CHEMISTRY IN NEW ZEALAND

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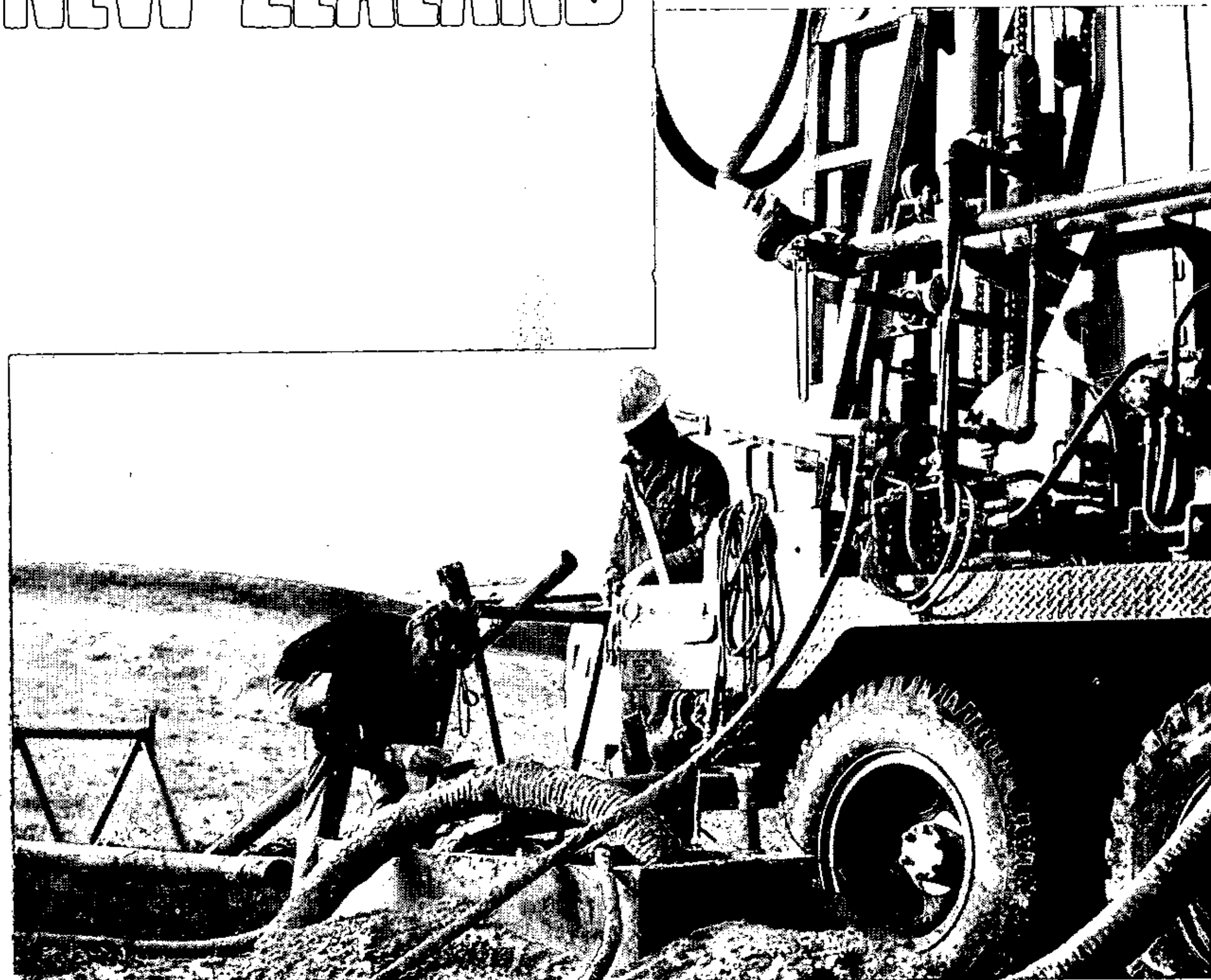

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COVER PHOTO

Bentonite Drilling in Harper Hills farmlands, Canterbury.

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NEW ZEALAND

APPOINTMENT OF POSTDOCTORAL RESEARCH FELLOW IN APPLICATIONS OF MÖSSBAUER EFFECT TO SOLID STATE CHEMICAL REACTIONS

The Council of Victoria University of Wellington proposes shortly to appoint a Postdoctoral Research Fellow for work in the applications of Mössbauer effect to solid state reactions involving the development of high potentials. The fellowship is tenable for a period of two years and the appointee will work under the immediate direction of Professor J. F. Duncan. Stipend for this fellowship will be £1,500 ($3,000) p.a., but in some circumstances could be more. Consideration will be given towards a contribution to the cost of travel to New Zealand from overseas.

Applications close with the Registrar at Victoria University of Wellington, P.O. Box 196, Wellington, New Zealand, on the 1st of October, 1967. Information concerning the technical aspects of the appointment may be obtained from Professor J. F. Duncan.

L. O. Desborough, Registrar.

MINERALS IN NEW ZEALAND INDUSTRY

T. J. McKee, B.Sc., M.Aust.I.M.M.

(Lime and Marble Limited, and Subsidiary Companies, Port Mapua, Nelson)

THE STEADY growth and diversification of New Zealand manufacturing has resulted in increasing use of mineral raw materials. Many mineral commodities or mineral derived raw materials are imported from world wide sources, supplemented by some local production — particularly non-metallics of a class requiring little beneficiation.

To an increasing degree the New Zealand economy depends on overseas mining industries. This must always be so, but there are indications that with the growth of demand new mineral products can be produced from local resources. If the past is any indication, it is reasonable to expect new discoveries of local raw materials will be made as mineral exploration is intensified.

Both agricultural and manufacturing industries are substantial users of imported mineral commodities, as statistics of recent imports show.

As well, it is to be expected that mineral engineering and pilot investigations will develop beneficiation procedures which will enable production of new mineral raw materials for industry, in substitution for imported products.

Given an economic scale of production some deposits such as Canterbury bentonite and West Coast ilmenite (or its products) are export possibilities.

A recent development very favourable to the economics of mineral production in our country is the new incentive taxation policy introduced during 1965, aimed at encouraging investment in mining industries. The new provisions allow a tax deduction of one-third on calls paid on mining shares for a wide range of specified minerals. Under Section 152 of the Tax Act taxation is payable only on dividends, and then at half the usual rate until twice the amount of capital invested has been returned to the investor. Metal ores of antimony, copper, iron, lead, zinc, molybdenum, mercury, platinum, tungsten, nickel, tin, titanium and uranium are specified, as well as non-metallics such as asbestos, bentonite, dolomite, kaolin, magnesite, talc, halloysite, pyrite, perlite.

The creation of a favourable mining investment climate should stimulate mineral exploration and development of several substantial deposits already known, both by overseas mining companies and New Zealand interests.

It has been announced the new policy has been introduced with view to:

* Increasing the industrial development of New Zealand.
* Reducing the quantities of raw materials and mineral rock imported to New Zealand.
* Building up an export trade in minerals surplus to New Zealand's needs.

RECENT PROGRESS IN MINERAL EXPLORATION AND DEVELOPMENT

Although in the past decade there has been little activity in mining and the tempo of prospecting has been slow, some worthwhile discoveries have been made. Also, the potential of some known deposits have been recognised as a result of further investigation, or as a result of overseas technological advances.

Some examples are as follows:

Asbestos: For a number of years a small pilot plant produced asbestos from the deposits in the Upper Takaka Valley to recover Grade IV and V fibre occurring as slip and cross fibre in serpentine. Over the years total production was reported as about 5,000 tons of fibre.

During 1964 a core drilling programme demonstrated the reserves of preferred fibre are rather limited, being about 28,000 tons. However, milling trials showed that the serpentine contains an unusually high content of Grade VII fibre and "shorts". There are reserves of several million tons of ore which will yield 40 to 50% fine fibre. While short fibre is of relatively low value ($35-$45 per ton), the high yield may make a reasonably large scale operation economic, provided suitable markets can be found. Milling and marketing is being currently studied by Canadian consultants. Grade VII fibre sells in New Zealand for about £30-£35 per ton, C.I.F. Main Ports.

Bauxite: A systematic study of Northland soils revealed the occurrence of bauxite clay derived from weathering of basaltic rocks. The reserves of better grade material are reported to be of the order of 20 million tons. The deposits are still under investigation by an overseas mining company.

Bentonite: During 1959 a prospector located non-swelling bentonite in the Harper Hills, Canterbury. Continued laboratory and milling tests have demonstrated that swelling bentonite, similar in performance to the Wyoming type, can be prepared by sodium modification. A non-swelling bentonite comprises essentially calcium and magnesium montmorillonite; montmorillonite being a complex hydrated alumino-silicate with exchangeable calcium and magnesium cations occurring between the silicate layers. Treatment with Na_2CO_3 forms the sodium montmorillonite better known as "swelling" or "Wyoming" type bentonite. Acid treatment of this bentonite has produced a good decolourising clay. Drilling programmes carried out in recent times indicate that substantial reserves may exist, possibly of several million tons. Drilling investigations are continuing.

Beach Sands: In the North Island a magnetometer survey for the Steel Investigating Company followed by a drilling programme at Waikato North Head disclosed unsuspected reserves of ironsands. In the South Island near Westport further sampling confirmed the earlier reported low chromium and vanadium content of ilmenite. The West Coast deposits have been recognised as one of the world's major reserves of low chromium ilmenite. An overseas pigment manufacturer has produced TiO_2 of satisfactory quality on a small experimental scale using Westport ilmenite concentrate. Pilot scale smelting by Chemistry Division, D.S.I.R., produced titanium slag containing 83% titanium oxide.

Some 700 tons of Westport sand have been shipped to Australia for treatability tests and recovery of values such as gold, zircon and monazite. The zircon has been shown to be of marketable quality.

Dolomite: At Mt. Burnett, Collingwood, dolomite has been quarried for twenty years, principally for use in agriculture. In recent times a detailed survey by company and government geologists indicates that drilling may prove reserves of the order of 50 to 100 million tons.

It has been demonstrated that selective quarrying, with analytical control and stockpile blending if necessary, can provide consistent quality bulk shipments for glass making. Dolomite contains iron oxide as an impurity. For agricultural use this is unimportant, but for glass use quality control of this is essential. For glass making the requirements are:

- low silica (within the range 0.5 to 1%)
- constant Ca/Mg ratio
- Fe_2O_3, 0.25% max.
- Sizing between 14 and 200 mesh.

The colour of the dolomite varies from light to dark brown according to the iron oxide content. A photometric method of sorting is being investigated.

Preliminary examination by two magnesium metal manufacturers indicates that Mt. Burnett dolomite is a suitable raw material, and sampling and analysis by an overseas concern have shown that it is suitable for use in a sea-water magnesia plant.

Halloysitic Clay: A drilling programme in Northland has proved reserves of several million tons of white halloysite which is being investigated for use in paper and pottery industry.

