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EDITORIAL

The benefits to be derived by Commonwealth scientists from periods of post-graduate study or refresher leave overseas are too well known to require comment. The need for this broadening of outlook and experience is in fact so well recognised that through University, Government or Industrial Scholarships or grants or through leave schemes, most chemists, if they so desire, can now look forward to at least one such trip. But we are inclined to think of this as a one-way traffic, all roads leading away from this country. It was gratifying therefore to note, when in Britain recently the interest taken by many research workers in our laboratories and in the work being done here, and their obviously sincere desire to visit and work in New Zealand laboratories during periods of leave. With the growing reputation of our laboratories we may expect this interest to increase and it is gratifying to find that one organisation at least has shifted its emphasis from mainly that of taking scientists to Britain to the idea of a wider Commonwealth exchange scheme.

Dr. S. Y. Thompson, who contributes an article to this issue of the Journal, is the first senior British scientist to visit and work in New Zealand under this Royal Society and Nuffield Foundation Commonwealth Bursaries Scheme. We hope there will be many more. It is important that these senior men should be able to work in Commonwealth countries—just as important as that similar opportunities for overseas experience should be available to us. That there is a real interest in gaining further experience within the Commonwealth is illustrated by the fact that in the first year of the Royal Society and Nuffield Foundation Scheme there were 54 senior applicants but funds were available for only 15. The remainder will no doubt be attracted to countries where financial assistance is more readily available. Because of the very great value to a country such as New Zealand of these men the provision of additional funds is surely a matter for serious consideration.

In his article Dr. Thompson gives some of his impressions on research in New Zealand and in particular compares the organisation of research and teaching in the two countries. He has restricted himself to his own field of agricultural science but, as he points out, this does not, in this country, narrow the field too much, and since our whole economy depends ultimately on agriculture, sound research and teaching in this field is of vital concern to us all.

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LIVERSIDGE LECTURE: NEW TRENDS IN FAT RESEARCH.

(As already recorded, Dr. F. B. Shorland, Director of the Fats Research Laboratory, D.S.I.R., has been invited to present the Liversidge Lecture at the forthcoming A.N.Z.A.A.S. Conference. The following is a summary of his lecture:—)

Following the discovery of the nature of fats by Chevreul in 1823, there was a century of relative stagnation in this field. During the past few decades, however, the elucidation of the fatty acid composition and glyceride structure of many natural fats, the application of spectroscopy, chromatography, low temperature crystallization, counter-current distribution and isotopic labelling, and the recent concepts of the mechanism of autoxidation, polymerization and hydrogenation, have all greatly contributed to the understanding of the chemistry and biochemistry of fats.

Although the Hilditch theory of even distribution has been useful as a guide to the rules that are followed in the formation of natural tri-glycerides, its validity has been questioned by Kartha. The final solution of this problem must await the development of more refined techniques.

The synthesis of unsaturated acids has proved unexpectedly difficult. The newer techniques using acetylenic compounds, however, have recently led to the synthesis of linoleic and ricinoleic acids.

Fats are needed for optimal growth. The processes involved in the intestinal absorption of fat are now being unravelled, while fatty acid-coenzyme A has become universally accepted as the substrate in the synthesis and degradation of fats.

Differences in fatty acid composition of the depot fats of animals, apart from ruminants, depend on the nature of the dietary fat. In ruminants the rumen plays an important role by (a) hydrogenating the dietary unsaturated acids, so that these occur in only trace amounts in the depot fat, and by (b) converting the non-fatty constituents mostly to acetic acid, to form endogenous fat. Propionic and branched-chain C_4 and C_5 acids are also produced, giving rise in the depot fats to traces of long chain fatty acids of the n-uneven and branched-chain series. The recognition of these acids as normal constituents of some animal fats adds a new chapter to the hitherto existing knowledge of fats.

FUNDAMENTAL PARTICLES.

By H. N. PARTON.

(*Chairman's Address to the Otago Branch, April* 1955).

One of the persistent questions in the history of thought refers to the nature of the ultimate stuff or substance, of which all things are composed and to which all things presumably revert. Men have always been inclined to assume that the vast diversity of things which make up the visible world is constituted of the same stuff, and have tried to determine its nature. The question was first raised by a group of Greek thinkers in Ionia, on the west coast of Asia Minor. Thales (c. 640-550 B.C.) suggested that water is the ultimate stuff; Anaximenes suggested air; and Anaximander that the primary stuff must be different from the forms of matter known to us, describing it as "the boundless", or "the indeterminate". A more subtle conception was that of Pythagoras (c. 570-500 B.C.) and his school. They stressed the form rather than the substance, of things. The study of music led them to the importance of proportion, e.g., between the lengths of strings and the notes produced by them. The health of a body they regarded as resulting from a certain proportion between its elementary qualities (hot and cold, dry and wet): other proportions led to disease. "All things are numbers" was their chief dictum. This school flourished in Southern Italy, and in the same region, at Elea, the ideas of Xenophanes were expounded by the Eleatics: "The All is One, and the One is God"; monism and pantheism.

Parmenides, an Eleatic, maintained that the world is one uncreated imperishable reality. Motion and other kinds of change, and the discrete nature of things, he believed to be illusory. In opposition to this view, Heraclitus emphasised the multiplicity of things - pluralism - and their incessant change. "No man steps twice into the same river". In this line of thought stand the first atomists, Leucippus and his follower Democritus, to whom the only realities were atoms and space. Atoms were considered to vary in size and shape, and all compound bodies are made of them. The atoms are the alphabet of the universe, and the differences among compound substances can be explained in terms of differing sizes, shapes, position and arrangement of atoms. This may be illustrated by letters:

A and M differ in size and shape:

M and W differ in position:

ON and NO differ in arrangement.

The atoms of Democritus were regarded as being in motion and his explanation of the universe is "mechanical". Secondary qualities (colours, sounds, tastes) were denied reality because they could not be explained mechanically.

Once born the atomic concept remained. The notion that matter is composed of small particles, pictured as hard and spherical, is sufficient to explain a wide range of phenomena, especially, as Dalton showed, the laws of chemical combination. What do we mean by "explain"?

In general, a scientific explanation seems to involve three kinds of statement: a general statement which is a theory or hypothesis; a particular statement of a factual or observational character; and a conclusion which is what is to be explained, and which may be a particular fact, or a set of facts, frequently expressed as a "law", e.g., Boyle's Law. The observation that an enormous number of chemical substances have constant composition by weight, expressed in the law of Definite Proportions, is thus "explained" as follows, in syllogistic form.

A. *Hypothesis.*—Dalton's Atomic Theory, which includes the idea that elements contain atoms of constant mass.

B. *Minor Premise.*—Compounds are formed by the combination of elements.

C. *Prediction or Fact to be Explained.*—The composition of compounds is constant.

The search for "explanations" or "causes" is then the search for general hypothesis and this is the chief concern of science. Dalton's theory is such a hypothesis, and it proved adequate to known observations for some decades. Indeed a modern writer (A. J. Berry) remarks "Notwithstanding the widespread confusion over chemical theory in the first half of the 19th century, great progress was being made on the experimental side of the science. Accordingly many chemists, possibly a majority . . . acquired a sort of dislike of theories. . . . Even after the doctrine of valency had been laid down by Frankland and Kekule, the greater part of the progress in chemistry was for long effected with a minimum of theory". This 19th century tradition is still alive in chemistry.

The discovery of the Periodic Law gave perhaps the earliest indication that atoms could not be ultimate particles. Atoms appear at regular intervals which seem to be more complicated versions of lighter atoms. Similarity of property suggests similarity of structure. Moreover Helmholtz, reflecting on Faraday's work on electrolysis, suggested that electricity must be atomic too. Nevertheless, to quote Berry again "In the 19th Century the possibility of subdividing atoms into smaller units was a subject with which chemists were not very seriously concerned." Certainly Graham remarked that "it is conceivable that the various kinds of matter . . . may possess one and the same ultimate or atomic molecule existing in different conditions of movement." But Mendeleef (1902) wrote: "I may mention that the more I have thought on the nature of the chemical elements, the more decidely have I turned away from the classical notion of a primary matter . . . The return to electro-chemism . . . and the notion of a splitting up of atom into "electrons", in my opinion only complicates and in no way explains so real a matter as the chemical changes of substances, which led to the recognition of the invariable . . . atoms of simple bodies."

