

JOURNAL OF THE NEW ZEALAND
INSTITUTE OF CHEMISTRY

Vol. 25 No. 2
April, 1961



GEO. W. WILTON & CO. LTD.

156 WILLIS STREET
WELLINGTON



63 SHORTLAND STREET
AUCKLAND

Established 1905

Representing the leading suppliers of Scientific apparatus, Glassware and laboratory chemicals, including:—

COOKE, TROUGHTON & SIMMS Microscopes,
Surveying Instruments

DIFCO Culture Media

EDWARDS High Vacuum Equipment

ELECTROTHERMAL Heating Appliances

ELGASTAT Water Deionisers

ENDECOTTS Test Sieves and Sieve Shakers

GALLENKAMP Ovens, Incubators Etc.

INTERNATIONAL Centrifuges

JOHNSON MATTHEY, Platinum Apparatus

L. LIGHT & CO. Organic Chemicals

PYREX Glassware

SCHMIDT Concrete Test Hammers

UNICAM Absorptimeters — Spectrophotometers

WHATMAN Filter Papers



LARGE STOCKS AVAILABLE . . .

PROMPT AND ECONOMICAL INDENT SERVICE.

JOURNAL OF THE NEW ZEALAND INSTITUTE OF CHEMISTRY

Vol. 25, No. 2

APRIL, 1961

CONTENTS

	<i>Page</i>
Of Conferences	31
Mitochondria : Power Plants of the Cell .. G. W. Butler	33
The Annual Chemistry Conference .. G. M. Moir	47
Exhibition of New Zealand Medicinal Plants S. G. Brooker	51
Meat Research Institute : New Laboratories at Hamilton ..	53
Frederick Palliser Worley : An Appreciation	57
Examinations Committee : Admission of Associates by Examination	62
Branch Chairmen	63
The Registry	66
Branch News and Notes	68
Australasian Corrosion Association (New Zealand Branch) ..	68
Council Minutes	69
Book Reviews	71
U.N. Conference on Energy Sources	75

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

EDITORIAL SERVICES LIMITED

20 Binham Street, Telephone 51-416.

C.P.O. Box 2721 Wellington, N.Z.

United Kingdom Advertising Representative

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

Edited by N. T. CLARE

109 Cambridge Road, Hamilton, N.Z.

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

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

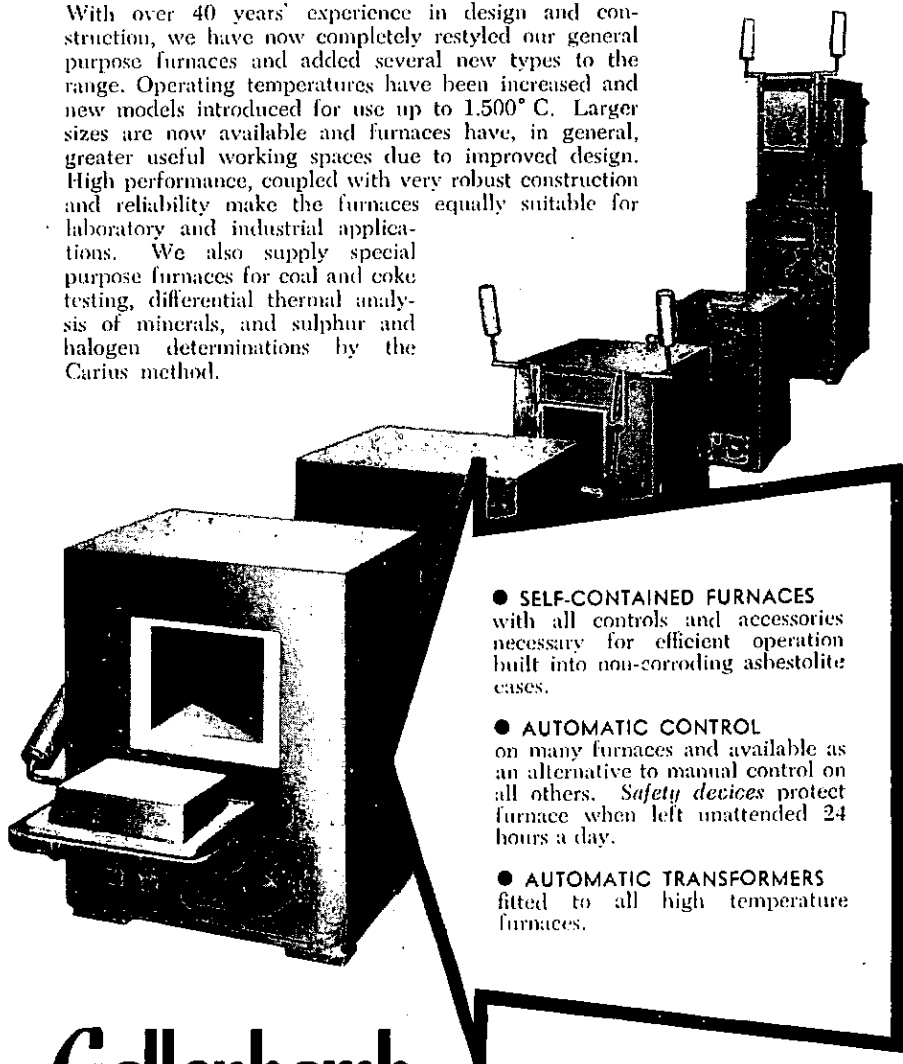
Employment Officer

J. L. Mandeno, 1 Pine Tce., Wellington.

MAKERS OF FINE FURNACES

Gallenkamp INTRODUCE A NEW RANGE OF 33 MODELS

With over 40 years' experience in design and construction, we have now completely restyled our general purpose furnaces and added several new types to the range. Operating temperatures have been increased and new models introduced for use up to 1,500° C. Larger sizes are now available and furnaces have, in general, greater useful working spaces due to improved design. High performance, coupled with very robust construction and reliability make the furnaces equally suitable for laboratory and industrial applications. We also supply special purpose furnaces for coal and coke testing, differential thermal analysis of minerals, and sulphur and halogen determinations by the Carius method.



● **SELF-CONTAINED FURNACES**
with all controls and accessories necessary for efficient operation built into non-corroding asbestolite cases.

● **AUTOMATIC CONTROL**
on many furnaces and available as an alternative to manual control on all others. *Safety devices* protect furnace when left unattended 24 hours a day.

● **AUTOMATIC TRANSFORMERS**
fitted to all high temperature furnaces.

Gallenkamp

SUPPLY THE WORLD'S LABORATORIES

A. GALLENKAMP & CO. LTD.,

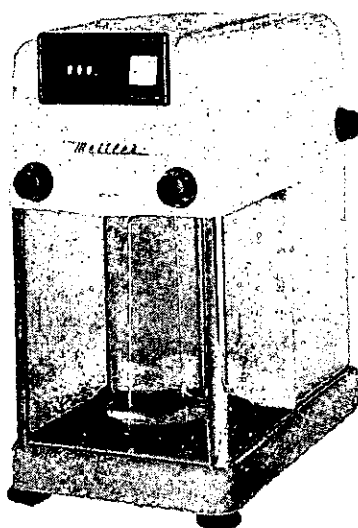
Technical House, Sun Street, London, E.C.2. Telephone: B1Shopsgate 0651.

APPOINTED AGENTS FOR NEW ZEALAND

GEO. W. WILTON & CO. LTD.,

63 Shortland St., Auckland, C.I.

156 Willis Street, Wellington.



METTLER MULTI - PURPOSE BALANCE

Capacity 160 gms.

Optical Scale
1200 mgm.

DELIVERY FROM
N.Z. STOCK

ASK FOR CATALOGUES ON FULL
RANGE OF METTLER BALANCES.

★ ANALYTICAL TYPES

B5 B6 M5 H15 H16

★ MULTI PURPOSE H3 H4 H5

★ PRECISION K4 K5 K7 or with
built-in Taring Device.

K4T K5T K7T

For all your laboratory requirements

CONTACT

WATSON VICTOR
LIMITED
(INCORPORATED IN NEW SOUTH WALES)

AUCKLAND

CHRISTCHURCH

WELLINGTON

DUNEDIN

Established over 70 years

065/E

Three decisive points:

- Purposeful Research
- Careful Manufacture
- Conscientious Control

are the principles forming the reputation of our products.

Guaranteed reagents *Merck*

are internationally recognized as the guarantee certificate on any package demonstrates their purity and reliability

From our sales range:

Preparations for laboratory use
 Indicators of all types
 Universal- and Special-Indicator-Papers
 Ion exchangers for analytical purposes
 Preparations for chromatography
 Spot reagents
 Titrants*
 Titriplexes*

Representatives in New Zealand:

Messrs. Henry H. York & Co. Pty. Ltd.
 11-13, Ghuznee Street, C. P. O. Box 6434
 Wellington/New Zealand

Also at Auckland and Christchurch.

E. MERCK AG



DARMSTADT

JOURNAL OF THE NEW ZEALAND INSTITUTE OF CHEMISTRY

Vol. 25, No. 2

APRIL, 1961

OF CONFERENCES

An historical note on chemistry conferences in New Zealand and preliminary information on the 1961 Conferences direct thought to the function and form of our annual Conference. The essential feature of a Conference is a bringing together of persons for the discussion of some common interest—that opinions regarding that interest may differ widely usually enhances the value of the discussion and stresses the need for it. Dr Moir's article emphasizes a long co-operation between two organizations of chemists in New Zealand, during which the younger far outgrew its foster parent. That the Conference is now solely an N.Z.I.C. affair has involved in effect mainly the dropping of the adjective "combined", for the bulk of the organization had fallen on the N.Z.I.C. for a number of years. The 1958 *List of Members* shows only 19 R.I.C. members who are not also N.Z.I.C. members and the majority of these 19 rarely attended. It is Council policy that these members be invited to attend the Conference and that provision be made for the R.I.C. Annual Meeting. It is also policy that the President of the N.Z. Section of the R.I.C. be invited to present the Easterfield Medal, and the recipient to deliver his lecture, at the Conference (*Journal*, October 1960, page 189). The actual procedure by which the Combined Conference was abolished by the Council was not without some unintended discourtesy to the N.Z. Section of the R.I.C. and Dr Moir's gently implied rebuke is merited. His article serves to remind us that in moving forward it is well to mark where we came from.

When Bacon wrote "conference maketh a ready man" he no doubt referred to the sharpening of the art of rapid and accurate thought and expression arising from the habit of general discourse and disputation. The phrase applies equally to "conference" in the present context, for our Conferences provide for younger members training not only in the assembly and oral presentation of scientific information but also in justifying their methods and conclusions in discussion. It is perhaps because a consciousness of inexperience impels them to more careful preparation that younger speakers often acquit themselves better than older members who have become careless, particularly in the timing of their papers. Conference chairmen should have no qualms at holding experienced members to their allotted time. The speaker who grossly exceeds

his time is guilty of discourtesy to his audience by the assumption that they are happy to hear so much of him; of injury to other speakers whose time he steals; and of insult to Conference officials by implying that he knows better than they how to organize the programme. A similar rounded period could be declaimed against that other Conference pest, the exhibitor of illegible slides.

One defect of New Zealand conferences in chemistry is that in any specialized branch of the subject there are usually comparatively few workers sufficiently well versed to discuss the more detailed aspects of the material presented. This has led to a tameness about many of our sessions. Members could rectify this by a little more homework on the abstracts normally circulated before the Conference. Not infrequently a paper on which there has been little discussion is the subject of comment in informal gatherings later. This type of discussion is a valuable feature of Conferences, but often both author and audience would have profited if the issues had been raised in open session. It is no function of a Conference to pillory a speaker, but if his facts are wrong or his conclusions questionable there are acceptable ways of telling him so.

The paucity of specialists in many fields is nevertheless a further justification for our holding Conferences. The informal congregation of chemists often reveals common interests and provides opportunity for the few workers in a field to exchange ideas on subjects not on the formal agenda.

The organization of an Institute Conference is delegated by the Council to a Branch and by the Branch to a committee of hard-working individuals. The style and duration of the Conference is left entirely to that committee. In fact, a fairly standard pattern of conference has emerged over the years. One departure from this pattern which has been suggested but not tried is the arrangement of part of the programme as a "school" giving an intensive course on a technique or specialized field. There are many subjects, particularly in the analytical field, which could interest a large group of members and, given experienced tutors with facilities for practical demonstrations, such a school could be of direct benefit to members in application to their work.

The general outlines of this year's Conference have now been settled by the Committee. Those who read Dr Moir's contribution in this issue of the *Journal* will at least come to Auckland with a better appreciation of the tradition behind Chemistry Conferences in New Zealand.

MITOCHONDRIA : POWER PLANTS OF THE CELL

G. W. BUTLER

Plant Chemistry Division, D.S.I.R., Palmerston North.

(Based on the Chairman's Address delivered to the Manawatu Branch, 1960.)

It is readily apparent to any student of science that some subjects of research receive a marked impetus by becoming "fashionable". The stimulus is provided by a new concept or a new technique, which is adopted by most research workers in the field and which leads to a sudden dramatic increase in our knowledge of the particular subject. One such recent fashion in biochemistry has been the study of mitochondrial metabolism. For several years this subject could be said to be the central research topic in biochemistry. During the last five years its place has been taken by the study of the relationship between protein synthesis and nucleic acid metabolism, but steady progress has been continued. This review surveys the present knowledge on mitochondrial metabolism.

