JOURNAL OF THE NEW ZEALAND INSTITUTE OF CHEMISTRY

VOL. XVIII. OCTOBER, 1952 No. 5

CONTENTS:

SURFACE-ACTIVE AGENTS — W. L. Barr

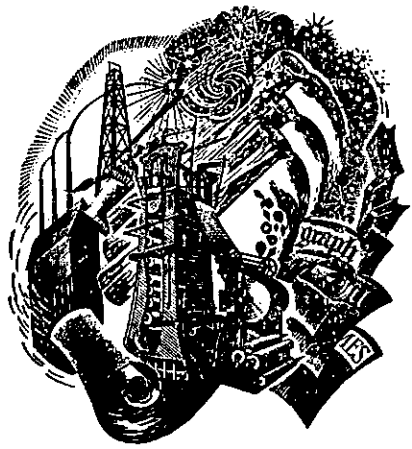
OBITUARY: C. W. BRANDT

SALARY SURVEY — J. K. Dixon and J. L. Mandeno

PHOTOSENSITIVITY DISEASES — N. T. Clare

COUNCIL MINUTES

NEWS NOTES REVIEWS



BARIUM

Patients may associate barium with the unpalatable meals which they are given before an X-ray examination, but it is barium sulphate which is used for this purpose, and not the soft silvery-white barium metal. Barium is found in nature in the form of barytes (barium sulphate) and witherite (barium carbonate); it is never found free since the metal readily reacts with air and moisture. It was first recognised as an element by Scheele, a Swedish chemist, in 1774. Its name is derived from a Greek word meaning heavy, because all barium compounds are much heavier than an equal volume of water. Barytes deposits, often found in lead and zinc veins, are mined in the North of England, Germany, Canada and United States. Witherite is far less common. The most famous witherite mine in the world is at Hexham in Northumberland, and workable quantities are also found in Durham. Compounds of barium are important in the manufacture of paper, glass, oilcloth, linoleum and in oil well drilling. Barium metal itself is used to remove the last traces of gas from radio valves and television tubes.

I.C.I. uses barium sulphate in the manufacture of paint, and barium nitrate in certain kinds of industrial explosives.

M&B LABORATORY CHEMICALS AND REAGENTS
IN THE SERVICE OF EDUCATION

Of unsurpassed importance, both as training grounds for the scientists of the future and as centres of research in every branch of scientific development, British Universities have been quick to recognise the value of the M&B range of Laboratory Chemicals and Reagents.

The specifications to which these chemicals are manufactured have been selected to allow wide application to the needs of University Laboratory practice. They have consequently been found suitable not only for normal undergraduate training, but also for the more exacting demands of post-graduate work.

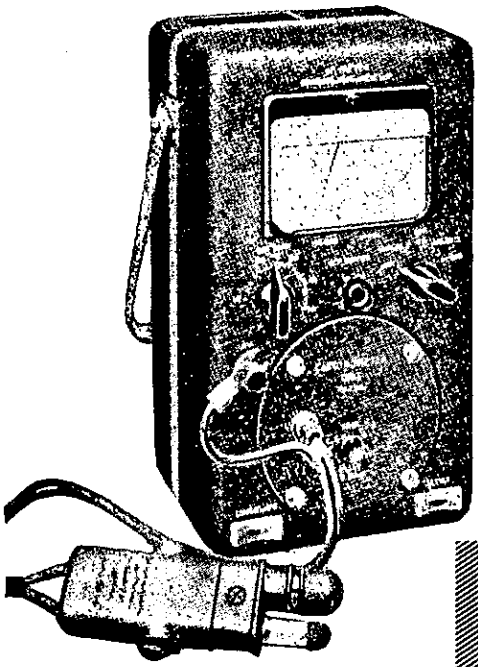
A complete brochure of specifications will be sent on request.

CH3316

manufactured by : MAY & BAKER LTD

distributors :

May & Baker (New Zealand) Ltd., P.O. Box 1395, Wellington



The TRULY portable pH METER

pH Measurement—NEW STYLE

pH measurement is now easier than ever. This new-style pH Meter is the handiest yet designed for routine testing. It is **truly** portable—weighs only 8 lbs.—and is direct-reading over the range 1-11 pH. It discriminates to O.O5 pH and can be used anywhere at a moment's notice. It is battery-operated and self-contained. The electrode system is ingeniously protected and stowed, the carrying handle adjustable to give support at a convenient angle. Priced to suit the smaller firm and permit the larger to employ whole batteries of them as "inspection tools."

Made by

MARCONI INSTRUMENTS LTD., ENGLAND.

Sole Distributors in New Zealand:

AMALGAMATED WIRELESS A/SIA LTD.

BOX 830, G.P.O., WELLINGTON.

JOURNAL OF THE
NEW ZEALAND INSTITUTE OF CHEMISTRY

VOL. XVIII OCTOBER, 1952 No. 5

SURFACE-ACTIVE AGENTS

By W. L. Barr, N.Z. Forest Products Ltd., Auckland.

This paper presents a brief account of the theory of surface action, a short description of the main types of surface activity, and an outline of the chief varieties of surface-active agents, with a tabulated appendix setting out those which are commercially available in this country.

No references are given in this paper—there would be too many. For further information the following works can be recommended:—

Schwartz and Perry: Surface-Active Agents (Interscience, New York, 1949).

Bailey: Industrial Oil and Fat Products (Interscience, New York, 2nd. Edn., 1951).

Moilliet and Collie: Surface Activity (Spon, London, 1951).

A surface-active agent is a substance which modifies the properties of the surface between two phases by virtue of its tendency to concentrate in the interface and form a layer separating the phases. Willard Gibbs's definition of a phase applies in this connection—a homogeneous part of a system which is bounded by surfaces and mechanically separable from the rest of the system. Phases may be solid, liquid, or gaseous, but surface-active agents are concerned only with those two- or three-phase systems in which at least one phase is a liquid.

The action of such agents is important in many industrial processes, and examples of surface-activity have been known for a long time—for example, the improvement of the lubricant properties of hydrocarbon oils by the addition of fatty acids, the emulsifying and detergent properties of soaps; the use of Twitchell

Published by the New Zealand Institute of Chemistry, G.P.O. Box 250, Wellington.
Edited by S. G Brooker, Box 9012, Newmarket, Auckland.
Printed by Percy Salmon, Wills and Grainger Ltd., 64, Fort Street, Auckland.

reagents in the hydrolysis of fats. Soaps are the oldest and still the most widely used of surface-active agents, but in recent years many other materials of this type have been developed.

In this discussion, only two types of liquid will be considered, aqueous and oily; for other liquids such as molten metals, liquified gases, fused salts, liquid non-metals, few, if any, surface-active agents have been developed, and none will be discussed here.

The essential properties of a surface-active agent are:—

(1) The one ion or molecule must contain a water-attracting (hydrophilic) and an oil-attracting (lipophilic) group.

(2) These two groups must be spatially separated so that the ion or molecule has a well-defined hydrophilic "head" and a well-defined lipophilic "tail," with a certain minimum distance between the two groups.

(3) The head and tail must be in balance for the particular purpose in view—neither must outweigh the other in its specific attraction under the conditions of use.

Such a structure gives a highly polar molecule which will strongly tend to place itself in such a position that the attraction of the head for water and of the tail for oil will be satisfied as far as the conditions allow.

The hydrophilic head of the molecule usually includes one or more of the following groups:—Carboxyl, sulphate, sulphonate, phosphate, or salts of these groups; hydroxyl, amide or amine, which may have substituent groups. These radicals all have strong secondary valence forces, and are chemically reactive. The lipophilic tail is usually an alkyl radical, but sometimes double bonds and aromatic or hydroaromatic groups are included. Indeed, in certain poly-functional surface-active agents used in tanning or as deflocculating agents for certain purposes, the tail is predominantly aromatic. The hydrocarbon chains are usually derived from the naturally occurring fatty acids, or from hydrocarbons in the kerosene range or from the Fischer-Tropsch synthesis. Sometimes the hydrophilic head is directly attached to the lipophilic tail as in the fatty acids, and sometimes there is another group intervening between, as in glyceryl monostearate,

$$C_{17}H_{35}—COO.CH_2—CHOH.CH_2\ OH.$$

Obviously many hundreds of different materials may be prepared which conform to this pattern; indeed, patent specifications and technical literature on the subject are exceedingly voluminous, but as a type material, let us consider a soda soap, the sodium salt of a long-chain fatty acid. In aqueous solution the anions are to

various products mentioned; he has tried to make it as complete a large extent grouped into colloidal aggregates in which the hydrocarbon chains are directed inwards and the carboxyl groups are on the surface. The surface of the liquid is covered by a layer of anions with their hydrocarbon tails upwards towards the air and their carboxyl heads downwards towards the water. This arrangement satisfies the hydrophilic attraction of the carboxyls and removes from contact with the water the hydrophobic alkyl tails. In a similar way at any phase boundary, the fatty acid anions tend to arrange themselves into a layer, each one lying at right angles to the interface, and all packed together side by side, with their heads towards the aqueous phase and their tails away from it. In this orientation one gramme of sodium oleate will give a continuous monomolecular film one thousand square metres in area.

Surface-active agents produce their specific effects by virtue of their tendency to arrange themselves at any phase interface in this orientation. In the case of electrolytic surface-active agents the ionic charges accumulate on the aqueous surface of this interfacial layer, an effect of importance in many applications of surface action. A soluble surface-active agent always lowers interfacial tension. There is evidence that in thickness some of these oriented surface layers are monomolecular—their thickness equals the length of a single molecule of the agent, while others in different circumstances may be bimolecular, the molecules being arranged tail to tail in two layers, with the heads outwards on both sides of the layer, and others again are several molecules thick. In the last case the precise arrangement of the molecules is in most cases unknown, but in a few examples there is evidence that the molecules are arranged alternately head to head and tail to tail across the layer.

In all surface-active agents the length of the alkyl radical is important. In his work on the lubricating effect of oriented monomolecular films of fatty acids, Sir William Hardy found little or no lubrication with fatty acids containing fewer than eight or nine carbon atoms, and an increasing effect with increase in length of the chain to twelve or thirteen carbon atoms, after which increase in chain length made little difference.

In a similar way, the soaps of fatty acids with fewer than twelve carbon atoms have little surface activity in emulsifying or deflocculating power. From twelve to eighteen carbon atoms, surface activity increases with chain length. The eight or nine carbon atoms adjacent to the carboxyl may thus be considered merely as "spacers" in these two types of activity, and the tail proper may be considered as starting at the ninth or tenth carbon. For

surface activity of the types mentioned, it appears that this tail must consist of at least three carbon atoms. The fatty acids occurring in natural fats have aliphatic chains lying within the most generally useful range of length, with twelve to eighteen or twenty carbon atoms.

A similar effect of variation in chain length is found with surface-active materials which have active groups other than carboxyl.

Surface activity includes several varieties of phenomena—
wetting and water repellance:
flocculation, deflocculation and dispersion;
emulsification and solubilisation;
detergency;
foam production and foam prevention or destruction

Some materials, notably the sodium and potassium soaps, are active in several of these fields, but the usefulness of most surface-active agents is limited to one or two of these applications.