Pyrite: Near Thames, a drilling programme by N.Z. Geological Survey and Mines Department indicated 15 to 20 million tons of rock containing 7 to 8% sulphur, at that time regarded as of sub-economic grade as a source of sulphur. The recent doubling of sulphur price may warrant a re-appraisal of these deposits.

At Copperstain Creek, Takaka, a pyrite showing is being drilled to ascertain grade and tonnage. Here the pyrite contains a little copper.

It is interesting to note at Nairne, South Australia, some years ago pyrite recovery was commenced by a consortium with Government assistance, particularly by way of a "sulphur bounty". Today this venture is economic and saved the importation of 39,000 tons of elemental sulphur last year. The quarried rock yields 9% sulphur equivalent. Actual cost of production is between \$(A) 17 and \$(A) 19 per ton of elemental sulphur, in the pyrite concentrate in bins at the Nairne treatment plant. In the deposit, overburden to ore ratio is 1:1 which adds to quarrying costs.

Petroleum and Natural Gas: The discovery of natural gas and condensate at Kapuni has drawn attention to the continental shelf to the west and south of Taranaki.

An aeromagnetic survey over 4,000 sq. miles of continental shelf in the southern Taranaki Basin together with a seismic and gravity survey on Farewell Spit indicates the possibility of a deep sedimentary section. This is to be tested by a marine seismic survey.

Quartzite: A deliberate search for high grade quartzite in Northwest Nelson during 1963 resulted in the discovery of substantial deposits near Rockville in Golden Bay. The grade is 98 to 99% silica with low alumina, suitable for ferro-silicon manufacture. Alumina is an undesirable impurity since it raises power consumption and results in a fragile product. Sampling and analyses by a ferro-silicon manufacturer confirm that the quartzite is of acceptable quality. There is less certainty about this material being suitable for silicon metal manufacture — the quality may be marginal. A drilling programme is required.

METAL PROSPECTS

Lead-zinc-copper: Prospecting by driving at the Tui mine, Te Aroha, has indicated lead-zinc-copper ore in sufficient quantity to warrant a small treatment mill.

Molybdenum: A geochemical investigation by the Chemistry Division, D.S.I.R., in the general area of Copperstain Creek (which is being investigated for pyrite) has shown anamolous molybdenum in stream sediments and soil samples on a grid pattern. It is interesting to note that previous to this, molybdenum mineralisation had not been recorded. Subsequently road construction and drilling revealed molybdenum mineralisation in granite rocks invading the schist formation. Geobotanical prospecting demonstrated that *Olearia rani* is an accumulator for molybdenum in the mineralised area.

Uranium: In the five years from 1955 spasmodic prospecting advanced the original Buller Gorge discovery of weak uranium mineralisation in the Hawks Crag formation in a minor porphyry dyke to a stage when fairly widespread radioactive occurrences were noted in more extensive bedded deposits. Some rich patches of uraninite ore, certainly amounting to several hundred tons, were finally located near the original discovery. Only one long adit was driven and this penetrated ore grade for 130 feet. A diamond drilling programme was not carried out anywhere on the West Coast.

While the original discovery of radioactivity was not entirely fortitutious, it was not the result of a systematic radiometric survey. Large areas of the Hawks Crag Breccia and underlying beds remain to be prospected. The uranium potential of the West Coast has not been resolved.

In 1960 a world oversupply of uranium resulted in prospecting work ceasing in the Buller area.

Scheelite: Through the industry of a farmer prospector scheelite has been discovered at Canaan in the Takaka Hills. Previously the occurrence of scheelite in Takaka was not known. Nine reefs have been sampled. At the present price of scheelite a treatment plant does not seem warranted on the score of grade and estimated reserves.

SOME MINERAL USING INDUSTRIES

Agriculture. New Zealand's agriculture has expanded by use of several imported mineral products together with widely spread agricultural lime production which amounted to 1,129,711 tons for the year ended 31st December 1965. Serpentine production during the same period amounted to 138,272 tons. Recent statistics show the principal mineral products imported mainly for agriculture. (Table 1).

Compounds containing the elements cobalt, molybdenum, copper and boron are also imported. Arsenical compounds are used in sheep dips and weedkillers.

Forest and Paper Industries. Paper fillers commonly used are kaolin and diatomite from U.S.A. Titanium white is imported from various sources. Some New Zealand halloysitic clay has been used. Good colour and low abrasive index is important.

Salt is used for the production of chlorine and caustic soda.

Building Materials

Cement production for local raw materials can be gauged by the use of limestone and marl — 1,474.563 tons during 1965.

Pozzolan, a mixture of diatomite and pumicite produced near Rotorua, is increasingly used as a concrete additive in hydroelectric construction. A plant has recently been installed with a capacity of 10,000 t.p.a.

Asbestos, a major mineral import for the building industry was worth £596,700 during the most recent import period. The variety crysotile (white asbestos) from Canada is mainly used, as grade IV and V. For the production of asbestos sheet and roofing, short fibre is not suitable. Grade VII and "shorts" are used to the extent of about 900 tons in plastic floor tiles. With this grade there is a possibility of substituting the New Zealand product.

Gypsum (crude and calcined) was imported from South Australia, 109,850 tons valued at £616,000 C.I.F., during the last

TABLE 1

Commodity	Tons	C.I.F. Value £ Year ended 30th June 1966
Elemental Sulphur	1,026,500	3.071,110
Rock phosphate	212,000	2,737,000
Potash Fertilizer	177,350	2,843,000
Basic Slag	11,800	165,300

import period. No commercial deposits are known in New Zealand.

Insulating materials are made from mineral products. One factory produces fibre glass. Some mineral wool and vermiculite is imported. In Nelson, raw materials such as high grade limestone, dolomite, clays and wollastonite are available from abundant deposits if required for future production of mineral wool.

Ceramics and Refractories. The 1965 manufacture of bricks and tiles required 354,000 tons of clay from abundant deposits. Potteries used 7,400 tons.

In recent years refractory imports have risen steadily but local production is increasing. Current value of imports is of the order of £342,000 C.I.F. The establishment of an iron and steel industry will substantially increase the requirements.

Potential indigenous raw materials are aluminous clays of Northland, and dolomite and magnesite in Nelson. These materials exist in large quantities. Abundant silica deposits are known.

High grade felspar, low in silica and iron is imported from Sweden. Present tonnage is 1,100 valued at £27,300 C.I.F.

A felspathic clay is mined at Kaka, Nelson, for production of insulators and porcelain ware. Small quantities of ground calcite and iron oxide and salt are used for glazing.

Glass. In the North Island two glass works are based on Northland's Parangaranga silica sand. Its characteristics after screening and washing are 97.6% silica, 1.2% alumina and 0.06% ferric oxide. In the South Island a glassworks draws supplies from Mt. Somers. A beneficiated silica sand is produced by first scrubbing the sand using an attrition process with an alkali leach to disperse and remove iron staining. The sand is then washed to remove the fine clay fraction. The raw material contains up to about 0.5% ferric oxide, which is reduced after processing to about 0.03%.

High grade limestone (97/99% $CaCO_3$) is used in glass as a flux. Again, iron is an unwanted impurity and an upper limit of 0.05% ferric oxide is set. This is achieved by selective quarrying and analytical control of quarry stockpiles.

Similarly with dolomite for window glass manufacture, close analytical control of stockpiles with blending is necessary.

Paint, Rubber etc.

Paint, rubber, plastic and adhesives industries all use similar minerals as fillers, extenders and pigments. All manufacturers have their own particular requirements. The three most extensively used minerals are calcium carbonate (whiting), kaolin and titanium dioxide pigment. With all three minerals colour is a prime requirement, with additional requirements of sizing, particle shape and low impurities.

Local production of limestone and calcite whitings can supply the bulk of New Zealand's requirements. Imports of calcium carbonate are mostly of chemically precipitated calcium carbonate formed by the recarbonation and precipitation of pure calcium carbonate from hydrated lime.

The paint industry uses the most extensive range of mineral fillers including barite, diatomite, bentonite, wollastonite, asbestos, silica, talc, iron oxides and a variety of mineral-based ingredients such as stearate-coated whitings.

The rubber industry uses large quantities of carbon black imported mainly from Australia and U.S.A. For some uses, finely pulverised coal has replaced part of the carbon black, particularly the coarser sized carbon black (about ½ micron) median size. However, coal lacks the cyclic structure and surface-active electrophilic groups which impart the high bonding properties of carbon black. Purified finely ground sulphur is used as a vulcanising agent.

Plastics use a variety of mineral fillers. Thermoplastics use whitings (usually precipitated whitings having a very small particle size.) Vinyl floor tiles can contain quantities of ground limestone, and asbestos shorts.

Soap, cleansers and abrasives

Acid activated bentonite is used for the decolourisation of tallow used in soap manufacture. Most cleansers use a number of minerals to supply abrasion properties. Silica and feldspar are the two most commonly used, with colour and particle size the most important properties. Where more severe abrasive qualities are needed for sand papers and sand blasting, etc., diatomite, tripoli, garnet sands, emery and carborundum which have larger particles are more often used.

Insecticides

Finely ground mineral fillers such as calcium carbonate, talc, bentonite, kaolinitic or halloysitic clay and diatomite are used in powder formulations containing D.D.T. and a variety of insecticidal and fungicidal technical chemicals which are imported into New Zealand for processing. Suitable diatomite is not yet available in New Zealand but other extenders are available from local sources. Extenders in given formulations are selected for various properties such as abrasiveness, absorbency, suspensibility and bulk density. All must be chemically compatible with the incorporated toxicants.

Drilling Muds

Finely ground barite is imported for use in drilling for geothermal steam and petroleum.

Food Manufacture

For sugar refining high calcium quicklime or calcium hydrate is required free from "taste impurities" and very low in magnesia.

Breweries and a few other food and drink manufacturers rely on minerals to form part of or assist in purifying their product. The clarification of beer, vinegar, fruit juices and some oils requires suitable filtration media. Impurities such as iron oxide, clay and free carbonite are undesirable in this application. Calcined diatomite with suitable diatom structure has widespread use in this field. Slaked lime is used for sugar refining. Stock and poultry foods may contain small amounts of bentonite and some salt licks contain not only salt but magnesite and trace elements.

Petroleum, Iron and Steel

Foundries are generally the least scientific of the mineral consumers. Large quantities of sand high in silica, pulverised coal or pitch and bentonite are used to form the moulds for casting iron. For more precise casting, particularly with steel, moulds of zircon sand, olivine sand or resin-coated silica sand are used.

Petroleum and iron products have a special place in New Zealand's mineral economy, requiring from £50-60 million overseas exchange each year.

Petroleum requirements are expected to double in fifteen years, with iron and steel demand increasing also at a high rate.

Self sufficiency in petroleum and steel would go a long way to solving this country's current balance of payments problem. Both objetcives may be possible to achieve.

It is reported that the proposed iron and steel industry will save annual imports to the extent of £20 million in ten years' time. This will be a bold step, since in processing titaniferous ironsands New Zealand will be the only country in the world to rely entirely on the smelting of ironsands for a steel industry. The comparative economics of doing this and using, say, conventional iron ore pellets from Western Australia in a modern blast furnace (capable of predictable costs and performance) at a deepwater site have not been published.