STRUCTURE

The term mitochondria is derived from the Greek words for "thread" and "grain", and has been used for many years by cytologists to designate a characteristic granule observable with the microscope within cells, and resembling bacteria in size and shape. The range of dimensions given by Palade for mitochondria is 0.2 to 0.5 μ by 0.3 to 5 μ . This is to be compared with the range 0.2 to 2 μ by 0.3 to 5 μ embracing the cells of most bacteria. The morphological form of mitochondria *in vivo* is not stable, the particles are continually changing their shape and positions within cells, and there are various specialized structural features of mitochondria from different tissues. Classically, they could be distinguished from other subcellular structures by their staining characteristics, particularly with the dye Janus Green B. With the electron microscope, using appropriate fixation, embedding and ultra-thin sectioning techniques, Palade, Sjöstrand and their co-workers have been able to demonstrate that mitochondria possess an internal structure specific for these granules.

Figure 1 shows schematic drawings of mitochondria according to Sjöstrand. The mitochondrion in fixed tissue is enclosed by the mitochondrial membrane, which consists of two, usually parallel

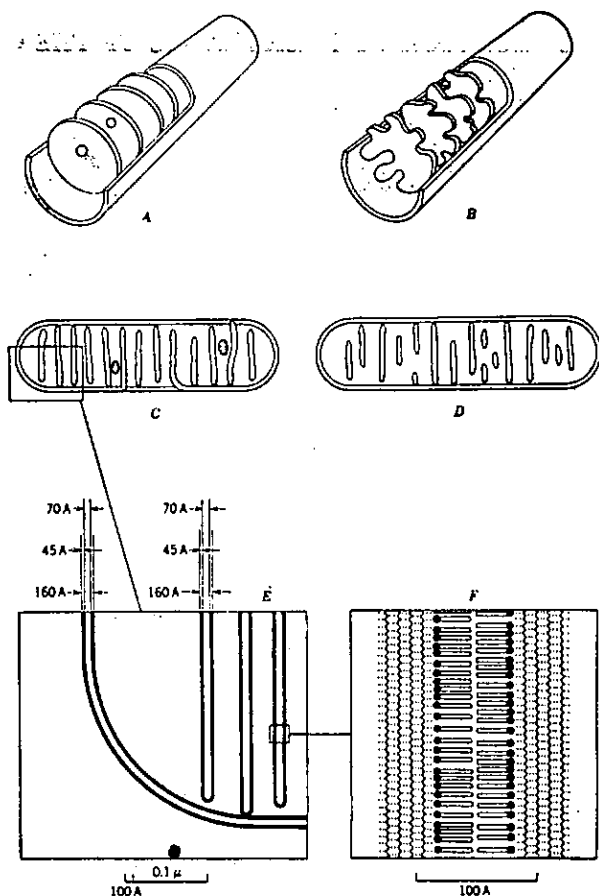


Fig. 1: Schematic drawing of mitochondria.

electron-dense layers, each *ca.* 40-60 Angstrom units in thickness, and separated by a less electron-dense space *ca.* 60-90 Angstrom units wide. The outer of the two layers surrounds the mitochondrion as a limiting membrane. The inner layer is continuous with an internal membrane system, composed of the *cristae mitochondriales* which project into the body of the mitochondrion. In plant mitochondria the cristae are less well developed than in animal mitochondria and tend to have a more random orientation. When sectioned, cristae show a structure similar to the mitochondrial membrane, with two parallel electron-dense layers which are continuous with the inner layer of the mitochondrial

membrane. This basic structure is remarkably constant—the *cristae mitochondriales* are accepted as the basis for the identification of mitochondria under the electron microscope. An example is shown in Fig. 2.



Fig. 2: Rat liver cell mitochondrion, $\times 235,000$.

ISOLATION

Isolation of mitochondria is readily accomplished from most tissues by mechanical disruption of the tissue followed by differential centrifugation of the various particulate fractions. The state of integrity of the isolated mitochondria is greatly dependent on the nature of the isolating medium. Thus, in distilled water, mitochondria swell to large size and lose most of their soluble protein while in saline solutions extensive aggregation occurs, with the result that a large proportion of the mitochondria is lost in sedimenting the nuclei and the remaining mitochondria become contaminated by agglutinated microsomes. Furthermore, the isolated mitochondria cannot be stained with vital stains. The most satisfactory isolation media have proved to be non-electrolytic, such as 0.8M sucrose, and it was the development of such an isolation procedure by Hogeboom, Schneider and Palade (1948) which opened the way to studies of mitochondrial metabolism. Allowance must always be made for contamination or adsorption during isolation. In Fig. 3 are shown mitochondria isolated in sucrose (top section) and distilled water (bottom section).

In some studies of the enzymic activities of mitochondria it has been found advantageous to break down the structure of the mitochondria, the main object being to remove permeability barriers to various substrates. This can be done by freezing and thawing and by sonic vibrations, the latter procedure producing submitochondrial fragments.

FUNCTIONS

Mitochondria are almost completely self-contained units capable of carrying out both respiration and phosphorylation. In the words of Albert Lehninger, who has contributed much to our knowledge in this field, "it is necessary only to supplement a suspension of mitochondria with a substrate such as pyruvate, a trace amount of a 4-carbon catalyst such as fumarate or oxalacetate as fuel to the tricarboxylic acid cycle, inorganic phosphate, ADP, and also Mg^{++} ions, which help to preserve mitochondrial structure. All of the necessary coenzymes and other cofactors are contained in the mitochondrial structure in such an organized manner that the complex cycle oxidations are smooth and complete with no obvious or conspicuous bottlenecks, indicating the high degree of enzymatic and morphological organization in the mitochondria."

"The results of many investigations suggest that most of the substrate-level enzymes of the Krebs tricarboxylic acid cycle and

the fatty acid oxidation cycle are present in the lumen or in the intercrystal space. On the other hand, it has been a universal finding that the enzymes involved in electron transport and coupled



Fig. 3: Isolated mitochondria in sucrose (top section) and distilled water (bottom section).

oxidative phosphorylation are present entirely in the insoluble membranes of the mitochondria in organized 'solid-state' systems; the separate enzymes of this system are not dissociated easily in truly soluble form." This is the point of greatest significance about mitochondrial metabolism and we shall now consider what is known about the mechanisms of electron transport and coupled oxidative phosphorylation in mitochondrial membranes.

Electron-transport Mechanism

Keilin and Hartree fathered our present concepts of the electron transport system in a series of investigations beginning in the late 1920's. They recognized spectrophotometrically three heme-containing proteins, named cytochromes a, b, and c, which were widely distributed in nature and which underwent a cycle of reduction and oxidation. According to Keilin, the ferric forms of the cytochromes were reduced by various dehydrogenase systems whereas the ferro systems were oxidized by molecular oxygen with cytochrome oxidase as the catalyst. It was left somewhat indefinite as to which dehydrogenases were involved in the reduction of the cytochromes, although succinic dehydrogenase was usually at the top of the list. Furthermore, the nature of the functional group of cytochrome oxidase was left in doubt with either a heme group or copper as possible alternatives. Cytochrome c was the only one of the three which could be extracted and isolated as a water-soluble hemoprotein. Later another cytochrome was found to be widely distributed in animal tissues and bacteria; this was designated cytochrome a_3 and has spectral properties which are very similar to cytochrome a.

The reaction sequence of the cytochromes in intact muscle and yeast cells was concluded by Keilin and co-workers, on the basis of the effects of substrates, inhibitors, and partial separation of the components, to be $a_3 \rightarrow a \rightarrow c \rightarrow b$. However, work with particulate fractions at first suggested that cytochrome b was passed by; this uncertainty was resolved by Britton Chance, who in a series of elegant spectrophotometric investigations showed that the respiratory chain of liver mitochondria contained a sequence of six spectroscopically identifiable components: cytochromes a_3 , a, c and b, flavoprotein and DPNH (reduced diphosphopyridine nucleotide). Thus, with β -hydroxybutyrate as substrate and ADP (adenosine diphosphate) as phosphate acceptor, the following first-order velocity constants were found:

Component	First-order velocity constants, sec ⁻¹
a ₃	158
a	120
c	39
b	20
fp	13

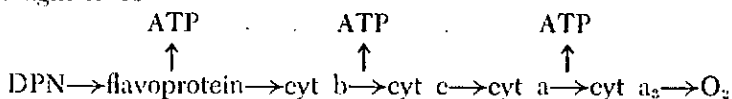
Oxidative Phosphorylation

This term refers to the process whereby the energy released during the passage of a pair of electrons from DPNH to molecular O₂ ($F = ca. 55,000$ cal/mole) through the electron transport chain is largely transferred to ATP through intimate coupling of a phosphorylating mechanism with the respiratory chain. The mechanism involved remains one of the most conspicuous and challenging unsolved problems of contemporary biochemistry.

In earlier experiments, oxidative phosphorylation came to be regarded as an unstable, evanescent phenomenon which occurs only with relatively "mature" and unfractionated extracts or homogenates of tissues. It is often inactivated by procedures which scarcely affect the purely oxidative activity of Krebs's cycle reactions, suggesting that coupled phosphorylation of ADP is not an obligatory accompaniment of oxidation, but may be inactivated or uncoupled. Simple procedures such as freezing and thawing, treatment with detergents, exposure to hypotonic or strongly hypertonic agents all cause uncoupling of the phosphorylation. Also treatment with a variety of chemicals causes uncoupling—2,4 DNP, nitro- and halo-phenols, gramicidin, the anti-coagulant Dicoumarol, and a number of redox dyes.

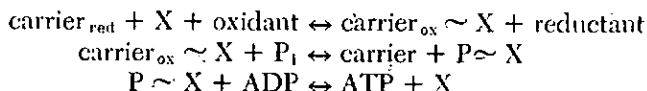
Now the ΔF between DPNH and molecular O₂ is *ca.* $-55,000$ cal/mole. Since formation of one mole of ATP (adenosine triphosphate) from ADP requires 12,000 cal, it is evident that rather more than 4 moles of ATP could theoretically be generated during consumption of 1 mole of oxygen, provided suitable coupling mechanisms existed. In practice, P/O ratios approaching 3.0 have been found—*e.g.*, by Lehninger and co-workers who supplied DPNH to rat-liver mitochondria which had been pretreated in a hypotonic medium to produce sufficient alteration in permeability of the mitochondrial membrane to admit the DPNH to oxidative centres within the mitochondria. Thus oxidative phosphorylation occurs along the respiratory chain, presumably in three stages. Using cytochrome c as electron donor or acceptor, Lehninger showed that the passage of electrons from reduced DPN to cytochrome c caused the formation of two moles of ATP, and

that the passage of a pair of electrons from cytochrome *c* to oxygen yields a single phosphorylation. Chance confirmed these gross locations from spectroscopic studies in which the changes in the steady state of the components of the respiratory chain were determined after the initiation of oxidative phosphorylation by the addition of ADP. Thus the location of the phosphorylation sites is thought to be



Our knowledge of the mechanism of oxidative phosphorylation is very largely due to the work of Lehninger and his co-workers. This group made a significant technical advance in 1955 when, by treatment of mitochondria prepared by the sucrose method with 1% digitonin solution in the cold, they were able to prepare fragments in which the activity of the electron transport chain and associated phosphorylation mechanisms were largely preserved, but where there was complete loss of Krebs cycle and fatty acid cycle activity. Digitonin has been successfully employed in several systems for dissociating lipoprotein structures and is believed to exert its dispersing effect through its ability to react with certain sterols to form digitonides. The "digitonin fragments" are thus believed to be fragments of the mitochondrial membrane.

The hypothesis on which their work is based is the following:

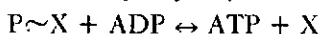


In this scheme, the substance *X* is the vehicle of energy coupling and forms a high-energy compound with the carrier during the transfer of electrons from the reduced carrier to the next in the chain (designated as "oxidant"). $\text{Carrier}_{\text{ox}} \sim \text{X}$ then undergoes phosphorylation to form $\text{P} \sim \text{X}$, which in turn donates its phosphate to ADP.

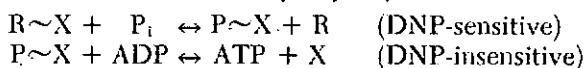
Lehninger's group have started with ATP and attempted to work back through the partial reactions to the carrier level. Using "digitonin particles", they observed two different isotope exchange reactions of ATP which occur in the absence of electron transfers. The first is the ATP- P_i^{32} exchange, in which labelled P_i^{32} is rapidly incorporated into the terminal phosphate group of ATP. The second is the so-called ATP-ADP exchange, in which P^{32} or C^{14} -labelled ADP is incorporated bodily into ATP. Both of these

reactions are completely inhibited by the classical uncoupling agent DNP, indicating their relationship to oxidative phosphorylation and distinguishing them from many other similar exchange reactions which have nothing to do with oxidative phosphorylation.

Close study of the interrelationship of these exchange reactions has revealed that the ADP-ATP exchange reaction is in reality the terminal reaction of oxidative phosphorylation



and is in itself an intermediate in the ATP- P_i exchange. Since phosphate is not involved in the ADP exchange, but ADP is an obligatory component of the P_i exchange, the sequence of the two terminal reactions of oxidative phosphorylation is established as



where R may be an electron-carrier molecule. Wadkins and Lehninger (1958) have reported that a soluble enzyme preparation has been prepared from acetone-dried "digitonin fragments" which catalyses the ATP-ADP exchange.

Very recently, still a third exchange reaction which is very closely associated with the process of oxidative phosphorylation has been demonstrated in "digitonin fragments" by Chan, Lehninger and Enns (1960). This is an exchange between the oxygen atoms of inorganic phosphate and those of water. In an ATP-activated system P_i - H_2O^{18} exchange is about nine times as fast as ATP- P_i^{32} exchange; in a respiration-activated system as many as 30 moles of O^{18} may be exchanged per pair of electron equivalents traversing the chain. This exchange is interpreted as occurring per medium of a high-energy intermediate which is unstable and cannot be accumulated.