WETTING

Dynamically, the action of wetting is the displacement by a liquid of a gas or another liquid from contact with a solid surface. Statically, wetting is the strong adhesion of a liquid to a solid surface so as to resist displacement therefrom by other fluids or by mechanical means.

The wetting effect of water soluble surface-active agents proceeds by a two-fold action. The reduction of the interfacial tension reduces the energy requirement for extension of the interface over the whole of the solid surface; and where there is resistance to wetting from the presence of a strongly adsorbed film of grease, the oriented layer of polar molecules with their tails to the solid and their heads to the water spreads a "carpet" over the whole surface. When the action of wetting is completed, this oriented layer forms a bond between the solid surface and the water.

A similar wetting action has been recognised for many years in the field of lubrication. The presence of about 0.5 per cent of oleic acid in a hydrocarbon oil enhances its ability to maintain a film between bearing surfaces under adverse conditions of temperature and load. Many other surface-active additives besides the fatty acids are used nowadays to produce the same effect. At the metal surfaces the free electrons of the metal attract and hold the electrophilic carboxyl or other active group, and an oriented layer is formed, strongly adsorbed on the metal. The hydrocarbon tails hold a film of oil in the bearing under heavy loading pressures, and

where point contact occurs between the two metal surfaces the two adsorbed layers prevent metal-to-metal contact and consequent seizing and wear. This effect was one of the earliest in the field of surface-action to be investigated scientifically, by Sir William Hardy sixty years ago.

WATER REPELLANCE

In the waterproofing of textiles certain surface-active materials (substituted pyridine derivatives) are adsorbed by the fibres from aqueous solution, and decomposed by heating in an oven. Pyridine is evolved and a highly polar residue is left, insoluble in water and stable to laundering.

Iron and steel surfaces are sometimes protected from moisture by covering with a coating of grease containing suitable oil-soluble surface-active materials. Even if the protective coating is partly rubbed off, the oriented layer adsorbed on the metal remains strongly water repellant.

Steam pipes may be shielded from contact with condensate and protected against corrosion by dissolved oxygen or carbon dioxide by means of an adsorbed film of octadecylamine.

DISPERSION, DEFLOCCULATION AND FLOCCULATION

A powder will mix readily with a liquid if each of its particles is readily wetted, so that adsorbed air is easily displaced. Such an action is dispersion; if the particles have any tendency to be water-repellant, dispersion may be assisted by a wetting agent.

Even though all adsorbed air is displaced, the adhesion of the liquid to the surface of the particles may be weak; in that case the particles will tend to attract each other, and clump together into flocs. Deflocculation is the separation and scattering of such particles and is sometimes accomplished by the aid of a soluble surface-active agent, which enhances the wetting of the surface; an oriented layer is adsorbed on the surface, and about this layer is an adsorbed "sheath" of solvent molecules, firmly bound by the hydrophilic groups, which keeps the particles apart and prevents aggregation. If the layer is ionic the mutual repulsion of the surface charges on the particles assist this separation.

A remarkable phenomenon may be observed with aqueous dispersions of certain pigments which themselves are strongly hydrophilic and therefore readily wetted and dispersed (e.g., Prussian Blue). The gradual addition of a wetting agent will cause

flocculation of the dispersed particles as long as its concentration is below a certain minimum level; above that level the action is reversed and the flocculated particles are redispersed. The first effect of flocculation is caused by "reverse" adsorption, i.e., the hydrophilic heads of the wetting agent molecules are more strongly attracted to the solid surface than to the water; a protective sheath of bound water is displaced, and the oriented layer presents to the water the hydrophobic hydrocarbon tails. The surface of each particle is thus rendered water-repellant and flocculation occurs. As the concentration of the wetting agent is increased, however, a second layer of oriented molecules begins to form, superimposed on the first and in normal orientation, with the hydrophilic heads outwards; a sheath of firmly bound solvent molecules is again built up round each particle, and the loose aggregations break up until complete dispersion is achieved.

The manufacture of paint involves dispersion of pigments in vehicles, either aqueous or oily. In oil paints, fatty acids, the fatty acid soaps of various metals, certain sulphonated naphthalene derivatives or some other highly polar materials may be used to ensure wetting of each particle of the pigment by the oil. The head of the polar molecule is adsorbed on the solid surface, presenting to the oil a carpet of hydrocarbon chains. These agents are especially valuable where the oil must displace water from the surface of the pigment, as for example, where white lead paste is ground in oil.

In paint technology, the control of flocculation is important. If the pigment is highly deflocculated, so that each particle is thoroughly wetted by the vehicle, the paint will have a high degree of fluidity, and during storage the pigment will settle out in a dense closely packed mass that is difficult to redisperse by stirring; on the other hand, any excessive flocculation may make the paint flow badly and be hard to spread satisfactorily. A balance between these characteristics is adjusted by variation of the pigment mixture, control of the acidity of the vehicle, or the use of oil-soluble metallic soaps with or without the addition of a little water.

EMULSIFICATION

An emulsion is a system in which one liquid is dispersed in tiny globules throughout another liquid with which it is immiscible. The large area of interface between the two liquids is stabilised by surface-active agents or by certain other materials, notably proteins and carbohydrate gums, which do not come into that category and will therefore not be discussed here. The former act by forming an oriented layer at the interface in the manner already described.

Consider, for example, a soap solution into which oil is vigorously stirred. At the interface the COO^- group of the anion is attracted to the aqueous phase and the hydrocarbon chain to the oil phase. The anions pack thus into the surface layer, and as the surface of contact of oil and water is increased the newly-formed surface is similarly packed and lined. Probably in most cases the oriented film is not monomolecular, but several molecules thick. This arrangement of parallel orientation with the hydrocarbon chains lying side by side is found in the crystal structure of fatty acids and glycerides and imparts a certain strength and rigidity to the film, enabling it to resist rupture and contraction under the influence of interfacial tension. The ionic charges accumulate on the aqueous side of the interface, where there is also formed an adsorbed sheath of bound water; coalescence of globules is hindered, and as the stirring breaks up the oil into ever smaller particles, the final result is an emulsion of the oil in the water.

The average size of globule is determined by the relative proportions of oil and water, the amount of soap available to form the anionic layer, and the vigour of the agitation. The emulsification of water in oil with a different emulsifying agent is brought about by a strictly analogous procedure.

In an emulsion system, the factor which determines whether the emulsion will be oil-in-water or water-in-oil may be the volume relationship between the two phases. With some non-ionic emulsifying agents, particularly some fatty acid amides and phosphatides, there is a critical water:oil ratio above which the emulsion is oil-in-water, and below which it is water-in-oil. In other cases, the nature of the emulsifying agent determines the type of emulsion; the phase in which it is more soluble or for which it has the greater attraction will be the continuous phase. Thus soda and potash soaps always form oil-in-water emulsions, but calcium and magnesium soaps always water-in-oil.

Some investigators have suggested that the shape of the molecule or ion of the emulsifying agent determines the emulsion type. In a sodium soap solution, the ionised carboxyl group is larger in diameter than the alkyl radical to which it is attached; in the layer of oriented anions there will be more intense crowding on the aqueous side, and the film will tend to be convex towards the water and concave towards oil, directing the emulsion into the oil-in-water type. The molecule of calcium or magnesium soap on the other hand is "V" shaped; the alkyl radicals lie at an acute angle with the metal atom at the apex. In an interfacial film such molecules will fit into an oriented layer concave towards the side where the metal atom is situated, i.e., the aqueous side; this agent will therefore produce water-in-oil emulsions.

Bancroft put forward a theory to cover these cases and others, and formulated a general rule. The oriented layer at the interface is to be considered as a third distinct phase with two surfaces of contact, one with water and one with oil, each with its own interfacial tension. On the side of the oriented layer towards the liquid in which the emulsifier is less soluble or for which it has the lesser attraction, there will be the greater interfacial tension; that interface will become the concave side of the oriented layer, and the liquid on that side will be the dispersed phase. Where there is little difference in interfacial tension on the two sides of the oriented layer, phase reversal may be easily effected.

SOLUBILISATION

This is the incorporation of one liquid into another normally immiscible with it by means of a surface-active agent without the formation of an emulsion. For example, aqueous solutions of soap and other surface-active agents will take up appreciable quantities of hydrocarbons in the range pentane to decane; the hydrocarbon molecules are dissolved into the micelles of the anions. There is a sharp limit to the percentage of a hydrocarbon that may thus be incorporated into a particular soap solution; below this limit increasing hydrocarbon content makes little, if any, difference to the optically measured turbidity of the solution, but above the limit the turbidity increases abruptly and rapidly as the system is transformed into an emulsion. Similarly in self-emulsifying disinfectants and deodorants which consist of solutions of sulphated oils in the main oily ingredient, it is possible to add a considerable amount of water before there is any appearance of a water-in-oil emulsion, as the water is taken up and bound by the hydrophilic sulphate groups. When more water is added than the sulphate groups can take up, a water-in-oil emulsion is formed; and as still more water is added, a point is reached where the system undergoes phase reversal and becomes an oil-in-water emulsion.

DETERGENCY

This action may include several types of surface activity. The application of the solution of soap or other detergent to the surface or fabric to be cleaned is usually accompanied by rubbing or some other mechanical action, such as vigorous boiling in the domestic copper. There is first the wetting of the surface to be cleaned, and the detachment of the dirt by a penetrating film of water; then the dirt is dispersed and deflocculated, if solid, and solubilised or emulsified, if oily or greasy. Most of the dirt in wearing apparel and other domestic washing consists of solid particles covered by an adsorbed oily or greasy film; such particles

behave like oil globules, and are dispersed by a process analogous to emulsification, by formation of a layer of oriented ions on the surface of the oil coating. Such greasy dirt is easier to remove from fabrics than dry solid dirt, since the lipophilic tails of the detergent are more strongly attracted to oil than to the surface of solid particles. The dirt which has been removed must be thoroughly dispersed in the aqueous phase to prevent redeposition on the cleaned fabric, so the detergent must have a high power of deflocculation.

It has been shown that in the washing of textiles with soap, an adsorption equilibrium is reached among the components, dirt, soap and fabric, and the process involves the establishment of the adsorption complexes dirt/soap and soap/fabric by disruption of the original dirt/fabric complex. This action is probably accompanied by a certain amount of ion exchange. All textile fabrics have some tendency to bind ions to their surfaces; some of the dirt may be held thus on the fabric, and may be removed by ion exchange with the soap.

FOAMING

Foam production involves another type of surface effect where the phases involved are liquid and gas. Foam consists of a more or less stable structure of air pockets enclosed within thin liquid films. One would expect such a system to be highly unstable because of surface tension and drainage of liquid from the film. Pure liquids do not foam, but most solutions have some tendency to foam, apparently with no relation to the nature of the solute; in fact, there is no comprehensive theory of foaming known to the writer which will explain foam formation, and the various properties of foam—ease of formation, stability, average bubble size, rigidity, and average film thickness—together with the effects of the liquid:gas ratio, the nature of the gas, the presence or absence of another phase, i.e., a finely divided solid or a liquid, and so on.