Between 1895 and 1900 came the experiment of J. J. Thomson which showed that the atom is not a simple entity. The mass of the electron was deduced, 1/1840th of that of the lightest atom. But atoms are neutral electrically, and an assembly of electrons would be unstable. Something positive was required. Lenard studied atomic structure by electron scattering, and showed that atoms are almost perfectly transparent to fast electrons. He suggested a small impenetrable centre, a dynamid, surrounded by an electron cloud of loose texture. Rutherford, with α-particles as projectiles, established the nuclear atom, which in Bohr's hands explained the facts of spectroscopy. Bohr's arbitrary application of Planck's quantum theory gave a stable atomic model. He pictured the electrons as revolving round the nucleus in stationary orbits, and only interacting with the environment during transfer from one orbit to another. In its orbit, the electron was conceived as being immune from detection, an unsatisfactory concept at best. Up to about 1930, there were two fundamental particles, protons and electrons. They were oppositely charged and differed remarkably in mass, $Mp+ = 1836Me-$.

The Neutron.—Helium has mass 4 and nuclear charge 2, and was regarded as made up of 4 protons and two nuclear electrons, with two extra-nuclear electrons. Why is there always a surplus positive charge on a nucleus? May not a nucleus exist with equal number of protons and electrons: in particular with one of each? The discovery of such a neutral particle occurred in due course. Bothe and Becker (1930) noted a penetrating radiation when light elements such as Li and Be are exposed to α-particles. The Curie-Joliots found that the radiation expelled protons from substances containing H, such as paraffins. Known γ rays do not do this, but the observers failed to make the correct deduction. Chadwick (1932) using the Wilson cloud chamber, inferred that the new radiation consists of heavy uncharged particles, since in the photographs of the cloud chamber tracks, that of the particle coming from the Be remains invisible, and hence does not ionise the air, while the tracks of the nuclei which it hits are visible. He estimated the neutron mass as about that of the proton. In fact $Mn = 1839\ Me-$. It was now possible to regard nuclei as made up of protons and neutrons. The electron could only have a place in the nucleus as a constituent of the neutron.

The Positron.—The difference in mass of the positive and negative atoms of electricity remained a puzzle. Positive electrons and negative protons would restore symmetry. Dirac's (1928) relativistic quantum mechanics postulated the existence of a positive electron (e+) and gave the conditions for their occurrence and disappearance. Discovery came from cosmic ray investigations. To demonstrate the presence of radiations and to investigate their properties, small gas-filled ionisation chambers are used. Gases are made conducting by the radiations, which strip off electrons. In measuring the strength of a radiation by the current produced between the electrodes, it is necessary to be sure that no current flows when there is no radiation. In fact the current never vanishes. This was traced (Hess 1912: Kohlhorster 1914) to a radiation coming from interstellar space—cosmic rays. The intensity increases with height and is the same day and night. On the earth's surface, what is observed is the original radiation mixed with electrons ejected from air molecules or produced in other ways (pair production, see below). The cloud chamber tracks are curved in a magnetic field, and electrons are present with speeds which would require 10^{8}–10^{9} volts to produce. Anderson (1932) observed tracks of opposite curvature, produced by particles going in the same direction, and concluded that electrons of opposite sign exist. The positron (e+) was discovered. The discovery supports Dirac's theory. Neither kind of electron is immutable. By colliding they can annihilate each other, with the emission of energy as photons. Conversely a large photon (quantum of radiation) can become the source of a "pair" (e+ and e−). The fact that negative electrons predominate is not inconsistent with the theory.

Photons.—Although the quantum theory dates from 1900, a wave model comes naturally to the minds of most of us when we think of light. It is well to be clear about the role of models, and analogies, in our thinking. If we consider a pendulum, simple equations describe its behaviour if we neglect friction and large amplitudes. These limitations can be removed by appropriate complications in the theory. One can apply the equations to a hypothetical pendulum of length 10^{-20} cms., but one has no reason to believe the results. Such extrapolation far beyond the range of testing, is always tentative. In the same way the application of Newtonian mechanics to a model of elastic colliding balls of negligible volume enables us to calculate the P-V relations of gases at low pressure. But the mass, number, and speeds of the balls are not observed in simple experiments with gases, and we extrapolate far beyond directly measurable quantities. Quantum mechanics, or atom mechanics, is a non-Newtonian theory of the behaviour of mechanical systems. We do not readily conceive models which follow quantum behaviour. Dirac claimed that quantum mechanics contains the solution of all chemical problems. But even with the greatest imaginable development of computing methods, it is certain that the structure of complex molecules, such as organic molecules, will continue indefinitely to be established by what Longuet-Higgins called "the culinary methods of organic chemistry".

Newton interpreted light as a stream of particles, with inertia. Interference phenomena, studied by Young and Fresnel, led to the replacement of this theory by a wave theory. A particle by definition obeyed Newton's laws of motion, and no stream of such particles could be diffracted by a grating. Mathematical expressions had been developed for such wave motions as sound and water waves. Such motions showed diffraction and it was natural to develop a wave model for light. The success of the theory in Maxwell's hands is well known. But Hertz, who found the long electromagnetic waves, radio waves, predicted by Maxwell's theory, also discovered the photo-electric effect, the emission of electrons from metals by light. This and other effects demand a different model for light, a kind of non-Newtonian particles which act like a wave motion when observed in large numbers: all phenomena involving large numbers can be interpreted by the classical wave theory. None of the phenomena involving small numbers can be so treated: in particular one electron is ejected by one light particle, or quantum. The name photon was later adopted.

In considering photons, certain concepts from relativity theory are needed. This theory denies the reality of absolute motion and regards the velocity of light (photons) as finite and the same for all observers regardless of their relative motion. It retains the laws of conservation of energy and momentum. The following equations result, m being the apparent mass of a particle of velocity v, P is the momentum (mv), T is the kinetic energy, and m_0 is the "rest mass" (at v = o):

$$m = m_0 (1 - v^2/C^2)^{-1/2}$$
$$T = (m - m_0) C^2$$
$$C = 3 \times 10^{10} \text{ cm sec}^{-1}$$

The mass, momentum and kinetic energy of a particle of finite rest mass all tend to infinity as v tends to C, the velocity of light. For the photon, the rest mass must be zero, and hence, its total energy E is given by

$$E = h\nu = mC^2$$
$$P = mC$$
$$m = h\nu/C^2$$

For any particle, including the photon,

$$E = mC^2 = T + m_0 C^2$$

where $m_0 C^2$ is a kind of potential energy—the rest mass potential energy. Except for the electron—positron reaction, it has not been possible to release all of this potential energy. In nuclear reactions the decrease in $m_0 C^2$ appears as kinetic energy of the product particles and high energy photons (γ rays).

The Compton effect (1922) is regarded as showing the particle aspect of photons most directly. Compton scattered γ rays (0.7A°) by the electrons of light elements, which are bound by energies small with respect to the kinetic energy of photons. He observed an energy loss (increase in wave length) of the photon in agreement with the particle calculation. If photons are similar to electrons, protons, neutrons and atoms, we might expect the latter to show wave properties if observed in the appropriate way. De Broglie (1925) stated the relation clearly:

$$\lambda = h/P$$

i.e., a particle of momentum P should have an associated wavelength given by this relation. Davisson and Germer (1927) diffracted electrons, and since then other particles have been shown to follow the De Broglie relation. Wave-particle duality is one of the well established principles of atomic physics. The same agency which usually presents itself as a field of electromagnetic force spread out in space and time, can also appear in the form of a quantum of energy and momentum satisfying conservation laws in the way characteristic of a material particle. In the same way, the agency known under its particle aspect as the electron has dynamical functions, e.g., in establishing molecular bonds of the covalent type, which can only be described in terms of fields of force obeying specific wave equations.

Comment was made earlier on the tentative nature of extrapolations to atomic dimensions. One result of macroscopic physics which applies accurately is Coulomb's law, which was found experimentally by observation on charged bodies, and applies equally to nucleus—electron interaction. For example, if the term for the potential energy in Schrodinger's wave equation is assumed to be coulombic, the solution of the equation leads directly to the correct description of the hydrogen spectrum. It appears that Coulomb's law is explicable in terms of the transmission of energy between the interacting charged bodies by contact with the intervening photon field, without "action at a distance".