ULTIMATE MEMBRANE STRUCTURE

Turning again to the question of mitochondrial structure, some attempts have been made to visualize the molecular architecture of the membranes as a result of the work with membrane fragments. The membranes are rich in lipid (30-40%), which is mostly phospholipid. Chance showed that, with intact mitochondria, the various electron carriers which can be detected spectrophotometrically occur in approximately equimolar ratios, and this also has found to be true of the phosphorylating subfragments (Devlin, 1958). This suggests that each respiratory "assembly"

consists of the six (or more) carrier molecules arranged in contiguous manner. These would be supplemented at three points by sets of 2 to 3 (or more) auxiliary enzymes necessary for the postulated coupling mechanism. This is shown schematically in Fig. 4.

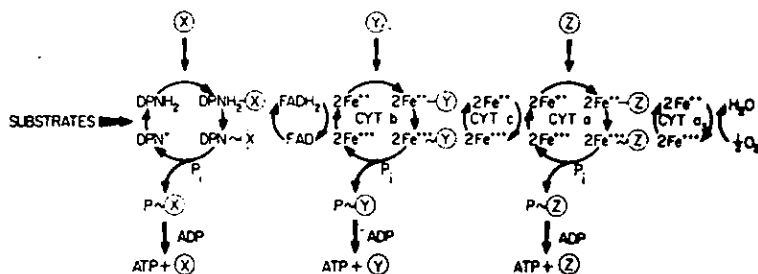


Fig. 4: Respiratory phosphorylating assembly.

With regard to the distribution of such respiratory assemblies along the membranes, it was found that, when phosphorylating membrane fragments were separated into a wide spectrum of particle sizes by differential centrifugation, the ratio of the respiratory carriers to total protein was constant regardless of the size of the particle. The ratio of the respiratory carriers to each other was relatively constant also. Evidently the respiratory carriers are distributed fairly evenly along the membranes, and fragmentation of the membrane produces pieces of different size made up of multiples of a basically recurring unit (Fig. 5).

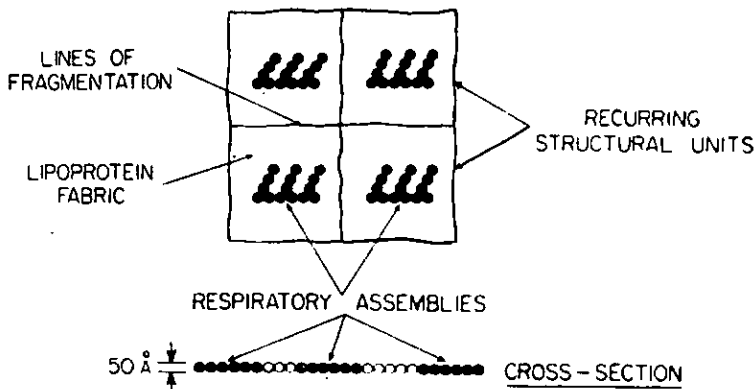


Fig. 5: Fragmentation of respiratory assemblies.

PERMEABILITY OF MITOCHONDRIAL MEMBRANE

The mitochondrial membrane is also a structure capable of characteristic and selective permeability and active-transport phenomena. By optical measurements of either turbidity or light scattering by mitochondrial suspensions, it has been shown that the permeability may be altered by the ambient concentrations of ADP, Mg^{++} , sulphhydryl reagents and inorganic phosphate. Minute concentrations of thyroxine alter the permeability very drastically with rapid swelling and increased permeability to sucrose and other small molecules. It is interesting that quite a number of hepatotoxic substances appear to have a similar effect on mitochondrial membranes causing swelling and losses of essential cofactors such as pyridine nucleotides from the mitochondria, and an inorganic complex *dl*-Tris—1:10 phenanthroline ruthenium⁽¹¹⁾ perchlorate, has the same effect apparently solely by virtue of electrostatic charge effects.

Packer (1960) has recently described experiments bearing on the way ADP regulates mitochondrial size. For example, in an experiment with heart mitochondria endogenous substrate was allowed to disappear first, this being indicated by a slow rate of respiration (0.03 μM per sec). Then an oxidizable substrate, β -hydroxybutyrate, was added; respiration was increased sevenfold and the steady-state reduction of cytochrome b was increased. In this condition (ADP low, substrate high, respiration low) the mitochondria swelled to a steady-state level. Then the phosphate acceptor ADP was added, electron transport was increased fourfold and this was accompanied by an oxidation of cytochrome b. In this condition (ADP high, substrate high, respiration fast) oxidative phosphorylation occurred (P/O 2.8) and there was complete reversal of swelling induced by the prior addition of substrate. Then when the small amount of ADP added was phosphorylated to ATP, respiration declined fourfold, cytochrome b was reduced and swelling again occurred. Multiple additions of small amounts of ADP caused a repetition of these changes. Mitochondria from a number of different tissues all showed this type of behaviour. Thus metabolic states which increase the intra-mitochondrial ADP concentration all favour shrinking (ADP addition, exhaustion of substrates, anaerobiosis, inhibition of electron transport and uncoupling agents). In Packer's words "one way in which mitochondria may be envisaged to exert a control of metabolic reactions in cells is by reversible changes in

size. The transport of metabolites between extra- and inter-mitochondrial systems will be regulated by chemical and physical changes in mitochondrial volume and surface". An important point to notice is that the number of water molecules extruded from mitochondria is out of all proportion to the number of molecules of ADP formed or utilized.

These studies were then extended to mitochondrial membrane fragments and it was found that the maximum increased light scattering was dependent on electron transport coupled to oxidative phosphorylation.

It would thus appear that there is a structural change closely associated with the phosphorylating-respiratory enzyme assembly and this is probably the origin of the energy-linked volume changes of intact mitochondria.

With regard to active transport, intact mitochondria are capable of accumulating ions such as K^+ , Na^+ , H^+ and phosphate when oxidation and phosphorylation takes place. Thus it is of interest that Lehninger's group have shown that "digitonin fragments" contain a considerable amount of bound K^+ , approximately 100-400 $m\mu$ mole/mg of N. It is found that the bound K^+ is retained by the fragments only if they are oxidatively phosphorylating, and using K^{42} as a tracer it has been shown that the binding of K^+ is inhibited by DNP and cyanide in the same way as oxidative phosphorylation and respiration. These preparations have very little capacity for binding sodium, so that the active binding mechanism appears to be very selective.

The permeability of the mitochondrial membrane to pyridine nucleotides has been studied by a number of workers; there is some evidence that the mitochondrial membrane *in vivo* is impermeable to *reduced* pyridine nucleotide. That there is compartmentalization of pyridine nucleotides within cells was shown recently in an elegant manner by Chance and Thorell (1959). They applied the technique of microfluorometry to single grasshopper spermatids and were able to measure separately the fluorescence of the cytoplasm and of the *nebenkern* (which are mitochondrial aggregates) in these cells. Using an exciting wavelength of 366 $m\mu$ they obtained a fluorescence which could be demonstrated to be due to the reduced pyridine nucleotides. With the grasshopper spermatid in anaerobiosis the fluorescence of the *nebenkern* was much greater than the fluorescence of the cytoplasm; in aerobiosis the fluorescence of the *nebenkern* is small compared with that of the cytoplasm. While an aerobic-anaerobic

transition has a large effect on the reduced pyridine nucleotide content of the mitochondria, it has no measurable effect on the cytoplasm, suggesting that there is separation of the two pools of pyridine nucleotides *in vivo*.

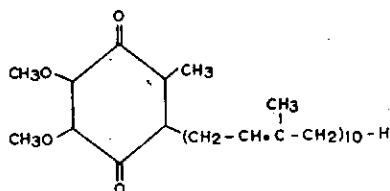
Incidentally, there appear to be some interesting differences in the DPN and TPN content of mitochondria from different tissues. Thus mitochondria from insect flight muscle, which should be highly specialized for oxidative energy generation, do not contain TPN; in contrast, liver mitochondria, which probably participate in the highly active synthetic processes of the liver, have a high TPN content. The TPN-TPNH system is envisaged to be a "high pressure line" of hydrogen functionally connected to numerous biosynthetic pathways.

OTHER POSSIBLE CONSTITUENTS OF THE ELECTRON TRANSPORT AND PHOSPHORYLATIVE SEQUENCES

There has been considerable investigation during the last few years of the possibility that vitamin A, vitamin K and ubiquinone (or coenzyme Q) participate in electron transport or oxidative phosphorylation. These compounds all have a quinone part and a polyisoprenoid chain.

It appears fairly definite that vitamin K has a role in oxidative phosphorylation: thus a specific requirement of vitamin K for oxidative phosphorylation has been developed by ultra-violet irradiation of various preparations. On the other hand, there is no good evidence for the direct participation of vitamin E in these processes. It may be acting as an antioxidant in preventing peroxidation of lipids essential for electron transport function.

Ubiquinone was first discovered by Morton (1958) in micro-organisms and later reported by Crane, working in Green's laboratory, to be present in beef heart mitochondria. Mammalian ubiquinone has the formula



and homologues varying in the length of the isoprenoid chain occur in various micro-organisms. In mitochondria it occurs at about the same concentration as DPN. Green's group have some

evidence that in succinate oxidation ubiquinone forms the link between succinic dehydrogenase flavoprotein and cytochrome c , since cytochrome b is not thought (by them) to function in this electron chain.

Green's group were the first to draw attention to the relatively high copper and non-heme iron content of preparations of mitochondrial fragments. No functional significance for these has been discovered.

CONCLUSION

The studies of the metabolism of mitochondria and mitochondrial fragments which have been described are of significance from the following points of view:

(1) The mechanisms of electron transport and oxidative phosphorylation are obviously important basic biochemical issues.

(2) These studies are among the most penetrating yet made in the field of "solid-state enzymology", to use Lehninger's phrase. Many questions remain to be answered. Do ordinary mass-law and ideal-collision considerations govern the behaviour of protein molecules in such a "solid-state" array? What is the mechanism of electron transfer?

(3) Our understanding of the mode of operation of biological membranes generally will doubtless benefit greatly from further elucidation of the mechanisms involved in these mitochondrial systems.

REFERENCES

- CHANCE, B., and THORELL, B. (1959): *J. biol. Chem.*, 234 : 3044.
CHAN, P. O., LEHNINGER, A. L., and ENNS, T. (1960): *Ibid.*, 235 : 1790.
DEVLIN, T. M. (1959): *Ibid.*, 234 : 962.
HOGEBOOM, G. H., SCHNEIDER, W. C., and PALADE, G. E. (1948): *Ibid.*, 172 : 619.
LEHNINGER, A. L. (1959): *Rev. Mod. Phys.*, 31 : 136.
MORTON, R. A. (1958): *Nature*, 182 : 1764.
PACKER, L. (1960): *J. biol. Chem.*, 235 : 242.
PACKER, L., and TAPPEL, A. L. (1960): *Ibid.*, 235 : 525.

THE ANNUAL CHEMISTRY CONFERENCE

G. M. MOIR

During conversations at the Combined Conference at Dunedin in August 1959, with Dr L. H. Briggs, then President of the New Zealand Institute of Chemistry, Dr G. M. Moir, who was then Chairman of the New Zealand Section of the Royal Institute of Chemistry, put forward the idea that a brief historical record of the development of the Chemistry Conference should be published. Here is the result of his researches.

The Chemistry Conference has come to be regarded as an event which takes place every year but that was not always so. Before many of the important details of early associated events are forgotten, it is opportune to set down a brief outline of how the Annual Conference began.

In January 1926, at the time of the Dunedin Exhibition, a Science Congress was organized under the auspices of the New Zealand Institute (now the Royal Society of N.Z.). Although not specifically a chemistry conference, that was the first time the present writer heard a short series of chemistry papers being delivered. The opportunity was taken to hold an informal gathering of chemists in the library of the Otago University Chemistry Department. On that occasion Professor J. K. H. Inglis introduced Professor T. H. Easterfield, who outlined the preliminary enquiries which were being made about forming a New Zealand Section of the Institute of Chemistry of Great Britain. It was explained that A. M. Wright of Christchurch had been prominently associated with T. A. Glendining of Wellington and W. R. Mummery of Wanganui in taking the initiative.

The Section was formed at a meeting in Wellington on November 2, 1926, attended by Professors T. H. Easterfield and J. K. H. Inglis, and Messrs. T. A. Glendining, B. C. Aston, H. W. Lawrence, W. R. Mummery, J. Sword, W. H. Udy and A. M. Wright. Letters of support were received from R. M. Bruce, C. L. Carter, J. Chilwell, R. Gardner, G. M. Moir, R. O. Page, N. Ratcliffe, T. Rigg. The first chairman was Professor Easterfield and secretary W. R. Mummery.

A one-day Conference of Chemists in Wellington on January 27, 1928, was organized on the occasion of the First Annual Meeting of the new Section. Discussions took place upon several

matters of interest, particularly Registration controlled by Act of Parliament, which was the subject of an address by Mr A. M. Wright. The Conference concluded with a dinner at the Hotel Cecil at which guests were the Mayor of Wellington and representatives of the Press.

The Second Chemistry Conference organized by the New Zealand Section was held in Auckland on January 23, 1929, a date chosen to coincide with a Science Congress organized by the New Zealand Institute (now the Royal Society of N.Z.). The Chairman's address was delivered by Professor T. H. Easterfield, who took as his subject, "The Future Training of a Chemist". In addition to other subjects, there was a joint discussion with the Auckland Chemical Society on the subject of legislative Registration, which was then receiving much attention in Britain.