There was little investigation into the possibility of smelting West Coast ilmenite to produce high grade iron and titanium slag for export. Electro-smelting pilot plant work by the Chemistry Division of D.S.I.R. has recently produced titanium slag containing 83% titanium oxide.

It is interesting to note the Sorrel plant in Canada is exporting a 70% titanium oxide slag to U.S.A., Japan and Europe to the extent of nearly 500,000 tons per annum.

The possibility of some by-product iron from ilmenite smelting intergrating with New Zealand steel making should be worth investigation, particularly since the world outlook for titanium products for pigment manufacture is attractive. There could be some advantages in working West Coast sand with the minor gold content as a credit and zircon in addition, which may pay cost of mining and concentrating the deposits. In Australia, beachsands have been worked at a cost as low as 6d. per ton with recoverable value of heavy mineral content of 2/- per ton. It is reported that initial capital development for the New Zealand steel industry is now estimated to cost £N.Z.17.5 million, mostly financed by Government and loan capital. It is worth noting thate a recent report indicates that New Zealand domiciled shareholders hold 8,200,000 shares (6.35%) in the Broken Hill Proprietory Limited. At current market prices this New Zealand investment in Australian steel marketing is worth $(A) 72 million at June 1967.

Petroleum

Since the discovery of Kapuni there has been little drilling activity, but some geophysical prospecting has proceeded. There is much interest in the Continental shelf, particularly the area to the west and south of Kapuni which exceeds 15,000 square miles. The Taranaki Basin extending south to Tasman and Golden Bays must be regarded as a prospect warranting very thorough investigation. The geological setting is like the Bass Strait shelf, although an aeromagnetic survey indicates the sedimentary basin may be deeper. The Kapuni discovery, Moturoa oil seep and oil seeps in formations on the West Coast of the South Island give no reason for pessimism concerning prospects on the western Continental shelf.

An area of 4,000 square miles in the southern Taranaki basin was recently subject to an aeromagnetic survey. There are strong indications of several anticlimal structures and deep sedimentary basins which may be favourable for oil or gas accumulation. The survey to date is sufficiently encouraging to warrant the next major step which is a marine seismic survey.

Today, 333 land petroleum licences have been issued. The total area covers 55,254 square miles. Seven areas have been granted over the Continental shelf amounting to 36,740 square miles. The New Zealand Continental shelf (200 metres) is approximately 80% the area of the New Zealand land mass.

Petroleum is an unusual mining industry inasmuch as most capital cost is incurred in its discovery. Once wells are established in a good field, production costs for crude oil can be extremely low, often over a long period of years.

Self sufficiency in petroleum is probably New Zealand's prime target in mineral exploration.

Of all possible mineral industries in New Zealand, petroleum discovery would probably have the greatest favourable impact on the New Zealand economy.

MINERAL EXPLORATION

Two prerequisites for mineral discovery and development are incentives and "knowhow". The Atomic Energy Act offered generous rewards for the discovery of radioactive deposits. The Director of the N.Z. Geological Survey published a guide for uranium prospectors. These steps stimulated uranium prospecting and caused amateur and professional prospectors to purchase and use radiometric equipment. Subsequently the first uranium discovery was made in New Zealand.

In the past, in our country, land is utilised often with little consideration being given to the possibility of the existence of valuable mineral resources. Large areas have been dedicated for National Parks and boundaries fixed without prior exploration for mineral deposits. Similarly, land development schemes have been launched without consideration of possible mineral potential. Examples are the Pakahi land at Westport (sands containing heavy minerals); at Maungaparerua Block, Northland (white halloysitic clay); Ngakuru, Rotorua (diatomite); the ironsand reserves for the proposed steel industry are in an afforested area.

Farming has been conducted with little consideration for mineral potential, but the clearing of land and farming itself have been useful in producing chance mineral discoveries. Some examples of farm finds are: scheelite in Canaan, Nelson, metallurgical grade limestone in Takaka Valley, bauxite in Northland, wollastonite on Takaka Hill, feldspathic clay at Kaka, Nelson, bentonite at Porangahau and Harper Hills, and copper at Parakao, Northland.

Chance discoveries will always occur. The lone prospector still has a part to play, particularly in the discovery of new deposits outcropping at the surface. Today there are new attitudes and techniques for mineral exploration which enable the location of hidden deposits, often at considerable depth. Doubtless there are more deposits concealed than exposed. Hitherto, almost without exception, all New Zealand mining discovery has been based on mineral showings outcropping at the surface. Overseas it is now common practice to drill geophysical and geochemical anomalies, usually after geological mapping, with little or no indication of useful mineral at the surface. As a result, new mines are being discovered. Outstanding examples are at Elliot Lake, in Canada (radioactive anomaly, with no uranium in the leached surface) and recently, base metals at Timmins, Ontario. This latter mining field was discovered after drilling the 57th geophysical anomaly in an exploration programme in the area. This major discovery resulted from a helicopter-borne electromagnetic survey. Recent promising discoveries of nickel near Kalgoolie resulted from a geophysical survey.

A primary requirement for a mineral exploration and prospecting programme in any area is a geological and topographical map, with a search of publications and mining records of the region. Old mining reports can provide valuable information. It is a generally held concept that a good place to look for a new mine is in an old mining area. We have several such areas in New Zealand untested by modern prospecting procedures.

We are fortunate in New Zealand in that we are very well provided with geological maps, even for very inaccessible areas. The N.Z. Geological Survey in recent years has concentrated on this basic work, so essential for mining companies interested in exploring particular regions.

Today, the task of prospecting in the field is facilitated by many modern aids which were not available 60 to 100 years ago when mining endeavour was an important sector of our economy. Prospecting survey teams can now camp with reasonable comfort in most inhospitable areas because of developments such as the primus stove, dehydrated food and specialised clothing. The helicopter is available for establishing camps and servicing inaccessible prospecting sites. Portable transistorised radio equipment provides communication. When a site is selected for close examination there are portable drills. Bulldozers provide access tracks for 4 wheel drive vehicles if the prospect warrants road access. If an adit is to be driven the helicopter can fly in portable huts, provisions, fuel, electric lighting plant, diamond drilling equipment, air compressors, pneumatic drills, ventilating equipment and explosives.

In the early days of our country's exploration it was generally out of the question to explore prospects in inaccessible and mountainous areas by drilling and driving adits. For this reason to this day, there has been little underground exploration beyond a few miles of roaded areas.

Today, after geological mapping, some scientific aids commonly used for finding and assaying mineral deposits are:

Geophysics; gravity, magnetic, seismic and radiometric survey. Petroleum relies heavily on the first three techniques. Ground and aeromagnetic surveys may locate base metal mineralization associated with magnetite. Electro-magnetic procedures are useful for locating massive sulphides when the conductor is continuous to depths of 100 to 400 feet. They are not, however, suitable for zinc sulphides since sphalerite is a non-conductor. Induced polarization is suitable for both massive and disseminated sulphides, being dependant on the edge effect at the interface of the sulphide particles and non-conducting host rock. This technique has not yet been used in New Zealand. It is more distinctive than electro-magnetic techniques but if graphite occurs in a formation it can interfere.

Light, portable, induced polarization, transistorised equipment is available suitable for a field crew of three men to operate in the bush or areas of difficult access.

There has been some reconnaissance aeromagnetic surveys of New Zealand done, but large areas of geologically interesting country remain to be flown over in search of anomalies. A major iron ore body (magnetite) could produce a detectable anomaly even if covered by overburden to a depth of 1,000 feet.

The new Afmag system, which is an audiofrequency magnetic method using electrical disturbances generated by distant thunderstorms, has greater depth penetration than other electro-magnetic methods. It was recently tried in New Zealand.

Neutron activation is a relatively new technique for prospecting. Thirty elements are detectable by irradiation with a strong gamma source. Rock penetration is, of course, shallow but the method is useful on weathered outcrops.

Gravity survey has been an aid for some ore bodies to a few hundred feet.

Geochemistry. Increasing use is being made of geochemical surveys to locate areas of mineralization. The technique is rapid and inexpensive. The laboratory of one exploration company in Australia has achieved analyses at the rate of 500 per day. Increasing reliance is being placed on emission spectrographic methods and atomic absorption determinations. A number of rapid chemical methods have been developed for determinations in the field. X-ray fluorescence is also used.

It was recently reported that a geochemical survey of stream waters near Gortdrum, Ireland, gave the first indication of copper mineralization in the area. Soil samples followed by an induced polarization geophysical survey and drilling have located a copper/silver ore body large enough to warrant a 1,500 ton per day treatment plant.

Geology. While 4 mile and 1 mile scale geological maps provide a basis for a prospecting programme, close mapping of formations is required when a "prospect" has been located and before a core drilling is done. Photogeology is a useful aid in interpreting structure. At the drilling stage detailed geological maps on the scale of 1 inch per 100 ft. are used.

Petrological and minegraphic studies are often indispensible to the understanding of the mineralization being investigated.

Engineering. A final stage of field exploration is sampling the deposit at the outcrop and at depth by drilling or driving.

In the final assessment the mining engineer is concerned with assembling reliable facts about the deposit, based on sample assays. The essential information is the average grade or value of the ore over a mining width and the tonnage available. This is usually derived from a drilling programme to delineate the ore body. This is a costly stage in exploration.

The cores recovered provide initial material for ore dressing tests. If there are ore dressing problems, adits or shafts may be required for bulk sampling for pilot scale treatments. Such trials assist with mill design and treatment cost estimates.

MINERAL PROCESSING

As yet there is little mineral beneficiation in New Zealand other than simple processes such as drying, milling and classifying. There is virtually no metal mining. Milling of quartz reefs for gold and associated values and scheelite working have ceased. Most mineral working is confined to non-metallic minerals. Various crushers, pulverisers and grinders for a wide range of products are in use at Lime and Marble Ltd.

At Lake Grassmere, solar salt mined from the sea is beneficiated by use of a logwasher and washing in brine. Finally the product is dried in a stainless steel drier.

FUTURE MINERAL PROCESSING IN NEW ZEALAND

The possibilities are too numerous and variable to mention here but if any base metals are discovered, after liberation by grinding these will require concentration by conventional froth flotation procedures appropriate to the mineral.

Heavy beachsand minerals are subjected to wet concentration by gravity in Humphrey spirals or pinched sluices, followed by magnetic and electrostatic separation.

Innovations developed in recent years could materially affect the economics of processing some deposits. One such important innovation is "ore sorting" by electronic means to discard waste rock which dilutes many ores delivered to mills for processing. Properties such as colour, radioactivity and electrostatic response are the basis for separating "ore" from "waste". Ore sorters are available with high throughput. Usually unwanted waste rock is discarded by a high speed compressed air jet operated by a valve which is capable of operating at five millisecond intervals, acting on free falling or accelerated rock fragments.

