow conformational change that the albumin must undergo before it is absorbed onto the allophane. This could explain why so far attempts to remove the absorbed protein with mild reagent treatment such as 10^{-2}M NaOH or Na_2CO_3 have not been successful. The protein must be denatured before it can be absorbed and so will no longer be soluble in water.

We are continuing further work using hemoglobin which has a higher isoelectric point, and investigating possible ways of removing protein from allophane.

LETTER TO THE EDITOR

Dear Editor,

The institute has carried out some very valuable work on salary surveys, but has done nothing to directly improve the status and salary scales of its members.

There is no real recognition by employers of membership of the institute; the engineers get recognition by registration.

To show the state of affairs as at 22.10.71 the following are the commencing salaries in the public service with no experience.

M.Sc. (1st class hons.)	$4,252
B.E.	$4,078
M.Sc. (2nd class)	$3,729
N.Z.C.S.	$3,555
M.Sc.	$3,425
B.Sc.	$3,235

A certificate in science is rated higher than an M.Sc., which removes any incentive for state servants wishing to attain higher qualifications.

Is it small wonder that the junior scientists in the public service are dissatisfied with their salaries?

I would like to see—

(1) Fair relativity with technicians.

(2) Incentives established to be members of the institute.

So that the institute instead of just surveying salaries will have some control over them.

J. M. SEAKINS.
Scientist.

THE ROYAL SOCIETY OF NEW ZEALAND

NATIONAL COMMITTEE FOR CHEMISTRY

Report for the year ended 31 March, 1971 (abridged)

The annual meeting of the Committee was held on 9 March, 1971. Professor Briggs chaired the meeting and paid tribute to Professor Packer who died on 24 February. The Committee placed on record its great appreciation of Professor Packer's work as Chairman since 1965.

Dr T. A. Rafter was elected as the new Chairman and Professor C. J. Wilkins agreed to continue as Secretary in the mean time. The New Zealand Institute of Chemistry has been asked to nominate a successor to Professor Packer on the Committee.

International Activities

IUPAC Relations

The Royal Society Council decided to appoint one New Zealand delegate to the forthcoming XXVI IUPAC Conference in Washington D.C., in July 1971. Dr Rafter was recommended as first delegate and Professor Wilkins second delegate.

The Royal Society has been asked to nominate Dr Rafter for a position on the Bureau of IUPAC.

Mr S. G. Brooker continues to serve as New Zealand's representative on the Oils and Fats Section of IUPAC, a position arising from his attendance as New Zealand's delegate to the XXV Conference of IUPAC at Cortina d'Ampezzo in 1969. This emphasises again the need for New Zealand's representation at international chemistry meetings.

Mr T. R. Hitchings continues to act as New Zealand's Corresponding Member of the IUPAC Committee on Teaching of Chemistry and is responsible for the two-way exchange of information in this field.

IUPAC Dues

The revised scheme proposed by Professor J. C. Bailar Jr., IUPAC Treasurer, and its application to New Zealand's membership was discussed. The assessment of dues is based on the annual chemical turnover of each country from figures taken from the United Nations Standard International Trade Classification. Although the assessment of New Zealand's annual chemical turnover on which the IUPAC Treasurer based his figures was questioned, the basis of the suggested unit system was approved. The continuation of New Zealand in Category C with annual dues of US$450 was approved. However, the Royal Society has been advised that these dues may be raised in the future to US$650-800.

Company Associates

In order to stimulate a more active interest from chemical industry in the activities of IUPAC and to assist in IUPAC finances a new scheme of Company Associates has been introduced and adopted in nine countries to date. For a single-unit subscription each year of US$250 an industrial company has the following privileges:

1. One copy of such official IUPAC publications as its journal, *Pure and Applied Chemistry, Information Bulletin and its Appendices, Comptes Rendus IUPAC Conferences, Rules of Nomenclature.*

(There is a IUPAC Bureau resolution that from 1972 Company Associates will be required to pay half the cost of *Pure and Applied Chemistry* (present annual subscription US$115).

2. Advance details of IUPAC-sponsored symposia and congresses.
3. Admission of one participant to IUPAC symposia and congresses at a reduced registration fee.
4. Use of any group travel facilities which may be arranged for IUPAC meetings.

Before approaching chemical companies and Research Associations in New Zealand to become Company Associates the question of taxation exemption for such subscriptions was sought from Inland Revenue Department. The Department has declined the application on the grounds that under the present law, such subscriptions, if paid through the Society did not meet the criterion of being for support of research. It suggested, however, that it would be receptive to proposals for tax exemption in specific cases where direct research benefit by company associate membership could be substantiated.

It was resolved that this matter be discussed personally with the Minister of Science and that Dr Rafter and/or Dr Shorland should meet the Minister, with the President.

Since Research Associations, on the other hand do not have the same taxation restrictions, it was resolved to approach them to join as Company Associates.

Finance raised in this way would help to ensure New Zealand's adequate representation at future IUPAC Conferences.