The Third Conference took place in Christchurch on January 31, and February 1, 1930. This was the first occasion when the Conference occupied two days. Professor T. H. Easterfield delivered the Chairman's address on the subject of "Chemical Knowledge in Modern Business". Visits were paid to Lincoln Agricultural College, the Wheat Research Institute and the Christchurch Gas Works. At the Annual Meeting Professor J. K. H. Inglis was elected Chairman. Among the business the following resolution was passed: "That in future a Registration Fee of 5/- to form a Conference Fund, be charged to Members attending the Annual Conference".

The Fourth Annual Conference was held at the Cawthron Institute, Nelson, on January 28 and 29, 1931. During the Annual Meeting the Chairman, Professor J. K. H. Inglis, delivered the Annual Address upon "The Value of a Chemical Training". Visits were paid to commercial factories and to the field experimental plots of the Cawthron Institute. It was at this Conference that a discussion took place on the formation of a New Zealand Institute of Chemistry and the following resolution was passed: "That this meeting approves of the objects of the New Zealand Institute of Chemistry, is sympathetic towards the formation of this new body and trusts that the high standard of qualification suggested will be insisted upon".

The Fifth Annual Meeting of the Section was held in Wellington on November 3, 1931, when the Annual Address was delivered by the Chairman, Professor J. K. H. Inglis, who took as his subject "Recent Chemical Work on New Zealand Plants".

A resolution was passed that it be an instruction to the Com-

mittee to maintain to the fullest extent the policy of co-operation with the New Zealand Institute of Chemistry on all matters concerning the welfare of chemistry.

There is no record in the minutes of a conference in 1932, but a general meeting of the Section coincided with the Fifth Annual Conference which was held at Massey Agricultural College, Palmerston North, on January 26 and 27, 1933. The Annual Address was delivered by the Chairman, Mr W. Donovan, whose subject was "Chemistry as Applied to the Mining Industry in New Zealand". The following day was devoted to a number of short papers and visits to places of technical interest.

The Seventh Annual General Meeting of the New Zealand Section coincided with the Sixth Annual Conference which was held at Victoria University College, Wellington, on January 25 and 26, 1934. The Chairman, Mr W. Donovan, delivered the Annual Address, his subject being "The Production of Motor Fuel and Lubricants in New Zealand". The following day a series of five short papers were given. The minutes of a committee meeting held on September 27, 1934, record that the secretary should circularize members to ask whether they would prefer Hamilton or Christchurch for a Conference to be held about January 26, 1935. It was also agreed that: "This Conference to be held if possible as a combined affair with the New Zealand Institute of Chemistry".

The minutes of a committee meeting on November 8, 1934, state: "The New Zealand Institute of Chemistry wrote accepting the proposal for a joint conference. It was considered that all the arrangements should be made by an Auckland Joint Committee; Mr F. H. V. Fielder to be appointed representative of the N.Z. Section on the Joint Committee".

This was the Seventh Annual Conference of the N.Z. Section, and the first combined Conference with the N.Z. Institute of Chemistry, and was in fact the first Annual Conference of the N.Z. Institute of Chemistry. It was held at the Hamilton High School on January 24 and 25, 1935. The Annual Address was delivered by the Chairman, Mr G. A. Lawrence, who discussed "The Part Played by the Chemist in Developing the Frozen Meat Trade". Eight short papers were delivered and visits were made to several industrial establishments.

Conference since that date has been a combined effort, and apart from the war years has been held annually. After the war,

when Joint Conferences were resumed; there was usually an address by the Chairman of the New Zealand Section of the R.I.C. as well as one by the President of the New Zealand Institute of Chemistry. This was felt to be a duplication and was among matters discussed by a special Combined Committee of representatives of both Institutes. This Committee met on July 21, 1951, and arrangements were made to avoid duplication of the Annual Address. It was agreed to continue the Combined Conferences as in the past. It was also agreed that combined committees of both Institutes in New Zealand should consider very carefully matters relating to joint policy in order to avoid duplication of effort or overlapping of the work of the two Institutes.

The Council of the New Zealand Institute resolved in November, 1958, to discontinue the status of Joint Conferences which had up till then operated, and that in future the Conference should be run entirely by the N.Z. Institute. This decision was communicated to the Secretary of the New Zealand Section of the Royal Institute of Chemistry some months later.

In addition to co-operation with the New Zealand Institute of Chemistry in arranging Joint Conferences at different places in successive years, the New Zealand Section has co-operated in a variety of other ways, particularly in assisting with funds for publications and various other purposes. Among the most notable instances of co-operation has been the arrangement which was negotiated for the award of the Easterfield Medal and the delivery of an address to Conference by the recipient. The award is sponsored by the Council of the Royal Institute of Chemistry in London, and the Selection Committee consists of the Chairman of the New Zealand Section and the President of the New Zealand Institute and co-opted advisers.

So, after a long and happy association of the two Institutes, there will no longer be a Combined Conference but we trust that co-operation will still continue in the furtherance of the interests of chemistry in New Zealand.

In retrospect, it is pleasant to think that the first Chemistry Conference which was courageously fathered by the New Zealand Section of the Royal Institute of Chemistry was a forerunner of many successful joint Conferences. Through these, together with the encouraging support that employers are giving to the conferences, the New Zealand Institute of Chemistry has grown to such proportions that it can now take full responsibility for the success of their own Conferences in the future.

EXHIBITION OF NEW ZEALAND MEDICINAL PLANTS

S. G. BROOKER

This exhibition, held in the Auckland Museum in conjunction with the Annual Meeting of the British Medical Association, attracted a great deal of interest. It was opened on February 8 by Sir Douglas Robb, an Auckland and the incoming President of the Association.

On display were over a hundred plants known or reputed to have been used by the Maoris or early settlers for medicinal purposes, with an account of these uses. Of particular interest to chemists were the accounts of what is known of the chemistry of the plants, together with three-dimensional models of a number of compounds of known structure which have been isolated from them. These models were prepared specially for the exhibition by Dr B. F. Cain, a chemist working with the British Empire Cancer Research Unit in Auckland, and Dr R. C. Cambie of the Organic Chemistry Department of the University of Auckland, both of whom have made significant contributions to the chemistry of New Zealand plants.

While there are quite a number of species involved and a large volume of references to their use in unofficial medicine, indications of true medical value are meagre. The koromiko (*Hebe salicifolia*) is the only plant which has found its way into the official literature of pharmacy, being included in the Extra Pharmacopoeia of 1895 as a remedy for dysentery, but it has been deleted from subsequent editions.

In a second category are plants which have been used for the same purpose as related species overseas. As an example, the nikau (*Rhopalostylis sapida*, formerly known as *Areca sapida*) is closely related to the areca nut which has some influence in muscle contraction and it is interesting to note that the pith of the nikau was eaten by Maori women to relax the pelvic muscles in childbirth. Incidentally, the active principle of the areca nut is arecoline which, in the form of its hydrochloride, is used for dosing dogs in the hydatids campaign, so that it is not impossible that the native plant could be used in the present emergency. The tutu (*Coriaria arborea*) was used for a variety of complaints and *Coriaria* species have also been used by the natives of Mexico and of Chile. *Geranium molle*, probably an introduced species, was used by the

natives as an antiseptic, which can be related to the discovery of antibiotic effects in seven species of *Geranium* by Indian workers.

A few compounds of therapeutic value have been found by organic chemists. Podocarpic acid occurring in kahikatea (*Podocarpus dacrydioides*) has estrogenic activity, while pukateine, an alkaloid of the bark of the pukatea (*Laurelia novaezealandiae*) has the analgesic properties of morphine but without its after-effects. The ngaio (*Myoporum lactum*) contains ngaione, a furfural derivative, and could be expected to have bactericidal and fungicidal powers of the latter compound. There is some reason to believe this to be true as the bark has been stated by Rev. Richard Taylor, a pioneer missionary in the Wanganui area, to heal ulcers and eruptions. The fern *Asplenium lamprophyllum* contains oil of wintergreen, but was not used medicinally by the natives. β -Sitosterol, which is a component of drugs used to lower blood cholesterol levels, has been found in a number of plants—e.g., tawa (*Beilschmiedia tawa*).

The exhibition was interesting in that it linked three disciplines, chemistry, botany and medicine. In addition to the plants on view, the chemical techniques of extraction and chromatography were also on show. It was worth noting that some investigations into the chemistry and pharmacology of plants have been valueless because the species have not been properly identified. A problem in this field is that in some cases we cannot be sure what species a particular Maori name referred to, and as time goes on there will be less and less chance of doing so. The unique nature of the native flora of New Zealand, with 75 per cent. of the flowering plants not found elsewhere, presents a tremendous challenge both to the organic chemist and the pharmacologist. Some screening of plants for antimutagenic activity has been undertaken under the British Empire Cancer Campaign programme but otherwise the surface has hardly been scratched.

In a handbook shortly to be published by the Auckland Institute and Museum an attempt will be made to record all available references to the use of native plants for medicinal purposes by the Maoris and early settlers, as well as giving an account of what is known of the chemistry of the plants involved and some indication of the pharmacology of related overseas species.



MEAT RESEARCH INSTITUTE

New Laboratories at Hamilton

On Saturday, March 4, the new laboratories of the Meat Industry Research Institute at Hamilton were opened by His Excellency the Governor-General, the Viscount Cobham, G.C.M.G., T.D. Among those present at this ceremony were representatives of the meat producing and meat processing industries throughout New Zealand, the Departments of Scientific and Industrial Research and Agriculture, research institutions, and scientific bodies. Australian meat research was represented by Dr J. R. Vickery, Chief of the Division of Food Preservation, C.S.I.R.O. In addition to the Governor-General, other speakers on this occasion were Sir W. W. Mulholland (chairman, M.I.R.I.), the Hon. W. H. Gillespie (Minister of Agriculture), Mr J. D. Ormond (Chairman, Meat Producers' Board) and Mr N. A. Thomson (representative of the freezing companies).

The Meat Research Institute has operated since 1957 in laboratories of the D.S.I.R. in Wellington. The new building in Hamilton is sited near the East Street entrance to the Ruākura Animal Research Station, about 300 yards from the main laboratory block of that Station. The building incorporates a number of interesting features of laboratory design and it is hoped to describe these in a later issue, after they have been subjected to the test of experience.

The building has been designed for the operation of four sections, microbiology, biochemistry, engineering and technical development—integrated under the Director, Mr N. H. Law. In a booklet produced for this occasion the work of the Biochemistry Section is described as follows:

“The Biochemistry Section undertakes research into the chemical and physical nature of meat.

“The structure of meat is basically a fibrous one. Microscopic studies show that the so-called muscle fibres are themselves

built up of still smaller fibrils, the contracting units of muscle. These, in their turn, are composed of spirally-wound protein threads mainly of two proteins, (actin and myosin). It is generally agreed that muscular contraction results from the interaction of these two proteins both with each other and with the smaller molecules in the fluid which surrounds them.

"Work is being carried out on myosin, the major component of the spiral threads. It has been found that this component is itself built up of smaller units. The properties of some of these units and the ways in which they can be separated are being studied here.

"Muscle fibrils have a very characteristic repeating pattern of bands which changes as the muscle contracts. A knowledge of these sequences is of great importance in understanding the mechanism of muscular contraction. A study of the change of patterns with shortening during rigor mortis onset in various muscles of the beef carcass has been carried out in this laboratory. It has been found that the tenderness of meat is closely related to the extent of shortening as shown by the pattern type.

"Studies have been carried out on the chemical processes occurring during the ageing of meat. Meat has long been known to increase in tenderness on so-called "hanging". The meat tenderizers sold commercially are protein-splitting agents of plant origin. It has been suggested that tenderization by hanging is due to the action of similar substances known to be present in the meat itself. These are not free to act in live muscle but might be liberated after death, causing partial digestion of the fibrous proteins of the meat. The application of methods which could detect protein fragments in aged meat has, however, shown that no appreciable splitting of proteins occurs during hanging. Further investigations of meat tenderization during ageing are to be carried out. In particular, a study will be made of the changes known to occur in the solubilities of proteins in meat during ageing.

"A study is being made of various aspects of rigor mortis in meat with particular reference to so-called "thaw rigor" and "heat rigor". This work is related closely to other more basic studies being carried out into processes of muscular contraction and relaxation. A few hours after the death of an animal its muscles stiffen and become inextensible as a result of a very complex and irreversible series of chemical changes. This stiffening (rigor mortis) is still only partly understood, but its chemistry has been clarified considerably in the past few years and it is now

known that factors which affect its rate and degree of onset also have a large influence on the quality of the meat. The shortening which accompanies the onset of rigor mortis in a muscle may be regarded as a slow and irreversible contraction, and the chemical changes accompanying both types of shortening are considered to be the same; consequently the whole field of muscular contraction—biochemistry, physiology, and pathology—are of vital importance to the study of meat quality.

"The connection between shortening in rigor mortis and muscular contraction is clearly seen in the phenomenon of "thaw rigor". If a muscle has been frozen rapidly as soon as possible after the death of the animal, then, on thawing, a massive shortening with release of much "drip" fluid may occur within a few minutes. With the introduction of faster freezing techniques, the possibility of pre-rigor freezing in the lamb industry has been studied. It has been shown that "thaw-shortening" is unlikely to occur, even if the carcass has been frozen largely in a pre-rigor state, since thawing will be slow and shortening will be impeded by the weight of the carcass. However, it is possible that "thaw-shortening" effects may occur in isolated faster-frozen cuts or joints. Further work is planned, and will include a study of the influence of freezing rate on the palatability and tenderness of meat.

"With a view to the better understanding of the mechanism whereby a muscle can undergo repeated cycles of relaxation and contraction, a study has been made of the control mechanism involved. The "relaxation factor" concerned has now been identified, and it is hoped to explain its function in the contraction-relaxation cycle and in the onset of rigor mortis. Since the ability of muscle proteins to retain water alters markedly both during contraction and with rigor onset, this project is closely related to the study of "drip" formation in meat.