Another innovation is the hydraulic cyclone used for classifying ore during grinding in closed circuit. Oversize is returned for further milling.

The same means of classification is used for separating "sand" from "slime" after treatment, particularly where waste sand residues are used for "backfilling" in a mine.

Still another cost cutting innovation for certain ores is autogenous grinding in large diameter rotating mills which rely on the ore charge as grinding medium and thus eliminate the cost of a ball charge and wearing costs.

A major mineral processing venture planned is, of course, the treatment of North Island iron sands for steelmaking. Information as to concentrating plant to be used has not been announced but no doubt the procedures will be similar to those used in the Australian beachsand industry.

Salt beneficiation is likely to be carried further at Lake Grassmere, Marlborough, by installation of a multiple effect evaporating plant to produce more highly refined grades of salt and thus reduce present imports.

Some projects planned are as follows:

Bentonite: A deposit in Canterbury will need treatment to produce a swelling sodium bentonite. Plant for a dry modification process has been installed and a wet modification process plant will be built. The latter will require specially designed mixing and drying plant to achieve optimum conditions and produce a swelling bentonite with maximum yield.

Talc: It has been demonstrated in pilot tests by the Otago School of Mines, University of Otago, that good quality talc can be produced by flotation from the abundant deposits of talc-magnesite at the Cobb Valley, Nelson. The imports of talc have doubled since the mineral dressing investigation was carried out. With imports now at 1,750 tons and C.I.F. value at £52,000 the installation of a plant in conjunction with other treatments is now warranted. A by-product will be about 2,000 tons of plus 90% magnesite, possibly useful for refractory purposes.

Coated Calcium Carbonate: Adequate plant is available for fine milling calcium carbonate. Recent trials show that a satisfactory stearate-coated calcium carbonate can be produced from a local "whiting" in the milling plant available.

West Coast Beach Sands: Pilot plant trials with a 700 ton sample shipment sent to

N.S.W., will establish treatability of Westport sands to recover ilmenite, zircon, monazite and fine gold.

Note on Bulk Transportation. Economics of large scale mineral ventures are governed by transportation costs where the commodity is of high bulk and low value. This is particularly applicable to a mineral such as ilmenite which is worth about £4 ton F.O.B. In West Australia, exports have been achieved by shipping bulk, in shipments of no less than 12,000 to 15,000 tons, to achieve a low shipping freight. A deep-water site is necessary with storage bins capable of holding a shipment, and a pier with a trough belt capable of loading about 1,000 tons per hour.

Export of ilmenite from New Zealand would not be possible without suitable facilities for bulk shipping.

Pipelining of minerals is being developed. An outstanding example in Australia is the pipeline to be built for the Savage River iron ore project. A nine-inch mild steel pipeline will be used to transport 2.25 million tons per annum of fine magnetite (–325 mesh) 54 miles through difficult country to the pelletizing site. A single pump requiring 1,800 h.p. will be used at the mine site. Because of terrain difficulties the cost is higher than usual being about £50,000 per mile. However, this is much cheaper than a railway.

The economy of pipelining mineral suspensions can be seen from the cost of pumping water from the Murray River to Whyalla in South Australia. The distance is 230 miles and the cost is 2/- per ton.

SUMMARY AND CONCLUSIONS

1. New Zealand's island economy, agriculture and most manufacturing — and thus its welfare — is precariously dependent on overseas mining. Its commerce is vulnerable to shortages of critical mineral raw materials.
2. Government policy of taxation incentives for mining, and special power rates for electro-industries makes the climate favourable in this field.
3. Despite the fact that New Zealand is not an active mining country, with consequent slow tempo of exploration, several interesting discoveries have been made during the last decade, some fortuitously.
4. The doubling of factory output during the last decade has caused generally a corresponding increase in the requirement of imported mineral materials. Domestic production satisfies only a small part of the total requirements.
5. The main exchange requirement for mineral products is for petroleum, steel, various metals, and fertilizer raw materials, at present amounting to possibly £70 million per annum.
6. Although there has been minor prospecting and exploration, modern techniques have been little used in New Zealand. Large areas with favourable geology, already mapped, remain to be explored in detail.
7. Few mineral beneficiation processes are used in New Zealand. There should be scope for modern technology to be applied to several extensive deposits such as ilmenite, dolomite, high-grade limestones, asbestos, bentonite and white filler clays.
8. New Zealand lacks semi-commercial pilot plant facilities. The pattern of investigation adopted by the Steel Investigation Committee and for the current South Island beachsand investigation seems to be a practical approach to speed up development. Overseas consultants and semi-commercial scale pilot plant facilities are used to test bulk samples.
9. To increase self sufficiency and improve New Zealand's security mineral investigation by D.S.I.R. and the Universities need to be intensified. Investigation of the type which will assist in attracting overseas concerns with capital, technology, experienced personnel and access to markets seem to be most appropriate to achieve progress.

A YEAR WITH THE ACADEMICS

T. R. Hitchings, M.Sc.

Education Department, Christchurch

In March 1966 I was fortunate to have the opportunity of taking up the first Visiting Teaching Fellowship (Chemistry) to be offered in New Zealand, at the University of Canterbury. The terms of reference of the fellowship, ". . . some teaching duties with Stage I classes and . . . encouraged to associate with one of the research groups . . ." provoked much comment from my school colleagues. The implication that this would be an opportunity to escape the rigours of the classroom for a year was apparent.

However, returning to the University after almost two decades proved in many ways to be a humbling experience. The quality of school chemistry in Canterbury has long been a particular interest of the Chemistry Department. Teachers have benefited tremendously from the ready involvement of the University staff in many aspects of secondary education. Notwithstanding this, one must admit some carefully nurtured prejudices and grievances surviving from undergraduate times. Under the handicap of exaggerated concern at the outcome of examinations it is perhaps understandable that one's own limitations are explained away in terms of imagined deficiencies in the system itself.

In the pattern of University education the formal lecture occupies a central place, although its value as a means of instruction is frequently challenged. Most graduates must, at some time or other, have experienced that sense of frustration which arises when a lecturer fails to convey the essence of his thoughts to them. But whether it be due to lack of judgment or skill, failure to communicate is not as disastrous in the lecture hall as in the classroom.

At first sight it would appear that the prime function of the science lecture is to transmit information as perceptively as possible. The principal skills needed would appear to be the selection and arrangement of the relevant ideas. At least this was how I approached the problem of constructing lectures for that part of the programme allotted to me. It soon became obvious that if these were the only criteria, some printed notes or a suitable list of textbook references would enable the student to achieve the required end much more efficiently. Why lecture at all? Experience resolved the question.

After delivering a few lectures it became apparent that although students seemed to be chiefly concerned with transferring information received with their eyes and ears on to paper this was, in fact, not the most important thing which was going on. I came to believe that the prime task I was endeavouring to perform was not that of teaching but rather that of stirring students to learn. This meant that while the lecture "set the pace" and provided what I hoped was a logically developed treatment of the topic, I recognised that what was more important was what took place afterwards in intensive and individual study.

In contrast, the smaller, more intimate atmosphere and slower pace of the classroom should provoke a greater measure of pupil response and teacher awareness. Here, the digressions and "spur of the moment" demonstrations are important. A sizeable proportion of a schoolboy's thinking is done in the classroom.

The consequences of this important difference between lecture and lesson are that a large measure of understanding need not coincide with the conclusion of the lecture. The lecturer only "fails" when he does not succeed in persuading his students that his lecture topic is worth studying.

It is often suggested that lecturers should receive a course of instruction in teaching techniques. In my view, while any training likely to make a person a more effective lecturer would be good, this is of small consequence compared with the possession, by a lecturer, of the ability to catch the imagination of his audience. Students are never more attentive than when at those lectures where the lecturer is deeply interested in the subject matter himself. If the student is able to take away well-structured notes it is not important that he has been able to follow the reasoning only imperfectly.

It is fortunate that it is the policy of the Chemistry Department to have many of its most able lecturers involved in the introductory course. Although chemistry can be said to be "strong" in schools, pupils generally experience relatively small classes, short periods and make minimal use of libraries and independent study. At University, reliance on homework and classroom notes means that the change-over could be difficult if lecturing at Stage I level was treated as unimportant by the staff. It would, in my opinion, be beneficial if the concern of the lecturing staff that they might not be doing enough for their students was matched in our schools by an appreciation that perhaps we schoolteachers are doing too much for our sixth formers.

It would be wrong to imagine that compared with a school pupil the science student enjoys a large amount of free time. His hours of lectures and laboratory almost exactly equal the taught time of the school pupil. In addition, he may have special courses such as that for a foreign language requirement. All these make his "escape" from the regimentation of school one of appearance rather than reality. Strangely enough even the grey school suit he appears to be so eager to abandon is immediately replaced by almost equally uniform undergraduate garb.

It was my impression that student life is a more serious matter than it used to be. The consequences of persistent failure are much more disastrous. The rewards for success in terms of post-graduate opportunities appear to be much greater. Capping activities are now compressed to a few days instead of lasting a month. In spite of this it was pleasing to find how many of the post-graduate students found time to take lectures in Music, Philosophy or English and their apparent nonchalance could not conceal completely the satisfaction they got in getting good passes in these subjects. There is no doubt that a very high proportion of those taking Honours courses have high ability and diverse interests in artistic and cultural fields.

The Department is actively concerned about students who found the pace too fast. They are frequently told that they are welcome to approach their lecturer directly, and several of them did come to see me. In addition as an experiment, once a fortnight a tutorial was substituted for a lecture. Attendance at these was voluntary and recommended only for those who really felt they needed help. Usually about thirty came from my lecture group of one hundred and ninety and this made it possible to go over work as it might have been done in a classroom. It was understood that no new work would be discussed. I believe this to be a very effective and worthwhile way to help those students with less ability or inadequate backgrounds.

Towards the end of the year members of the staff who were not otherwise involved were invited to lecture on topics nominated by those attending tutorials. These were essentially lectures on "repeat" topics and provided a useful review for the students.

Major changes have taken place in the method of assessing first year students. In place of the three examinations which used to be held for terms, a series of monthly tests have been substituted. Usually these are one hour papers and several of them have multiple choice tests. The use of these has sometimes been regarded with suspicion. But now, together with the more traditional essay type of question they have become firmly established and are a most effective way of testing a pupil's understanding, as well as his ability to recall information, over a very wide field in a relatively short time. This testing programme is, I believe, a much more effective way of measuring a student's ability and progress than the former one. It also encourages him to review his work more often.

A generation ago first year laboratory courses were dominated by qualitative analysis based on group separations. Now, a brief investigation of the solubility aspects of sulphide precipitation carried out in a single laboratory session suffices. Much new work in what is traditionally regarded as physical chemistry has now found its way into the Stage I course. Experiments to investigate thermochemical cycles, the measurement of equilibrium constants and pH measurements using a glass electrode are examples. Some of the traditional work, I believe rightly, still finds a place. Gravimetric and volumetric analyses remain. Chemists still weigh things and carry out titrations and the acquisition of these basic skills is still insisted upon.