Co-operation between IUPAC and EEC on Food Additives

Dr F. B. Shorland continues to correspond on his subject with Professor R. Truhaut, Chairman of the IUPAC Co-ordinating Committee for Analytical Methods, and will be kept informed on future developments.

Chemistry in South East Asia

Dr Shorland's lengthy Report on Research Facilities in Science and Technology in Asia, with Special Reference to Chemistry (Based on UNESCO Report 1968) has been forwarded to the Royal Society for the particular attention of its International Committee.

Bureau of Analytical Methods

IUPAC suggestion to set up this bureau was not supported on account of the availability of similar services provided by other sections of IUPAC and the high cost of the proposed centre (US$50,000 per annum).

Rules of Nomenclature

As new rules of nomenclature appear for various sections of chemistry these have been circulated to interested parties at the discretion of the Secretary.

National Activities

IUPAC Report on Chemistry Teaching and its Application to New Zealand

Arising from a request from last year's annual meeting to the Minister of Education on this subject an informal meeting of representatives of the Education Department (Messrs Phillips, Roy and Reeves) and this Committee (Dr Shorland, Professor Tomlinson and Mr Hitchings) met at the Curriculum Studies Unit of the Education Department on July 23rd. Many aspects recommended in the report were in fact under consideration by the Education Department. Some were already being implemented, although not at the desired level of intensity mainly for financial reasons. Under existing arrangements the close contact between Mr

Roy of the Education Department and Professor Vaughan of Canterbury University ensured that the Entrance Board kept the prescription for the syllabus used for University Entrance, Bursary and Scholarship examinations under constant review.

The meeting instituted valuable liaison between the Royal Society and the Department of Education.

L. H. Briggs
14 April 1971

Subsequent action arising from this report:—

(1) *IUPAC Conference*

Dr Rafter attended the Washington Conference. Professor Wilkins was unable to attend. Council approved the nomination of Dr Rafter for election to the Bureau but we have learnt that his election was unsuccessful.

(2) *IUPAC Dues*

The Royal Society Council agreed in principle that an increase in dues to US$650-$800 but decided no firm decision would be taken until the decisions of the IUPAC Conference on the revised dues structure was known.

(3) *Company Associates*

Immediately following the meeting of the Committee the President agreed to meet the Minister of Science with Dr Rafter and a submission was sent to the Minister on 11 March over the Persident's signature outlining the position and seeking the interview. Drs Willett and Rafter saw the Minister shortly afterwards when they received a sympathetic hearing and an undertaking to take the matter up with his colleague the Minister of Finance. Dr Rafter spoke to Mr Talboys again later and the matter was finally referred to the Commissioner of Inland Revenue. Following further discussion between an officer of his Department and the Royal Society Executive Secretary a favourable reply was received from the Commissioner. His letter of 3 August states;

> "Payments by business firms to become 'company associates' of IUPAC will be deductible for income tax purposes under section 111 of the Land and Income Tax Act 1954, provided the necessary connection exists between the type of business carried on and the type of research information provided by IUPAC.
>
> Where such subscriptions are taken out by New Zealand chemical firms, as suggested in your Society's letter of 12 February 1971 to this Department, it will be accepted that this necessary connection is present. My district officers will be advised accordingly."

This means that if a company is prepared to subscribe as a company associate Inland Revenue will allow tax deduction on the amount paid. Concurrently approaches will be made to research associations and to business firms which might be receptive to becoming associate members of IUPAC.

(4) *International Analytical Centre*

Council endorsed the Committee's view that it was not satisfied as to the need for this Centre because of the availability of services provided by other organisations and the high cost of the proposal. This was passed to the appropriate working group of IUPAC. The following is the text of the reply dated 19 July;

> "We agree that it is difficult to estimate the number of institutes and organizations which would make use of the services of ICACh. A survey which has been organized by the Working Group gives, however, a rather optimistic view. In addition to that, the excellent response of the International Analytical Quality Control Services of the International Atomic Energy Agency underlines the need for such activi-

ties. The above is now servicing more than 300 laboratories in 52 countries in the field of radiochemistry and trace-analysis, incidentally including some in New Zealand.

It is also expected that projects for developing countries needing analytical services would be dealt with by such a Center."

(5) *IUPAC Report on Chemistry Teaching and its Application to New Zealand*

Arrangements are in train for a further liaison meeting with the Department of Education, and the Society will facilitate Mr Hitching's attendance at the meeting.

MEMBERSHIP OF THE CHEMICAL SOCIETY

Many N.Z.I.C. members subscribe to the R.I.C. journal *Education in Chemistry* at $8.00 p.a. By joining the Chemical Society, N.Z.I.C. members would enjoy the privileges of membership of that body, including receipt of *Chemistry in Britain*, and receive *Education in Chemistry* at very favourable rates. The total annual sum for these is $8.75, little more than the present N.Z. subscription to *Education in Chemistry*.