"The metabolic reactions which occur in the live animal do not cease suddenly at the moment of death. There is, instead, a gradual running-down of these processes; some cease after a few seconds while others continue for many hours after death. Studies of these reactions are necessary for a full understanding of the biochemical nature of muscle tissue and of the factors affecting meat quality. One such current investigation concerns the re-synthesis of the substance adenosine triphosphate (ATP). It is during the partial breakdown of ATP to phosphate, ammonia, and inosine monophosphate that energy is released for muscular

work in life; the same reaction is believed to induce the physical changes in rigor mortis after death. It has now been established that, in the muscles of the living animal, ATP is re-synthesized, but not by a simple reversal of the breakdown mechanism. Ammonia for the first step of re-synthesis is derived from aspartic acid, while a source of chemical energy is necessary to drive the reaction. The compound so formed is then converted to ATP at the expense of the carbohydrate supplies of the muscle. It is proposed to carry out radioactive tracer studies, using isotopic nitrogen and phosphorus, in future work on this project.

"A survey has been made of the distribution of one of the enzymes (protein catalysts) involved in the breakdown of ATP in the muscles of a number of species. It is hoped to assess further the significance of the chemical reactions by relating enzymic concentration to muscle function."

Following the opening ceremony the 300 guests were shown through the laboratories, where demonstrations of apparatus and procedures were explained by members of the staff. Later, guests attended a reception, in the form of a buffet dinner, held in the Ruakura Farmers' Hall.

LECTURE SUMMARIES

In future issues it is intended to publish summaries of some of the papers presented by members at Branch meetings. Reviews are usually not capable of condensation in this way but papers dealing with local problems which have required chemical investigation provide suitable material. The main purpose of these summaries is to let members in other Branches know of work completed or in progress. The summaries will also be of interest to chemists in other countries especially as the *Journal* contents page is now being reproduced by indexing services in U.S.A. Members who are delivering such papers at meetings are requested to send a summary for publication, either through their Branch Editor or direct to the Editor. A convenient length for summaries is 400 words. Care should be taken not to include details which might prejudice more complete publication elsewhere. A statement of the problem, the approach adopted, and the conclusions reached are sufficient without the documentation of detailed observations. A reference should be included if the work has been published or accepted for publication in another journal.

FREDERICK PALLISER WORLEY

An Appreciation

On the death of Emeritus Professor Frederick Palliser Worley in December, 1960, the Institute, and the Auckland Branch in particular, has lost a member who, during his life, had contributed a great deal to the profession, and his passing will be mourned not only by his students but by all members of the profession who had the fortune to know him.

The Worley family came from Nelson and received their university education at the relatively new University College in Auckland which had been established in 1883. F. P. Worley studied under Professor F. D. Brown, the first professor of physics and chemistry at the new University College. He obtained the degrees of M.A. and M.Sc. with first class honours. His masterate thesis, "Bromine in Solutions of Potassium Bromide", was published in the *Journal of the Chemical Society* in 1905 and confirmed the combination of bromine with the bromide. Some idea of the high regard in which he was held at this time is conveyed by his appointment in 1907 as Acting Professor of Physics and Chemistry during the absence of Professor Brown. He then proceeded to London, where he studied under Professor H. E. Armstrong and obtained his D.Sc. and the D.I.C.

In 1914, following the retirement of Professor F. D. Brown, he returned to the Auckland University College as Professor of Chemistry, Physics now being set up as a separate chair. Conditions in the Department at this period were very difficult owing to lack of facilities and finance, both being made worse by the start of the first world war. The only staff, apart from the Professor, was Arthur H. Bowell, who had come to the Department with Professor Brown. Electricity was not available, gas being the only form of heating and lighting. In 1917 the University College had to move and the Chemistry Department first occupied its present home, the old Choral Hall. With the additional space now available and at the conclusion of the first world war, the Department was greatly strengthened by the appointment of W. F. Short as Lecturer in Organic Chemistry.

Following the first world war there was an upsurge not only in the number of students taking chemistry but in the quality and quantity of the work turned out. It is, of course, always invidious to try to list the students of those days and no exhaustive attempt is made here, but names which come to mind are J. C.

Smith, R. W. Harman, P. R. Parr, J. R. Hosking, M. C. Franklin, E. D. Robins, C. B. Radcliffe and L. H. Briggs. (now Professor of Organic Chemistry at Auckland).

The achievements of the early 1920's gave Worley the stimulus to campaign for better facilities and staff for his Department. Often frustrated, he always came back smiling, at times emphasizing the importance of the profession not only as a way of life but as a national necessity.

In 1939 the second world war again interfered with the smooth growth of the Department but Worley again was equal to the occasion. Shortly after the second world war, Worley retired but was able to hand on to his successor, Professor F. J. Llewellyn, a vastly different Department from that to which he succeeded in 1914. For his services to the Auckland University College extending over 30 years he was created an Emeritus Professor of the University. Worley must have been one of the earliest, if not the first, graduates to occupy a chair at his Alma Mater in New Zealand.

Apart from the teaching of chemistry, Worley always took a great interest in the profession in a very personal way. All chemists working in the Auckland area knew they would receive a ready welcome and kindly assistance from him at all times. To further intimate contact with each other, Worley invited all chemists in Auckland to meet in his home in 1925. This meeting was so successful that the Auckland Chemical Society was immediately formed. Regular meetings were held in the Chemical Lecture Theatre and it did a great deal to stimulate the profession in Auckland. When the idea of forming an Institute of Chemistry in New Zealand was mooted in 1930, solid support was forthcoming from the Auckland area. On the formation of the Institute, the Auckland Chemical Society became the Auckland Branch of the Institute. It was a fitting tribute to Worley's contribution when he was elected President of the Institute in 1936.

In addition, he took a great interest in public affairs generally and entered fully into the life of the community.

Worley's interests in chemistry were wide and at the time somewhat unusual. In addition to his scientific attainments, he was a good classical scholar and this may have accounted for his interest in the history of chemistry from the earliest days. There was little or nothing in Latin literature with a chemical flavour with which he was not familiar. He also had a remarkably good knowledge of the concise use of English as students presenting

theses for publication quickly knew to their cost. He believed that every word should mean something and that one word which expressed the meaning was always preferable to two. Believing that chemistry was essential for industrial development, he spent a considerable time convincing leaders in the business community of the value of chemistry in industry and many of his students owe their present positions to his activities in this direction.

Worley also took a great interest in the legal aspects of chemistry and achieved some fame as an expert witness. His careful preparation of evidence, his confident delivery of that evidence and his unruffled composure under cross-examination made him the ideal expert witness. Several stories are told of how he turned the tables on the legal profession during cross-examination.

While the problems of the finance and facilities required by the College occupied most of Worley's time, he did put considerable thought into many of the chemical problems of the day. Professor Brown had interested him in the cyanide process of gold recovery and Worley carried this problem over to his occupancy of the chair. In 1917 with V. R. Browne, "Hydrolysis of Sodium Cyanide" (*J.C.S.* 1917, 1057) was published, followed by "The Action of Alkali Cyanide on Gold" (*Australian Association for the Advancement of Science* 1923, 228), and with R. W. Harman "Hydrolysis of Alkali Cyanides in Aqueous Solution" (*Transactions of the Faraday Society* 1923, Vol. 20, page 3).

Surface tension was another topic holding considerable interest for Worley. Papers by his brother, R. P. Worley, were published in the *J.C.S.* during F.P.'s first year in the Chair, and he continued the work by a joint paper with P. R. Parr (*Australian Association for the Advancement of Science*, 1923, 227).

Worley had always been very interested in the structure of the atom and its effect on the properties of substances. This resulted in a paper published in the *Australian Association for the Advancement of Science*, 1923, 212, entitled "A New View of Atomic Structure and the Relationship of the Chemical Elements". The effect of chemical structure and reactions on the physical properties of substances always interested Worley and a number of papers with student co-workers appeared starting in 1927 with four papers on the mutarotation of the hexoses, with J. C. Andrews as co-author, in the *Journal of Physical Chemistry*.

Mineral deficiencies in plants was another topic in which

Worley was particularly interested from the theoretical point of view. From the literature on the subject and some unpublished work he showed how forest trees draw the required elements from the subsoil and how they were subsequently concentrated in the surface by leaf fall. In this way he was able to explain why the burn-off of forest areas resulted in good initial fertility which gradually diminished if the essential elements were not replaced by other means.

An early interest in the ceramic industry caused him to investigate a number of New Zealand clays for the possibility of producing tableware in New Zealand. It must have been gratifying to him to see such an industry eventually established in Auckland.

As a teacher he will be remembered by his students with mixed feelings. He always maintained that it was more important to teach a student to acquire the power of thinking for himself than to present a logical sequence of facts to be absorbed by the student as "ink in blotting paper". His lectures were very well illustrated by demonstrations and in this he was somewhat of a showman. The result, however, was good attendance at his lectures and if the student was prepared to study on his own the wealth of demonstration lent a reality to chemistry as a practical profession.

As a man he had a kindly disposition, always ready to guide and advise. Marrying relatively late in life, he was a good husband and father. Indeed, sickness in his family was a burden which he bore cheerfully over the years and never let it affect his work. In these years he was ably supported by his wife, Doris, to whom much credit is due. For relaxation he was a keen gardener, an activity which lent scope for practical demonstrations of his theories with regard to plant nutrients. Painting was a hobby he indulged in from time to time and his watercolour work was of a particularly high standard. He had a well-developed puckish sense of humour and every lecture contained some joke or story. As an illustration, on the birth of his first child his students presented him with a silver rattle at the beginning of one of his lectures. In reply, he said the gift came as a great surprise to him. No doubt it was as great a surprise as the news of the birth had been to the students but he hastened to assure them that this event had not the same element of surprise as far as he was concerned.

His outlook on life was a robust and honest one. While sometimes critical of events and people, his criticisms were never malicious, hurtful or harmful.

On his retirement he and his wife lived on a farm with their eldest son, Peter, but right up to the time of his death he always took a keen interest in university affairs and matters concerning the profession.

He is survived by his wife, two sons (Peter and Bruce) and a daughter (Adair), Mrs. Woodward.

All those who have been associated with Frederick Palliser Worley will regret his passing but will take satisfaction in the fact that not only did he advance the knowledge and profession of chemistry in New Zealand but had a wisdom and understanding not given to many.

Surely the words of *Proverbs 24, verse 3*, express succinctly what those who knew him intimately must feel as regards his life and work:

Through wisdom is an house builded
And by understanding it is established.

—J. C. ANDREWS.

CONFERENCE 1961

The 1961 Conference of the New Zealand Institute of Chemistry will be held in the Chemistry Department of the University of Auckland. The Conference will commence with an informal gathering on Tuesday evening, August 29, and will close with the A.G.M. on Friday afternoon, September 1. A one-day post-conference excursion has been arranged for Saturday, September 2.

The following tentative programme has been drawn up:

Tuesday evening: Informal coffee evening.

Wednesday:

9.30 - 11.00	Registration	2.00 - 3.30	Papers
11.00 - 11.15	Morning tea	3.30 - 4.00	Afternoon tea
11.15 - 11.30	Opening	4.00 - 5.00	Papers
11.30 - 12.30	Presidential address	8.00	Public lecture.

Thursday:

9.30 - 10.30	Guest lecture	2.00 - 5.00	Local excursions
10.30 - 11.00	Morning tea	8.00	Social function
11.00 - 12.30	Papers		

Friday:

9.30 - 10.30	Papers	2.00 - 3.00	Easterfield lecture
10.30 - 11.00	Morning tea	3.00 - 3.30	Afternoon tea
11.00 - 12.30	Papers	3.30 - 5.00	A.G.M.

Saturday:

One-day excursion visiting the Geothermal Power Station at Wairakei.

The Chairman of the Conference Committee is Professor D. R. Llewellyn and the Secretary Mrs J. M. Waters, Chemistry Department, University of Auckland, Box 2175, Auckland,

EXAMINATIONS COMMITTEE

ADMISSION OF ASSOCIATES BY EXAMINATION

At the Council meeting on February 24, two applicants were admitted to Associateship after passing an examination arranged by the Examinations Committee of the Institute. These were not the first Associates to be admitted by examination—a least one former Associate was subjected to some test arranged directly by the Council as early as 1936; but they are the first who have passed an examination for the purpose under the present Rules, and since the Examinations Committee was entrusted with this responsibility.

To the new Associates, Messrs. J. Breen and G. R. Russell, the Council and fellow members extend congratulations. They offered themselves somewhat as guinea-pigs to the Institute Rules and it may be some consolation for the delay they endured to know that, by proving the Rules, their cases have clarified interpretations and established procedure for future candidates.

This admission of Associates by examination coincides with renewed request by the Examinations Committee to be relieved of a responsibility which the Otago Branch has held for fourteen years, and the Council is seeking to transfer this Committee to the Auckland Branch during this year. Establishing standards and organizing examinations for the Laboratory Assistants' Certificate each year is no small task. The additional responsibility of pioneering the Associate qualification, together with negotiations for training and qualification under the Technicians Certification Authority, has meant an amount of work that few members not engaged in such activity can appreciate. Among those who have borne the bulk of the development work in this field during the last fourteen years are Mr O. H. Keys, Dr A. D. Campbell, Mr J. W. McChesney, Mr H. G. Woolman, and the present Chairman, Mr C. R. Edmond, and Secretary, Mr T. H. Kennedy. The February Council meeting specifically requested that the gratitude of the Institute be expressed in these pages to these and other Otago members associated with the work of the Examinations Committee.