A schoolmaster cannot but envy the experimental facilities. It is not the superb appearance of the laboratories or the instruments available, but rather the space available and assistance given by the supporting staff. Upper sixth formers and Stage I students are the same people; the major changes of adolescence have taken place much earlier. The experimental work carried out in the final year at school and in the first year at University is very similar. Nevertheless the contrast between sixth formers crammed into a small school laboratory designed for juveniles and the spacious uncluttered university facilities is too great.

A student enjoys nearly three times as much bench space when he moves to University. At school a chemistry teacher spends much of his laboratory time endeavouring to keep up with the demand for materials. At University, not only is a demonstrator available for every fifteen students but efficient technical staff is always present to provide materials or replace breakages. And furthermore, they regard this student-staff ratio as too high for effective help and supervision to avoid accidents. One supervisor to twelve students, in their view, would be a more desirable ratio. As a teacher I found it disappointing to discover that University students enjoy much more individual attention during practical work than they did at school. Schools do not require or expect the kind of facilities needed for the complex and lengthy work undertaken routinely at University, but they do need to provide similar supervision and guidance during experimental work.

The first year chemistry course is regarded as a general introduction to the subject and is intended for a variety of students, the majority of whom will go to other faculties of the University. This liberal policy, that not only those people whose primary interest is in chemistry are important, does not necessarily make the unit an easy one to pass; it does ensure that the large proportion of students who do not intend to become professional chemists are able to enter their own fields with a realistic standard in chemistry. More than two-thirds of the students who present themselves for examination pass at this level. In addition to the chemistry graduates who subsequently enter teaching it is pleasing to find that almost all the science graduates have at least one unit of chemistry. This greatly strengthens the teaching of the subject.

At advanced and research levels instruments which are to a greater or lesser extent black boxes deliver recorder charts when the appropriate dials are set and buttons are pushed. However, these still require a suitable sample, the preparation of which often requires much more expenditure of effort and skill and application of principles than the measuring of some property of the sample. This I found to be so in my research project.

It was my privilege to work with Dr J. E. Fergusson. We investigated the preparation of different complexes of some of the transition metals formed with several dipyrromethene ligands. Spectra, magnetic measurements and X-ray powder photographs were then used to elucidate their stereochemistry. The major portion of my time was devoted to this research.

The opportunity provided by the Teaching Fellowship of working with the staff and students is one for which it is difficult to express thanks adequately. Such people who combine both a devotion to a particular discipline with a breadth of personal interests may truly be said to exemplify the highest aim of a University.

The chemistry teaching force in schools is a large one and all its members are acutely aware of the continuous change in content and viewpoint which is going on. Obviously only a few can have the opportunity to enjoy a year's immersion in chemistry but it will be a great pity if this opportunity does not continue to be provided.

RECENT AWARDS

Dr MILLER

A 1967 Andre Meyer Research Fellowship has been awarded to a New Zealand soil scientist. He is Dr R. B. Miller of the Soil Bureau, D.S.I.R., Lower Hutt.

The awards, named after one of the most distinguished founders of the FAO, are open to scientists from all parts of the world. They are given for independent research work related to Food and Agricultural Organisation programmes. Dr Miller proposes to work with the Unesco-FAO world soil map project, a project initiated by Dr N. H. Taylor, a former director of the New Zealand Soil Bureau.

Dr Miller, who has wide experience in the chemistry of New Zealand soils and its applications, will start a programme of systematic study of the chemical properties of important world soil groups. He will relate these to the fertility and productivity of the soils.

After working at the FAO headquarters in Rome, Dr Miller plans to go to the Royal Tropical Institute in Amsterdam. He plans to be away from New Zealand for 18 months.

Royal Society Award to Chemist

The President of the Royal Society (Professor J. A. R. Miles) recently announced that the Hector Medal and Prize for 1967 has been awarded to Associate Professor R. C. Cambie of the Chemistry Department, University of Auckland, for researches in the chemistry of natural products.

INTERNATIONAL PRIZE

PRIX DU CINQUANTENAIRE DE LA SOCIETE DE CHIMIE INDUSTRIELLE AVIS DE CONCOURS

1. La Société de Chimie Industrielle (28, rue Saint-Dominique, Paris 7èeme et 80, route de Saint-Cloud, 92-Rueil-Malmaison) décernera en Mai 1968, à l'occasion du cinquantième anniversaire de sa fondation, un prix dénommé "Prix du Cinquantenaire de la Société de Chimie Industrielle".

2. Ce prix ne sera décerné qu'une fois; il sera d'un montant minimum de 50.000 F. français et pourra être d'un montant supérieur. Le chiffre définitif sera fixé avant le 30 Juin 1967 et fera l'objet d'un avis qui paraîtra aux mêmes endroits que le présent avis.

3. Le prix sera décerné par un Jury international siégeant à Paris; ce Jury a été constitué par le Comité du Cinquantenaire.

4. Le prix sera attribué à l'auteur d'une importante invention ou découverte de chimie, ayant déjà fait l'objet d'une aplication industrielle ou tout au moins ayant réuni tous les éléments nécessaires pour une application industrielle.

Les mémoires devront témoigner d'un niveau élevé de création industrielle ou technique pour le bienfait de l'humanité.

La première manifestation publique écrite de l'invention ou découverte proposée devra être postérieure au ler Janvier 1945.

5. Le concours sera ouvert à toute personne physique ou équipe de personnes physiques de toutes nationalités.

6. Le Prix du Cinquantenaire ne pourra pas être attribué à une personnalité ayant déjà été honorée d'un prix scientifique ou technique international.

7. Les candidats devront faire acte de candidature par dépôt d'un mémoire rédigé en Français, langue officielle de la Société, de dix pages dactylographiées au maximum résumant la découverte ou l'invention soumise au Jury et ses applications actuelles et potentielles.

Le mémoire pourra être accompagné d'un texte dans la langue préférentielle du candidat ainsi que des pièces annexes, tirés-à-part, brevets, etc. . . ., éventuellement nécessaires. Mais, en cas de contestation, seul le texte français fera foi.

8. Les mémoires et dossiers complets les accompagnant devront être envoyés sous *pli recommandé* avant le ler Novembre 1967, la date de la poste faisant foi, en *deux exemplaires,* complets, de langue française, auxquels seront joints:

(a) un résumé d'une page en français

(b) éventuellement, le ou les exemplaires en langue préférentielle du candidat

Ils seront adressés au "Jury du Prix du Cinquantenaire de la Société de Chimie Industrielle" 80, route de Saint-Cloud, 92-RUEIL-MALMAISON (France).

9. Nonobstant la couverture de l'invention par brevets ou tous autres droits au nom du tiers et notamment au nom de la Société qui emploie ou a employé le candidat, celui-ci par le fait même du dépôt du mémoire, reconnait s'être mis en règle avec le propriétaire des brevets ou autres droits, et dégage le Jury de toute responsabilité matérielle ou morale résultant de l'existence de tels brevets ou autres droits.

10. Au cas où serait faite une traduction du texte ou avis de concours dans une autre langue, seul le texte français fera foi.

The following is a translation received from the New Zealand Embassy in Paris of conditions governing the award of PRIZE FOR THE 50th ANNIVERSARY OF THE SOCIETE DU CHIMIE INDUSTRIELLE.

1. La Société de Chimie Industrielle (28 Rue Saint Dominique, Paris 7ème and 80 route de Saint-Cloud, 92-Reuil-Malmaison) will award a prize in May 1968 known as

"Le prix de Cinquantenaire de la Société de Chimie Industrielle," to mark the 50th anniversary of its foundation.

2. This prize will be awarded once only; it will be worth a minimum of 50,000 francs and possibly more. The final amount will be fixed before 30 June 1967 and notice of it will be distributed to the same addressees as the present communication.

3. The prize will be awarded by an international Jury located in Paris; this Jury has been chosen by the 50th Anniversary Committee.

4. The prize will be awarded to the originator of an important invention or chemical discovery which has already been used industrially or at least possess the necessary elements for industrial use.

The report should show a high standard of industrial or technical invention, beneficial to humanity.

The first account of the invention or discovery submitted should have been published after 1 January 1945.

5. The competition is open to all individuals or groups of individuals of all nationalities.

6. The Prize may not be awarded to any person who has already been the recipient of an international scientific or technical prize.

7. The candidates should register their candidature by submitting a report in French, the official language of the Society, in ten typewritten pages at the most, giving an account of the discovery or invention submitted to the Jury, as well as the present or potential uses of the discovery or invention. The report may be accompanied by a text in a language chosen by the candidate as well as by annexes, separate reprints, patents, etc., which might be necessary. But, in the event of a dispute, only the French text will be valid.

8. Two copies in French of the reports and the completed files which accompany them should be sent by registered mail before 1 November 1967 (the post mark being legal proof) together with:

(a) a one-page summary in French
(b) if necessary, the copy or copies in the language chosen by the candidate.

They should be sent to the "Jury du Prix du Cinquantenaire de la Société de Chimie Industrielle", 80 route de Saint Cloud, 92-Rueil-Malmaison (France).

9. Notwithstanding the patenting of the invention or the granting of any other rights to a third person and in particular the company which employs or has employed the candidate, the latter should, in submitting the report, make a declaration that he has made the necessary arrangements with the owner of the patents or other rights, and that he disengages the Jury from any material or moral responsibility resulting from the existence of such patents or other rights.

10. In the case of a translation being made of the text or announcement of this competition into another language, only the French text will be legal.

Note: Advice has been received that the prize has now been set at Francs 100,000.

OFFICIAL NOTICE

Annual General Meeting

An Annual General Meeting of the New Zealand Institute of Chemistry (Inc.) will be held in Room 006, Easterfield Building, Victoria University of Wellington, on Wednesday, 16 August 1967, at 5 p.m.

NEW ZEALAND GEOCHEMICAL GROUP

During the Geological Society Conference at Hamilton in May, the New Zealand Geochemical Group held a general meeting, and elected the following officers:

Chairman, Dr J. Rogers.
Secretary-Treasurer, Dr A. J. Ellis.
Editor, Mr S. H. Wilson.
Committee, Dr A. Challis and Dr R. G. Burns.

The Group now has over 80 members of which more than half are drawn from members of the N.Z.I.C. The Group issues a three-monthly newslettter, and as opportunities arise arranges geochemical seminar meetings.

At Hamilton on May 15th a symposium was arranged at the University of the Waikato on "Trace elements and Petrogenesis". Dr R. G. Burns of Victoria University Chemistry Department reviewed the significance of the rules of trace element distribution between minerals in the light of present day solid-state chemistry. Dr S. Banno of Tokyo University then presented analytical information on distribution coefficients for a number of transition elements, relating distribution to ion size and co-ordination numbers. Dr P. Blattner of Chemistry Division outlined a research project on element distribution between minerals during high grade metamorphic processes in an area of grandiorites. A spectrographic study of the relative abundances of rare earth and related elements in granitic areas of Westland was presented by Mr W. C. Tennant of Chemistry Division. Dr A. Ewart of the N.Z. Geological Survey concluded the symposium by presenting evidence from isotope and trace element abundances that the rhyolite rocks of the Central North Island were derived by partial fusion of greywacke sediments under deep crustal conditions.