Neutrinos.—β radio-activity is a nuclear transformation producing positive or negative electrons. The simplest example is neutron decay to a proton and electron.

$$n = P + e^-$$

If the difference between the energy of the initial nucleus n and that of the final nucleus P is ΔE, then the kinetic energy of the emitted electron should be

$$T = \Delta E - mC^2$$

where mC^2 is the energy necessary to create an electron of mass m, assuming the energy conservation law. In fact T has any value up to ΔE and the conservation law appears to fail. Pauli postulated the existence of a particle which plays the role of an almost undetectable carrier of energy (and also spin and momentum), to preserve the conservation law. The neutrino hypothesis is self-consistent and makes possible a theoretical description of β decay from which predictions can be made and tested.

$$n = P + e- + \nu^{\circ}$$

Kinetic energy is shared between the electron and neutrino in varying proportions. In a further development of the theory, Fermi regarded protons and neutrons as different inner quantum states of the same "particle". A quantum jump between the two states results in the creation of an electron or positron, depending on whether the initial state of the "particle" was the neutron or proton state. A neutrino or antineutrino is simultaneously created and the pair, either electron and neutrino, or positron and antineutrino, are ejected from the nucleus, sharing the available energy.

Mesons.—If Heisenberg's theory that atomic nuclei are built of neutrons and protons is to hold, a theory of nuclear forces is required. The neutron-proton force law can be studied by neutron scattering by protons. The results indicate (a) that the force falls off very rapidly with distance, with an effective range of 3×10^{-13} cms: (b) the force is non-central, depending on the angle between the axes of spin and the line joining the particles: (c) interaction varies with the relative speeds of the particles, especially at speeds greater than 0.1C. Yukawa (1935) tried the assumption that the forces are transmitted by a field, in the same way as the Coulomb forces are transmitted by the electromagnetic field. Since the nuclear forces do not follow the inverse-square law, the field equations must be different. An expression for the potential energy was developed and the modified wave equation leads to waves which are propagated, not with velocity C, but with a velocity depending on the energy hv of the associated particle. The particle hence has a finite rest mass, and from the formula for the potential this mass is 150-250 electron-masses. Particles of such mass were discovered in cosmic ray experiments (Anderson 1935) and named mesons. These were charged particles, and neutral mesons were observed later, followed by a complex array of new particles with masses ranging up to and above that of the proton. Artificial mesons have been made by allowing particles (e.g., protons) accelerated to high energy in the synchro-cyclotron to impinge on a target. Just as a beam of electrons produces photons (X-rays) on striking a target, so a beam of "nucleons" (nuclear particles) radiate π mesons.

We have then the following:—

Atomic Building Stones.

m = mass of electron.

	Rest Mass.	Charge.	
Proton	1836 m	+1	
Neutron	1839 m	0	
Electron	m	−1	
	Atomic "Cements".		
	Rest Mass.	Charge.	Av. Life.
Photon	0	0	Stable
π^{0} meson	262 m	0	$< 10^{-4}$ sec.
$\pi+$,,	275 m	+1	2×10^{-8} sec.
$\pi-$,,	275 m	−1	2×10^{-8} sec.

With regard to nuclear stability, we may consider an analogy. Let us assume we are investigating hydrogen and helium, and can only give them energies up 5 electron-volts (115,000 calories per mole). We could neither ionise them nor even raise the electrons to high energy levels. We could not learn explicitly of the existence of the electron. The process $H_2 = 2H$ could be studied, and atomic scattering experiments performed, giving information about interaction energies which could be described by potential energy curves. We would regard the hydrogen and helium atoms as fundamental particles. At higher energies, as we learn to develop and control them, ionisation occurs and new phenomena appear. Theory has to be based on electrons and nuclei, and the earlier theory becomes a limiting approximation at low energies.

For the nucleus, most current information comes from a relatively low energy range. To excite or dissociate protons and neutrons, if they can undergo such processes, very high energies are needed. However, the complexity of nuclear interaction suggests that these particles may be complex. If they are, a theory may be successful parallel to that of chemical bond. Suppose for example that the proton and neutron are each systems of two particles, one heavy and the other light (cp. Hydrogen atoms). When a proton and neutron approach each other, the light particles might interact and "exchange" in the manner of electrons. If these particles have half a unit of spin, the potential might become repulsive at very short distances, as the Pauli principle requires. On the other hand, nuclear stability may depend on factors not yet thought of at all.

On the experimental side, high energy cosmic rays may prove to be a vital tool. They are known to cause many disintegrations, for example in photographic emulsions. In some manner our present "building stones" may yet be disintegrated and it will be said again of some future Rutherford that "he divided the indivisible, made plain the invisible, destroyed the indestructible and unscrewed the inscrutable".

SOME IMPRESSIONS OF RESEARCH IN NEW ZEALAND.

By S. Y. Thompson,

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It is natural for a visitor from abroad to begin making comparisons between the conditions and opportunities which exist in his country, in this instance Great Britain, and the country he is visiting. Comparisons of this sort are difficult to make owing largely to differences in the economic pattern of the two countries and represent very much the particular viewpoint of the visitor who, in these days of extreme specialisation, can only hope to come in contact with a small fraction of the total research organisation of any country. Fortunately in this instance the author can confine his attention to agricultural and related research without having narrowed the field too much, in this country at any rate, and at the same time he can remain not too far removed from his own sphere—biochemistry.

Some comparisons between the research organisations in the two countries seem appropriate at this point.

In Great Britain three government organisations have been established under the Lord President of the Privy Council to assist and co-ordinate scientific research on all problems that affect the life and activities of the nation as a whole. The three organisations are the Department of Scientific and Industrial Research, the Medical Research Council and the Agricultural Research Council. The relations between these three organisations are very close. Where agriculture touches industry, as for instance in the processing and storage of agricultural products, much of the necessary research work is undertaken by the Department of Scientific and Industrial Research. Where agriculture touches medicine and public health, as for instance in the nutritional value for man of different agricultural products, much of the research work required is undertaken by the Medical Research Council. The Agricultural Research Council was the last of the three organisations to be set up and came into being in 1931. Because of the author's particular interest and the importance of agricultural research to New Zealand most attention will be given to the work of this Council. The duties of this body are to give advice and criticism to the agricultural departments (the Ministry of Agriculture in England and Wales and the Department of Agriculture for Scotland) on research grants and on programmes of Research Institutes, and to expend at its discretion money specially provided from the Development fund. Established by Royal Charter, it is answerable to a Committee of the Privy Council, and not to any Government department. The Agricultural Research Council consists of fifteen members and is made up of certain Ministers of the Crown who are members of the Privy Council, ten scientists, appointed after consultation with the President of the Royal Society, and eminent in the basic sciences underlying agriculture, and others appointed because of their experience and interest in agricultural affairs. In the constitution of the Council we see again the desire to keep research free from direct government control, the same desire that led to the placing of the earlier Research Institutes in the Universities.

The relations between the Ministry of Agriculture or the Department of Agriculture for Scotland and the Agricultural Research Council can be regarded as vertical, the Council assisting the Ministry or the Department by co-ordinating agricultural research throughout the country as a whole and thus helping to provide new knowledge that can be passed on to the practical farmer. The relations between the Agricultural Research Council and the Department of Scientific and Industrial Research or the Medical Research Council can be regarded as horizontal, each organisation while primarily concerned in investigations within its own sphere, endeavouring to link together all fields of scientific research for national service. In addition to their relations with various Government departments these three research organisations keep in touch with Universities, and by making special research grants and in other ways, endeavour both to stimulate the development of research in the subjects with which they are concerned and to recruit able young scientists for the Research Institutes which are devoted wholly to investigations within their special fields.

The Agricultural Institutes in Great Britain may be divided into three categories:—

(a) Those under the direct control of the Ministry of Agriculture and the Department of Agriculture for Scotland. In this category come the Veterinary Laboratory at Weybridge and the Plant Pathology Department at Harpenden which are concerned mainly with research and routine investigation in connection with those diseases of animals and plants for whose control the Ministry is the responsible authority. In Scotland similarly there is the seed testing, plant registration and plant-pathology service.

(b) Those under the direct control of the Agricultural Research Council. Most of these stations or units have been set up since the war mainly to fill the gaps between (a) and (c).

(c) Those, the greater number, which with certain exceptions, have their own governing bodies, but which are financed entirely by maintenance grants. The grants are borne on the votes of the Ministry of Agriculture or the Department of Agriculture for Scotland and made on the advice of the Agricultural Research Council. The National Institute for Research in Dairying at Reading comes in this category.

An Agricultural Research Institute may vary in size from the large experimental station such as Rothamsted to A.R.C. units of a few workers housed in a University Department or elsewhere.

Apart from research in private organisations, there are three ways in which research can be carried out in England. It can be carried out by the individual usually a teacher; many problems, however, from their magnitude will be beyond him as he will have routine teaching to do and only perhaps a few voluntary assistants. Yet it is important that research should be encouraged in the higher training centres, otherwise there will be no production of the recruits necessary for research in the State-aided Institutions. Financial assistance is therefore given to the Universities to promote research; it is not given to the individuals as it is not desirable that a University should find itself with staff owing part allegiance to an external authority.