The theory that is accepted as explaining satisfactorily most observed effects is that of Foulk:—At the surface of a solution the solute is either positively or negatively adsorbed, i.e., it is at a higher or lower concentration than in the body of the solution; and adjacent to the surface there is a zone in which is established a concentration gradient, or with electrolytes, a corresponding ionic arrangement, which is the condition of minimum free energy. When a bubble film is formed, and the liquid between its surfaces drains away, the zones of concentration gradient approach each other until their inner boundary regions come together. Closer approach of the two film surfaces would involve formation of a

zone of uniform concentration and disturbance of the equilibrium concentration gradients which would require work. Therefore, closer approach of the surfaces to each other is resisted and a temporary equilibrium is established. Because gravity continues to drain away the liquid against the resistance within the film, the foam is not permanently stable. In a pure liquid there is no solute to produce the effect described, and any film that is formed can collapse immediately.

Surface-active agents in solution facilitate foam production by reducing surface tension, and stabilise the foam by lining the film surfaces with a layer of oriented molecules which resists contraction and confers some measure of mechanical strength.

Much investigation has been done on foam formation, because of its importance in fire fighting and ore flotation. Patent literature in the field is voluminous and involved. Most work has been empirical and ad hoc for the problems of a particular set of circumstances, and theoretical treatment is fragmentary. Contrary to popular belief, foaming appears to play no active role in detergent action.

In fire-fighting foams, mechanical and thermal stability is essential and may be promoted by surface-active agents, sometimes in conjunction with finely divided solids or precipitates which are entrained or adsorbed in the foam. In ore flotation foaming is used as a means of separating one mineral from others in an aqueous slurry of ground ore. One type of mineral particle is selectively rendered hydrophobic and entrained and entangled in the foam. In the slurry there must first be established conditions of selective wetting, and special types of surface-active agents known as "collectors" are used for this purpose. As a rule such agents are adsorbed on the surface of particles of one mineral type with the hydrocarbon tails outermost, so that the particles become hydrophobic or water repellant and tend to flocculate, while other minerals are more completely wetted. Alkyl xanthates are commonly used for this purpose. Foam is produced by blowing air through the slurry and another surface-active agent is sometimes added to promote foam stability.

DEFOAMING

Anti-foam action may be either prevention of foam formation or destruction of foam already formed; an agent that is excellent for the former operation may be much less efficient for the latter. No single explanation covers all anti-foam phenomena, and indeed, the action is probably not the same in all cases. Some anti-foam agents have the polar molecular structure characteristic of surface-active agents and produce their effects by virtue of the surface pro-

perties such a structure bestows. For aqueous solutions all such agents known to the writer are insoluble and function as a separate phase which forms a barrier between the water and the gas; but in oily media some materials of the type are soluble and still produce their effects. Other anti-foam materials have no such polar structure and presumably act in a different way.

Soluble anti-foam materials produce their effect by altering conditions in the surface zone. Some of these are specific in action and are effective in inhibiting foaming only with a certain solutes and in a certain concentration ratio with them; a negatively adsorbed solute may inhibit foaming which is due to a positively adsorbed solute and vice-versa. As a rule, the inhibition of foaming requires a much smaller amount of anti-foam agent than destruction of a foam that has been formed. In the latter case the anti-foam action must take place over a vastly increased area of liquid-gas interface.

Certain silicone compounds are of outstanding efficiency in this field.

TYPES OF SURFACE-ACTIVE AGENTS

For convenience in discussion, surface-active agents may be classified as soluble or insoluble in water. All included in the latter class are soluble in oils and are used in conjunction with them, save in the case of certain foam suppressors for aqueous solutions.

(1) Water Insoluble Types:

Among the simplest of these are the fatty alcohols, containing eight or more carbon atoms per molecule, which exert anti-foaming action by forming a film over an aqueous surface. Other simple types are fatty acids and their oil-soluble soaps; orchard spraying oils, for example, are rendered emulsifiable by adding oleic acid and conc. ammonia and warming. Oils may also be rendered emulsifiable by the addition of the so-called "sulphonated" fatty oils—more correctly termed "sulphated" oils, since the action of sulphuric acid on the oil is addition at a double bond of a fatty radical to form a secondary sulphate with the grouping X—CH_2—CH (OSO_2OH)—In the reaction with castor oil, the oxy group of the ricinoleic radical is esterified to give the same type of sulphate. The hydrophilic sulphate group makes these oils good emulsifying agents in neutral or acid conditions, but the sulphate group is easily removed by alkali or even by warming with water. Sulphated oils are usually poor detergents, but are valuable as emulsifiers for cutting oils in engineering and for fat-liquoring in tanneries.

The true sulphonate group, containing a —C —S— linkage is found in several surface active agents and is usually produced by the action of sulphuric acid on the aromatic nucleus. Thus Twitchell reagents are made by warming sulphuric acid with oleic acid and with benzene or naphthalene. The aromatic nucleus is both sulphonated and condensed with oleic acid, presumably at the double bond to give $CH_3\ (CH_2)_7.\ CH\ (C_6H_4SO_3H).\ CH_2)_8\ CO_2H$. These materials promote the formation of relatively unstable water-in-oil emulsions in fats boiled with water to be hydrolysed; in addition they catalyse the hydrolysis of the fat since the action is much less rapid with other types of emulsifiers. Complex organic sulphates and sulphonates, obtained as by-products in the refining of petroleum, are used as emulsifying agents in textile spinning oils and in cutting oils. Sulphonic acids from this source and certain oil soluble metallic soaps (e.g., calcium phenyl sulphate) are added to motor oils to deflocculate sludge and prevent the formation of deposits of hard carbon on metal surfaces.

The use of fatty acids to improve the wetting of metal surfaces by lubricants has already been mentioned; other polar materials have been developed for the same purpose—esters such as methyl dichlorostearate, alkyl phosphates and alkyl substituted chlorinated aromatics; certain organic sulphides are used in extreme pressure lubricants required in steel rolling mills and in automotive back axle gears of the offset or hypoid type.

Various silicones, alkyl phosphates and organic sulphates are used as anti-foams in oil circulating systems. Calcium or amine salts of sulphonic acids and certain alkyl-aryl sulphides, and alkyl-aryl carboxylic acids are used in oil solution to protect metal surfaces from corrosion. Lubricating greases of the water-in-oil type are made with calcium soaps as emulsifiers—the so-called "cup" greases; the soap also confers a plastic solid structure. These greases are useful for lubricating surfaces liable to be reached by water, but they are not suitable for use at temperatures which may evaporate the water from the emulsion.

Other materials in the oil-soluble class are the higher fatty alcohols (mainly cetyl and stearyl); the ethers of these with polyhydroxy alcohols such as glycerol or a sugar; and the partial esters of such alcohols with fatty acids, of which glycerol monostearate is the commonest example. These materials are used in edible or cosmetic emulsions, since they are physiologically harmless and in some cases digestible.

(2) Water Soluble Types:—

Water soluble surface-active materials may be electrolytes or they may be non-ionic in nature; in the former case the activity may be associated with either the anion or the cation.

(a) Anion Active Materials

Almost all agents in this class except the alkali soaps are sodium salts of organic sulphates or sulphonic acids. The sodium salts of normal fatty acids have three limitations on their technical use. They can be used only at a relatively high pH; they are incompatible with calcium and magnesium salts; and those made from higher saturated fatty acids have a low solubility in cold water. However, if the carboxyl of the fatty acid is replaced with a sulphate group, the sodium salt is a good detergent, effective in neutral or slightly acid solution; the calcium and magnesium salts are moderately soluble so that the detergent can be used in hard water; it is also amply soluble in cold water. In alkaline or strongly acid solution, however, the organic sulphate linkage is hydrolysed.

The alcohols used for sulphation are usually produced by catalytic reduction of fatty acids; for example sodium "lauryl" sulphate is made from the fatty acids of coconut oil, reduced to alcohols, esterified with sulphuric acid, and neutralised. Similar products are made by the reaction of olefines with sulphuric acid to yield secondary alkyl sulphates of the type R′—CH.(O.S O_2.ONa)—R″. In this class are several general purpose wetting agents and detergents made from petroleum hydrocarbons; if R′ is methyl or ethyl and R″ is a long chain alkyl group, the molecule will have the necessary polar structure for surface activity as emulsifier or detergent, but if R′ and R″ are of approximately equal size the product may be a good wetting agent but a poor detergent.

The sulphate group may be separated from the alkyl radical by intervening groupings. Thus one of the free hydroxyl groups of glyceryl monostearate may be esterified with sulphuric acid and neutralised; in fact, such a detergent is being commercially produced by a continuous process of interaction of triglyceride (fat), glycerol, and sulphuric acid. Indeed sulphation of a hydroxyl group is a device commonly used to enhance the hydrophilic effect of the head of the molecule.

The other principal type of anionic surface-active agent is the alkyl aryl sulphonate. The aromatic nucleus is alkylated by reaction with an olefine and sulphuric acid, or by the Friedel-Crafts reaction with a chlorinated hydrocarbon; the alkylated aromatic hydrocarbon is then sulphonated. The olefine or chlorinated hydro-

carbon is usually derived from the kerosene fraction of petroleum. The sodium salts of these sulphonic acids are good detergents and are compatible with hard water; they may be used in acid or alkaline solution and are not hydrolysed by either.

A particular variety of the alkyl aryl sulphonate type is the group of dinaphthyl methane disulphonate derivatives, made by heating a mixture of naphthalene, formalin and sulphuric acid, or by heating naphthalene sulphonic acids with formalin. The general formula is HO SO_2 $C_{10}.H_6.CH_2.C_{10}H_6.SO_2OH$. The naphthalene may be alkylated; the condensation may be carried further to include three or four naphthalene molecules. These materials do not have the usual "head and tail" structure of surface-active agents, but they are particularly effective as deflocculating and dispersion agents for aqueous suspensions and pastes.

Certain phosphoric esters and derivatives are made as wetting agents for particular purposes, but as they are more expensive than their sulphuric analogues, and are incompatible with calcium and magnesium salts, they are of limited application.

(b) Cation active materials.

In almost all cases these are quaternary ammonium salts, one of the substituent groups of which is a normal alkyl radical containing 12 to 18 carbon atoms. Primary, secondary and tertiary amines with such a substituent group, and their salts, are usually insoluble except in strongly acid solution, where, however, they exhibit strong surface activity. The quaternary salts, on the other hand, are soluble in neutral solution, and in alkaline solutions the corresponding hydroxides are likewise soluble.

In the preparation of these quaternary salts, a primary amine may be obtained by hydrogenation of the amide or nitrile of a fatty acid such as stearic; this may be methylated to the tertiary amine which is treated with methyl halide or sulphate. Alternatively a long chain alkyl halide may be directly combined with a tertiary amine such as trimethyl amine, dimethyl aniline or pyridine.