The expanding membership of the Geochemical Group reflects an upsurge in interest in geochemical work in New Zealand. Whereas a few years ago work was limited to a few specialised facets of geochemistry there is now a wide range of investigations going on in Universities and Government organisations, including geochemical prospecting, isotope geochemistry, element distribution and phase studies, hydrothermal studies, bio-geochemistry, soil chemistry, and chemical oceanography.

It is hoped to arrange a Geochemistry Symposium at the A.N.Z.A.A.S. Conference at Christchurch next January.

On Tuesday evening, 11 July, a joint meeting of the Geology Section of the Wellington Branch of the N.Z. Royal Society and the N.Z. Geochemical Group was held at the Institute of Nuclear Sciences, D.S.I.R., Lower Hutt. A wine and cheese social function preceded and stimulated discussion at the symposium which was entitled "Mineralization—Active, Fossil and Hydrothermal".

The group of speakers was chosen to bring together new information from detailed mineralogical work in areas of metallic mineralization, from studies on metal transport and precipitation and rock alteration in active hydrothermal areas, and from laboratory information on ore mineral solubilities in high temperature solutions.

Professor Paul Cloke, at present at Chemistry Division on sabbatical leave from the University of Michigan, outlined some of the current theories of metal transport and deposition in nature. Field observations suggest that emplacement of certain ores was accompanied by the passage of large quantities of water. Control of ore deposition by faulting is found in many deposits and many hydrothermal ore deposits are the fissure-filling type. Complexing of metal ions by bisulphide and chloride ions in high temperature solutions are the most likely means of obtaining metal sulphide solubilities high enough to transport ore-body quantities of heavy metals.

Dr B. G. Weissberg of Chemistry Division summarised some recent work on precipitates from New Zealand hot spring and geothermal drillhole waters. Some precipitates high in concentrations of elements such as arsenic, antimony, mercury, tungsten, gold, silver, and thallium provide present-day evidence of selective solution and deposition processes which may have been important in forming hydrothermal ore deposits, such as in the Coromandel area. Precipitates containing several ounces per ton of gold may form from thermal waters containing only 0.00004 ppm gold.

Two mineralogical and geochemical studies of rock alteration associated with hydrothermal solutions were presented by Dr A. Wodzicki and Mr A. Steiner of the N.Z. Geological Survey. Dr Wodzicki described the hydrothermal alteration zones surrounding ore veins of the Te Aroha lead-zinc mine, and how the chemical composition of the rocks had changed during alteration. Mr Steiner gave, for comparison, an outline of deep hydrothermal alterations in geothermal areas of the North Island. The rock alteration found in both types of environment is of a common type, suggesting that the temperatures and compositions of the hot waters were similar in both areas. Yet with the exception of some mercury deposits there is little evidence of present-day association of an active thermal area with extensive ore deposition.

There was considerable discussion as to whether the association of hydrothermal ore deposits with active volcanic areas was due only to the heat derived from a magma intrusion providing energy for a hydrothermal process, or whether metal-rich volatiles given off from an intrusion were also essential to the mineralizing process. Suggestions were made that perhaps in areas such as Wairakei, ore deposits were forming at a deeper level, or alternatively would be formed at an older stage of the system.

BRANCH NOTES

Auckland

On April 4th the Auckland Branch, at the invitation of Dr J. Rogers, held a meeting at the New Zealand Fertiliser Manufacturers' Research Association, Otara. After a buffet meal and tour of the laboratories, Messrs P. Blomfield, R. A. Warburton, P. J. Gallaher and Dr Rogers were the speakers in a Symposium on the fertiliser industry which aroused lively discussion.

At the May meeting, we had as our guests Chemistry Teachers drawn from the Auckland and South Auckland Education Boards areas who were attending a refresher course conducted by the Departments of University Extension and Chemistry in association with the Education Department. The speaker was Mr Peter Tarrant, Deputy Principal of Henderson High School who presented a demonstration lecture entitled "Fun with Chemistry". Mr Tarrant left us to enjoy some chemical music (Samba of the White Suit) whilst he fetched his 'lab coat', and then, having rejoined the meeting suitably attired in flowing garb and high conical hat, he waved his magic flash wand and cast a spell that was to hold his audience for the duration of his 70 minute non-stop performance.

He described the preparation of gun cotton—an essential component of his flash wand—charmed a Pharoah's serpent of ever increasing length and then produced a series of bangs as he covered the field of explosives to end Act one.

Act two was quieter in that the big bangs were absent, but the magic was even more in evidence as we listened to stories of the turning of water into wine, the problems one can encounter when purchasing ink, and the goings-on at the prefects' after-dance party. This last one drew spontaneous applause from the audience as they saw all the 'alcoholic' beverages returned to the decanter and repoured as 'milk' just as the master of discipline descended upon the prefects gathering to satisfy himself all was above board. Peter Tarrant gave enough away during this act to ensure that many of the audience would spend hours in the future building up their own repertoire of magic using potassium iodate, sodium thiosulphate, iodine, starch, potassium permanganate, barium ions, etc.

Act three was devoted to those chemists and non chemists who like to make their own fireworks. Demonstrations of how to obtain basic colours from simple mixtures, a patent method for the manufacture of superfine, granular gunpowder and an indicator of the preciseness of the mathematics necessary for the construction of a successful rocket, captivated the enthusiast.

Act four was a real mixture and included a new sport to satisfy the gambling instincts of most school pupils, namely fire-racing, ink for people who change their minds, electrically-fired smoke bombs and the biggest of big bangs from the hydrogen bomb, the build up to which was such that the tension in the room became almost unbearable.

The vote of thanks at the end indicated that the audience had enjoyed their "Fun with Chemistry".

Manawatu

Dr S. Moustafa of the Plant Chemistry Division, D.S.I.R., is on leave at Purdue University, Lafayette, Indiana.

Dr Ross Grimmet has left the Department of Chemistry and Biochemistry of Massey University to take up an appointment as lecturer in chemistry at the University of Otago.

Dr Sylvia Rumball, who has recently returned from a year's post-graduate research at Oxford, has joined the staff of Massey University as lecturer in inorganic chemistry.

Construction work has commenced on the Science Block on the Massey Campus.

Recent lectures to the Branch have included: "Microbial Hydroxylation" by Professor Sir E. R. H. Jones and "Potassium from Sea Water" by Professor M. Kennedy.

Dr P. S. Robertson has been appointed Assistant Director of the New Zealand Dairy Research Institute. Mr J. S. Sargent succeeds him as Chief Bacteriologist of the Institute.

Dr P. J. Peterson, secretary of the Manawatu Branch, has been invited to join the U.S. National Science Foundation's Research Vessel "Alpha Helix" on an expedition to the Amazon region. He will join the expedition in August and will spend approximately six weeks studying the selenium metabolism of the Amazonian flora.

Dr R. C. Lawrence of the Dairy Research Institute will act as secretary of the Manawatu Branch during Dr Peterson's absence.

Dr J. W. Lyttelton of the Plant Chemistry Division, D.S.I.R., has left on an overseas tour, during which he will spend three months visiting research institutions in the United States, United Kingdom, Europe, Japan and Australia. On his return journey he will attend the 7th International Congress of Biochemistry at Tokyo and a conference on the Replication and Recombination of Genetic Material at Canberra.

We congratulate Dr H. W. Whitehead and Dr F. H. McDowall, both former directors of the New Zealand Dairy Research Institute, on being honoured with the Distinguished Service Award of the New Zealand Society of Dairy Technology.

Mr Krishna Aiyer, a Commonwealth Scholar from India, has begun work for a Ph.D. in the Faculty of Food Technology of Massey University. He will study the gelation of milk proteins.

Dr W. A. McGillivray, Director of the New Zealand Dairy Research Institute, will leave in August on a six-week visit to the United States, the United Kingdom and Europe for the purpose of studying scientific and technical aspects of the marketing of dairy produce.

Mr W. Jones, a graduate of the University of Wales, has joined the staff of the D.S.I.R., Plant Chemistry Division. He will undertake chemical studies in connection with the bloat research programme.

Wellington

Dr G. J. Leary has been awarded the B.P. Postdoctoral Fellowship for 1967. Dr Leary leaves Chemistry Division in October to work with Professor P. G. Porter at the Royal Institution on photochemical reactions in organic chemistry.

Mr A. Nestoridis has recently rejoined the staff at Chemistry Division. He was formerly with Eleusis Bauxite Mines Inc., Athens.

. . . and in Nelson

Mr R. J. Brook, L.R.I.C., has recently joined the staff of the Cawthron Institute where he will be investigating the volatile oils of N.Z. hops and related problems by gas chromatography. Prior to his coming to Nelson Mr Brook was chemist in charge of the gas chromatography section, Imperial Smelting Corporation's research laboratory at Bristol.

Canterbury

Mr H. McD. Rankin has transferred from N.Z. Breweries Ltd., Auckland, to be their Production Manager in Christchurch.

Mr D. E. Lewthwaite has been appointed a Chemistry Tutor at the Christchurch Technical Institute.

Dr M. J. McEwan has been appointed Lecturer in the Chemistry Department, University of Canterbury. He has been doing post-doctoral research at York University, Toronto, following his Ph.D. at University of Canterbury.

Dr D. T. Hurst from Kingston College, London, has been appointed Visiting Lecturer in the Chemistry Department, University of Canterbury, for a period of twelve months from July 1967.

Dr T. Sorensen, an Assistant Professor of Chemistry at the new University of Calgary, Alberta, Canada, is spending three months in the Canterbury Chemistry Department working on the instability of penicillin molecules. Calgary was established seven years ago as a branch of the University of Alberta at Edmonton. It already has a role of 5,000 and plans to expand to 18,000 compared with Edmonton's present roll of 15,000, Dr Sorensen said.

Professor J. F. Bunnett, Professor of Chemistry and Dean of Science at the University of California, Santa Cruz, is spending three months at the University of Canterbury as an Erskine Fellow. He recently addressed the Canterbury branch on "Unusual Reactions of Aryl Halides". Professor Bunnett said that Santa Cruz was one of the two newest of the nine University of California campuses and had adopted a collegiate system which was creating considerable interest. It was designed to break down the university community into smaller units. In small universities and colleges of 500 to 1500 students, Professor Bunnett said, the student could know and be known by all his teachers, he felt personal interest and loyalties and felt he was an important and integral part of the whole. Somewhere between a roll of 2000 and 4000 students these relationships began to falter. At Santa Cruz teaching was done in colleges which each had a staff of about 40 and about 600 students. Some instruction, chiefly in natural sciences, was done on a university-wide basis. The Santa Cruz campus was expected to grow to 27,500 students by 1955.