BRANCH CHAIRMEN

AUCKLAND BRANCH



The Branch Chairman for this year is Professor D. R. Llewellyn, B.Sc.(Birm.), D.Phil.(Oxon.), D.Sc.(Birm.), F.R.I.C. Professor Llewellyn graduated from Birmingham University in 1943 with an Honours Degree in Chemistry and then proceeded to the Clarendon Laboratory, Oxford, as research assistant to Sir Francis Simon. In 1945 he transferred to the Cavendish Laboratory, Cambridge, and later held an academic post in the Chemistry Department of the University of North Wales, Bangor. In 1949 he was awarded an I.C.I. Fellowship which he held at University College, London, until he received an appointment as Lecturer there in 1952. He came to New Zealand

in 1957 to take up his present position as Professor of Chemistry and Director of the Chemical Laboratories in the University of Auckland. Professor Llewellyn is a Fellow of the Institute and is Chairman of the Conference Committee for 1961.

WAIKATO BRANCH

The Chairman for 1960-61, Mr J. E. Allan, graduated B.Sc. from Otago in 1940 and joined the Dairy Division of the Department of Agriculture as Assistant Chemist at the Grading Store in Wellington. He served with the N.Z. Army during 1942-45, then returned to the Chemical Laboratory of the Dairy Division at Wallaceville where he was engaged on determination of trace metals and ascorbic acid in dairy products and investigations with Dr Moir on curd preservation. While at Wallaceville he continued his studies, completing the M.Sc. degree at Victoria College in 1948. In 1949 he transferred to the Rukuhia Soil Research Station at Hamilton. At Rukuhia he has been responsible



for the development of spectrochemical methods of analysis and their application to routine determinations on soil and plant material. Mr Allan's use of atomic absorption spectrophotometry for this purpose has attracted especial attention and as a result of this work he was invited by the C.S.I.R.O. to attend the Australian Spectroscopy Conference at Melbourne in 1959. Mr Allan was Secretary of the Waikato Branch for several years.

MANAWATU BRANCH



Mr G. M. Wallace, Senior Lecturer in Agricultural Biochemistry at Massey College, is this year's Chairman of the Manawatu Branch. Mr Wallace graduated from Victoria University College in 1941. After a period in the Middle East, he spent several years with the Dunlop Rubber Company, both in New Zealand and South Africa. He joined the Food and Drug section of the Dominion Laboratory, Auckland, in 1949, after a year at Massey College. In 1956 he was appointed to the staff of Massey College.

Mr Wallace has served on various Institute committees. He was Associate Editor and Editor of the *Journal* during his period in Auckland. He was elected an Associate in 1949, and a Fellow in 1957.

WELLINGTON BRANCH

Mr W. E. Dasant, the Chairman for 1960-61, graduated M.Sc. with first-class honours in chemistry from Victoria University in 1950. After a year with the Biochemistry Department at Massey Agricultural College, he returned to a lecturing position on the staff of Victoria University. He visited England on a Nuffield Research Fellowship during 1959 and investigated aspects of the chemistry of positive-halogen compounds with Dr T. C. Waddington at Cambridge University. His research and teaching interests are in the field of inorganic chemistry. Mr Dasant became an Associate of the Institute in 1951.



CANTERBURY BRANCH



Mr E. R. Hounsell, Chairman of the Canterbury Branch, graduated from Canterbury University College M.Sc. with Honours in Chemistry in 1936. After spending a year at the Christchurch Teachers' College in 1937 he joined the Christ's College staff in 1938 and was appointed Head of the Science Department in 1951. He was an executive member of the Canterbury Science Teachers' Association from 1948-57 and its Chairman in 1956. He is the present Chairman of the newly formed Junior Chemical Society, a body catering for sixth form chemistry pupils. He was appointed to his present position of Liaison Officer of the University of Canterbury in April 1959. He was elected an Associate of the Institute in 1941.

OTAGO BRANCH

Dr R. E. Corbett, the Chairman for 1960-61, graduated M.Sc. with first-class honours in chemistry from the University of Otago in 1944, and was appointed Assistant Lecturer in Chemistry at Otago. In 1947 he was awarded a National Research Scholarship which he held at Cambridge, where he investigated the structures of the tropolone antibiotics puberulic acid, puberulonic acid, and stipitatic acid, under Professor Sir Alexander Todd, F.R.S. For this work he gained the Ph.D. degree. He was awarded a Carnegie Travel Grant in 1950, and visited the United States.

Returning to Otago in 1950 he was promoted to Lecturer in Chemistry. He visited Great Britain in 1958 at the invitation of the Nuffield Foundation. In 1959 Dr Corbett was appointed Reader in Chemistry at Otago.

Dr Corbett's research interests are New Zealand natural products, principally essential oils, and bark and heartwood extractives. In 1956 he was awarded the Easterfield Medal of the Royal Institute of Chemistry for these studies. For the past ten years he has been Secretary of the Nuffield N.Z. Advisory Committee.



THE REGISTRY**Fellow**

(Elected February 24, 1961)

WALKER, Thomas Williams, B.Sc., Ph.D., D.Sc.(Lond.), Lincoln College, Christchurch (Professor of Soil Science).

Associates

(Elected February 24, 1961)

GORGENYI, George Zoltan, Davis Gelatine (N.Z.) Ltd., Christchurch (Works Chemist).

HARTSHORN, Michael Philip, B.Sc.(Hons.), D.Phil., University of Canterbury (Lecturer).

RAMMELL, Colin George, B.Sc.(Hons.)(Birmingham), Dairy Laboratory, Wallaceville (Bacteriologist).

Laboratory Assistant Certificates

(Awarded February 24, 1961)

BARRETT, Miss J. T.

CLARKSON, C. J.

BARTLETT, G. C.

FLETT, Miss E. O.

CHRISTIE, E. A.

KINGDON, Mrs B. L.

WHITE, Miss M. D.

Resignation

CARMAN, Raymond Maurice, M.Sc., Ph.D.

BRANCH NEWS AND NOTES**WAIKATO BRANCH**

Dr B. B. Marsh of the Meat Industries Research Institute leaves in July to attend the International Biochemical Conference to be held in Moscow during August. He will also attend the Annual Meeting of European Meat Research Workers in Warsaw in September and in the course of his travels will visit research institutions in Australia, Japan, Germany, England and the United States.

MANAWATU BRANCH

The Branch extends its congratulations to Mr J. K. Scott, formerly Head of the Engineering Department, Dairy Research Institute, on his appointment to the Chair of Food Technology at Massey College.

Mr E. C. Jessop, Glaxo Laboratories, Palmerston North, is in England on a study course.

Mr R. Grimmitt, formerly assistant lecturer in Pharmacology at Otago University Medical School, has joined the staff of the Biochemistry Department at Massey College.

WELLINGTON BRANCH

Mr Noel Vere-Jones, who retired from the Chemical Engineering Section of the Dominion Laboratory, in 1960, has returned from a six-month visit to England and Scotland and has again taken up residence at his home in Ngaio, Wellington.

Mr Stuart Neil Dawes is transferring from the Extension Division, Department of Agriculture to rejoin the Dominion Laboratory, D.S.I.R.

Mr R. E. R. Grimmett, who has been Technical Secretary at the Soil Bureau, Wellington, since his retirement from Rukuhia Soil Research Station has now retired from his present position on account of indifferent health. Mr Grimmett was Secretary for the Ninth New Zealand Science Congress held in Wellington in May 1960.

Mr R. L. Andrew, who retired from the positions of Director of the Dominion Laboratory and Government Analyst in 1946, recently made a presentation of a copy of *De Re Metallica* to the Laboratory. A short function was held in the new Library at Gracefield for the presentation of this work which was translated into English by past-President Hoover of the U.S.A.

Dr Western A. Anderson, Manager of basic research in magnetic resonance at Varian Associates, Palo Alto, California, addressed the Branch on March 14.

He also visited laboratories and addressed other interested groups.

CANTERBURY BRANCH

Mr J. L. Grigg has transferred from Winchmore Irrigation Research Station to be Officer-in-Charge, South Island Soil Testing Station, Taeri Agriculture Centre.

Mr A. G. Armstrong has left the Dominion X-Ray Laboratory to take up a position as science teacher at Ngata College, Ruatoria.

Dr Helen M. Thomson has retired from the position of Senior Lecturer in Textiles at the School of Home Science and is now residing in Christchurch.

Mr L. P. Gregory has resigned from the staff of Christchurch West High School to accept an appointment as chemist at the Dominion X-Ray Laboratory.

Mr S. W. White, formerly chemist at Davis Gelatine (N.Z.) Ltd., is now a science teacher at Christchurch Technical College.

OTAGO BRANCH

Mr A. H. Lewin of Cadbury, Fry, Hudson Ltd., and a past chairman of the Otago Branch, left for the United Kingdom in March for a three-month visit to the factories of the Cadbury and Fry organizations.

Dr M. H. Panckhurst and Dr G. N. Malcolm, of the University of Otago Chemistry Department, are presenting papers at the A.N.Z.A.A.S. Conference in Brisbane in May.

We note the gift of £100,000 from the Wellcome Foundation to the Otago University Medical School for Medical Research. Some of our local members will benefit from this generous gift and, on their behalf, we express our gratitude.

We extend our congratulations to Mr R. C. Cunninghame, Assistant Lecturer in Chemistry at the University of Otago, on his award of a Shell Post-graduate Scholarship. He intends to further his studies with Professor R. S. Nyholm, of University College, London.

Mr S. G. Wyllie, a recent graduate, has been appointed Assistant Lecturer in Organic Chemistry at the University of Otago,

AUSTRALASIAN CORROSION ASSOCIATION (NEW ZEALAND BRANCH)

Last year there was formed in Auckland an Association of about 60 persons who are concerned at the cost and consequences of corrosion. This group later affiliated with similar groups in Australia to form the Australasian Corrosion Association. The New Zealand Branch of this Association at present consists solely of the Auckland group but it is hoped that similar groups will be formed in other centres. Writing of the aims and objects of the Association, Professor Titchener, Chairman of the N.Z. Branch, states, "The cost of corrosion to this country is very large, probably 18 or 20 million pounds a year. Some of this is inevitable, but much is not. Frequently the avoidable losses are taking place under our very noses, perhaps unnoticed, perhaps noticed but ignored because they are commonplace. They may be on a small scale or they may be of spectacular proportions. Regardless of their form or scale, however, their neglect represents an economic blunder. To do nothing is hardly ever cheaper than to attempt a remedy."

In March, 1961, the Auckland group expects to adopt a formal constitution. In succeeding months meetings will be devoted to technical aspects of corrosion, and these will be published in book form. The Association is arranging a course on the fundamentals of corrosion in conjunction with Seddon Memorial Technical College. It will collaborate in the preparation of a new edition of a directory of products and services available for prevention of or protection against corrosion, previous editions of which have been published by the parent association in Australia. "This edition will, of course, list those products and services available on the New Zealand as well as on the Australian market. In it members will have a free allocation of space in which their products or services can be listed, together with brief technical descriptions and notes on the fields of application. Non-members will also be able to obtain listings, but only on payment of a fee. The directory will be available free to members. Non-members will be able to buy it."

The proposed constitution provides for three classes of membership: Sustaining members (organizations—suggested fee £10 10s. 0d.); Members (individuals—subscription about £1 1s. 0d.); Student members (age under 23—subscription about 7s. 6d.). In addition to the directory and the proceedings of the Auckland group, members will receive the journal, published by the Australasian body, containing technical papers on corrosion problems.

There should be many Institute members interested in the problems of corrosion and its control. Those requiring further information should communicate with the secretary (Mr P. Skinner, Auckland Industrial Development Laboratories, P.O. Box 2225, Auckland), or the chairman (Professor A. L. Titchener, School of Engineering, University of Auckland, Ardmore College P.O.),

COUNCIL MINUTES

ABRIDGED MINUTES OF A MEETING OF THE COUNCIL OF THE NEW ZEALAND INSTITUTE OF CHEMISTRY (INC.) HELD IN THE CONFERENCE ROOM, D.S.I.R., SYDNEY ST., WELLINGTON, ON FRIDAY, 24TH FEBRUARY, 1961, AT 10 A.M.

PRESENT

Prof H. N. Parton (President, in the Chair), Dr F. B. Shorland (Vice President), Prof. D. R. Llewellyn (Auckland), Mr N. T. Clare (Editor and Waikato Proxy), Mr C. M. Wallace (Manawatu), Mr H. R. Peuhale (Wellington Proxy), Mr D. J. Hogan (Registrar and Canterbury Delegate), Dr W. G. Hanger (Otago), Mr A. P. Oliver (Acting Hon. Gen. Secretary). Apologies were received from Dr E. P. White, Dr W. E. Harvey, and Mr W. E. Dasent.

CONFERENCE 1961

The Auckland Branch will try to arrange a visit to Wairakei in conjunction with Conference.

EXAMINATIONS COMMITTEE

The Committee announced that six candidates had completed their examinations and were eligible to receive their Laboratory Assistant's Certificates (See under *Registry* for names.).

Resolved (Manawatu/Waikato): That the above candidates be granted Laboratory Assistant's Certificates.

Associateship Examinations: The Acting Hon. Gen. Secretary informed the two candidates, J. N. Breen and G. R. Russell, on December 8, 1960, that they would be examined in Practical Chemistry only, and the Examinations Committee was informed of this.

Resolved (Auckland/Waikato): That Breen and Russell be exempted from an examination in a foreign language.

Resolved (Auckland/Manawatu): That Breen and Russell be awarded a pass in the Associateship examination.

Resolved (Auckland/Manawatu): That subject to all documents and examination fees being in order, Messrs J. N. Breen and G. R. Russell be admitted as Associates forthwith.

Resolved (Chair/V.P.): That Council congratulate Messrs Breen and Russell, the first Associates to be admitted by examination.

Resolved (Chair/Wellington): That reports from the Examination Committee on the following subjects be received:

1. Scale of fees for examiners.
2. Obtaining permission from University Registrars to use laboratories for examinations.
3. Future conduct of Associateship examinations.
4. Change of venue of the Examinations Committee.