In solution the cations of such quaternary ammonium salts are compatible with the ions of heavy metals, but are liable to form precipitates with large or complex anions, in particular with those of anionic surface-active agents. They are efficient wetting-agents, detergents and emulsifiers and in addition are strongly bactericidal. The nature of the anion with which the active cation is associated has a considerable effect on the properties of the solution and its efficiency for a particular purpose. These materials are too expensive for wide general use, but are valuable in special applications—textile dyeing, ore flotation and fire-fighting foams, to mention only three.

(c) Non-ionic Materials

The hydrophilic groups of some non-ionic agents are derived from sugars or from sugar alcohols, such as sorbitol or mannitol, prepared by the reduction of sugars. One such molecule may be esterified with one molecule of fatty acid; it may react with the hydroxyl group of a fatty alcohol, an alkylated phenol or a fatty acid monoester of glycol or glycerol. Orthophosphoric acid may provide the link between the head and tail of the molecule, by esterification first with a sugar or sugar alcohol and then with a fatty alcohol. A free hydroxyl group of the dicitrate or tritartrate of glycerol may be esterified with stearic acid to give water-soluble detergents.

Some hydrophilic groups are substituted amides; e.g., stearic acid may be heated with diethanolamine to yield a detergent of the formula $C_{17}H_{35}.CO.N(C_2H_4OH)_2$. But the commonest non-ionic hydrophilic grouping and the one that has the widest application is formed by the catalysed condensation under heat and pressure of several molecules of ethylene oxide with the hydroxyl group of a hydrophobic molecule to give products of the type $R—(OCH_2CH_2)n—OH$. By alteration of the proportions in the reaction mixture the length of the ethylene ether chain may be varied to give any desired degree of solubility in water or any desired condition of balance with the lipophilic part of the molecule. Propylene oxide reacts similarly.

The hydrophobic molecule in the reaction may be a fatty alcohol or an alkylated phenol; the product is then an ether, compatible with hard water, acids and alkalies, and strongly resistant to hydrolysis. It may be a fatty acid, which is usually cheaper; the product in this case is an ester, readily hydrolysed by alkalies and strong acids. This reaction of condensation with ethylene or propylene oxide may be used to increase the solubility in water of many non-ionic agents of the varieties already described—phosphate, esters, monoglycerides, and esters or ethers of sugars and sugar alcohols. Sometimes costs of manufacture are lowered by reducing the proportion of ethylene oxide polymer in the molecule and compensating for the reduced solubility in water and the reduced polarity by sulphation of the terminal hydroxyl group. In this case, of course, the product is ionic.

The following table sets out the surface-active agents other than soap products offered for sale in this country at the present time. The writer gratefully acknowledges the assistance rendered by the suppliers of the various products mentioned; he has tried to make it as complete and accurate as possible, and if there are any omissions, he offers his apologies.

Table of Surface-Active Agents offered for sale in New Zealand, June 1952

Supplier	Name and Class	Chemical Nature 39	Applications
ICI	LISSAPOL N., N.X., N.X.A., N.D.A., N.D.B. Non-ionic detergent and wetting agent.	Condensation products of ethylene oxide with an alkylated phenol.	General purposes—wool-scouring, dust-suppression, cleaning oil tanks, concrete mixing.
ICI	LUBROL W. and M.O. Non-ionic emulsifiers and wetting agents.	Condensation products of ethylene oxide with a fatty alcohol.	Emulsification of oils and fats, degreasing of metals, concrete mixing.
ICI	PERMINAL COL. Anionic wetting agent.	Sulphated condensation product of ethylene oxide with a fatty alcohol.	For use with concentrated electrolytes in soldering fluxes, de-icing fluids, etc.
ICI	CALSOLENE OIL, H.S. Anionic wetting agent.	Sodium salt of a highly sulphated oil.	General wetting and penetrating purposes, e.g., in hypochlorite liquors and wire drawing solutions. Compatible with acids, alkalis and electrolytes.
ICI	LISSAPOL C. Anionic detergent.	Sodium salt of a sulphated fatty alcohol.	General detergent for household cleaning powders, textile scouring, etc. Compatible with acids, alkalis and electrolytes.
ICI	LISSAPOL L.S. Anionic detergent.	Sodium salt of oleyl-p-anisidide sulphonic acid.	Detergent; general textile and dye-bath assistant. Dispersing agent for lime soaps. Compatible with acids, alkalies and electrolytes.
ICI	PERMINAL B.X., P.W., E.M.L. APHROSOL, F.C. Anionic wetting, emulsifying and foaming agents.	Sodium salt of alkyl naphthalene sulphonic acid with emulsion or foam stabilisers.	General wetting and dispersing agent for textiles and leather; metal degreasing and pickling; foam production for fire-fighting and light-weight concrete; oil-in-water emulsions. Compatible with acids, alkalis, electrolytes.
ICI	DISPERSOL T. Anionic dispersing agent.	Sodium salt of methylene di-naphthalene sulphonic acid.	Dispersion of powders in aqueous pastes and suspensions. Scale modification in evaporators. Compatible with acids, alkalis, electrolytes.

ICI	WHITCOL, J.B.N. Anionic emulsifier.	Sodium salt of mixed fatty and cresylic acids.	Emulsification of mineral oils; metal degreasing, cleaning greasy floors, etc.
ICI	FIXANOL, C., V.R. VANTOC B. Cationic wetting, emulsifying and dispersing agents. Bactericides.	Alkyl pyridinium bromide.	Textile and leather finishing; dyeing. Wetting agent in soldering fluxes. Assists bitumen adhesion in roadmaking. Oil-in-water emulsifying. Bactericide in food industries.
ICI	LISSOLAMINE, A. CIRRASOL, O.D. VANTOC, A. As last.	Cetyl trimethyl ammonium bromide.	Special applications in acid solution or in presence of electrolytes. Bactericide in food industries.
RH	TRITONS, X100, N.E., X.155 & X.45. Water soluble non-ionic detergents and emulsifiers.	Alkaryl polyether alcohols of graded solubility in water and organic solvents.	General detergent and emulsifying purposes. Compatible with acids, alkalis and electrolytes.
RH	TRITON, B.1956 Oil soluble, emulsifier and wetting agent.	Modified phthalic glycerol alkyd resin in ethylene dichloride.	Emulsifiers for oil-in-water emulsions, insecticides and orchard sprays. Compatible with acids, alkalis and electrolytes.
RH	TRITON 200 Anionic detergent and emulsifier.	Sodium salt of alkylaryl polyether sulphonic acid.	Metal cleaning and pickling and general cleaning. General emulsifying uses. Compatible with acids, alkalis, electrolytes.
RH	TRITONS 770 and X.301. Anionic detergent and emulsifiers.	Sodium salt of alkylaryl polyether sulphate.	General detergent uses, especially with textiles. Compatible with alkalis and electrolytes, but not with strong acids.
RH	TRITONS K.60 & X.400 Cationic wetting and emulsifying agents.	Stearyl dimethyl benzyl ammonium chloride.	Emulsifier for resins and chlorinated hydrocarbons, wetting agent in dyeing and pigment dispersion. Compatible with strong acids (other than nitric), electrolytes and mild alkalis.

RH	HYAMINES 1622, 10X. & 2389 Cationic bactericides.	Quaternary ammonium chlorides of complex formulae.	Cleaning, sterilising and disinfecting in pharmacy and in food industries.
D	D.C. ANTIFOAM A. Oil soluble foam suppressor.	Silicone.	Foam suppression with oils, and, dissolved in an organic solvent, with aqueous solutions also.
C	LANOLIN & WOOL WAX ALCOHOLS Oil soluble emulsifiers.	Natural products, refined to various degrees.	Emulsifiers for water-in-oil emulsions for cosmetic and general purposes.
C	CRILLEX Nos. 17, 18, 19. Non-ionic emulsifiers.	Condensation products of ethylene oxide with propylene glycol monostearate.	Emulsifiers for oil-in-water emulsions for cosmetic and general use.
C	CRILLEX, Nos. 20, 21, 22, 23. Non-ionic emulsifiers.	Polyoxyethylene stearates.	Emulsifiers for oil-in-water emulsions for textile cosmetic, and general purposes.
C	CRILLEX, Nos. 24, 25, 26. Oil and alcohol soluble emulsifiers.	Fatty acid monoesters of propylene glycol.	Emulsifiers for oil-in-water or water-in-oil emulsions, according to conditions, for edible, cosmetic, pharmaceutical and general purposes.
C	CRILLEX, Nos. 27, 28, 29. Oil soluble emulsifiers.	Condensation products of ethylene oxide with complex fatty acid esters of sugars.	Emulsifiers for water-in-oil emulsions for cosmetic and pharmaceutical purposes.
C	CRILLEX, No. 30. Oil soluble emulsifier.	Condensation product of ethylene oxide with mannitan monopalmitate.	Emulsifier for water-in-oil emulsions for cosmetic and pharmaceutical purposes; also for wax polishes and insecticides and emulsions of urea-formaldehyde resins. Compatible with acids and electrolytes.
H	CERFAK	Sodium salts of alkylaryl sulphonic acids.	General detergency and wetting and in textile dyeing.
H	SURFAX, T.R. Wetting agents; detergents.		
H	CERFAK, 1300 & 1301. Non-ionic detergent.	Type not specified.	Textile detergent.

H	CERFAK, N.100. Detergent.	Slightly alkaline. Type not specified.	Textile detergent.
H	SURFAX, W.O. & S. Wetting agent.	"Sulphonated synthetic fatty oil."	Textile dyeing and finishing, leather processing, oil in-water emulsions of mineral oils. Incompatible with hard water, heavy metal salts, strong acids and alkalis. Imparts permanent water absorbency to paper and textiles.
S	TEEPOL Anion active wetting agent and detergent.	Sodium salts of sulphates of mixed secondary alcohols.	Used in scouring, laundering, dyeing, metal cleaning and pickling, dust suppression, cement mixing, etc.
S	SOFTOL, D.A., D.P. & T.R. Oil soluble wetting, emulsifying dispersing and defoaming agents.	Salts of sulphonated castor oil. D.A.—ammonium salt. D.P. and T.R.—potassium salt.	Pigment grinding in paint manufacture. Cosmetic emulsions of oil in water. Fat liquoring of leather.
M	EMPICOL series of 12 Products. ELTISOL, L. Anionic detergents.	Sodium, ammonium and ethanolamine salts of primary alkyl sulphates.	Detergents for general purposes—laundry, industrial, toilet and pharmaceutical uses.
M	EMPILAN series of 4 Products. Non-ionic wetting agents, emulsifiers and detergent "builders."	Type not specified.	General wetting and emulsifying agent.
M	EMPIMIN series of 2 Products. Finishing agents for textiles.	Type not specified, but apparently surface-active.	Finishing and softening agent in textile dyeing and scouring.
M	NANSA series of 6 Products. Anionic detergents.	Sodium salt of alkylaryl-sulphonic acids.	General detergent purposes.
M	EMPIWAXES Two self-emulsifying waxes.	Higher primary alcohols.	Pharmaceutical and cosmetic pastes and creams.
M	GLYCERYL MONOSTEARATE.	Glyceryl Monostearate.	As auxiliary emulsifier in food products, a dough improver or as shortening in baking.