Professor Bunnett commented on the reading problems of chemists and quoted Lord Todd as estimating that if an organic chemist read all new literature in his field for eight hours a day it would take him 18 months to cover a year's output! To try to meet this problem the American Chemical Society has appointed Professor Bunnett editor of a new journal to begin next January. It will attempt to summarise all significant new work in chemistry, in monthly issues. Contributions will be short factual accounts (about 5000 words) giving some criticism and some informed speculation.

Otago

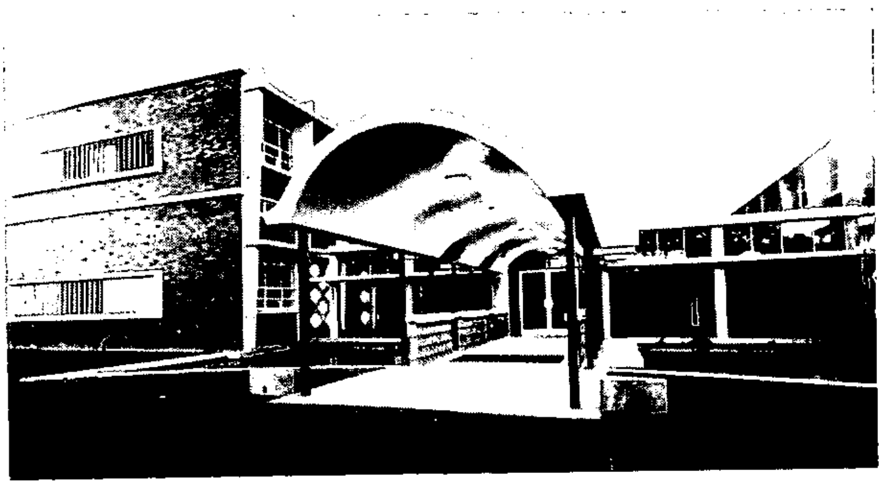
The second of the "Illustrated Lectures in Chemistry to 6th Form Pupils" was given on June 1st. The speaker was Dr C. G. Pope, and his title was "How Chemical Reactions Occur". About 200 people attended. This lecture will be repeated at Invercargill.

The Otago Branch of the Royal Society of New Zealand have initiated a Science Projects Awards Scheme. The idea is to encourage school science students to do independent research of their own on topics outside the normal school syllabus. The competition is open to all school pupils in the Otago/Southland area. A public prize-giving evening will be held in October, and all suitable entries will be then displayed for one week in the Otago Museum.

The Chemistry Department of the University of Otago is pleased to welcome Dr D. V. Fenby and Dr M. R. Grimmett to the lecturing staff. Dr Fenby has just completed a four-year term of study with Professor R. L. Scott at U.C.L.A. in the field of non-electrolytes. Dr Grimmett was formerly a lecturer at Massey University.

Miss J. Dow, of the Department of Medicine, Otago Medical School, is leaving to take up a teaching fellowship in the Department of Biochemistry, Downstate Medical Centre, New York, at the beginning of September. She will be studying for a Ph.D. degree under Dr W. R. Sanslone who is working on the effects of acid-base disturbances on cellular metabolism.

WOOL RESEARCH ORGANISATION LABORATORIES



Entrance to the New Wool Research Organisation Building

THE laboratories of the Wool Research Organisation of New Zealand were opened by the Governor-General Sir Bernard Fergusson on February 16, 1967.

The Organisation was founded in 1961 with Mr N. Roberts as Director. Mr Philip King of Hamilton was the architect for the laboratory building which is on a site adjacent to Lincoln College. The basic design is of two wings connected by a glassed-in front foyer, with a covered entrance over an ornamental pool. Part of one wing houses the Wool Industries Research Institute which had previously been in less comfortable surroundings in Dunedin. This Institute will retain its autonomy under the Directorship of Dr L. F. Story, and its direct association with the wool manufacturing industries. It is concerned with all aspects of wool manufacturing processes from the raw wool to the finished cloth, including studies on the interrelationships of problems of the wool producers and those of the wool manufacturers.

The W.R.O. is expected to expand its staff to over fifty, about half being professional scientists, and to concern itself with the problems as wide-ranging as wool biosynthesis, the chemistry of wool proteins, modifications of wool properties, transport and handling of wool shipments abroad and the technology of carpets made from local wool.

Directors of overseas wool research laboratories and leaders of the research and development branches of the International Wool Secretariat contributed to a symposium held as part of the opening activities. These discussions emphasised the overall strength of the international research effort in wool science. A close liaison between the I.W.S. and wool research laboratories is maintained through regular meetings of the I.W.S. Research and Development committee which also met during opening week.

There have been some successful wool research ventures in New Zealand in earlier years, notably those of Dr I. K. Walker at Chemistry Division, D.S.I.R., and the W.I.R.I. group, but now, rather belatedly, a research effort more commensurate with the importance of the industry is possible.

THE NEW ZEALAND INSTITUTE OF CHEMISTRY (INC.)

INCOME AND EXPENDITURE ACCOUNT — For Year Ended 30 April 1967

EXPENDITURE

1966 £		£ s. d.	£ s. d.
	ADMINISTRATION EXPENSES		
338	Travelling Expenses	166 17 2	
456	Printing, Stationery, Postages and Tolls	453 14 0	
240	Salary, Registrar	260 0 0	
222	Branch Expense Allowances	205 12 0	
60	Honorarium to Secretary	75 0 0	
67	Audit Fees	42 0 0	
11	General Expenses	29 13 9	
8	Depreciation	6 0 0	
(1,402)			1,238 16 11
	Cost of Journal (including proportion of Editor's Honorarium £60)	1,359 0 2	
	Less Net Revenue from Advertising	773 5 6	
657			585 14 8
160	"Chemistry in Action" — Net Cost		11 1 0
	Examination Expenses	56 0 0	
	Less Examinees Fees Received	15 0 0	
6			41 0 0
—	Overseas Visitors' Travelling Fund Overspent		35 11 1
25	Chemistry Essay Prize		—
20	Instrument Survey		—
68	Provision for Taxation		—
—	Excess of Income over Expenditure for Year		104 4 1
£2,338			£2,016 7 9

INCOME

1966 £		£ s. d.	£ s. d.
1,655	Subscriptions—Annual	1,868 5 0	
5	Proportion Compounded Subscriptions	5 1 7	
(1,660)			1,873 6 7
	INTEREST RECEIVED		
28	Bank of New Zealand	16 8 6	
76	Local Body Stock	90 6 4	
1	Taxation Prepaid	—	
(105)			106 14 10
52	Surplus, Distribution of Publications		36 6 4
5	Donations		—
516	Excess Expenditure over Income		—
£2,338			£2,016 7 9

OVERSEAS VISITORS' TRAVELLING FUND

1966		£ s. d.
—	Travelling Expenses paid during year	306 0 0
148	Balance	—
£148		£306 0 0

1966 £		£ s. d.
116	Balance, 30.4.66	148 4 10
32	Conference Surplus Credited to Fund	15 4 1
—	Donations Received	107 0 0
—	Amount overspent charged to Income and Expenditure Account	35 11 1
£148		£306 0 0

TRUST FUND ACCOUNT

1966 £		£ s. d.
1289	Balance, 30.4.67	1,290 3 8
£1,289		£1,290 3 8

1966 £		£ s. d.
1,288	Balance, 30.4.66	1,289 0 9
1	*Interest*: Post Office Savings Bank	1 2 11
£1,289		£1,290 3 8

BALANCE SHEET AS AT 30th APRIL 1967

1966 £		£ s. d.	£ s. d.
	CURRENT LIABILITIES		
203	Sundry Creditors	37 10 0	
177	Subscriptions Received in Advance	113 19 0	
200	Royal Institute of Chemistry Funds held in Trust ...	200 0 0	
68	Provision for Taxation ...	—	
(648)			351 9 0
	SPECIAL FUNDS		
12	Compounded Subscriptions ...	7 6 0	
75	Education Fund	75 0 0	
148	Overseas Visitors' Travelling Fund	—	
(235)			82 6 0
	TRUST FUND		
1,289	As per statement attached ...		1,290 3 8
	ACCUMULATED FUNDS		
	Balance as at 30.4.66	695 0 2	
	Add Taxation Provision written back	67 17 4	
	Taxation Refund	98 6 9	
	Excess of Income over Expenditure for Year ...	104 4 1	
695			965 8 4
£2,867			£2,689 7 0

1966 £		£ s. d.	£ s. d.	£ s. d.
	CURRENT ASSETS			
13	Petty Cash Funds		9 15 1	
809	Bank of New Zealand		439 12 0	
	Subscriptions in arrears ...	240 15 0		
	Less Provision for overdue subscriptions	50 0 0		
			190 15 0	
104				
87	Sundry Debtors		116 2 3	
14	Publications on Hand		117 19 0	
20	Advance, Conference		—	
(1,047)				874 3 4
	TRUST FUND INVESTMENTS, AT COST			
39	Post Office Savings Bank ...		40 3 8	
500	Hutt County Council Redemption Loan		500 0 0	
750	Lyttelton Harbour Board Stock		750 0 0	
(1,289)				1,290 3 8
	GENERAL FUND INVESTMENT			
500	North Canterbury Hospital Board Stock			500 0 0
	FIXED ASSETS, AT COST			
	Office Equipment	99 19 0		
	Less Depreciation	75 19 0		
30			24 0 0	
	Addressograph Plates	31 3 6		
	Less Depreciation	30 3 6		
1			1 0 0	
(31)				25 0 0
£2,867				£2,689 7 0

AUDITOR'S REPORT

I have audited the books of the New Zealand Institute of Chemistry (Inc.) for the year ended 30th April 1967 and have received all the information and explanations I have required. In my opinion, according to the best of my information and the explanations given to me and as shown by the books of account, the Balance Sheet, Income and Expenditure Account, and Trust Fund Account are properly drawn up so as to give a true and fair view of the state of the Institute's affairs as at 30th April 1967.

Christchurch
5th July 1967.

J. W. SHANAHAN, A.P.A.N.Z.,
Auditor.

SYMPOSIUM ON SECONDARY SCHOOL CHEMISTRY

THERE will be a one-day symposium at the University of Canterbury Chemistry Department on Monday, October 2nd, and the main speaker will be Sir Ronald Nyholm, F.R.S. The symposium will be open to Secondary School teachers, and to members of the Education Department and University Chemistry departments. There will be two sessions, the morning being devoted to a discussion on School Chemistry below 6th Form level and the afternoon will be devoted to Entrance and Scholarship Chemistry.