A special circular on this matter has been sent to subscribers to *Education in Chemistry*, but it is thought that N.Z.I.C members in general should be aware of the advantages of joining the Chemical Society. Application forms may be obtained from:-

Professor S. N. Slater,
(N.Z. representative of the Chemical Society) Victoria University,
Box 196,
Wellington.

or

D. J. Hogan, Registrar, N.Z.I.C.

ELECTROCHEMISTRY GROUP

Professor J. W. Tomlinson has retired as foundation Chairman, and Professor M. H. Panckhurst was elected Chairman at the Hamilton Conference on 24 August 1971. Dr G. A. Wright, University of Auckland continues as Secretary.

The Third Australian Electrochemistry Conference will be held at Terrigal, New South Wales on 16-18 February, 1972. Intending participants should contact the Secretary, Dr. D. A. J. Swinkels, B.H.P. Central Research Laboratories, Shortland, N.S.W. 2307.

EASTERFIELD PRIZE

Applications will shortly be called for the 1971 Easterfield Award.

BRANCH NOTES

Auckland

Auckland Regional Authority

Dr. M. E. U. Taylor has been appointed Chief Chemist to the Authority, and will be based at the Manukau Treatment Works laboratory. Dr. Taylor was formerly Research Scientist at the Cawthron Institute.

Fletcher Holdings Ltd.

Mr. R. H. Hopgood, Associate Director (research and development) has been appointed by the Auckland Manufacturers Association as one of their representatives on the University Faculty of Engineering.

Fletchers have announced that the trials on extracting sulphur from the deposits at Lake Rotokawa (near Taupo) have so far proved successful. But more work will be required before the commercial viability of production can be established. The project is being carried out jointly with Gulf Resources and Chemical Corporation (U.S.A.) and is based on a modified version of the Frasch process. Hot water, produced from geothermal sources, is forced down a bore pipe under pressure, and the molten sulphur which results is tapped through a second pipe. The sulphur deposit is mixed with silt and lies at depths of 150 to 200 feet. Use of a gravel filter has made it possible to separate the silt and produce high grade sulphur.

Chemistry Division, D.S.I.R.

Mr. A. C. Kennett attended the Australasian Corrosion Conference in Melbourne in November and delivered a paper on plastics and corrosion.

Luncheon Meeting

The Auckland Branch held a special Luncheon Meeting at Danish House on 13 October. Professor A. L. Titchener (Chemical and Materials Engineering) spoke on "The Use of University Facilities by Industry". Over 87 members attended, and this proved to one of the most popular branch functions for many years. Many of the industrial members were able to attend, and took part in the discussion on the possible benefits and problems involved in operating a Unisearch-type organization in Auckland.

Other Branch Meetings

Professor R. O. Farrelly (Physiology Dept.) gave an address on "Cell Membranes" on 29 September. Professor Farrelly graduated M.Sc. (Hons) in Chemistry at Auckland in 1945, and was associated with R. A. Robinson and R. H. Stokes in research in the field of electrolytes. Since graduating in Medicine in 1956, he has turned to research on membrane function, a field embodying chemical and biological principles.

Mr. John C. Hawthorn delivered his Chairman's address on 20 October on the controversial subject: "Where have all the Chemists Gone?" He covered the problems and decisions facing N.Z.I.C., and his address was followed by a lively discussion on the future of the Institute.

University

Professor R. C. Cambie has been awarded a Nuffield Travelling Fellowship and will spend 1972 at the University of Sussex, where he will be working in collaboration with Professor A. Johnson, F.R.S.

Dr. W. R. Roper will spend a year's study leave at the University of Bristol, working with Professor F. G. A. Stone.

Dr. J. Aggett has been awarded a research grant from the Mineral Resources Committee, to work on the development of specific reagents for hydrometallurgical processing of ores.

Visitors

Recent visitors to Auckland include the following:—

Professor Sei Otsuka (Osaka University) who specialises in inorganic synthesis and reactivity.

Professor R. H. Fowler, F.R.S. (Bristol) who is grandson of Lord Rutherford and also an atomic physicist. Professor Fowler delivered the Rutherford lecture on "Evolution of the Elements" to the Auckland Institute and Museum.

Dr. M. L. Huggins (Arcadia Research Institute, California) originator of the hydrogen bond concept in 1919, and a well known research worker in the fields of crystallography, polymer science and structural chemistry.

Personal

Mr. M. B. Rands has been appointed production chemist with Philips Industries (N.Z.) Ltd., Wellington.

Mr. P. G. Robinson has taken up a position as Research Fellow in the Department of Pediatrics, Auckland Medical School.

Wellington

Chemistry Division

Dr. M. Kingsford, leader of the Chemistry Division Food and Drugs Section, left on 13 September to visit Australia, U.K., Italy, Switzerland, Australia, U.S.A. and Canada, for eight weeks. In addition to visiting Food and Drug laboratories he will attend the 31st International Congress of the Pharmaceutical Sciences at Washington.

Dr L. Y. Foo has joined the Drugs Section where he will be studying the transport phenomena of drugs across membranes. Dr Foo gained his B.Sc.(Hons) at Sydney University, his Ph.D. at Monash University and recently completed a post-doctoral fellowship at St. Francis Xavier University, Antigonich, Nova Scotia.