NDA	GLYCERYL MONOSTEARATE.	Glyceryl Monostearate.	As in preceding item.
MC	SANTOMERSE, No. 1 70 and 88. Anionic wetting and dispersing agent, emulsifier and detergent.	Sodium salt of dodecyl benzene sulphonate, with different amounts of sodium sulphate.	For general wetting and detergent uses, metal pickling and cleaning, textile and leather treatment and dyeing.
V	STANVAC 40E. & 75E. Anionic detergent and wetting agent.	Sodium salts of alkylaryl-sulphonic acids.	A detergent in wool scouring and dyeing; in laundering, in dairy and general industrial applications. As wetting agent in fire-fighting.
BP	COMPROX Anionic detergent, wetting and dispersing agent.	Sodium salt of an alkyl sulphate along with other unspecified substances.	General detergent, especially for textiles; wetting agent in dyeing and a "spreader" in aqueous sprays.

KEY TO SUPPLIERS

ICI Manufactured by Imperial Chemical Industries Ltd., Great Britain.
Sold by Imperial Chemical Industries Ltd., New Zealand.

RH Manufactured by Rohm and Haas Co., Philadelphia.
Sold by Mair and Co., Ltd., Christchurch.

D Manufactured by the Dow Corning Corporation, Midland, Michigan.
Sold by Swift and Co., Ltd., Wellington.

C Manufactured by Croda Ltd., Snaith, Goole, Yorkshire.
Sold by Swift and Co., Ltd., Wellington.

H Manufactured by E. F. Houghton and Co., Philadelphia.
Sold by Paykel Bros., Ltd., Auckland.

S Manufactured and sold by the Shell Co.

M Manufactured by Marchon Products Ltd., Whitehaven, England.
Sold by E. A. Piper, St. Heliers, Auckland.

NDA Sold by National Dairy Association of New Zealand.

MC Manufactured by Monsanto Chemicals Ltd., England.
Sold by Gollin and Co., Pty., Auckland.

V Sold by the Vacuum Oil Co.

BP Manufactured by the Anglo-Iranian Oil Co., Ltd., England.
Sold by the British Petroleum Co. of N.Z. Ltd.

OBITUARY

Carl William Brandt (1908-1952)

On August 1st, 1952, the ranks of organic chemists in New Zealand were seriously depleted by the untimely death in Detroit, U.S.A., of Carl William Brandt, who had been an Associate of the N.Z. Institute of Chemistry since 1940. He had become one of the foremost investigators of our organic natural products, and his sad passing at the early age of 44 cut short a brilliant career which was probably just approaching its zenith.

Born at Feilding in 1908, Carl Brandt was educated at the Feilding Agricultural High School, where he impressed his teachers with his ability for original thought. In 1926 he came to Wellington to attend Victoria University College, and in 1934 he graduated with the degree of Master of Science, the overseas examiners remarking that his thesis was easily up to Ph.D. standard and was probably the best ever to have come from New Zealand.

He joined the Dominion Laboratory, Department of Scientific and Industrial Research, Wellington, as a cadet in 1928, and after a period on general analytical work he became assistant to the late Dr. J. R. Hosking in 1931. Under Hosking, who had worked extensively with Professor L. Ruzicka, Brandt's interest in organic natural products, especially in the diterpene field, was aroused, and this marked the commencement of his extensive researches into the structures of diterpenes and diterpenoids which was to be interrupted in such a tragic manner. The deep interest sustained in this field of research led him to spend much time outside of normal working hours at the laboratory bench.

Brandt's first problem, in co-operation with Dr. Hosking, was the examination of the oxygenated diterpenoids from *Dacrydium* species. This culminated in the proof of the structures of manoyl oxide, ketomanoyl oxide and manool, and the results were published in Berichte der Deutschen Chemischen Gesellschaft (4 papers), and the New Zealand Journal of Science and Technology. For several years he worked on phyllocladene and its isomeride isophyllocladene, diterpenes whose reactions proved somewhat difficult of interpretation, and the latest publication, in the July issue of this year's New Zealand Journal of Science and Technology, recorded almost conclusive evidence for structures of these compounds

which he had advocated for many years. It is indeed unfortunate that he was not granted the opportunity of conducting the few final confirmatory experiments.

From 1938 to 1948, Brandt was associated with the direction of three M.Sc. theses on natural products, namely, those of L. G. Neubauer on Miro Resin, D. J. Ross on Ngaione, a furan derivative from the essential oil of *Myoporum laetum,* and D. F. Nelson on the resin from Norfolk Island pine. The work of the first two of these theses were later extended, leading to publications in the Journal of the Chemical Society, of which Society he was a Fellow.

Investigations of a more official nature which led to publications were those on Ragwort and *Phormium tenax*. The toxic alkaloid, jacobine, was isolated from ragwort, and considerable progress was made in elucidation of its structure, and he was also responsible for the first complete chemical examination of the leaf and fibre of *P.tenax*.

Early in the present year, Brandt was granted a Fellowship at Wayne University, Detroit, U.S.A., to work under Professor Carl Djerassi. Djerassi has become one of the leaders in the field of steroid chemistry in North America, and was responsible for much of the work on the structure and synthesis of cortisone. The Fellowship was to have covered structural investigations on a cardiac stimulant from a species of Cactus, a steroid chemically related to cortisone, but after a brief two weeks in Detroit the sad blow fell.

His undeniable personal charm made Carl Brandt extremely popular with all with whom he came in contact, and his outstanding manipulative skill as an experimenter, together with his clear thinking on interpretation of experimental results made him an admirable teacher for all who had the fortune to work with him. As the writer was in this fortunate position, it can be added that his cheery but not undue optimism, coupled with his fund of suggestions was a real inspiration at all times, but more especially when the course of research appeared to have met an insuperable barrier.

All who knew Brandt well have felt a deep personal loss at his untimely passing, and the deepest of sympathy is extended to his widow in her very great loss.

The following is a list of Mr. Brandt's publications,

Chemistry of *Phormium tenax*, N.Z.J.Sci. Tech., XVIII, 613 (1937).
Notes on the Diterpenes, ibid., XXB, 8 (1938).
The Resins from some New Zealand Coal Measures, ibid., XXB, 306 (1939).

The Wood Resin from *Dacrydium bidwillii,* ibid., XXXIIIB, 141,(1951).
The Constitution of Phyllocladene and Related Diterpenes, Part I, ibid., XXXIVB, 46 (1952).

Note on the Influence of Phenolic Diterpenoids from some N.Z. Conifers on the Drying of Linseed Oil, ibid., 65.

With J. R. Hosking:

Diterpene oxides of the Resin of *Dacrydium Colensoi* Ber., LXVII, 1173 (1934) : LXVIII, 37, 286 (1935).

The Diterpene Alcohol from the Wood of *Dacrydium biforme* Ber., LXVIII, 1131 (1935).

The Toxic Principle of Ragwort, N.Z.J.Sci. Tech., XVII, 638 (1936).
Contributions to the Chemistry of the Genus *Dacrydium* ibid,, 750.

With L. G. Neubauer:
Miro Resin, J.C.S., 1031 (1939); 683 (1940).

With P. P. Lynch:
Quinine Poisoning—Report of a Fatal Case. N.Z. Med. J., August, 1940.

With D. J. Ross:
Podocarpic Acid as a Source of an Oestrogenic Hormone Nature, CLXI. 892 (1948).

The Constitution of Ngaione, J.C.S., 2778 (1949).

With B. R. Thomas:
The Wood Resin from *Dacrydium cupressinum*, N.Z.Sci.Tech., XXXIIIB, 30 (1951).

9—Ketoferruginol and Its Identity with Sugiol, J.C.S., 2442 (1952).

L.G.N.

SALARY SURVEY, JULY, 1952

By J. K. Dixon and J. L. Mandeno

INTRODUCTION:

This is the fourth Salary Survey authorised by the Council. The report on the Third Survey was published in the Journal (Jour. N.Z.I.C. 12 (1948) 32; 132). The questionnaire and method of reporting of the present survey follow the lines of the third survey and this makes possible direct comparisons between the 1948 and 1952 results. The questionnaire was sent out in July, 1952, to about 420 members of the Institute. Through a mishap, the time given for reply was rather short, but any reply received by August 1st was included in the survey. By this date, 279 replies had been received, representing some 66 per cent of members, a similar figure to the previous survey.

RETURNS:

In Table I are set out the replies received in groups. Industry again provided the greatest number of returns, followed by Government and University. School teaching and research associations provided more returns than in previous surveys, and enable a clearer picture to be obtained of their salary levels. In Table II. is set out the distribution of salaries according to age classes for industry. Similar tables have been prepared for other occupational groups. The table of Salaries in Industry is quoted in detail because there are salary scale for the Government, University and School Teaching that give information which is lacking for industry.

In Table III. are set out the average salaries for each age class of several occupational groups, and these are compared with similar groups in 1948 and 1944. Graph I shows the trend of salaries for the two major groups. Industry salaries vary considerably after 40 years for the small number of returns, as a detailed examination of Table II will show. The actual average salaries for the higher age groups in Industry are plotted on the graph, and cross the Government graph in the 46-50 years age

group, but it is more probable that it continues on the trend of the 41-45 and 46-50 groups and continues higher than the Government graph. The results shows that while the lower salaries in Industry are better than those in the University, the University salaries pass those in Industry at about 31-35, and remain better in the older age classes. Government salaries are consistently below those of Industry and up to the 41-45 age group, Government salaries lag about 5 years behind the Industrial ones, as was the case in the 1948 survey. In both the Government and Industry groups, the salary increase is about £129 per 5-year period. School teaching gives rather a similar picture to the Government. The lower paid employees in Research Associations do not compare favourably with the Government average, but at the higher levels they more than hold their own. The groups for local bodies and private practice are so small that it is difficult to discuss them without disclosing individual members' salaries. Suffice it to say that for local bodies the ages ranged from 31-50, and the salaries from £900/£1399 p.a.; for private practice, the age range was from 26-55, and the salaries from £600 to greater than £2000.

Table IV sets out the proportions of each group receiving salaries of more than £1400 p.a. These are compared with the members receiving more than £1000 in 1948. Evidence from the Government Statistician's Abstract of Statistics for the "Consumer's Retail Price Index" and for the "weekly money wage rates for adult males," suggests that there has been about a 40 per cent increase in costs and wage rates since 1948. Thus £1000 in 1948 should equal about £1400 in 1952. If this assumption is accepted, then Table X shows very similar percentages for 1948 and 1952; 19 per cent of members from Industry had salaries over £1000 in 1948 and 14 per cent over £1400 in 1952. There was 3 per cent in the Government service in 1948 over £1000 and 1 per cent over £1400 in 1952. Similarly the proportion in the University is steady at 17-18 per cent.

It is of further interest to note that this 40 per cent increase is closely followed in all the age groups of the various classes of employment, so that it can reasonably be concluded that average salaries of chemists have just kept pace with the cost of living since the 1948 survey.