Secondly, in the history of the development of agricultural research we pass to the part played by institutions founded and endowed by a wealthy citizen or to the voluntary society which by supplying financial aid, supported agricultural investigation. The best known institution of this type is Rothamsted, recognised the world over as the leading centre for soil research.

Lastly, and at present the most important factor in the national system of agricultural research, is the institution or organisation supported wholly from public funds.

The following policy was decided for the State-aided research:—

(a) To establish a number of research institutes in or attached to existing Universities;

(b) To finance agricultural research workers of established reputation wherever they might be found; and

(c) To establish a national advisory service to help in applying the research findings.

The decision to attach Research Institutes to Universities was due to the desire that research should be carried out by self-governing and independent bodies and not by departments directly controlled by the State. The Universities possessed this independence and consequently all earlier research institutes were connected with them.

The basic qualification of the agricultural research worker is normally a degree in pure science or an honours degree in agricultural science, followed by specialisation in some appropriate subject. In addition to basic qualifications, however, some specific post-graduate training in research is usually desirable. This is provided for by the Agricultural Research Scholarships, thirty being awarded annually.

Before the results of agricultural research can be utilised by farmers, they have to be tested in actual practice and often modified to meet local needs. Finally their value has to be demonstrated to farmers. This is the work of the Agricultural Improvement Councils of the two departments of Agriculture and the National Agricultural Advisory Service in England, Wales and Scotland.

A joint committee of the Agricultural Improvement Council, the Scottish technical committee and the Agricultural Research Council ensures that the different stages in the progress of research from its fundamental aspects to its application in practice proceed smoothly. Through this arrangement the problems of farmers are carefully considered and analysed, then passed to the appropriate research agencies. This also ensures that the research service is free to carry out fundamental research and is not encumbered with the day to day problems of the farmer. It is the duty of the National Agricultural Advisory Service to deal with the latter.

What about the cost? The current annual maintenance expenditure from public funds for agricultural research amounts to about £1,600,000 per year. Of this sum £1,320,000 is distributed almost equally between research on plants and soils and research on animals, the balance being spent on engineering and other problems. The personnel engaged on State-aided agricultural research number about 700 scientists.

The National Agricultural Advisory Service has a staff of about 1,800 and costs nearly £2,000,000 to run. But no simple machine can provide each of 350,000 farmers with competent advice on each and every problem that may arise and the cost is only a three-hundredth of the value of the annual output of the country's farms (£600,000,000).

There are three activities involved in making available the resources of scientific knowledge and education to the industry of agriculture. There is research work, advisory work and education in the teaching sense. So far this article has dealt with the first two only.

Institutions which are concerned with agricultural instruction and education of pupils and students fall into four groups: (i) schools, (ii) county classes and farm institutes, (iii) colleges and (iv) universities.

It is considered important even in industrial England that pupils who go into non-agricultural occupations do so with some knowledge and understanding of farming. This is regarded in Great Britain as most necessary, because the maintenance of an informed public opinion, about what must always remain her basic industry, is a matter of first importance. An increasing number of schools have agricultural classes and many have young farmers' clubs associated with them and staffs of agricultural colleges or local farmers co-operate in giving talks or farm visits.

For many years the Government has assisted county councils by paying a fixed percentage of approved expenditure and has assisted college and University Departments of Agriculture by grants towards current and capital expenditure. Practically all counties have an organiser of agricultural education with a staff of assistant agriculturalists qualified in Dairying, Husbandry, etc. They organise systematic courses of instruction of day and evening classes and foster farmers' discussion groups and young farmers' clubs.

Some counties have experimental farms and a few of these are residential 'Farm Institutes' catering for young people 17-18 years of age onwards for whom the advanced courses at Colleges or Universities are not appropriate and who intend earning their living on the land. The course lasts one year and in addition to lectures, stresses the practical aspects. It is contemplated that there will be similar institutes for horticulture and that the present number will be raised from 17 to 40.

The institutions concerned with 'higher' agricultural education are:—

(a) Agricultural Colleges where courses are held for the National Diplomas in Agriculture, Dairying, etc., and for external London degrees in Agriculture and Horticulture.

(b) Agricultural Colleges at Wye and Sutton Bonnington which have become University Departments of Agriculture.

(c) Departments of Agriculture in former Colleges which have since become Universities, e.g., Bangor and Aberystwyth which are now in the University of Wales, and the Yorkshire College at Leeds which became the University of Leeds in 1904.

(d) Departments of Agriculture at Oxford, Cambridge and Durham were established in existing Universities.

In Scotland there are three centres for agricultural teaching, at Edinburgh, Aberdeen and Glasgow.

The National Diploma in Agriculture has been popular since it was established in 1898 and is a two-year course provided by all Agricultural Colleges. There are also National Diplomas in Dairy Husbandry, Dairy Technology, Horticulture, and Poultry Husbandry. The ratio of people taking degrees to the National Diplomas has increased for many years and it is difficult to forecast the future of the National Diploma. A University degree course in agriculture lasts normally over three years and involves the student in pure science to begin with and later in agricultural science. In the future post-graduate diploma courses may be taken by those who have taken a general agricultural degree and wish to specialise in various branches of agriculture. In the past most University Departments of Agriculture have made some provision for agricultural students to specialise in one of the agricultural sciences, e.g., agricultural chemistry, but the time has come when the agricultural specialist must be fully trained in his special subject. There are now, therefore, under consideration, post-graduate courses for graduates in pure science, e.g., in agricultural chemistry for graduates in pure chemistry.

Readers will be familiar with the organisation of research and education in New Zealand and the foregoing provides a basis for comparison between the two countries. There are some points of similarity and some major differences. In New Zealand, the Department of Health has in its particular field, as the guiding influence for research, the Medical Research Council. The Minister for Scientific and Industrial Research has the services in an advisory capacity of the Council for Scientific and Industrial Research. There is no third body in the shape of the Agricultural Research Council to deal exclusively with agricultural research and no committees similar to those of the Privy Council to act as buffers between the research councils and the Government department.

The field of agricultural research is shared between the Departments of Agriculture and of Scientific and Industrial Research, the former dealing broadly with the animal side and the latter with the plant side, while soil research is shared.

The Council for Scientific and Industrial Research is the co-ordinating body for numerous investigations carried out by Government Departments, the University and Research Institutes and is able to provide financial support for the expansion of particular investigations. Research and services carried out for the benefit of the farming industry naturally form a large part of its activities. Of its grant of £1,000,000 about 40 per cent. goes to the seven branches directly concerned with agriculture, the research associations and institutes and the two agricultural colleges, although the latter receive only 1 per cent. of the total grant.

The Department of Agriculture with its Animal Industry, Dairy, Horticultural, Extension and Marketing Divisions and also the Animal Research Division with their stations at Wallaceville and Ruakura, has some points of similarity to its British counterpart. At Wallaceville much of the work is diagnostic and of direct help to the veterinarian and hence to the farmer; but like the veterinary laboratory at Weybridge, they do carry out original research work. But in the Department of Agriculture in England there is no counterpart to the Ruakura Animal Research Station, established on a scale adequate for the investigation of many problems of animal breeding, animal nutrition and management problems connected both with stock and pastures. In many respects this station fulfils the functions of the experimental farms of the National Agricultural Advisory Service.

It may not be a justified criticism but there appears to be a lack of central co-ordination for research. This may not have been necessary in the past with a relatively small organisation, but will be so with an increasing number of stations and workers.

What is the position regarding agricultural education in New Zealand? Agricultural educationists here deplore, quite rightly, the virtual lack of agricultural education at primary school level and also that at post-primary level it is neglected in favour of such urban activities as engineering, woodwork, arts and craft, home science and physical education and other subjects of commercial and industrial interest. The education of the adult farmer is largely in the hands of the Extension Division of the Department of Agriculture as is also the organisation and supervision of the young farmers' clubs. Many of its staff have made outstanding contributions to agriculture. Its field workers have, however, to cope with a gigantic task, being few in number, underpaid, and under civil service control. Only 80 per cent. of their time can be devoted to their primary function of education.

Adequate facilities for higher education to a degree standard are provided at Lincoln and Massey Agricultural Colleges, but a large proportion of students are on short courses of a non-degree character, which means that the best brains as teachers are squandered largely on a number of students who cannot rise to degree level to the detriment of those who can.