Resolved (Otago/Auckland): That the principle of a change of venue be accepted, and that the Chairman, Secretary and other members be thanked for their work.

Resolved (Waikato/Manawatu): That the Auckland delegate be asked to invite Mr O. H. Keys to become Chairman of the Examinations Committee and to form a Committee.

Resolved (Manawatu/Otago): That on the formation of a new Examinations Committee, it be asked to study the suggestions made by the Otago

Examinations Committee with a view to bringing down modified Examination Regulations.

JOURNAL

Resolved (Auckland/Wellington): That the Editor's Honorarium for 1960 which was voted at the December meeting of Council be divided equally between Mr N. T. Clare and Dr W. A. McGillivray, and that Dr McGillivray be thanked for his services.

PROFESSIONAL STATUS COMMITTEE

Resolved (Canterbury/Wellington): That the Professional Status Committee be asked to organize the preliminaries of the Salary Survey so that the Survey can be conducted before the end of 1961.

EMPLOYMENT SUBCOMMITTEE

Resolved (Vice-President/Wellington): That the report be accepted for distribution subject to the salary table in the middle of Page 4 being corrected in such a way as to satisfy the Executive Committee.

TECHNICIANS CERTIFICATION AUTHORITY

The Vice-President recommended that our nominee on the Executive Committee for Science Technicians be asked to ensure that adequate practical work be incorporated in the study course for the National Certificate.

MEMBERSHIP

Resolved: That Council pay the cost of *Journals* for the Ministers of D.S.I.R., Education, and Agriculture, who have been elected Honorary Local Members of the Wellington Branch.

OVERSEAS VISITORS

Resolved (Canterbury/Wellington): That it be a recommendation to the Overseas Visitors Subcommittee to invite a guest lecturer to attend Conference 1961 and to undertake a lecture tour.

Resolved (Manawatu/Auckland): That the sum of £300, as originally approved, be transferred to the Overseas Visitors' Fund.

ROYAL CHARTER

Consideration of this matter was deferred as all Branches had not considered the question.

A.N.Z.A.A.S.

Resolved: That the following members be appointed delegates to the General Council meeting of A.N.Z.A.A.S.: Prof D. R. Llewellyn, Dr B. R. Penfold and Dr M. H. Panckhurst.

BANK ACCOUNT

Resolved (Canterbury/Otago): That Dr W. E. Harvey, Prof S. N. Slater and Mr W. E. Dasant be authorized to operate the Bank Account, the signatures of any two to be required.

NATIONAL COMMISSION FOR UNESCO

Resolved (Canterbury/Manawatu): That the following be nominated to the Commission: Prof C. C. Aikman, Mr G. Ashbridge, Miss M. Lambie and Prof H. N. Parton.

INCOME TAX

The Chairman considered that personal applications from members for exemption on subscriptions to learned societies, professional books and equipment would be more likely to succeed than a united approach to the Inland Revenue Department.

A. P. OLIVER, *Acting Hon. Gen. Secretary.*

BOOK REVIEWS

NEW ZEALAND'S INDUSTRIAL POTENTIAL. Published by the Auckland Branch of the N.Z. Geographical Society (Inc.). 194 pages. Price 11s. 6d. Available from the Secretary, N.Z. Geog. Soc., Box 2175, Auckland at 10s. per copy.

This booklet contains the 1960 Lectures to the Auckland Branch of the Society illustrated with eight plates and 32 figures. The main subjects covered in these papers are the mineral, power, and petroleum resources of New Zealand, the development and future of the forest industries, and the possibilities of the iron and steel and aluminium smelting industries. Considered in relation to these are the role of consumer industries and, to illustrate much that is said in the other papers about future trends, there is an account of industrial development in the Auckland Metropolitan Area. The organizers of the series reveal an imaginative and constructive approach by rounding it off with a paper, entitled "The Human Factor", which deals with the potentials and problems of the new "single-industry" towns such as Mangakino and Kawerau. Apart from one paper substituted through ill-health of the original speaker, each is the work of a specialist and most of these are actively contributing to the developments they describe.

In addition to the main texts, there are 18 pages of appendix material some of which makes credible the statement in the Introduction that "the year 1960 has seen the beginning of a new industrial era in New Zealand."

Nearly all of these papers contain material of direct interest to chemists in this country, a number of whom have contributed to the results recorded. If there are occasions when the adequacy of the data and the validity of extrapolations from them appear questionable, this serves to emphasize the scope for further work in these fields. The usefulness of some of the papers would have been greater with the inclusion of a few key references.

The Auckland Branch of the N.Z. Geographical Society is to be commended for bringing together these authoritative statements on our industrial potential at this time.

—N.T.C.

TRANSPORT PHENOMENA, by R. Byron Bird, Warren E. Stewart, and Edwin N. Lightfoot. Published by John Wiley & Sons, Inc., 1960. Price 13.75 dollars.

The work of the Department of Chemical Engineering at the University of Wisconsin and the associated Naval Research Laboratory which had earlier been responsible for work in this field under the direction of Professor J. O. Hirschfelder is already well known. This volume puts together in a coherent manner material which has to some extent been sought in the original literature emanating from these laboratories. To workers in the fields of physical chemistry, chemical physics and chemical engineering this will be an essential part of the library and it should be bought by every university library and any other large research library.

Transport Phenomena covers momentum, energy, and material transport, that is the basic phenomena behind the design of contact apparatus, and indeed practically all process equipment. The treatment is an extension of lecture courses in the subjects which have been made available

to other universities, but this is not merely a textbook for a course but an extremely competent and thorough treatment of the subject. As the book is laid out it would be more suitable for post-graduate students than for under-graduate work, for, although it is complete in itself and assumes no more than is necessary in the way of mathematics, it does make appreciable demands on both the student's mathematical preparation and more particularly his previous experience of process engineering. Its usefulness for post-graduate classes is reinforced by a collection of topics for discussion under tutorial conditions at the end of each chapter as well as a collection of carefully thought out and useful problems with answers, a commendable feature for post-graduate study. Another useful feature is an appendix covering some of the more difficult mathematical techniques required for portions of the text.

This is a book which fulfils a real need and is extremely well produced.

—S.R.S.

SEMICONDUCTOR ABSTRACTS, compiled by Battelle Memorial Institute. Published by John Wiley & Sons, Inc., 1960. Price 12.00 dollars.

This is the latest volume of abstracts on semiconductors. The current volume is improved in that it has a fuller index with more cross-references than previous volumes and within the volume. It covers over 400 pages of carefully selected abstracts, but a somewhat narrower field than formerly, in that solid-state phenomena of lesser relevance are omitted, ferromagnetics, luminescence, etc.

The Table of Contents includes, under Elemental Semiconductors: Boron, Diamond, Graphite, Germanium, Silicon, Tin, Bismuth, Selenium, Tellurium; and under Compound Semiconductors: Halides, Monoxides, Dioxides, Sulfides, Intermetallic Compounds.

—S.R.S.

AN INTRODUCTION TO INDUSTRIAL MYCOLOGY, George Smith. 5th edition. 399 pages. Edward Arnold, London. Price £2.

I have read the new edition of this book with pleasure and profit. It is still divided into a section containing descriptions of numerous fungi that are important in the fermentation, horticultural and packing industries, and a section dealing with elementary laboratory methods.

Amongst others, the organisms used for the production of gibberellin, griseofulvin, cephalosporin N and sporidesmin are not described. There is no mention of laboratory deep fermentation techniques or of mycological methods of increasing the production of a metabolic product. The utility of the book would be increased if the role of each organism in, for example, horticultural husbandry were briefly mentioned where possible. As an illustration of this defect there is no mention under *Rhizopus nigricans* (and not *R. arrhizus* as stated on p. 345) of its use for the 11-hydroxylation of progesterone and related steroids.

Two quibbles in conclusion: Can phrases such as "outside the scope of" and "industry" (a term indiscriminately applied for example to the packing industry when this is not obvious from the context) be omitted or made more explicit in future editions?

The book is well produced, the print is easy to read, and there are 168 illustrations.

—A.T.

ADVANCED ORGANIC CHEMISTRY (Third Edition), G. W. Wheland, John Wiley and Sons Inc., New York, 1960. 871 pages. Price \$17.50.

The review of the 1949 edition of this book stressed the critical and detailed discussions of the structural theory of organic chemistry and the attention given to aspects not commonly treated in organic chemistry textbooks, descriptive chemistry or "groups" such as carbohydrates, alkaloids, etc., being considered only when required to illustrate fundamental principles. This edition, maintaining the same approach, introduces newer topics such as N.M.R. (a "superficial treatment" of 3 pages), conformational analysis (8 pages), and charge transfer complexes (10 pages). Other sections have been brought up to date, and extended, with references up to 1958 in some cases. The book is intended for advanced students but despite the detail of discussion it is extremely readable, and chemists whose work and interests are far from academic will find many sections (such as "the Origin of Optically Active Substances in Nature" and "Use of Chemical Reactions in Determination of Structure") a stimulus to thought and a challenge to easy acceptance of some basic beliefs in organic chemistry.

The 30 pages of subject index contain some inconsistencies probably due to the incorporation of new material. Otherwise the production maintains the Wiley standard, particularly in clear presentation of structural formulae.

—N.T.C.

MECHANICAL PROPERTIES OF INTERMETALLIC COMPOUNDS, edited by J. H. Westbrook. Published by John Wiley & Sons, Inc., New York, 1960. 435 pages. Price 9.50 dollars.

This book records the proceedings of a symposium organized by the Electrothermics & Metallurgy Division of the Electrochemical Society and held at Philadelphia in May, 1959.

The subject matter of the book may be divided into five categories. A review of the literature in the first chapter is followed by two chapters treating the effects of crystal structure and temperature. Three papers are concerned with experimental techniques, four discuss the effects of dislocations and point defects and seven deal with the mechanical properties of specific compounds.

In the past interest in intermetallic compounds chiefly concerned their role as intermediate phases in alloy systems and little systematic attention was paid to their intrinsic properties and reactions, particularly in the bulk state.

The semi-conducting properties of intermetallic compounds and their high melting points and thermal stability have recently suggested the possibility of their use in a number of modern military and industrial applications and have stimulated research into the mechanical properties of these compounds and the results of much of this research were reviewed in the papers presented at this symposium.

In addition to the authors' texts, the symposium discussions of each paper are recorded and these coupled with the numerous references supplied give a comprehensive picture of the current state of knowledge in this subject.

—G.S.L.

BOOKS RECEIVED

SOLUBILITY OF INORGANIC AND METAL-ORGANIC COMPOUNDS. Seidell-Linke. Vol. I (A-1r). Van Nostrand Co., Princeton. 187s.

The fourth edition of the well known "Seidell", revised and extended by Dr W. F. Linke, is planned in three volumes. This volume includes inorganic and metal-organic compounds down to iridium oxide, Volume 2 will complete this section, and the third volume will cover organic compounds. As in the last edition the data are arranged alphabetically according to chemical formula, but an innovation is a 64-page index which considerably simplifies location of the data for any compound listed. This volume, with publication date March 1959, includes all solubility material abstracted by *Chemical Abstracts* up to the end of 1956.

ANNUAL REPORTS ON THE PROGRESS OF CHEMISTRY, 1959. The Chemical Society, London, 1960. 476 pages. £2.

The 56th volume of the *Annual Reports* continues the style and coverage of its predecessors. Of especial interest to certain groups of New Zealand chemists are reports on chemistry of bone and tooth materials and on new amino-acids from plants.

THE NEUROCHEMISTRY OF NUCLEOTIDES AND AMINO ACIDS. A Symposium of the Section on Neurochemistry, American Academy of Neurology. Edited by Roscoe O. Brady and Donald B. Tower. Published by Wiley and Sons, New York, 1960. 292 pages, 64 tables, 62 figures. Price 10 dollars.

The seven articles on nucleotides and six on amino acids are reviews which include recent research by the speakers. Extensive discussions on each paper, reported *verbatim*, contain valuable experimental experience of participants. Some of this might have been better condensed and pruned of extraneous comments for publication.

LIBRARY ACCESSION

Spectrographic Data

The Librarian, Mr S. G. Brooker, reports receipt, from the Chemical Institute of the Kazak Academy of Sciences at Alma Ata, of complete tables of the spectral lines for all the elements for both the glass and quartz spectrographs. Accompanying these tables are photographic reproductions of the spectral lines. The tables and photographs will be housed with the Institute's books and journals at the Auckland Museum and may be borrowed on application to the Librarian, Box 9027, Auckland, S.E.1.

For the benefit of the Editor and others geographically ignorant, Mr Brooker points out that Alma Ata is in that part of the USSR north-east of Afghanistan, not far from fabled Samarkand.

UN CONFERENCE ON ENERGY SOURCES

Rome, August 21-31, 1961

This Conference will consider prospects for the practical application of new sources of energy other than the atom. The Conference aims at bringing together experts in the fields of solar energy, wind power and geothermal energy, as well as people interested in energy development in general, to provide participants with up-to-date information on progress achieved and to facilitate an exchange of views and experience relating to practical problems, potentialities and limitations in utilizing these three sources of energy, especially in areas lacking conventional energy sources or facing high energy costs. Emphasis will be placed on application of these forms of energy rather than scientific principles or basic research.

The agenda provides for two parallel series of technical discussions, one devoted basically to the utilization of geothermal energy, wind power and solar energy for power purposes, the other to solar energy for purposes other than power.

Participation at the Conference will be by invitation issued by the Secretary-General of the United Nations. Participants will be selected from among duly qualified persons who have been nominated to attend. Nominations will be made by governments of member states or their governmental services; by the United Nations and its specialized agencies; and by interested non-governmental organizations or societies. It is contemplated that qualified individuals will also apply for participation, and their requests will receive particular attention.