Medians show substantially the same trends as the average salaries.

QUALIFICATIONS:

In Table V. academic qualifications are shown. While the major degree is still M.Sc., the University and Research Associations have higher percentages holding the doctor's degree than do the Government or Industry, while Industry holds the greatest percentage of those with the bachelor's degree.

In Industry, there appears to be very little difference in salary between Bachelors and Masters, but those with doctor's degrees are all in the top salaries. In the Government, Masters generally appear to command higher salaries than Bachelors, but those with the doctor's degrees do not appear to get higher salaries than masters.

In the University generally M.Sc. is the lowest acceptable degree. Those with doctor's degrees form an older and higher paid class.

In Industry, Fellows represent an older group, without higher salaries, but in the Government, Fellows receive the higher salaries over a fairly wide age range. It is worth noting (Table VI) that the percentage of Fellows is highest in Research Associations, University and the Government Service, and lowest in School Teaching and Industry.

(Continued on page 151)

TABLE I.
Returns

Group	Male	Female	Total
Industry	95	4	99
Government	80	9	89
University	30	3	33
Research Associations, including Cawthron Institute	12	0	12
School Teaching	20	0	20
Local Body	4	0	4
Private Practice	5	0	5
Retired	4	1	5
Unclassified	11	1	12
Totals	261	18	279

† Includes returns received after August 1st, and those whose present occupation is obviously not that of a normal chemist.

TABLE II.—Distribution of Salaries in Industry.

REMUNERATION

AGE	£ Below 450	£ 450 499	£ 500 549	£ 550 599	£ 600 649	£ 650 699	£ 700 749	£ 750 799	£ 800 899	£ 900 999	£ 1000 1099	£ 1100 1199	£ 1200 1399	£ 1400 1599	£ 1600 1799	£ 1800 1999	£ Above 2000	Total
21 - 25						1	1											2
26 - 30			1		2	1	8	4	6		3	2	1					28
31 - 35				1		2		2	4	4	3	1	2	1				20
36 - 40					1			1	3	2	5	2	2				3	19
41 - 45									2	1		1	2	2		1	2	11
46 - 50									1		2	2					2	7
51 - 55					1				1		1		1	1	1			6
56 - 60								1		1		1						3
61 - 65										1				1				2
65 +												1						1
			1	1	4	4	9	8	17	9	14	10	8	5	1	1	7	99

TABLE III.

Comparison of 1944, 1948, 1952 Salaries

Age Group	Government			Industry			University			School Teaching	Research Assns.
	1944	1948	1952	1944	1948	1952	1944	1948	1952	1952	1952
21-25	300	425	589	310	515	700		525	714	—	—
26-30	378	480	707	432	571	828		604	765	750	—
31-35	470	617	871	545	721	953		779	960	806	730
36-40	535	672	974	660	850	1086		817	1537	925	1500
41-45	625	821	1093	770	1100	1436		908	1300	1091	1075
46-50		893	1183		844	1171		1370	1300	1187	—
51-55		(850)	1275		950	965		950	1700	(950)	1550

TABLE IV.

Higher Salaries

Group	No. in Group		No. Receiving		% of total in group	
	1948	1952	£1000 or over in 1948	£1400 or over in 1952	1948	1952
Industry	74	99	14†	14††	19	14
Government	68	89	2	1	3	1
University	29	33	5	6	17	18
Research Associations	—	12	—	3	—	25
Others	38	20	6	1	16	5
School Teaching	—	20	—	1	—	5

† Includes 2 over £2000.
†† Includes 7 over £2000

TABLE V.

Academic Qualifications

(Percentage in brackets)

Qualifications	Government	Industry	University	School Teaching	Research Associations
No Degree	1 (1)	6 (6)	0	—	1 (8)
Bachelor	19 (23)	34 (34)	1 (3)	3 (15)	1 (8)
Master	56 (62)	54 (55)	17 (55)	17 (85)	3 (25)
Doctor	13 (15)	4 (3)	14 (42)	—	7 (58)

TABLE VI.

Fellows and Associates

	Government	Industry	University	School Teaching	Research Associations
Fellows	17	10	8	1	5
Associates	72	89	25	19	7
Totals	89	99	33	20	12

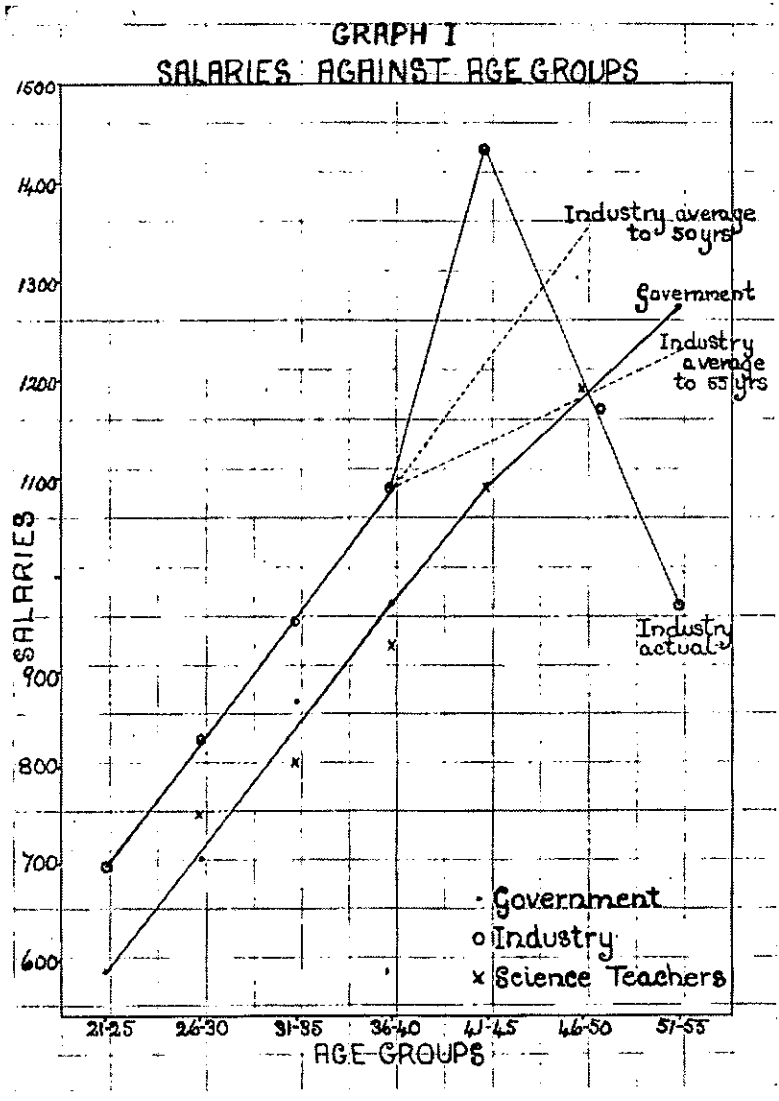
TABLE VII.

Superannuation (Industry)

Estimate of employer's contribution as a percentage of salary to superannuation or insurance.

Percentage	0	½ - 2½	3 - 4½	5	5½ - 7	7½ - 9	10	?†
Number	30	7	8	36	5	4	4	5

† 5 belong to an employer subsidised scheme, but extent of subsidy is unknown.


GRAPH I
SALARIES AGAINST AGE GROUPS
1500
1400
1300
1200
1100
900
800
700
600
SALARIES
Industry average to 50yrs
Government
Industry average to 55 yrs
Industry actual
· Government
o Industry
x Science Teachers
21-25
26-30
31-35
36-40
41-45
46-50
51-55
AGE-GROUPS

FEMALES:

There are relatively few returns from female members. In the Government Service the female salaries would be indistinguishable from the males in the same age class, but in Industry for each age class the female salary is the lowest for that age class.

SUPERANNUATION:

In the Government, University, Research Associations (generally) and Local Bodies, employees have the right, if they wish, to join the Government Superannuation Scheme. If the contributors join before the age of 30 the rate is 5 per cent, and this is subsidised £ for £ by the employer. For later entry into the scheme, the rate rises 1 per cent for each 5 years with a maximum of 10 per cent. From Table VII, it is seen that in Industry 36 per cent of members belong to a scheme where the employer subsidy is 5 per cent. Some (7 per cent) are subsidised by as low a rate as up to 2½ per cent, but 4 per cent get a 10 per cent subsidy. Some 30 per cent of the members do not belong to an employer subsidised scheme, but it is not clear whether this is their own wish or because of the refusal of the employer to subsidise a scheme. Some time ago, the Council went to the trouble of organising a scheme through the National Provident Fund, which would have given similar benefits to the Government scheme, and, whereas it would have required only ten members to start such an Institute sponsored scheme, only one member applied. It can thus be concluded that those who do not belong to an employer-subsidised scheme do not, in general, worry about it.

Note: This report is abridged from a fuller report obtainable on loan from the Secretary.

* * *

At the August meeting of the Auckland Branch, Mr. I. C. Luketina, physicist to the N.Z. Fertiliser Manufacturers' Research Association, discussed "The Use of Radio-Isotopes in Agricultural Research."

In July at a special meeting of the Auckland Branch, Professor Ingold of the University College, London, delivered an address on "Nitration and Nitrating Agents." A very large attendance listened to one of the most able addresses it has been their pleasure to hear. On behalf of the local members of the Chemical Society of London, Professor Briggs welcomed Professor Ingold as the first President of the Society to visit New Zealand during his term in office.

Mr. R. W. Bailey, on leave from the Soil Research Station, Hamilton, has left for England. He expects to study at the University of Birmingham on polysaccharides, probably of bacterial origin.

Miss M. P. Bartrum has returned recently from 20 months' leave in Europe during which time she spent 7½ months at the National Institute for Research in Dairying at Shinfield, near Reading. Miss Bartrum attended the meeting of the British Association at Edinburgh and visited Agricultural Research Stations in Great Britain.

Mr. D. S. Leatham has left to study at the University of Birmingham.

NEWS AND NOTES

At the June meeting of the Canterbury Branch, Dr. C. J. Wilkins spoke on "The Electron Diffraction Method of Determining Molecular Structure." Dr. Wilkins has recently returned from England, where he had been carrying out research under a Nuffield Travelling Scholarship.

Another member of C.U.C. to return recently, after obtaining his Doctorate in England, was Dr. M. R. McGlashan.

During the winter months, Prof. Packer and Dr. Wilkins have conducted a refresher course at C.U.C. on "Modern Developments in Organic and Inorganic Chemistry."

Mr. A. H. Swaney has left the Canterbury Frozen Meat Co. to take up a position in Wellington with the I.C.I. Ltd.

Mr. W. J. Wilson, until recently with the Chemistry Department, Otago University, is now in the Dominion Laboratory, Wellington.

Dr. K. L. Sutherland, the leader of the Physical Chemistry Division of C.S.I.R.O. in Melbourne, is visiting New Zealand at the invitation of the Professors of Chemistry and the Otago School of Mines. Whilst here Dr. Sutherland will lecture at the four centres on the "Fundamentals of Flotation" and various other aspects of Physical Chemistry.