Dr C. D. Stevenson has been appointed to Chemistry Division where he will investigate some aspects of water pollution. Dr Stevenson completed his M.Sc. at Victoria University and then proceeded to Cambridge where he gained his Ph.D. under the supervision of Dr Husain on atomic energy transfer studies. He then worked for a year at the I.C.I. Petrochemical and Polymer Laboratory in England.

Mr. A. W. Missen, who recently submitted his Ph.D. thesis to the University of Auckland, has joined the Toxicology Section. At Auckland he investigated syntheses of steroid intermediates from some naturally occurring diterpenoids, under the supervision of Professor R. C. Cambie.

Mr J. L. Love has been appointed to the Pesticides Section. He recently completed research work for a Ph.D. on some aspects of molecular nitrogen complexes, under the supervision of D. J. Fergusson.

Institute of Nuclear Sciences

Dr T. A. Rafter visited America in July to attend the 26th IUPAC conference in Washington as president of the N.Z. National Committee for Chemistry. He also attended the IUPAC scientific congress in Boston which followed this conference. Shortly after his return he attended the first Australian conference on Mass Spectrometry and gave a plenary lecture on "Sulphur Isotopes in Geochemistry—The Evolution of a Scientific Discipline".

Mr G. J. McCallum attended the 4th International Conference in Geneva on the Peaceful Uses of Atomic Energy, and delivered a lecture on "The Value of a Low Energy Accelerator in Advancing Nuclear Technology in Developing Countries". He also visited laboratories concerned with the new analytical technique of proton induced X-ray fluorescence. This is being used extensively for determination of trace elements in air and has wide potential applications elsewhere.

Dr H. C. Sutton attended a one-day meeting of the Chemical Society of London, held in Hamilton on 3 September, in honour of Professor Porter's visit to New Zealand. He lectured on his work on peroxy radicals in aqueous solution.

A new member of our staff is Dr B. W. Robinson, originally from England, who gained his Ph.D. at the University of Alberta in Canada. He is primarily a geologist and his work will deal with sulphur isotopes in geochemistry.

The Institute acted as host during the Carbon-14 Users Conference on 17 and 18 August. More than 60 delegates attended. Amongst topics of particular interest were new approaches to the treatment of soils for C-14 dating.

On 5 October we were visited by members of the Japanese Diet en route from Australia to Canada to discuss the possibility of a multi-national agreement to establish a uranium enrichment plant in the Pacific area.

We were pleased to be visited by members of the Institute of Chemistry for the monthly meeting on 1 September.

Amongst visiting scientists in this period have been Dr J. Troughton and Dr J. Moorby (from Macquarie University in Sydney) who have been using C produced by the Van de Graaff accelerator for studies of carbon pathways in plants.

Chemistry Department

We congratulate Dr B. Halton on his promotion to a Senior Lectureship. Dr Halton, who has research interests in photochemistry and the synthesis and properties of organic small ring compounds, has been at Victoria University since 1968.

Dr N. Calvert is spending six months Study Leave at Victoria University carrying out research in carbohydrate chemistry in association with Professor R. J. Ferrier. Dr Calvert, a graduate of Manchester University and the Chester Beatty Research Institute London (where he worked on cancer chemotherapy), is on leave from the Chemistry Department, University of Malawi.

Dr E. Sinn is visiting the University of Virginia, Charlottesville, U.S.A., till June 1972, as Associate Professor.

Canterbury

A very successful social evening was held recently to mark the retirement as Head of the Chemistry Department, Otago University, of Professsor H. N. Parton who was a foundation member of the Canterbury Branch. The branch was pleased to welcome representatives from Auckland, Manawatu and Wellington branches.

Mr. B. G. McFarlane has transferred from Wellington Branch to take an appointment as Inspector of Secondary Schools, Department of Education, Christchurch.

Dr. J. M. Coxon is spending 12 months sabbatical leave in association with a Fulbright Grant working with Professor M. A. Battiste at the University of Florida, Gainsville, Florida.

Dr. D. A. R. Happer has returned from leave at Northwestern University, Evanston, Illinois.

Dr. R. F. C. Claridge has returned from leave on a Erskine Fellowship. He attended the Fourth International Symposium on Magnetic Resonance in Israel. While away he visited laboratories in South Africa, Czekoslovakia, Switzerland, Germany, U.K., U.S.A., and Canada.

Dr. M. P. Hartshorn of the Chemistry Department, University of Canterbury has been awarded the Research Medal of the N.Z. Association of Scientists.

Dr. R. P. Garland has transferred to Manawatu Branch to take up an appointment with Tasman Vaccine Laboratories Ltd., working in the Department of Biotechnology, Massey University.