Agenda items include such basic concerns of the Conference as harnessing of geothermal energy and geothermal energy production, design and testing of wind power plants and use of solar energy for heating and cooling, for water distillation and electricity production and for high-temperature processing.

It is planned that the proceedings of Conference will be published as United Nations sales publications. Information concerning this Conference can be obtained from the U.N. Information Centre, 44 Martin Place, Sydney.

AUSTRALIAN SPECTROSCOPY CONFERENCE

The Third Australian Spectroscopy Conference will be held in the Chemistry School, University of Sydney, from August 22 to 24, 1961, under the sponsorship of the Standing Committee on Spectroscopy of the Australian Academy of Science. The Conference is open to all with an interest in spectroscopy.

The scope of this Conference includes all aspects of pure and applied spectroscopy including the newer fields such as resonance spectroscopy. In addition to contributed papers on original unpublished research work there will be a number of invited review papers, and an exhibition of modern spectroscopic equipment is also being organized.

Accommodation will be available for both men and women at the Women's College University of Sydney at a cost of £2 per day. Applications for registration and all correspondence should be addressed to Dr L. E. Lyons, Conference Secretary, Department of Physical Chemistry, University of Sydney.

FOOD SCIENCE CONFERENCE**Sydney, September, 1961**

New food research laboratories for the Commonwealth Scientific and Industrial Research Organization, Australia, are being opened at North Ryde, near Sydney, on September 18, 1961, and to mark the occasion a food science conference is being held there from September 19 to 22.

The conference will take the form of three symposia, each introduced by a distinguished food scientist, and two general discussions led by panels of scientists. The tentative programme is as follows:

- Sept. 18 3.15 p.m. Official opening of new headquarters and laboratories.
- Sept. 19 9.30 a.m. Opening of food science conference. 9.50 a.m. Symposium—Chemical aspects of food processing. 2.30 p.m. Inspection of North Ryde research laboratories. 6.00 p.m. Reception.
- Sept. 20 9.30 a.m. Symposium—Factors affecting meat quality. 9.30 a.m. Symposium (Parallel Sessions). Contributed papers on chemical aspects of food processing. 2.00 p.m. Panel discussion—Public health aspects of handling and processing of foods.
- Sept. 21 9.30 a.m. Symposium—Food preservation and the organization of plant and animal tissues. 9.30 a.m. Symposium (Parallel sessions). Contributed papers on chemical aspects of food processing. 3.45 p.m. Unveiling of memorial to the late E. W. Hicks, former leader of the Physics Section in the Division of Food Preservation.
- Sept. 22 9.30 a.m. Panel discussion — Trends in food research. 12.30 p.m. Closing of Conference.

The Conference is open to scientists, technologists and managerial staff from the food industry, and food research laboratories, and the organizers are most anxious to encourage participation by research workers from as many countries as possible. A number of twenty-minute papers are being delivered in each symposium. Persons proposing to attend the Conference are invited to write for registration forms and further information to:

The Chief, C.S.I.R.O. Division of Food Preservation, Private Bag, Homebush Post Office, N.S.W., Australia.

**THE DAIRY RESEARCH INSTITUTE (N.Z.)
PALMERSTON NORTH**

Applications are invited for the following

RESEARCH STAFF

CHEMIST, for work on the Chemistry of Dairy Products. Minimum qualification required—University Degree (preferably Honours) in Science with Chemistry or Biochemistry as a major subject.

CHEMIST OR AGRICULTURAL CHEMIST, preferably with Commercial Experience, for work on Development of Methods for Utilisation of Dairy Products. Minimum qualification required—University Degree in Science or Agricultural Science (preferably Honours).

TWO ENGINEERS (Chemical or Mechanical) for Process Development Work in the Dairy Industry. Minimum qualification required—University Degree or equivalent Professional qualification.

Salaries are within the ranges £900-£1,210; £1,250-£1,700; £1,750-£2,000. Commencing salary will depend on qualification and experience.

Further particulars of the above positions may be obtained from

The Secretary,

THE DAIRY RESEARCH INSTITUTE (N.Z.),

Massey College P.O., Palmerston North.

N.Z. WALLBOARDS LTD.

SENIOR INDUSTRIAL VACANCY

A Chief Chemist or Chemical Engineer is required by Messrs. N.Z. WALLBOARDS LTD. to take charge of the Company's laboratory. The appointee will be directly responsible to the General Manager, with direct responsibilities for the Auckland Factory, and responsibilities also for the Wellington and Christchurch Factories.

Duties will consist of the technical supervision of raw materials, of the product, and of processing methods at the Plasterboard Factories, and research and development into new materials and methods.

Applicants should have a good degree in physical or inorganic chemistry or chemical engineering, and a few year's Research or Industrial experience.

A friendly personality and ability to instruct staff will be essential.

Applications and enquiries to the undersigned will be treated in strictest confidence.

G. MASKILL-SMITH,
GENERAL MANAGER.

N.Z. WALLBOARDS LTD.

**153A Balmoral Road,
AUCKLAND, S.2.**

Phone 65-884

DE LAVAL

De Laval Separators and Plate Heat Exchangers — key machines in modern industry

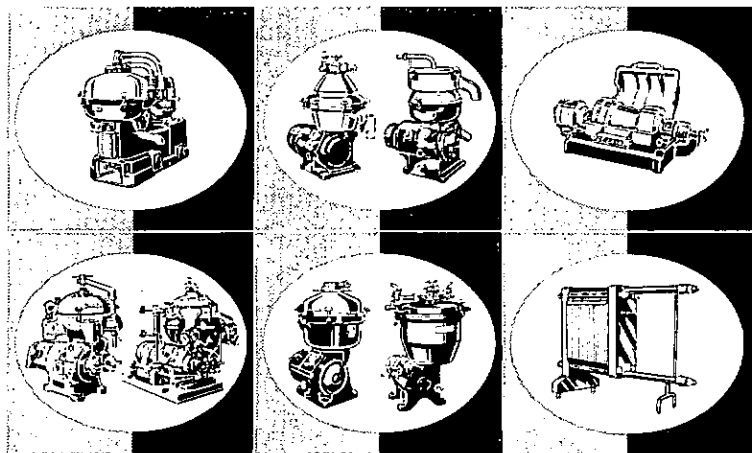
Day and night, all over the world, De Laval centrifugal separators are harnessing centrifugal force in the service of modern industry.

In *engine rooms* ashore and afloat, De Laval centrifuges ensure the clean supply of high-grade fuel and lubricating oils for the running and maintenance of costly machinery.

In *factories* for the continuous pro-

duction of food, pharmaceuticals and starch, and in chemical plants, refineries and slaughter-houses etc., De Laval separators form the basic units around which production is built.

De Laval make over 150 different types of centrifugal separator and a wide range of Plate Heat Exchangers for a great variety of applications. Here are a few examples.



Starch (top)

Nozzle separator for the separation, washing, and concentration of starch.

Foods (top)

Self-cleaning automatic separator (left) and nozzle separator for yeast factories (right).

Fish oil, whale oil, fats (top)

Horizontal centrifuge "De-Sludger" for continuous removal of separated sludge.

Lubricating and fuel oils (bottom)

Separators for the cleaning of fuel and lubricating oils in workshops and on board ships. Standard unit to the left, self-opening unit to the right.

Breweries, fruit juice, wine (bottom)

Hermetic unit for air-sensitive liquids (left), cylinder-bowl clarifier for beer wort, fruit juice, wine, etc. (right).

Plate heat exchangers (bottom)

with counter-current flow between corrugated stainless steel plates. For industrial heating, heat recovery, pasteurization, cooling etc.



WORLD LEADERS IN CENTRIFUGAL APPLICATIONS
ALFA-LAVAL SEPARATOR CO. (N.Z.) LTD.

ID-109

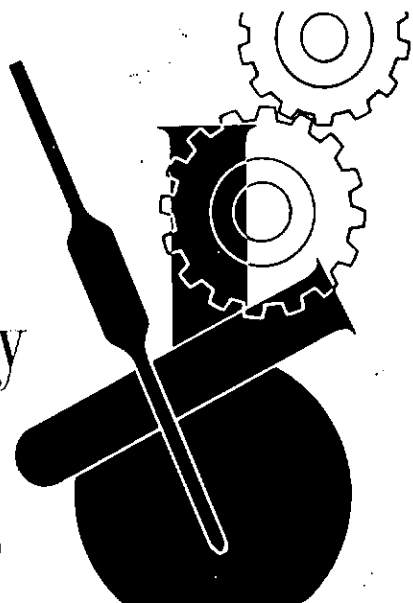
Head Office: P.O. Box 430, Hamilton.

Branches: P.O. Box 397, Palmerston North; P.O. Box 401, Christchurch.

B.D.H.

Laboratory

Chemicals



in education, research and production

In innumerable laboratory applications B.D.H. reagents play a vital part in healing, teaching, research and every productive activity from agriculture to atomic energy. Analytical reagents manufactured by B.D.H. to the published 'AnalaR' specifications have an international reputation as materials for use in analytical work of the most responsible character; and over a thousand other B.D.H. laboratory products are labelled with specifications of minimum purity.

Recent B.D.H. booklets, issued free, include
**Titration in Non-Aqueous Solvents, Biological Stains and
 Staining Methods, 'Union Carbide' Molecular Sieves,
 Ion Exchange Resins, Sugar Phosphates and Related Substances.**
 We shall be happy to send you copies.



THE BRITISH DRUG HOUSES LTD.

BDH LABORATORY CHEMICALS DIVISION • POOLE • DORSET

FIXANAL

GUARANTEED REAGENTS

Speed and exact preparation of volumetric solutions save time and money

★

These, chemically pure reagents are supplied in ampoules and bottles, which contain the correct amount of reagent. To obtain the desired normality (1, 5, 10 litres, etc.) it is only necessary to add the correct volume of pure distilled water.

★

The reagents are accurately weighed and an accuracy within the limits of plus or minus 0.2% is guaranteed.

★

Prices are remarkably competitive and a complete range is available.

★

Also handy rolls Indicator Papers in distinctive plastic containers, with colour chart built in, can readily be carried in pocket. Simple refills available in pH 1/11, 1/5, 5/9, 9/13.

★

N.Z. Representatives:

ELLIOTT BECKETT & CO. LTD.,

156 Grafton Rd., AUCKLAND.

P.O. Box 989

REIDEL-DE HAEN A.G. SEELZE-HANNOVER

LIFE'S QUITE RELAXING

Perhaps because in many ways it's so much easier today. Thanks to new materials and better ways of making those already well known, there's more time to spare for everyone. Ten years ago, for example, washing and ironing clothes took up a sizeable part of the housewife's day, and mending nets was a regular time-waster for fishermen. I.C.I.'s 'Terylene' has changed all that. This remarkable synthetic fibre is as happy in easy-to-care-for clothes as in fishing nets and cordage, and its great strength and immunity to rot, sunlight and weathering are finding it new uses in industry every day. Polythene is another I.C.I. product that makes for easier living. Farmers have been released from the back-breaking task of carrying water to their stock since water could be piped through easily laid tubes of 'Alkathene' (I.C.I.'s brand of polythene), and the same versatile plastic in the form of colourful kitchenware is lightening and brightening housework throughout the world. Wherever you look, the story's the same: new plastics, new drugs, new dyestuffs and new metals from I.C.I. are saving time and allowing hard-working people everywhere the opportunity for the occasional, well-earned yawn.



You benefit from I.C.I. Research

Imperial Chemical Industries (N.Z.) Ltd.

PR/2/60



*You have a
Laboratory*



WHETHER it's small or large . . . research or industrial . . . whatever the size or type the N.D.A. can be of assistance to you.

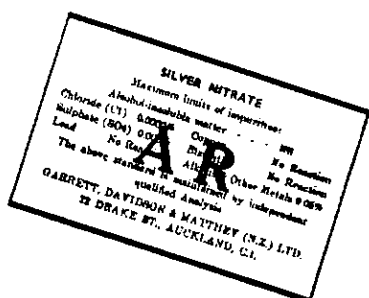
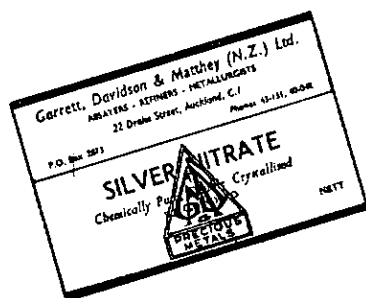
WE stock a comprehensive range of analytical and laboratory reagents, technical and industrial chemicals, scientific apparatus and laboratory equipment.

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

**THE NATIONAL DAIRY
ASSN. OF N.Z. LIMITED**

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

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



CHEMICALS

by

Garrett, Davidson & Matthey (N.Z.) Ltd.

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

SILVER NITRATE C/P.

SILVER NITRATE A/R.

SILVER NITRATE
DENTAL

SILVER CYANIDE
SINGLE SALT

SILVER SALT
(ready mix)

SILVER IODIDE

SILVER IODATE

SILVER OXIDE

GOLD METAL C/P.

GOLD CHLORIDE

GOLD PLATING
SOLUTION

GOLD PLATING SALTS
PLATINUM BLACK

PLATINIZED
ASBESTOS

PLATINUM CHLORIDE

RHODIUM SOLUTION

ELECTROLYTIC
CLEANING SALTS.

"QUALTEST" OUTFIT
(Testing precious metals)

AMMONIA C/P.

*

22 Drake Street AUCKLAND P.O. Box 2073

Telephone: 21-786 (2 Lines) Telegraphic Address: "Rollers"

Registered at the G.P.O. as a magazine.

A. K. WILSON LTD.