Mr. S. R. Gay, who has been at the Burnside works of Kempthorne, Prosser and Company, for the last two years, has returned to their Hornby works.

Professor E. C. Dodds, a 1952 Sims Travelling Professor, arrived in Dunedin for a twelve-day stay during September. Professor Dodds is Professor of Biochemistry at the Courtauld Institute, Middlesex Hospital, University of London; during his stay he addressed the B.M.A. and medical staff of the Medical School on "Synthetic Oestrogens from the Clinical Point of View."

Professor N. L. Edson recently attended the A.N.Z.A.A.S. and Commonwealth Science Conference in Sydney. He was president of the Physiology and Biochemistry section, the title of his Presidential Address being "The Metabolism of the Sugar Alcohols."

Professor Ingold, during his recent visit, gave lectures to the Otago branch and to the University.

COMMENTS ON CONFERENCE

The Conference Committee and the various section chairman are to be congratulated on the extremely smooth running of Conference. The quality of papers was high, whilst the topics were so varied that Prof. Briggs has made the suggestion that three parallel sessions be organised in future, the third to be on purely academic subjects. The chairmen of the various symposia were extremely well chosen and so familiar with their subject that Mr. R. Hicks, for instance, chairman of the symposium on Waste Disposal, was able to provide the introduction, the whole of the discussion, and the vote of thanks. Since hardly any speaker exceeded his allotted time, the programme time-table was kept to admirably. Professor Slater's Presidential Address, whimsical but full of food for thought, was received with enthusiasm. Several very successful group discussion

meetings were held on Wednesday, 27th, in the evening, with very good attendances. Even the weather co-operated, the first two days being like a breath of summer, although the last was not so good.

A special mention should be made of the Annual General Meeting of the N.Z.I.C. which was enlivened by Mr. K. M. Griffin's motions of censure of Council. The first motion concerning subscriptions was carried As a result of the discussion the President and Mr. Griffin were seen to depart after the meeting in the most cordial spirits.

The local press was most intrigued with Mr. Fyfe's paper on "Stability of Complexions"!

—L. HARTMAN.

"CHEMICAL ASPECTS OF PHOTODYNAMIC ACTION AND PHOTOSENSITIVITY DISEASES IN ANIMALS"

Summary of a lecture given by Mr. N. T. Clare to the June Meeting of the Waikato Branch

Photodynamic action is essentially a system of oxidation by molecular oxygen, the energy being derived from light absorbed by a sensitizer, usually a fluorescent pigment, which is itself unchanged by the reaction. Theories of the mechanism of this process were reviewed. Until recently the most acceptable theory was that the sensitizer molecule (photodynamic agent) was activated by absorption of a quantum of radiation and transferred its energy of activation on collision with a substrate molecule. The latter could then react on collision with a molecule of oxygen. Recent work had revived alternative mechanisms in which the dye acted as a hydrogen carrier between an H donor and oxygen, forming hydrogen peroxide which oxidised the substrate. For example, the photosensitized inhibition of growth of seedlings by flavoproteins had been shown to involve formation of hydrogen peroxide and oxidation of indoleacetic acid. Probably both mechanisms occurred in different systems. A wide range of substances could be photodynamic agents, the one property in common being fluorescence which was itself evidence of activation. In animal cells the subtrates were usually the histidine and tryptophane groups of proteins, and the subsequent effects probably arose from release of toxic oxidation products.

The speaker classified photosensitivity diseases into three types depending on the origin of the sensitizer or the way in which its reached the skin.

Type I (Primary Photosensitization) could be caused by plant pigments such as hypericins (polyhydroxy derivatives of reduced helianthrone) of St. John's Wort, or by a similar pigment in buckwheat. Work at Ruakura had shown that dried millet (*Panicum miliaceum*) contained chlorophyll derivatives which produced Type I photosensitization in rats and two of these had been identified as phaeophorbide a and pyrophaeophorbide a.

Type II (endogenous type) was due to a defect of pigment synthesis in the body. This type was represented by congenital porphyria in cattle.

Type III (hepatogenous) was due to some defect in the liver hindering excretion of the chlorophyll derivative phylloerythrin, which is normally excreted in the bile. Many examples of this type were known. *Tribulus*

terrestris produced the disease geeldikkop (yellow thick head) in South Africa. The liver damaging substance had not been isolated. *Lippia rehmanni* contained 3 isomeric icterogenins. *Lantana camara* gave three lantadenes which on degradation gave trimethylphenanthrene and sapotalene.

Other plants about which there was less known concerning the liver damaging agents were some *Agave* species, ngaio (toxicity due to the oil), a *Microcystis* species (toxin an alkaloid), a *Tetradymia* species (toxicity due to a petroleum ether soluble substance) and several other plants.

Photosensitivity could also be caused by carbon tetrachloride, aniline, mechanical obstruction of the bile duct, and possibly by phenanthridinium, a drug used for sleepy sickness in cattle. Recent information on attempts to isolate millet and facial eczema toxins was given. Millet toxin could be extracted by methanol and the facial eczema toxin by ether or acetone. Guinea-pigs were now used as experimental animals for this work. Biochemical and other approaches to facial eczema work were mentioned.

REPORT OF ANNUAL GENERAL MEETING, VICTORIA UNIVERSITY COLLEGE, AUGUST 26th, 1952, 11 a.m.

Number present 88, under the chairmanship of Prof. S. N. Slater, President.

The minutes of the last Annual General Meeting, held at Hamilton on August 20th, 1951, were taken as read and confirmed, subject to the following amendments:—

(1) Mr. K. M. Griffin's letter of apology for absence to be recorded.

(2) Finance Section M573, should read that the Chairman, Mr. P. R. Parr, suggested that Branches discuss the possibility of increasing the subscription.

PRESIDENTIAL REMARKS: Prof. Slater welcomed the following visitors:—Dr. E. Copping, Dr. Sutherland, C.S.I.R.O., Melbourne, Dr. England, Prof. Evans.

Congratulations were extended to Dr. C. R. Barnicoat on his award of the D.Sc. Degree by the University of New Zealand; to Mr. Beckwith on gaining a Shell Scholarship, and to Drs. Neubauer, McGillivray and Davies on their election to the Fellowship of the N.Z.I.C.

Members stood as a mark of respect to the late Carl Brandt, who died in Detroit while studying at Wayne University.

The President announced that the Registrar had been appointed for an indefinite period, and pointed out that previously the appointment had been for specific periods.

The University of New Zealand will no longer examine for C.O.P. in Chemistry, and the Institute has in hand the preparation of Regulations for conduct of our own examinations. Membership of the Institute continues to grow, and stands now at 454, with 160 local members.

Representations to the Hon. Ministers of Agriculture and S.I.R., were successful in restoring travelling expenses privileges to Government Chemists attending Conference. The President thanked Dr. H. E. Annett for his assistance in the matter.

It was announced that Conference 1953 would be held in Dunedin.

The large amount of voluntary work done by the members of sub-committees of Council was gratefully acknowledged by the President, who also thanked those members who had sent in back numbers of the Journal.

Reports were received from the following Sub-Committees:—

1. *Membership.*
2. *Journal.* It was resolved that the Committee be thanked for their work, which is resulting in a steady increase in the excellence of the Journal.
3. *Professional Status Committee.* One of the matters being examined by the Committee is the comparison of the standards of admission to Commonwealth Chemical Institutes.
4. *Salaries.* Dr. Dixon, Convenor, presented tables and a graph showing present trends. One noteworthy feature was that many chemists still do not belong to employer-subsidised superannuation schemes.
5. *Examinations.*
6. *Medical Advertisements.*
7. *Standards Institute Committee.*
8. *Employment Committee.* Branches are asked to consider the desirability of closing the Register.
9. *Standard Methods of Analysis.* Dr. Davies in his report on Soils and Fertilizers suggested that at the present time the Secretary could now become a centre for the exchange of information.
10. *Conference Committee.*
11. *Contracts of Service.*
12. *Patents Committee.*
13. *U.N.E.S.C.O.*

Sir Theodore Rigg moved a vote of thanks to the members of the Sub-Committees for their work, involving the progress and prestige of the Institute. He referred in particular to the work of the Journal Committee for raising the standard of the Journal. The motion was carried by acclamation.

INSTITUTE PRIZES. It was announced that Council had made a posthumous award of the I.C.I. Prize to Mr. C. W. Brandt. The Morcom Green and Edwards Prize was awarded to Dr. McGillivray. Mr. A. Odell's entry was highly commended.

REVISION OF RULES. It was announced that after consideration by Branches, the amended draft would be considered by Council at a special meeting in November.

TIMBER PRESERVATION. In connection with the submissions being made to the Borax/Boric Acid Committee of Inquiry, Mr. K. M. Griffin protested that the submissions were not shown to Council or to the Institute members actively engaged in the study of timber treatment.

The President explained that the matter arose urgently, and since the submissions were non-technical, dealing only with the position of chemists in any proposed legislation, he had authorised their immediate presentation. Mr. C. G. W. Mason, our representative on the Timber Preservation

Committee, was selected to present the evidence. This selection was held to be in order by the Chairman of the Committee of Inquiry.

UNQUALIFIED CHEMISTS. No discussion was held on this topic, as it is understood that Dr. Richardson had very few replies from individual University teachers.

NOTICES OF MOTION by Mr. K. M. Griffin.

1. The motion re subscriptions was amended by the mover following a point of order raised by Mr. O. H. Keys. The motion, which was seconded pro forma by Dr. W. Metcalf then read: "That this Annual General Meeting of the New Zealand Institute of Chemistry protests against the manner in which the increase in subscriptions, passed by Council in November, 1951, and mentioned in the Journal, received in February, 1952, was notified to members." Speaking to the motion, Mr. Griffin explained that he was concerned with the manner in which the increase had been effected, and not with the right of Council to impose an increase. He suspected that there had been little consideration of the necessity to increase subscriptions by Branch meetings.

The motion was carried by 38 to 32, there being 18 abstentions.

2. Younger Chemists for U.S.A.

At the suggestion of the President, Mr. Griffin amended his motion to read: "That this General Meeting of the N.Z.I.C. records its grave dissatisfaction with Council's handling of the 'Young Chemists for U.S.A.' project. The American Chemical Society relied entirely on local groups to select these young chemists. The Institute had a golden opportunity to depart from the usual method of academic selection. In refusing to accept this challenge, Council and its Selection Committee did a grave disservice to chemical industry in New Zealand."

The motion was seconded pro forma by Mr. B. E. Swedlund.

The President stated that a letter from Mr. Griffin to Council on this matter was not read to the Annual General Meeting in Hamilton as there was no request in the letter that it should be other than confidential to Council. However, in view of the protest contained in the letter, a statement on the selection was made to the meeting. Mr. Griffin felt that an exaggerated importance was often attached to chemists from overseas, and considered that young New Zealanders from Industry should have received more consideration. He thought that there was a tendency for the New Zealand Institute of Chemistry to become too academic in nature.