Chemical Process Technology Unit

In 1971, the University of Canterbury offered for the first time, a full-time course designed to equip students of chemistry with a background of chemical engineering and process development principles. The course "Chemical Process Technology" is designed to assist in the preparation of chemistry undergraduates for New Zealand industry. It was originally designed by the University's chemical engineers and is given under the joint auspices of the Chemistry and Chemical Engineering Departments.

Dr. Alan Metcalfe has been appointed to handle the organisation of the course and the Chemistry Department's contribution to it. He will also be responsible for the development of the Chemistry Department's liaison with chemical based industries and hopes to be able to visit key industrial centres in the near future.

INTERNATIONAL MEETINGS

Information has been received from IUPAC on forthcoming international chemistry symposia, as follows:

VIIth International Symposium on the Reactivity of Solids—Bristol, U.K.—17-21 July, 1972.

Vth International Congress on Catalysis—Miami Beach, Florida, U.S.A.—21-25 August 1972.

IXth International Congress of Biochemistry—Stockholm, Sweden—July 1-7, 1973.

IIIrd International Congress of Pesticide Chemistry—Helsinki, Finland—3-9 July, 1974.

VIIIth International Symposium on the Chemistry of Natural Products—New Delhi, India—6-12 February, 1972.

The following information and correspondence has also been received:

CODATA Newsletter No. 5.

Appendices on Tentative Nomenclature, released February 1971:

No. 10 Abbreviations and symbols for the Description of the Conformation of Polypeptide Chains.

No. 11 Recommendations regarding Cataloging of Raman Spectra.

No. 12 Abbreviations for Synthetic Polymers and Polymer Materials.

No. 13 Basic Definitions of Terms relating to Polymers.

H. C. Sutton,
Hon. Sec.

BOOK REVIEWS

"Valence Theory" (2nd edition), by J. N. Murrell, S. F. A. Kettle, J. M. Tedder. Published by John Wiley and Sons Ltd., 1970. 428 pages. Price $A8.28.

This book has been written as an introduction to theoretical chemistry at the Bachelors' level and for the non-specialist graduate student; in this it succeeds admirably. It helps to bridge the gap between the qualitative picture given by Coulson's "Valence" and the formal mathematics of Eyring, Walter and Kimball's "Quantum Chemistry".

The first five chapters introduce in a qualitative form the basic ideas of quantum chemistry. Little mathematics is required at this stage. Such concepts as the wave-particle quality of matter and radiation, atomic orbitals, the self-consistent field approach, and the reasons for the combination of atoms, are introduced in a semi-qualitative, easily grasped approach with the emphasis on physical models. Such ideas as hybridisation, VSEPR theory, and the relationshrip between the molecular orbital and the valence bond treatments are discussed. In chapter three the authors develop (via the Schrodinger equation for the hydrogen atom) the concept of the atomic orbital. The mathematics, though kept to a minimum, is sufficient for the student to follow the logical development of spherical harmonics and the boundary conditions which give rise to the quantum numbers l and m. The idea of the electron occupying a delocalized orbital is emphasized. This chapter should do a lot to help clear up the misconceptions of many students who have been taught the fundamentals of quantum chemistry on the basis of the "planet-orbits" of the classical Bohr theory.

In later chapters the authors consider the quantum mechanics of many electron systems. At this stage it is assumed that the student has had some mathematical training. They consider such topics as group theory, atomic energy levels, molecular orbital, valence bond and ligand field theories, electron—deficient molecules, pi electron theory of organic molecules, reactivity of organic compounds, and weak chemical bonds. Those whose interests lie more in the field of organic chemistry will find the latter chapters particularly relevant. Most of the theory for organic molecules is developed from the point of view of simple Hückel theory, though such methods as SCF calculations and the p— method get a brief mention. This may be a good basis for an undergraduate course, but the lack of comment on modern semi-empirical methods such as CNDO, the SCFMO treatment of sigma and pi electrons etc., reduces its value for those intending to advance in theoretical chemistry.

An excellent feature of "Valence theory" as a student text is the number of problems at the end of each chapter. Hints for the solution of the problems are contained in a section at the back, and fully worked answers are also provided.

References to the original literature are few, most being fairly general. However, the references given are quite sufficient to enable the interested student to go further.

The main changes between this and the first edition have been in the organic chemistry chapters. The treatment of sigma—electrons by extended Hückel methods and by the application of symmetry rules has been taken into account in the revision of these chapters. However, the combined treatment of sigma and pi electrons in SCFMO calculations has been neglected. The somewhat large numbers of errors contained in the first edition have been corrected.

This is an excellent text for the undergraduate student and for the non-specialist (particularly in the field of organic chemistry).

R. H. MEINHOLD.

Chemical Topics for Students, by W. Foerst and H. Grunewald. Vol. 2 *"Theory of Molecular Spectra"*. Published by W. A. Bingel, John Wiley and Sons Ltd., 1969. Pp. x + 180. Price $A6.50. (Translation from original German edition published in 1967).

This is an introductory book for readers with only an elementary knowledge of quantum mechanics and group theory. A little less than half of this book is concerned with rotational and vibrational spectroscopy, while the remainder deals in rather more detail with the electronic states and electronic spectra of diatomic and simple polyatomic molecules. The treatment of infrared and Raman spectroscopy is particularly brief.