Arrangements are as follows:

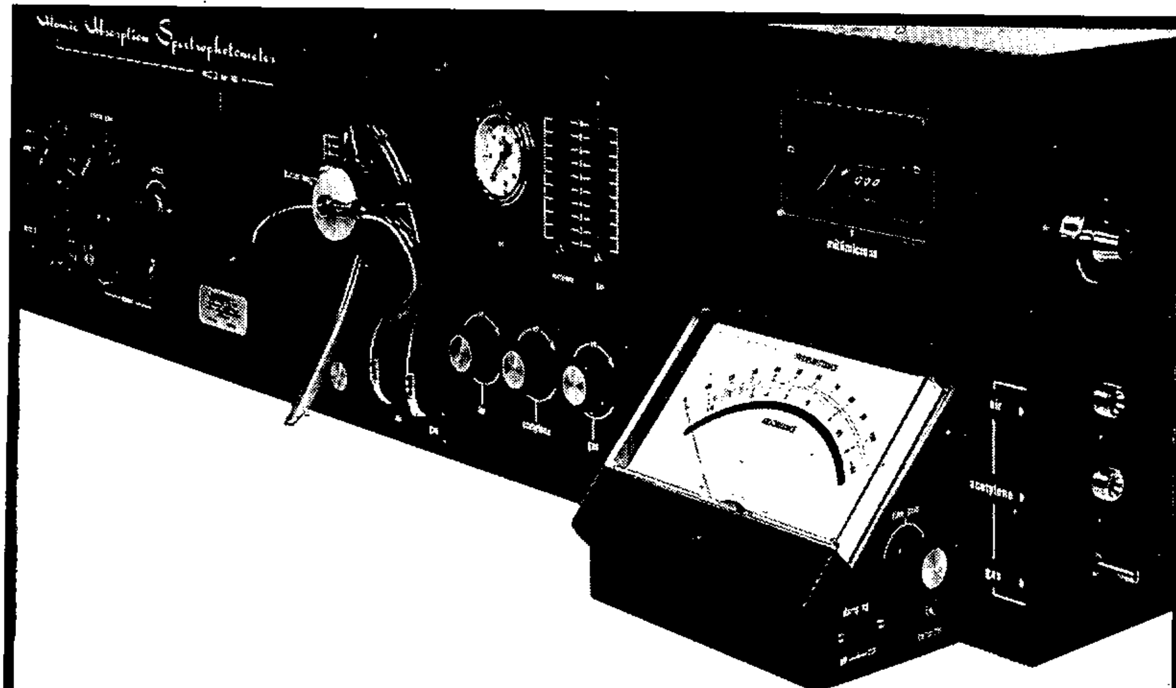
Morning—Junior School Chemistry:

1. *Prof. R. S. Nyholm*—British Developments (30 mins.).
2. *Mr R. Chapman*—School Certificate Chemistry (30 mins.).
4. Panel discussion with all three speakers and with *Mr J. W. McChesney* as Chairman.

Afternoon—Sixth Form Chemistry:

1. *Mr T. R. Hitchings*—Comparative Comments on New Zealand practice (30 mins.).
2. *Prof. C. J. Wilkins*—New Zealand Developments (30 mins.).
3. *Prof. R. S. Nyholm*—British Scene (30 mins.).
4. Panel discussion with all three speakers and with *Professor M. H. Panckhurst* as Chairman.

3. *Mr R. U. Roy*—N.Z. Development (including General Science) (30 mins.).



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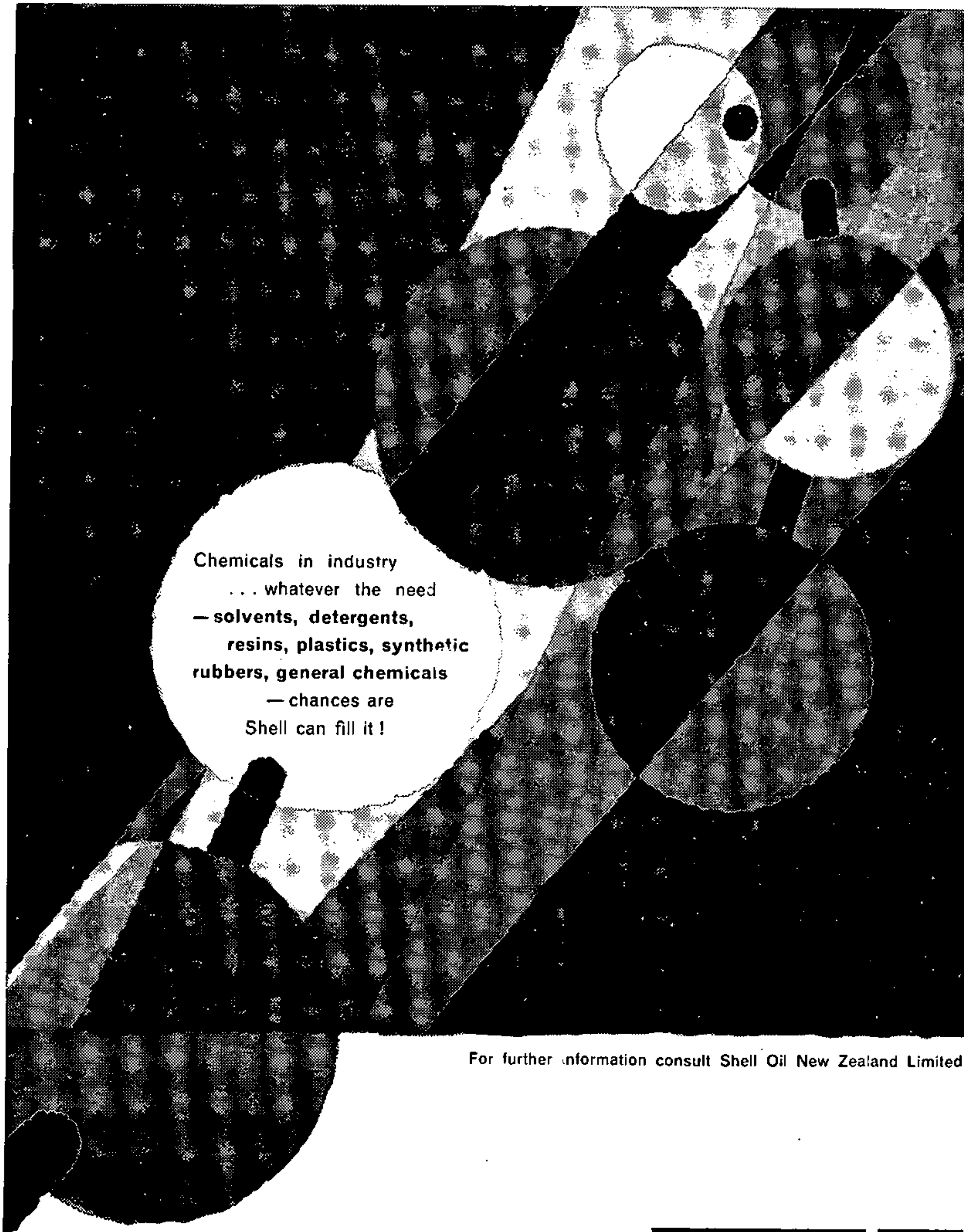
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resins, plastics, synthetic
rubbers, general chemicals
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Staff appointments

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

POSITIONS AVAILABLE

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

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

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

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

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

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

ADVANCEMENT

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

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

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

SALARIES

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

VACATION EMPLOYMENT

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

ENQUIRIES

More detailed information is available in the booklet "A guide to graduate employment with Shell Oil New Zealand Limited".

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

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

or Shell House, Albert Street, PO Box 1084, Auckland. Telephone 32-240

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

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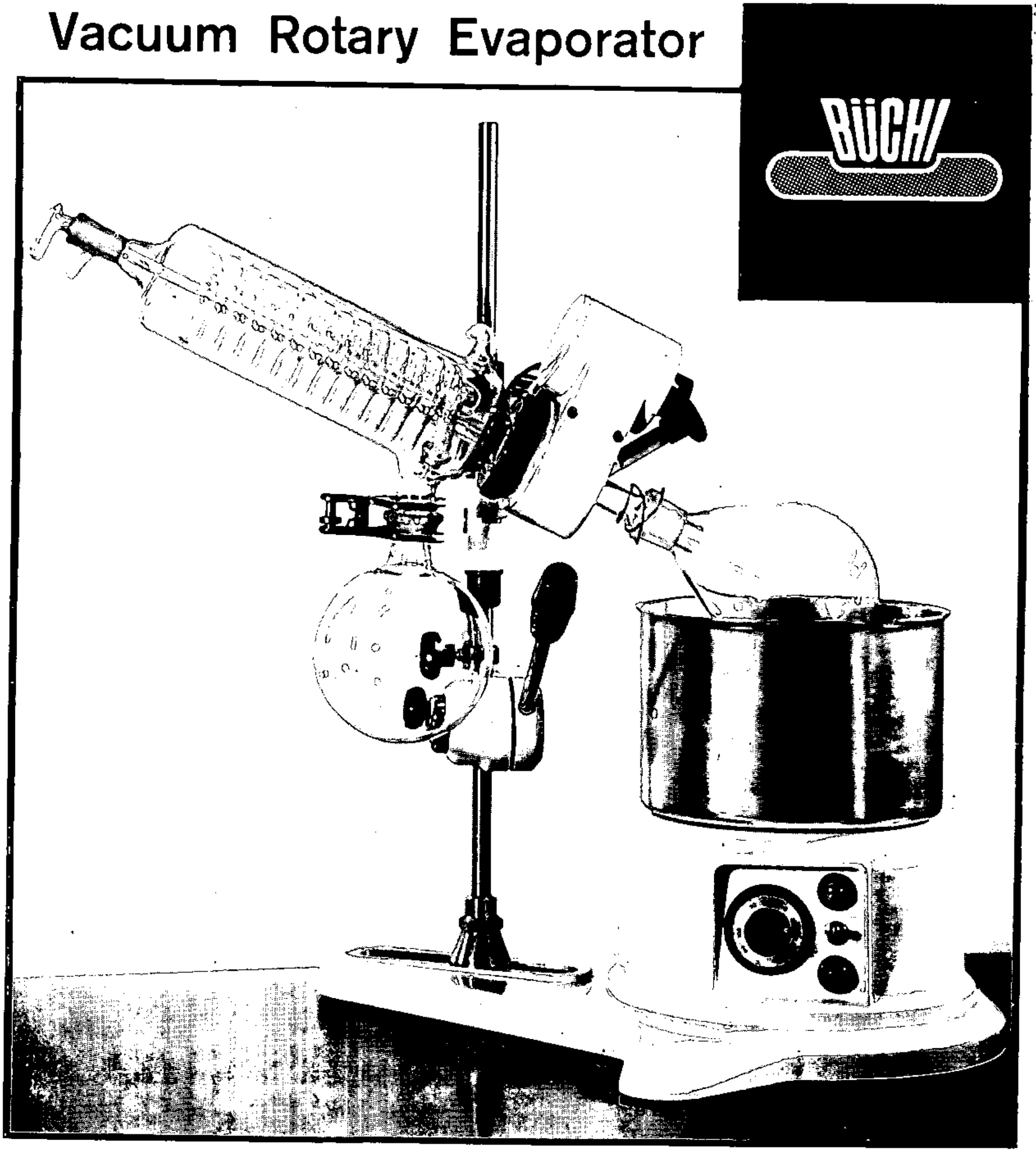

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