Both the President and Dr. A. T. Johns (one of the successful applicants) emphasised that the final selection was made in America, and not by the New Zealand Institute of Chemistry Selection Committee.

The motion was lost.

This year is the Centennial Year of the Auckland Institute and Museum, the equivalent to the branches of the Royal Society in other centres. To mark the occasion, the Auckland Institute and Museum have invited kindred scientific bodies to hold a meeting under their auspices. The Auckland Branch of the Institute of Chemistry held their invitation meeting at the Museum in September, at which Mr. K. M. Griffin "Reminisced on Forensic Chemistry."

REPORT OF COUNCIL MEETING HELD ON AUGUST 25, 1952.

PRESENT: Prof. S. N. Slater (chairman); Dr. H. E. Annett (Vice-President), Mr. G. Lambert (Auckland), Mr. R. E. R. Grimmett (Waikato), Dr. R. M. Dolby (Manawatu), Mr. A. P. Oliver (Wellington), Mr. F. H. G. Johnstone (Canterbury), Mr. O. H. Keys (Otago), Mr. W. G. Hughson (Hon. Gen. Secretary), Mr. H. K. Palmer (Registrar). Mr. B. E. Jackson, usual Proxy for Auckland, was present by invitation.

SUB-COMMITEES OF COUNCIL:

Conference 1952. Following successful representation to the Hon. Ministers for Agriculture and S.I.R., the position of Government Chemists attending Conference was restored to that of previous years. It was resolved that the Ministers be thanked and that the Public Service Commission be asked officially to clarify the position for future years.

Conference 1953 will be held in Dunedin.

STANDARDS COMMITTEE:

The Sub-Committee appointed by Council to consult with Mr. Mason on Timber matters reported also on the preparation of a submission to the Committee of Inquiry on Borax-Boric Acid treatment of timber. This is being presented by our representative, Mr. C. C. W. Mason. The submission does not concern the merits of the treatment, but refers to policy matters only.

EMPLOYMENT COMMITTEE:

Branches are asked to consider the desirability of closing the Register. Council feels that one Employment Officer would be sufficient in the present circumstances.

EXAMINATIONS COMMITTEE:

The closing date for entrance for the Laboratory Assistants' Certificate Examination has been set at June 30th. The Examinations Committee will ask Branch Committees to appoint a Supervisor to arrange for the examinations to be conducted, and will at the same time indicate the subjects and number of candidates. Mr. J. W. McChesney will join the Examinations Committee for the remainder of the year in place of Dr. G. M. Richardson, who has resigned.

Mr. Keys presented on behalf of the Committee, a draft of Regulation I, governing the examination of candidates for the Associateship who are not eligible under Rule 8. The Committee was thanked for the draft and the painstaking work which it had entailed. The draft as amended by Council will be circulated to Branches for further comment.

SALARIES COMMITTEE:

A full report of the recent survey was not available, but Dr. Dixon sent tables and a graph showing the main trends. These were exhibited at Conference, and aroused great interest. Further information will appear in the Journal.

MEMBERSHIP:

Dr. E. B. Davies, of Hamilton, was elected a Fellow of the Institute. The following were elected Associates:—

S. M. Betty, Christchurch.
D. R. Boaden, Auckland.
J. N. Caradus, Hawera.
B. Cleverley, Auckland.
Dr. B. B. Marsh, Wellington.
E. A. Mooney, Auckland.

T. A. Turney, Wellington.
D. M. Alexander, Christchurch.
A. H. Horn, Hamilton.
O. J. Kelsey, Auckland.
R. R. White, Hamilton.
H. M. Stone, Wellington.
T. A. Mitchell, Hamilton.
M. H. Pankhurst, Christchurch.
K. E. Seal, Auckland.

INSTITUTE PRIZES:

The I.C.I. Prize was awarded posthumously to Mr. C. W. Brandt, Dominion Laboratory, Wellington, for his entry dealing mainly with research on Diterpenes.

The Morcom Green and Edwards Prize was awarded to Dr. W. A. McGillivray, Massey College, for his entry on the metabolism of Vitamin A in ruminants and seasonal variations in Vitamin A potency of N.Z. butterfat.

The entry of Mr. A. L. Odell on the construction of a magnetic susceptibility balance was very highly commended by the examiners.

RULES:

Time did not permit the examination of the revised draft, which includes submissions made by the Auckland Rules Sub-Committee. The draft will be circulated to Branches for comment. Council proposes to hold a two-day meeting in November so that the matter can be finalised.

BOOKS RECEIVED

(Reviews by Dr. H. Bloom, Auckland University College)

Structural Chemistry of Inorganic Compounds. Volume II, by Walter Hückel, Professor of Pharmaceutical Chemistry, Tubingen University, translated by Dr. L. H. Long. 654 pages. 1951: Elsevier Publishing Co. Distributors: Cleaver-Hume Press (London). (90/-).

Although many of the topics chosen are well treated, it is clear that this book fails in its primary object, namely, to furnish inorganic chemistry with a systematisation based on structural and constitutional theory similar to that possessed by organic chemistry. Various sections deal with Volatility of inorganic molecules, Crystal chemistry, Silicates and glasses, Metallic substances, the Chemical Reaction in Inorganic Chemistry and finally—Lines of Research in Chemical science, a chapter which does not contribute anything useful and would better have been omitted. The diagrams, general arrangement and printing are excellent, but the language is rather stilted apparently due to a too literal translation from the German. Several typographical errors apart from those listed under "Errata" have been detected.

An Introduction to Modern Thermodynamical Principles. 2nd Edition, by A. R. Ubbelohde. 182 pages. 1952. Oxford University Press. 21/-. A very useful summary of modern thermodynamics. The errors of the 1st edition have been corrected and sections have been added on melting, rubber-like solids, the formal thermodynamics of continuous phase transitions and some applied calculations of thermodynamic functions.

Gmelins Handbuch der anorganischen Chemie. System Number 41: Titanium, 481 pages and 100 figures. 1951: Verlag Chemie, GMBH, Weinheim/Bergstrasse. DM 113.

Part of the 8th edition of the well known exhaustive treatise on Inorganic Chemistry. The work has been enlarged in scope and much new material added, the most recent references being to publications in 1949. It is interesting to note that more than a page has been devoted to the occurrence of titanium in New Zealand (which follows Tasmania under the heading "Australia"). The book has been very well produced and is easily the most useful, complete and up-to-date collection of inorganic data available.

Gmelins Handbuch der anorganischen Chemie. System Number 17: Arsenic, 475 pages and 20 figures, 1952: Verlag Chemie, GMBH, Weinheim/ Bergstrasse, DM 140.

Allgemeine Und anorganische Chemie. By Prof. Dr. G. Schwarzenbach. 4th (enlarged) edition, 474 pages, 1950: Georg Thieme Verlag, Stuttgart. DM 21.60 ($5.15)—a well-written general text book of inorganic chemistry from a structural and physical viewpoint.

Detonation in Condensed Explosives. By J. Taylor, Research Department, Nobel Division, Imperial Chemical Industries Ltd. 196 pages, 10 plates, 1952: Oxford University Press. 25/-.

An excellent account of the theory and research into the processes of detonation in condensed explosives, very well printed and fully documented.

Mixtures: The theory of the equilibrium properties of some simple classes of mixtures, solutions and alloys. By E. A. Guggenheim, Professor of Chemistry at Reading University, 270 pages. 1952: Oxford University Press. 42/-. Although the mathematical treatment is correctly described as "elementary" the extent to which it occurs throughout the text may deter all except the physical chemist specialising in thermodynamics. The use of simple models on which to build up the theory of mixtures leads to formulae which are capable of solution, but does not necessarily enable the prediction of the properties of mixtures exactly. The emphasis throughout the book is very heavily on the theoretical rather than the experimental side.

Valence. By C. A. Coulson, Rouse Ball Professor of Mathematics in the University of Oxford. 388 pages. 1952: Oxford University Press. 25/-.—This very important book covers valence theory both from the molecular-orbital and valence-bond resonance methods. Although the author develops the necessary wave mechanical theory in sufficient detail to be of value in the discussion, the mathematical treatment is sufficiently simple to be followed easily and makes the book a very important acquisition to chemists. The early chapters deal with valence theory, atomic orbitals and wave mechanical principles. Then follows an account of the molecular-orbital and valence-bond theories of di— and polyatomic molecules with well chosen examples. The remainder of the book deals with hybridization, conjugated and aromatic molecules, non-metallic solids, metals and the hydrogen bond.

Man and the Chemical Elements. By J. Newton Friend. 354 pages. 1951: Charles Griffin and Company Ltd., London. 27/6.—A very readable and useful book for the teacher and student of elementary inorganic chemistry. Most of the material is of a light-hearted and inaccessible nature, and is of the type which helps to brighten up lectures in the introductory sections of elementary inorganic chemistry.

The book is not entirely free from errors, e.g., the product of the Frank and Caro process for the fixation of nitrogen is incorrectly described as "calcium cyanide, Ca $N.NH_2$" and the data on the solidification of helium is not strictly accurate.

SPECIAL NOTICE

The address of the Editor is now P.O. Box 9012, Newmarket, Auckland, New Zealand.

B. D. H.

REAGENTS FOR

CLINICAL ANALYSIS

This series of prepared reagents contains the more important solutions together with special B.D.H. reagents used in conjunction with the Lovibond Comparator to enable tedious analytical procedures to be carried out quickly and conveniently.

As New Zealand agents for the Laboratory Group of Messrs. British Drug Houses Ltd., we can offer ex stock a comprehensive range of their products covering all lines of chemicals and testing apparatus.

We can also offer for immediate delivery adequate supplies of all everyday requirements as needed in almost every laboratory.

Your enquiries will at all times receive our careful attention and you are cordially invited to visit our showrooms at either of the addresses listed below:

THE NATIONAL DAIRY ASSOCIATION OF NEW ZEALAND LTD.

WELLINGTON
THORNDON QUAY,

FANSHAWE STREET,
AUCKLAND.

TEEPOL - for simplified and improved processing

TEEPOL

neutral liquid wetting agent and detergent.

TEXTILES: scouring, carbonising, anti-shrinking, bleaching, dyeing, finishing.

LEATHER AND FUR TRADES: soaking, scouring, pickling, stripping, wetting-back, fat-liquoring, dyeing.

LAUNDRIES: washing all classifications, especially woollens, silks, rayons, coloured goods, and all heavily soiled articles.

WORKS MAINTENANCE: cleaning all types of plant and equipment in the factory, canteens, workshops.

PAINT MANUFACTURE: stabilizing emulsion-based paints; wetting and dispersing pigments.

PAPER MAKING: boiling and pulping straw, esparto, rags; bleaching, dyeing, sizing; cleaning wires, felts.

ENGINEERING: de-greasing, acid pickling and electro-plating.

Write for Technical Information regarding the detailed applications of "TEEPOL" (Registered Trade Mark).

SHELL

THE SHELL COMPANY OF NEW ZEALAND LIMITED
(INCORPORATED IN ENGLAND)
Auckland Wellington Christchurch Dunedin

Registered at the G.P.O. Wellington for transmission by post as a Magazine