A good deal of the space devoted to electronic spectroscopy consists of a discussion of the various kinds of correlation rules used to determine the term manifold of a molecule, and examples of assignments from the spectra of a number of simple molecules. In the case of diatomic molecules, the united atom—separated atom correlation is discussed, first in terms of the electronic states of the atoms, and then in terms of the one—electron orbitals of the molecule. The treatment of polyatomic molecules is largely restricted to triatomics, whose electronic configurations, geometry and electronic states are discussed with the aid of Walsh's diagrams. These sections contain nearly all of the illustrative examples given in the book.

The presentation is generally quite good, although there is a surprising number of typographical and other small errors, some of which could be misleading. For example, the symbols h and h are sometimes confused, and a small π is sometimes used for the electronic state symbol Π.

The author states that his aim is to give a general picture of the spectroscopy of small molecules as a whole, with particular stress on the recent advances in the electronic spectroscopy of simple polyatomic molecules. He succeeds in this aim, although the fact that the book is effectively restricted to diatomic and triatomic molecules must limit its potential readership to some extent. It will probably be of most use as an introduction to the more comprehensive monographs on the electronic spectra of small molecules.

G. A. Bowmaker.

The Architecture and Properties of Matter, an approach through models, by Milton B. Armerod. Published by Edward Arnold Ltd., London. Price $11.55.

The approach in this text is to explain the physical and chemical properties of many common organic and inorganic substances by considering the model of the species concerned as pictured by molecular orbital theory. Also in many cases alternatives such as Valence Bond and hybrid orbital models are presented, and the advantages and limitations of each are discussed.

The text is intended as a teacher's guide, the author making suggestions as to the suitability of the material in the sections of a chapter, with regard to the age of the pupils.

Among the major topics covered are: hydrogen —including hydrides, acids and bases, and solvation; hydrogen bonding; sigma bonding, pi bonding, delocalised orbitals (with both organic and inorganic examples); the structure of metals, non-metals (particularly network solids) and metalloids; electrolysis; types of chemical bonding; coordination complexes; oxyanions, oxyacids and oxides; and halidies. A comprehensive Formula Index and General Index are included.

Although, as the above list indicates, the topics are mainly suitable for 7th form work, the chapters on the structure of metals and non-metals and on hydrogen bonding make useful background reading for teachers of 5th form Science. For classes below the 7th form the author's treatment may be simplified, as the shapes of many of the molecules considered may be successfully predicted from electron-pair repulsion models, already widely used at 6th form level.

The author's use of these models to explain the course of many chemical reactions makes the text a reference from which teachers can develop their own ideas.

Of use to the University student are the chapters on coordination compounds and electrolysis (dealt with in terms of the double layer theory), where the depth of treatment tends to be too great for secondary school pupils. The background chapter on the fundamental concepts of molecular orbital theory may also be useful to students who have difficulty understanding the presentation in more advanced texts.

Kits for the construction of the models described and colour filmstrips in support of each chapter have been developed in conjunction with the text and are obtainable from the suppliers listed in the appendix.

J. R. Milligan.

Elements of Sterochemistry, by E. L. Eliel, with a section of coordination compounds by F. Basolo. Published by Wiley, New York, 1969. 95 pages. $A2.95.

In the preface to this book one of the authors states: "This brief and elementary summary of the subject of stereochemistry was originally composed for the benefit of the non-chemist. Alas, and perhaps justifiedly, it was not considered elementary enough for this purpose." Nevertheless, for all students of organic and inorganic chemistry beyond the first-year university level this book provides a well written and concise summary of the basic principles of stereochemistry. Fundamental concepts of stereochemistry are not always easy to explain or grasp clearly, and the authors recognize this and utilize commonplace macroscale examples to exemplify molecular phenomena. "Thus for a book, a plane passing midway between the two covers and bisecting the spine will be a plane of symmetry (if one disregards the printing)."

The first four chapters encompass the introduction, history and background, basic concepts and terminology, and stereochemistry of carbon compounds. Both R/S and E/Z nomenclatures are defined and used frequently, and all important classes of chiral organic compounds are discussed. Chapter 5 is a brief summary of the stereochemistry of other tetrahedral elements, while Chapter 6 is a short contribution by Basolo on the stereochemistry of metal complexes. Inorganic chemists will no doubt find this all too brief, but it is refreshing in these days of interdisciplinary emphasis to find a subject discussed from the viewpoints of both organic and inorganic chemistry. The final 23 pages of the book are concerned with review problems and clearly explained answers.

The text is free from errors (except for diagrams 28 and 31 on pages 52 and 54 respectively), and the moderate price is within the reach of all.

In summary, both students and teachers alike will find this text a valuable and concise introduction to basic concepts of stereochemistry; a list of General References is included for those who wish to explore the subject in greater depth.

PAUL D. WOODGATE.