It is probably truer to say, in New Zealand more than in any other country, that the provision of an adequate supply of men with degree qualifications to enter professional agriculture is of great national importance. Yet out of 1,200 degrees granted annually by the University of New Zealand only 1 per cent. are directly concerned with agriculture despite the fact that it is on the efforts of those engaged in primary industry that the national income and prosperity depends.

This apathy towards agriculture reflects the attitude which is prevalent not only in New Zealand but in many other countries. An eminent educationalist in reply to an anxious parent said: "In no circumstances should any of the subjects included under the heading of Agriculture be taken at this stage. They are merely padding to fill up the curriculum for boys who are too stupid to do anything else."

This attitude has prompted Dr. Burns, Director of Canterbury Agricultural College to say:—"Agricultural education has been and is now the poor relation, the Cinderella in our educational system, and the attitude throughout the community which fosters this view must be changed. If agricultural education in the schools, from the primary level to the Universities, is put into its right place and an adequate proportion of the really able students are attached to it and given good opportunities, then the future of this country is bright."

Surely a New Zealander who has not made some study of agriculture has no right to consider himself well educated, and yet there is nothing in the present educational system to ensure that all New Zealanders have this knowledge.

Out of a total production of £400,000,000 nearly two-thirds are due to agriculture and the bulk of this is exportable surplus. It is this surplus which is to a large extent a measure of a nation's wealth. In 1952, exports of pastoral products amounted to £228,100,000 out of the £240,500,000 total merchandise exported. Yet of the total expenditure of £13,000,000 made by the Government for the development of primary and secondary industries only about £1,000,000 was for scientific and industrial research representing about ½ per cent. of the gross farm income.

Some idea of the monetary value of research to New Zealand agriculture can be gained from an estimate made by Dr. W. M. Hamilton that the contribution of science is worth more than £6,000,000 annually. What a handsome dividend for an annual outlay of £1,000,000 on research! Although this sum underestimates the monetary value of research, it does give some idea of the magnitude of the contribution made by science to the prosperity of New Zealand's agriculture. With the present shortage of manpower in New Zealand, the brighter students obviously follow courses which offer greater financial reward than agriculture, such as medicine, dentistry, veterinary, or the pure sciences.

It has become customary for Agricultural Research Institutes in Great Britain to appoint graduates with pure science degrees. This is also now the case in State Departments in New Zealand concerned with Agricultural Research and points either to an insufficiency of able agricultural graduates or to the feeling that the pure science graduate has had better training. Many of the outstanding contributions to various aspects of agriculture have been made by workers trained in pure science who, through working at agricultural institutions, have in fact acquired in this way a post-graduate training in agriculture. It has been suggested both in England and New Zealand that probably the best training, in view of the heterogeneous nature of the agricultural degree, is for graduates to take pure science and then post-graduate courses in agricultural sciences.

What appears to be needed, particularly in New Zealand, is a clear distinction in the type of course suitable for a man who is to proceed to (a) farm work, (b) extension work and (c) agricultural research on fundamental problems. The need of (a) is met in England by Farm Institutes, (b) by the general agricultural course at the Universities and (c) by the Honours Agricultural Chemistry or Botany course or the pure science graduate who has entered a Research Institute working in the agricultural field. In fact in every field the more fundamental the work the less likely one is to find graduates whose initial training was specialised.

No one would deny that agriculturists the world over and in Great Britain in particular, have the highest esteem for the excellent research work which has and is still being done in New Zealand. A great deal has been done in soil research, in selection of improved pasture plants, and in the development of an efficient agriculture both in the field and in the factory.

The author has seen so far only a cross section of the total research going on in this country, ranging from research in pure physics, a line to which New Zealand has a just claim to fame and biochemical research at Otago, Lincoln, Massey, the Cawthron Institute and the Grasslands Division and Fats Research Laboratory of the D.S.I.R. In general there would appear to be no lack of quality in either men or facilities and no lack of scope for more research work—quantity is the missing factor.

For some reason, either due to restricted nature of the research field or to more direct control by Government Departments and Producer Boards, much of the research is, and must be, mainly applied research, i.e., the pursuit of science for its immediate utilitarian aspect. However, in many fields problems crop up about which there is insufficient fundamental knowledge and perhaps no work proceeding abroad. Many such problems must surely be best investigated here. Many of these problems are biochemical and there would appear to be a need for more courses in biochemistry in the constituent and agricultural colleges with scholarships to foster post-graduate research within the University.

The necessarily small size of the research organisation in New Zealand leads to a sense of scientific isolation particularly in the Agricultural Colleges. There is little doubt that to some extent this is overcome so far by New Zealand's policy of sending some of her graduates abroad for post-graduate training. This has benefited not only the graduate through the contacts and the experience gained, but the country through the introduction of new knowledge and specialised techniques from abroad. There is no doubt that given more facilities for research in the framework of the University, the Agricultural Colleges in particular, more graduates would come to New Zealand for post-graduate training and to qualify for higher degrees. The author was made particularly aware just before he left Britain of the growing interest among graduates in the prospects for scientific work in New Zealand particularly in the agricultural field. They were interested in the various fields of research being developed here and would welcome an opportunity to be able to work in this country for a few years. An increase in the number of visiting scientific workers would again reduce this sense of isolation and given reasonable prospects could lead to the retention in this country of valuable scientific personnel. The demand for movement within the Commonwealth is amply shown by the fact that there were 54 applicants in the first year of the Royal Society and Nuffield Commonwealth Bursary Scheme; funds were however available for only 15. The distance separating our two countries is probably the main obstacle to the freer interchange of scientists due to the time and cost involved in travelling. There would seem to be a need for the provision of adequate bursaries and fellowships for travel and maintenance by Government and industrial organisations and at the same time, that senior scientists in New Zealand should be given more opportunity to supervise research by freeing them from elementary teaching and routine administration.

PERIODICALS RECEIVED BY THE NEW ZEALAND INSTITUTE OF CHEMISTRY.

The following is a list of periodicals currently received by the New Zealand Institute of Chemistry. With the exception of Nature which is supplied by Messrs. G. W. Wilton & Co., Ltd., and the Australian Journal of Applied Science supplied by Messrs. Abels Ltd., Auckland, these periodicals are received in exchange for copies of our own Journal. They are housed at the Auckland Institute and Museum and may be borrowed on application to the Librarian, Auckland Institute and Museum, P.O. Box 9027, Auckland, S.E.1.

Acta Chemica Scandinavica.
Arhiv za Kemiju.
Asociacion Quimica Argentina. Anales.
Associacao Quimica do Brasil. Boletim.
Australian Journal of Applied Science.
Chalmers Tekniska Hogskolas. Handlingar.
Chemistry in Canada.
Chimie Analytique.
Deutsche Akademie der Wissenschaften zu Berlin. Sitzungsberichte. Klasse fur Mathematik und allgemeine Naturwissenschaften.
Industria y Quimica.
Irish Chemical Association Journal.
Journal for Scientific Research (Indonesia).
Kemija u Industriji: Casopis Kemicara i Technologa Jugoslavije.
Nature.
Reviews of Pure and Applied Chemistry (Royal Australian Chemical Institute).
O.S.R. Bulletin and O.S.R. Publication (Indonesia).
Polish Technical Abstracts.
Revista Portuguesa de Farmacia.
Royal Australian Chemical Institute Journal.
Royal Institute of Chemistry Journal.
South African Chemical Institute Journal.
South African Industrial Chemist.
Svensk Kemisk Tidskrift.
Tidskrift for Kjemi, Bergvesen og Metallurgi.
Uppsala Kungl Lantbrukshogskolans Annaler.

CONFERENCE.

The following is a list of papers which will be presented at the 1955 Conference:—

INDUSTRIAL CHEMISTRY.

1. The purification of geothermal steam.
G. Maskill Smith (Dominion Laboratory).
2. Unsolved problems in the Kraft pulping industry.
D. L. Stacey (Forest Products).

FATS CHEMISTRY.

3. The modification of dietary fat in the rumen.
R. O. Weenink (Fats Laboratory).
4. Variation in fat content of milk throughout milking.
W. G. Whittlestone (Ruakura).
5. Some minor fatty acids of shark liver oil.
Isobel M. Morice (Fats Laboratory).
6. Some aspects of carotene metabolism.
W. A. McGillivray (Massey Agricultural College).
7. The metabolism of carotene and vitamin A given intravenously to calves, rabbits and rats. S. Y. Thompson (Reading).
8. Metabolism of the antioxidant butylated hydroxyanisole in the animal body. J. C. Dacre (Medical School).

SOIL CHEMISTRY.

9. Excess soluble salts in glasshouse tomato soils.
K. J. McNaught (Rukuhia).
10. The reaction of crushed limestone with an acid soil.
B. E. Elphick (Lincoln).

PHYSICAL CHEMISTRY.

11. The kinetics and mechanics of the reactions of the trimethyl halogeno-silones with methyl magnesium halides. C. J. Wilkins (Canterbury).
12. Heats of solutions of the rare gases in water.
D. M. Alexander and H. N. Parton (Otago).
13. Bromamines. J. K. Johannesson (Wgtn. City Council).

PLANT PHYSIOLOGY.

14. The return of mineral nutrients to the soil under exotic conifers.
G. M. Will (Forest Res. Inst.).
15. Nitrogen metabolism of azobacter. R. M. Allison (Lincoln).
16. Exudes from clover roots.
G. W. Butler and N. O. Bathurst (Grasslands).

ORGANIC CHEMISTRY.

17. The synthesis of some polycyclic aromatic hydrocarbons.
A. D. Campbell (Otago).
18. The action of ammonia on the reducing sugars.
E. L. Richards (D.R.I.).

WATER AND SEWAGE CHEMISTRY.

19. The practical treatment of small water supplies.
F. L. Lowe (Candy Filters).
20. Pollution of Wellington harbour.
J. K. Johannesson (Wgtn. City Council).

INDUSTRIAL CHEMISTRY.

21. Chemical engineering problems of large-scale algal cultures.
M. I. Kennedy and N. W. Vere-Jones (Dom. Lab.).
22. The function and scope of the metallurgist in industry.
W. F. Chubb (Cairo).

PROTEIN CHEMISTRY.

23. Ultra centrifugal analysis of plant proteins.
J. W. Lyttelton (Grasslands).
24. The amide and C-terminal residues in proteins.
J. L. Mangan (Grasslands).

ANALYTICAL CHEMISTRY.

25. The use of flame methods of analysis for agricultural materials.
J. E. Allen (Rukuhia).
26. Some analytical applications of disodium ethylene diamine tetra-acetic acid.
A. J. Metson (Soils Bureau).

Papers 1 and 2 will be presented on the afternoon of Tuesday, 23rd August, following the Official opening of the Conference. Wednesday morning will be devoted to Fats Chemistry (papers 3 to 8) with a concurrent Soil Chemistry Session (papers 9 and 10) during the first half of the morning. In the afternoon the Annual General Meetings of the New Zealand Institute of Chemistry and the

New Zealand Section of the Royal Institute of Chemistry will be held at 2 p.m. and 4 p.m. respectively. Papers 11 to 13 will be presented on Thursday morning concurrently with papers 14 to 16 and following morning tea, papers 17 and 18 concurrently with papers 19 and 20. On Thursday afternoon there will be a further Industrial Chemistry Session (papers 21 and 22) followed by an address by the Guest Speaker, Dr. C. M. Johnson (Kearney Foundation for Soil Science, University of California) on "Chlorine as a Plant Nutrient". The remaining papers, 23 to 26, will be presented in combined sessions on Friday morning and the afternoon will be devoted to visits to laboratories, etc. On the Tuesday evening, the Chairman of the New Zealand Section of the R.I.C., Mr. H. G. Woolman, will present his Chairman's Address. Wednesday evening will be a Social Evening and Thursday evening will be free for discussion groups, etc.

OFFICIAL NOTICE.

A GENERAL MEETING OF THE NEW ZEALAND INSTITUTE OF CHEMISTRY (INC.) WILL BE HELD IN ROOM D4, MASSEY COLLEGE, PALMERSTON NORTH, ON WEDNESDAY, 24th AUGUST, 1955, AT 2 P.M.

AGENDA

1. Confirmation of Minutes of previous General Meeting held at the Girls' College, Nelson, on August 26th, 1954.
2. Business arising from Minutes will be dealt with below under respective headings.
3. Presidential Remarks.
4. Institute Prizes.
5. Activities of Institute Sub-Committees:—
    1. Membership.
    2. Journal.
    3. Professional Status.
    4. Salaries.
    5. Examinations.
    6. Standards Institute.
    7. Employment of Chemists, (N.Z.I.C. and R.I.C.)
    8. Conferences (N.Z.I.C. and R.I.C.)
    9. Patents.
    10. U.N.E.S.C.O.
6. Commonwealth Scientific Societies.
7. Benevolent Fund.
8. Finance-Statement of Receipts and Payments.
9. Rules and Regulations.
10. General.

W. G. HUGHSON,
Hon. General Secretary.

NEWS AND NOTES.

Mr. B. G. Stanley, of the Shell Company, is shortly leaving Wellington for the United Kingdom where he is to gain extended experience of the market development of petroleum chemicals. Mr. Stanley, who will be away one or two years, will originally be working in London, but may later visit the Continent. During the past year Mr. Stanley has been acting as the Assistant Honorary General Secretary to the N.Z.I.C.

Dr. P. G. Harris has been appointed to the Department of Geology at Leeds University where he will lecture in geochemistry and mineralogy. Dr. Harris, who is at present working in the rock analysis section of the Dominion Laboratory, hopes to be able to continue his work on the origin and geochemistry of volcanic rocks.

Mr. L. Hartman, of the Fats Research Laboratory, has left to spend six months' leave overseas. While he is away, Mr. Hartman hopes to study recent developments in the chemistry and technology of fats, waxes and detergents. He will travel via Australia and Europe to the United Kingdom where besides visiting various industrial establishments and research laboratories he is to give some lectures arranged by the Society of Chemical Industry. Before returning to New Zealand, Mr. Hartman will spend two months in the United States where he has been invited to present a paper on the recent work of the Fats Research Laboratory at the fall meeting of the American Oil Chemists' Society.

It was with regret that the Wellington Branch said goodbye to Dr. W. S. Metcalf on his recent departure to Christchurch. Dr. Metcalf has been very active on the Wellington Committee for some two years and his energetic ideas and enthusiasm have always been a great asset to the branch.

Mr. A. I. Biggs, Chemistry Department, Kuala Lumpur, has been appointed Chief Chemist, Federation of Malaya. He has also been elected a Fellow of the Royal Institute of Chemistry.

Mr. E. Schache, at present with Harvey Sims Ltd., Auckland, is leaving shortly to take up the managership of Rubber Distributors Ltd., Wellington.

Mr. L. H. Bird, a member of the staff of Wheat Research Institute since 1938, has resigned to take up a position as Cereal Chemist with the Agricultural Research Institute, Waggawagga. He was Secretary-Treasurer of the Canterbury Branch from 1938 to 1940 and Chairman in 1948. He was farewelled at the May meeting of the Branch.

Dr. R. M. Allison, of the Crop Research Division, D.S.I.R., has returned after completing a Ph.D. degree at the University of Wisconsin where he worked on biological nitrogen fixation.

Mr. T. A. Mitchell, formerly on the staff of the Rukuhia Soil Research Station, has joined Messrs. H. C. Urlwin Ltd., Christchurch, as Supervisor of their Plastics Division.

Mr. R. M. Grigg, formerly of B.A.L.M. (N.Z.) Ltd., has been appointed General Manager of the Leader Paint Co., Christchurch.

Mr. W. F. Rolt, a Christchurch industrial chemist, has joined the staff of the Rukuhia Soil Research Station.

At the recent Annual Meeting of the Royal Society Council, chemists formed a large proportion of those present. These included Professor L. H. Briggs (Vice-President), Professor F. G. Soper (Fellows' Representative) and the following branch representatives; Dr. E. B. Davies (Waikato), Mr. O. H. Keys (Otago), Dr. H. O. Askew (Nelson), Dr. J. K. Dixon (Rotorua) and Mr. S. G. Brooker (Auckland). The item of most interest to Chemists was that no progress was made with the proposal to affiliate other scientific bodies with the Royal Society.

The 1956 Conference Committee is already active in Auckland. Its chief officers are: Chairman, Professor F. J. Llewellyn; Secretary and Registrar, Mr. H. S. Maslen, Chemistry Department, Auckland University College.

Institute Expenditure.

It has been suggested that members might be interested to know the proportion of their subscriptions which are spent on the various Institute activities. The Registrar has therefore analysed the net expenditure over the last five years in terms of the subscription revenue. The Institute has, of course, income other than subscriptions, but this has been offset against the appropriate headings to give the figure actually paid out of subscriptions, e.g., the Journal figure is the total printing and publishing cost less revenue from advertising, etc.