Energy and Bonding, by Michael Hudson. Published by The English Universities Press Ltd., London, 1969. 178 pages. Price £1.05 U.K.

This book has been written in an attempt to bridge the gap between leaving school and entering university; and, hopefully, to try to reduce the number of failures at the first year level. The spectrum of the subject matter is good and in many respects well covered. However, a number of statements are of weak scientific definition or are potentially confusing to a student at this level. For example, the book defines the atomic number as "the number of electrons outside the nucleus" and subsequently suggests that an alternative definition would be the number of protons in the nucleus. In addition, there are a number of mechanical errors. The result is that one is left with the feeling that a future revised issue of this book is needed before it can gain general acceptance.

J. C. BOWLES

NEWS RELEASE — RENNET SOLUTIONS

A standard method for comparing the coagulating power of commercial rennets has been published by the Standards Association.

This standard was first issued as a provisional standard (NZS 2272P) in May 1969. No modifications have been requested during the trial period and the document is now published, without amendment, as NZS 8311: 1970 **Method for the determination of the relative milk-coagulating power of rennet solutions.**

The standard describes a method for comparing the coagulating power of commercial rennets of unknown strengths, with each other or with a reference rennet, by using a defined substrate under specific conditions. The method is a modification of that described in BS 3624 **Method for the determination of the milk coagulating power of rennet.**

Copies of NZS 8311, which has been reproduced photographically from typescript, may be obtained at 65c each from the Sales Section, Standards Association of New Zealand, 6th Floor, New Zealand Display Centre Building, Sturdee Street, Wellington 1 (Private Bag, Wellington).

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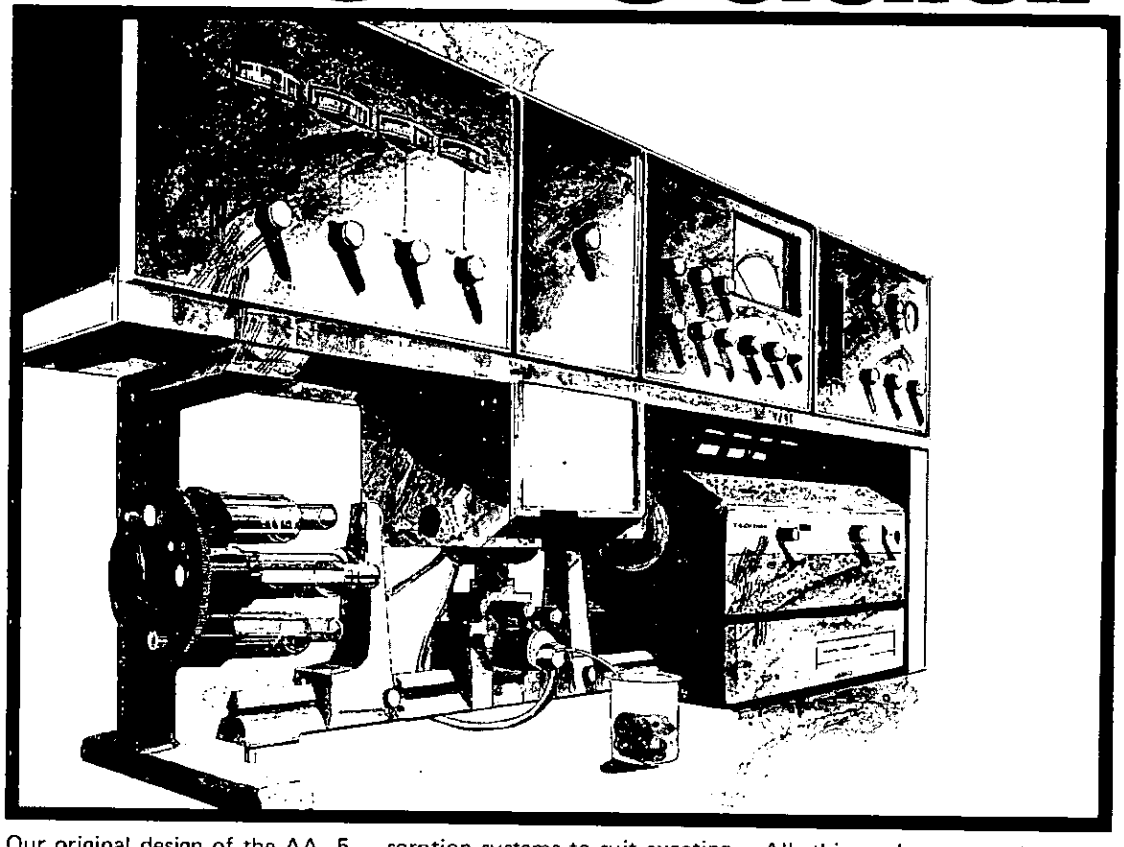

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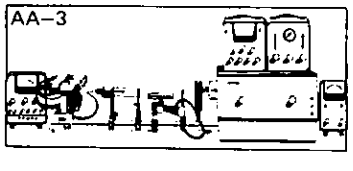