It should be pointed out that the excess income shown for 1954 does not represent the true position since it does not take account of expenditure to which the Institute was already committed and for which provision had in fact been made, e.g., printing of list of members and books of rules. The 1955 excess income may be expected to be further reduced with additional travelling expenses, the Jubilee issue of the Journal and increased grants to branches.

	1954		1953		1952		1951		1950	
	£	%	£	%	£	%	£	%	£	%
Administration:										
(a) Fees .... +	190	19	240	25	250	26	180	28	160	26
(b) Services .... ++	200	20	240	25	220	23	130	20	130	21
(c) Travelling	70	7	100	10	70	8	60	10	70	12
(d) Overseas Visitors	30	3	20	2	—	—	—	—	—	—
Journal:	260	26	230	24	250	26	230	36	110	18
Excess Income	250	25	140	14	160	17	40	6	140	23
Total Subscription Revenue	1000	100	970	100	950	100	640	100	610	100
No. of Members	480		468		455		429		400	

\+ Includes Honorarium. Hon. Gen. Sec.; Registrar's, Auditor's, Legal Fees.

\+\+ Includes Printing, Stationery, Branch Allowances, Postages, Duplicating and Addressing, Tax.

COUNCIL MINUTES.

ABRIDGED MINUTES OF A MEETING OF THE COUNCIL OF THE NEW ZEALAND INSTITUTE OF CHEMISTRY (INC.) HELD IN THE COUNCIL ROOM, DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, ON FRIDAY, MAY 27th, 1955, AT 10 A.M.

PRESENT:

K. M. Griffin, President, in the chair; Dr. M. M. Burns, Vice-President; J. Ricketts, Auckland Delegate; N. T. Clare, Waikato Delegate; Dr. F. H. McDowall, Manawatu Delegate; T. A. Rafter, Wellington Delegate; F. H. G. Johnstone, Canterbury Delegate; Dr. G. A. Bottomley, Otago Delegate; V. J. Wilson, Registrar; B. G. Stanley, Assistant Secretary; W. G. Hughson, Hon. General Secretary. (D. G. Howard, Business Manager of the Journal, attended for a short period to present his report and participate in discussing it).

WELCOME:

The President drew attention to the fact that this was the first of a continuous series of at least seven meetings of Council-in-person, extending over 1955 and 1956.

REPORTS FROM SUB-COMMITTEES OF COUNCIL:

Conference, 1955 (Palmerston North): H. G. Woolman, Chairman of the N.Z. Section of the Royal Institute of Chemistry has agreed to give his Presidential Address at this year's Conference. Dr. McDowall, Chairman of the Conference Committee, reported generally on registrations, lectures and addresses, accommodation, refreshments, etc.

Resolved: THAT this Council, learning from the Conference Committee of the possible visit of Dr. C. M. Johnson, a Fulbright Scholar now in Australia, conveys to the United States Education Foundation on behalf of the Institute, our appreciation of their interest in the projected visit to New Zealand of a scientist with special knowledge of trace elements.

Resolved: THAT this Council is interested to hear of the projected visit of Professor Eyring, whose interests include wool and we await further information.

Resolved: THAT recognition be given to this the JUBILEE Year of the Institute at the Social Evening to be arranged during the Conference, that W. A. Joiner, first Secretary of the Institute, be asked to speak to a toast to the Institute and that K. M. Griffin, President, make the response.

The Secretary was asked to see Professor W. P. Evans, Founder President of the Institute to see if there is any possibility of his attending the Conference. Delegates were asked to arrange in some way for the history of their particular Branch to be written up in a form suitable for publication.

Future Conferences: The list set out previously was approved and Auckland announced that they had already held their first meeting of the Conference Committee for 1956 in Auckland under the Chairmanship of Professor F. J. Llewellyn.

A.N.Z.A.A.S. Melbourne, August, 1955:

Resolved: THAT in addition to T. A. Rafter, who was appointed delegate at last meeting of Council, a second delegate, Dr. F. B. Shorland, be now appointed.

Resolved: THAT congratulations be extended to Dr. F. B. Shorland, on behalf of the Institute for being awarded the Hector Medal of the Royal Society of N.Z. and for being elected to give the Liversidge Lecture at the Melbourne meeting of A.N.Z.A.A.S.

Resolved: THAT Dr. L. H. Briggs, an officer of A.N.Z.A.A.S., be thanked for his willingness to represent New Zealand in an unofficial way at the Melbourne Conference.

U.N.E.S.C.O.:

Resolved: THAT Wellington Branch be empowered to appoint a representative to the Technical Sub-Commission on Science in place of Dr. W. S. Metcalf, subject to confirmation by the Council.

Salaries:

Resolved: THAT the following telegram be sent to the Prime Minister and Ministers of Agriculture and S.I.R.—

> "COUNCIL OF NEW ZEALAND INSTITUTE OF CHEMISTRY AGAIN STRESSES IN NATIONAL INTEREST ABSOLUTE URGENCY OF ADJUSTING SALARY SCALES FOR KEY SCIENTIFIC PERSONNEL TO PREVENT THE CONTINUING LOSS TO AUSTRALIA. RECENT LOSSES HAVE BEEN SERIOUS AND MANY OTHER LEADING SCIENTISTS HAVE BEEN APPROACHED WITH OFFERS GIVING ADDED TAKE HOME PAY EXCEEDING £1,000 (N.Z.) PER ANNUM"

and that the telegrams be confirmed by a letter, a copy of which to be sent also to Secretaries of Federated Farmers, Dairy Board, Meat Board, Wool Board, etc.

Resolved: THAT the postal resolution to hold a salary survey in 1955 be confirmed.

Examinations:

Resolved: THAT the Council learns with interest of the existence and activity of the Institute of Science Technologists in Great Britain and that the Otago Examinations Committee be asked to investigate and report on the standard of the Laboratory Assistants' Certificate as a first step to the Associateship and Fellowship of the Institute of Science Technologists. The Vice-President will provide the necessary information.

Resolved: THAT Miss Dora Leslie Brown be awarded the L.A.C. (optional subject: photography).

Membership:

Death: The death of A. H. Bowell was recorded.

Resignations: The resignations of Mrs. G. I. A. Dunne and Mrs. C. J. Jacobsen were accepted with regret.

Applications:

Fellowships. Resolved: THAT L. F. Addis-Smith be elected to the Fellowship under Rule 9.

Associates. Resolved: THAT June Moyra Johnson, David Smith Adcock, Frank Anton Denz, John McDonald O'Kane, David Gerald Fitzgerald, John Clyde Benstead, Louise Elisabeth Greig, Ronald McRae Milburn, be elected Associates.

Resolved: THAT in the opinion of the Council, B.E. (Chem.) be considered 1 year's study of Chemistry under Rule 8.22.

Resolved: THAT B. E. M. Jakobsson be elected Associate subject to the approval of the Membership Committee.

JOURNAL:

Resolved: THAT the Business Manager's report be received and he be thanked for the considerable amount of work involved.

Resolved: THAT the advertising rate for full page advertisements be raised to £7 gross and other rates adjusted accordingly and in cases where advertisers deal direct with the Business Manager he be authorised to adjust the charges.

Resolved: THAT one issue of the Journal preferably October, be designated the Jubilee Issue and the Editor be authorised to expend up to £60 additional and include up to 16 extra pages and priority be given to historical material concerning the origin and early activities of the Institute, including a list of Past Presidents, Secretaries and Editors.

FINANCIAL:

Branch Lectures:

Resolved: THAT the annual grant to Branches be raised to £10 with the object of fostering the interchange of lectures between Branches, such increase to operate from the current financial year.

CHEMISTRY IN SCHOOLS:

Waikato undertook to circulate to Branches the report on Chemistry in Schools.

GENERAL:

Resolved: THAT Dr. Askew be thanked for his letter regarding the use of the word "chemist" by Pharmacists and that the Hon. General Secretary investigate and take appropriate action and report to the August meeting of Council and the General Meeting.

Presidential Visits: The President has received several requests to visit Branches and the general feeling was that every facility should be extended.

Resolved: THAT approval be given to the principle of the President arranging to visit as many Branches as convenient and that financial support be made if required.

BOOK REVIEWS.

MODERN GAS ANALYSIS, by Paul W. Mullen. Published by Interscience Publishers, Inc., New York and London. 354 pages. 5.50 dollars.

Consequent upon the pressing demand for simpler, faster and more accurate methods of gas analysis, there has occurred a re-evaluation of the chemical and physical properties of gases which might be utilised in the development of new methods of analysis. This manual is devoted to a discussion of the theory upon which the general methods of both absorptionmetric and instrumental gas analysis are based and contains a description of some of the available equipment, an account of the general type of analysis possible by each method together with a brief survey of their advantages and disadvantages.

PAINT AND VARNISH, Manual by Philip L. Gordon and Ruth Gordon. Published by Interscience Publishers, Inc., New York and London. 182 *pages.* 3.50 *dollars.*

This manual aims to acquaint the student of chemistry and the technician entering the paint and varnish field or engaged in related industries, with the laboratory practices encountered in the control and development laboratories of the paint and varnish industry.

A SYSTEMATIC HANDBOOK OF VOLUMETRIC ANALYSIS, by Francis Sutton (13th Edition), revised by Julius Grant. Published by Butterworths Scientific Publications (London), 1955, 752 pages. Price 72/6.

Thirteen editions and more than 90 years of service as a text of Volumetric Analysis is no mean achievement and although it is 20 years since it was last revised, "Sutton" is too well known to require any introduction by the reviewer. This edition, while following the general scheme of earlier editions has been considerably revised. The brief, and somewhat elementary, theoretical treatment is presented in one section (Part I) rather than being distributed throughout the general text. The scope of Part II (Methods, Instruments and Apparatus) has been widened to include subects such as microvolumetric methods, micro-diffusion analysis, standardisation of volumetric apparatus, etc. The same subject headings have in general been retained in the remaining Parts but new methods have been introduced. Particular reference may be made to the considerably extended section (Part VI) covering "Potentiometric Titrations." The whole text is certainly extensive— in fact the reviewer's main criticism is that the field is now too wide to be covered adequately in one volume. It is a far cry to the time of the first edition when Sutton could claim that he had tested all the methods he described. Nevertheless the present edition will fulfil a useful purpose as a student text and subsequent reference book.

SEMICONDUCTING AND LUMINESCENT MATERIALS."—A set of abstracts of the literature of 1953 compiled by the Battelle Memorial Institute, sponsored by the Electrochemical Society. Published by John Wiley Inc. (New York) 1955, 5.00 dollars.

These abstracts will be of most value to physicists and chemists who are directly connected with the development and manufacture of luminescent powders or inorganic substances for modern electronic devices. Fundamental work on the properties of these useful materials is included. Organic materials receive a separate section but this wide field is represented by only a few selected papers. Continental references, including Russian, are plentiful. It is surprising to find described a method developed in Germany for measuring decay times of luminescent materials (Abstract No. 617) whereas a very similar method published at the same time by Rollefson and Bailey in U.S.A. is not abstracted. This same abstract is wrongly classified under "Applications", but such a mistake will easily be forgiven. The scientist for whom this book is written will read all the 775 abstracts and be grateful to have them between two covers for five dollars.

—W.S.M.

A MANUAL OF PAPER CHROMATOGRAPHY AND PAPER ELECTROPHORESIS, by Richard J. Block, Emmett L. Durrum and Gunter Zweig. Published by Academic Press Inc., New York, 1955, 484 pages, 8.JJ dollars.

It is scarcely three years since "Paper Chromatography: A Laboratory Manual", by Block, Le Strange and Zweig first appeared. Nevertheless in the interval the list of pertinent references has more than doubled and this virtual revision of the earlier text with the addition of a section on the related technique of paper electrophoresis is most opportune.

The first part of the book, occupying 329 pages, deals with paper chromatography. As pointed out in the Preface, no attempt is made to list all the references in which this technique has been used but rather the aim has been to write a practical manual in which tried and proved procedures, employing relatively simple equipment and available reagents, are summarised. This aim has been most adequately achieved. The material is presented in a clear, lucid manner giving the reader a feeling of confidence that he is being presented with the most suitable method for his particular problem in sufficient detail to make recourse to the extensive original literature unnecessary.

Following a brief introduction covering the theory and general methods of paper chromatography, subsequent chapters deal with specific applications to the separation of protein and related materials, carbohydrates, aliphatic acids, steroids and bile acids, purines, pyrimidines, etc., phenols, aromatic acids and porphyrins, antibiotics and vitamins, together with a range of miscellaneous organic substances and a short chapter on inorganic separations.

Part II deals, necessarily more briefly, with paper electrophoresis, the emphasis being on basic principles and methodology with particular reference to the separation of protein mixtures. It contains a wealth of experimental detail—those all important points which are so often taken for granted—and reflects the author's obvious keenness for his subject and his desire to guide the reader easily through its problems.

The book is strongly recommended to chemists interested in either of these techniques.

—W.A.McG.

ORGANIC SYNTHESES. Collective Volume III.. Edited by E. C. Hornig. 1955: John Wiley & Sons, New York, 890 pages, 15.00 dollars.

This volume contains material originally published in Organic Syntheses, Volumes 20-29, now brought up to date with references to 1952, rechecked and corrected. This volume is all the more necessary since some of the original volumes are now out of print and it is certain to win a place in the hearts of organic chemists alongside its predecessors as "Col. Vol. III."

DAS LUSTIGE ATOM (The Merry Old Atom), by Fritz N. Wolf Vulkan-Verlag Dr. W. Classen, Essen, Germany. 208 pages. DM. 9.60.

A light-hearted attack on atomic theory in verse, illustrated with numerous original humorous drawings. The subject seems to be more closely related to sex than we had suspected.

GMELIN'S HANDBOOK OF INORGANIC CHEMISTRY, 8th Edition. The two latest bindings in this series, published by Verlag Chemie, Berlin, are Thorium and its isotopes, System No. 44 (406 pages, DM 227) and Copper No. 60 part A, Section 1 (DM 367).

Thorium for the first time is treated alone and not just as one of the rare earths. The volume is made up of 200 pages on the history, extraction and properties of the element itself, 150 pages on its compounds and 50 pages on its isotopes. The section on copper deals with its history, extraction and occurrence in 710 pages, and includes powder metallurgy and technical production of copper salts used in the manufacture of commercially important copper compounds. This volume should be of great value to all interested in the metallurgy of copper, and like the volume on thorium, covers the literature up to 1954.

GMELIN'S HANDBUCH OF INORGANIC CHEMISTRY. System No. 62: Gold, part 2, pages 101-406, D.M. 168. Part 3, pages 407-964, D.M., 312. System No. 13: Boron. Supplementary volume, 253 pages, D.M. 140, 1954. Berlin, Verlag Chemie.

The first two of these new volumes in the Gmelin series cover the occurrence of gold, its extraction, physical and chemical properties, use in the arts, compounds, and finally alloys. The last section is particularly noteworthy, extending to almost 200 pages. It lacks only the alloys with platinum, which will be considered with this element since it follows gold in the Gmelin system. The supplementary volume on Boron covers the whole literature on this element from 1925-1939, and naturally has a good deal to say on the interesting and curious compounds with hydrogen and nitrogen. In common with Beilstein, these volumes have no index, but a very full table of contents.

—S.G.B.

THE ANALYSIS OF DRUGS AND CHEMICALS, by Norman Evers and Wilfred Smith. Published by Charles Griffin & Co. Ltd. (London), 1955, 546 pages. Price 60/-. This book was first published in 1929 but has now been completely rewritten, only the general form and arrangement of the previous edition being retained. Although the text has been compiled with close reference to the current editions of the British Pharmacopoeia and the British Pharmacopoeia Codex, it is intended to supplement rather than substitute for these works. The subject is, in fact, treated from the point of view of the chemist and analyst rather than being, as in the case of these standard works, more exclusively concerned with official standards and requirements. In addition a number of materials finding increasing use in medical practice, food manufacture, agriculture, etc., but which are not covered in the B.P. or B.P.C., are dealt with. The aim of the book is to give the analyst just the facts he needs to know regarding each substance and each method of analysis. The range of materials is certainly comprehensive and a vast amount of valuable information is presented within a very reasonable compass. The reviewer's main criticism is the omission of some of the newer techniques, particularly methods of micro-analysis. While this latter omission is deliberate it seems unfortunate in a book of this scope.

JUBILEE OF INSTITUTE.

As mentioned in the Council minutes, this year marks the 25th Jubilee of the founding of the New Zealand Institute of Chemistry. Opportunity will be taken at the Conference Social Evening for appropriate recognition of this occasion, Mr. W. A. Joiner, the first Secretary of the Institute, proposing a toast to the Institute and the present President, Mr. K. M. Griffin, responding. In addition, an early issue of the Journal (it is hoped the October issue) will take the form of a Jubilee Number devoted to the history of the Institute and the development of Chemistry in New Zealand. To leave space for these articles, as much normal Journal material as possible will be held over for a subsequent issue.