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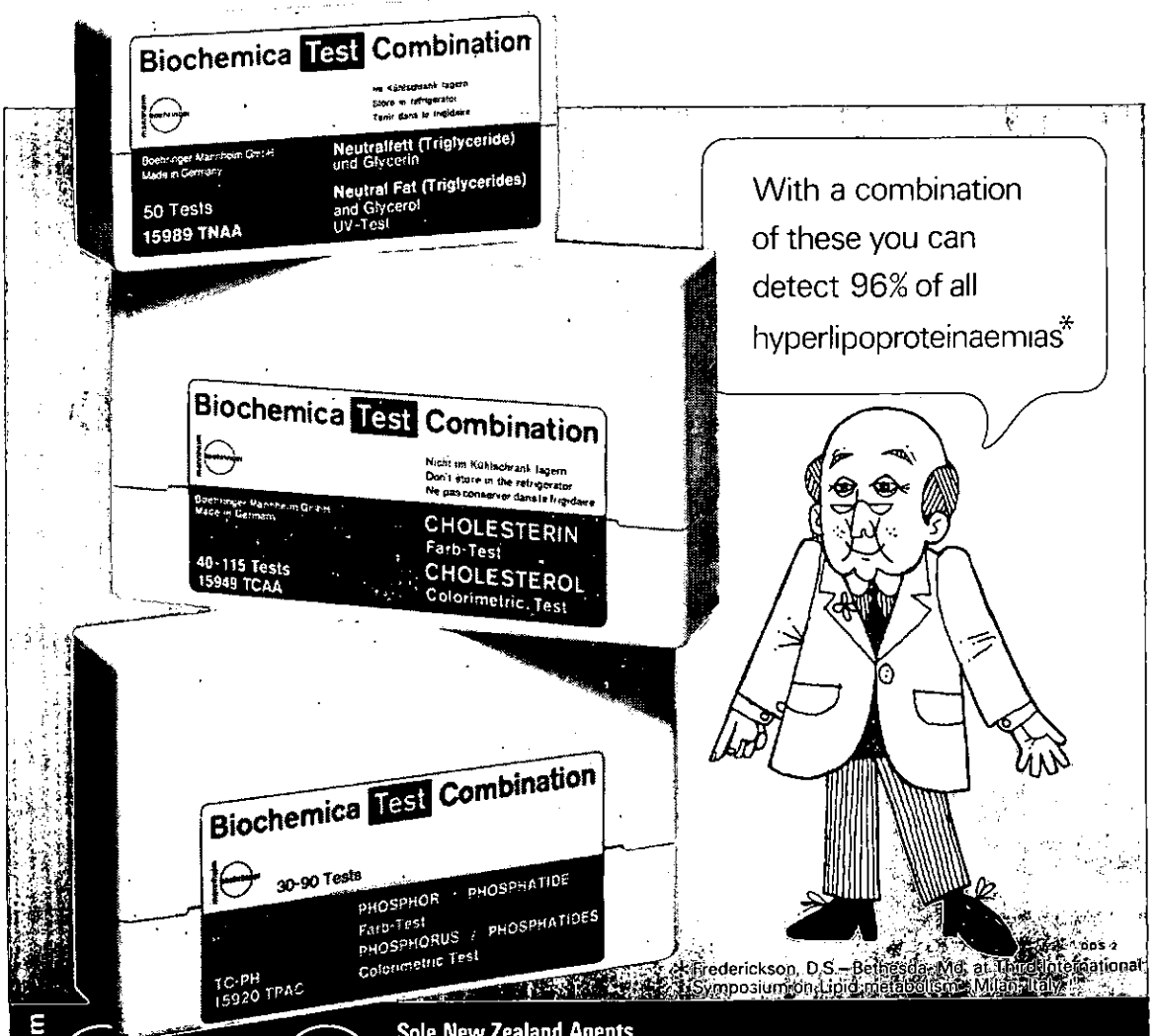

* Frederickson, D.S.–Bethesda, Md. at Third International Symposium on Lipid metabolism, Milan, Italy.

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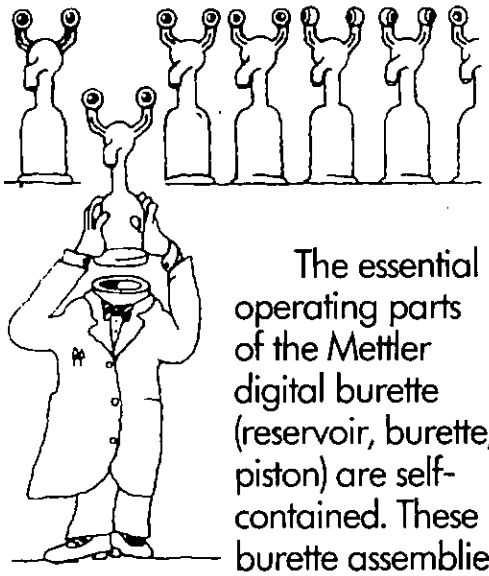

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