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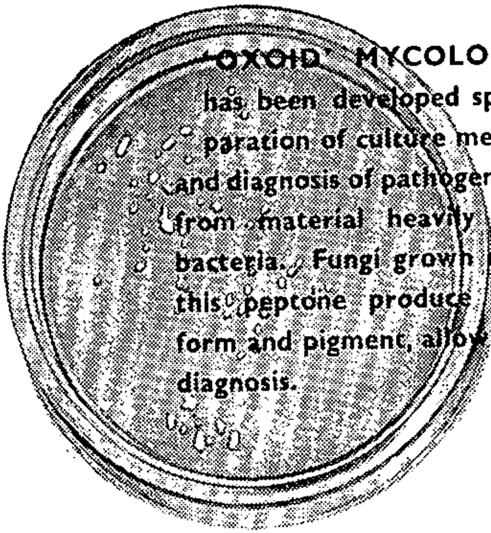
CONTENTS

THE BIOLOGICAL SIGNIFICANCE OF THE METALS
C. R. Barnicoat.

A CHEMICAL WOOD-PULP INDUSTRY FOR NEW ZEALAND.
A. W. Mackney.

NEWS REVIEWS NOTES



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NEW ZEALAND INSTITUTE OF CHEMISTRY

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EDITORIAL

With the establishment of the Waikato and Manawatu groups, the number of branches of our Institute has grown from four to six, the first increase since our society was formally constituted in 1931. This is welcome as a very pleasing sign of life within our Institute: it means that some 45 of the 78 members outside the four centres desire that their membership should mean more than the possession of a frequently redundant professional qualification. They feel that they should meet together as chemists for the reading of papers and discussion, this being the first reason for the establishment of the Chemical Society of London and its followers in other lands. In these older bodies, the publishing function has rivalled or outgrown the holding of meetings, but we have not yet reached that state. Regular meetings can attract other chemists at present outside the Institute to link up as Associates or Local Members. There is scope in this third group for technicians and the interested laity and we would urge our friends in the Manawatu and the Waikato not to overlook them.

An important point is that the members in these two new branches will now have direct representation on the Council by delegates living in their own cities, and the Council will be strengthened by a further two members so that its structure can no longer be criticised for containing too large a proportion of executive officers.

We are sure that we speak for all members in extending our hearty greetings to both these new branches.

THE BIOLOGICAL SIGNIFICANCE OF THE METALS

By C. R. Barnicoat, Ph.D. (Minnesota), M.Sc.

Address delivered at the Annual Conference, Christchurch, **August, 1950.**

It is my privilege this afternoon to present the Chairman's address at the 1950 Annual Conference of the New Zealand section of the Royal Institute of Chemistry.

I suggested the subject, "The Biological Significance of the Metals" because it seemed to be of general interest to chemists in this country, for even a glance at the literature of certain biologically-important elements, notably Ca, P and the so-called "trace elements" Co, I, Cu, B (and recently Mo and F), will remind us of the prominence of New Zealand chemists in the field of mineral deficiencies in plant and animal nutrition. Now, the importance of these elements to the animal—and my remarks will, on the whole, relate to the animal organism—has been proved by the results of many nutritional studies and by recent work in various fields of biochemistry which has extended, and indeed altered, many of our views on the functions of inorganic elements in biological processes. I therefore felt that it might be of interest to review some of this work, and I am glad that several papers read at this Conference have been related to this topic, though presented from rather different aspects.

One of the five major constituents commonly estimated in food and tissue analysis is the *ash*. By careful treatment inorganic substances originally present may be obtained in the ash free from organic matter and in a state suitable for further analysis. The composition of the ash is really no indication of the state of combination of the elements in the original material, but from the universal occurrence of certain elements it has been established that the tissues of animals and plants, in addition to the principal organic elements— C, H, O, N—invariably contain Ca, Mg, Na, K, P, S, Cl, Fe, and the "trace" elements Cu, I, Mn, Co, Zn and F (animals), Mo and B (plants). By means of the spectroscope about 40 other elements have been detected in minute traces. It is not yet known which of these are present as essential components of the organism—"unidentified 'trace' elements," so to speak—and which are merely to be regarded as impurities.

From the nutritional point of view the animal's needs must be met by a steady and adequate intake of minerals, for even with fully-grown animals there is a continuous demand for certain inorganic elements to replace wear and tear of the tissues.

In reviewing the numerous functions of the inorganic elements in living organisms, the simplest possible classification, based on their biological functions, will be followed, viz.:—

(i) Elements present as structural components;
(ii) Elements present as functional group components;
(iii) Elements maintaining activity of protoplasm;
and (iv) Elements essential for enzyme systems.

Let us consider these functions of the inorganic elements in the order stated:—

(i) **Elements present as structural components:** Inorganic matter (ash) amounts to about 5% by weight of an animal and in terms of chemical equivalents nearly 90% is Ca and P, mostly present in bones and teeth. (Fig. 1.) The section on "Mineral Metabolism" in many biochemistry text-books comprises "Biochemistry of Calcification," and it is not intended to discuss this subject further, except to remark that this field is of vital interest to New Zealand because of the widespread incidence of dental caries. Much laborious and ingenious work in the fields of nutrition, histology, chemistry and bacteriology has unfortunately failed to establish the fundamental cause of dental caries. The work of Hevesy and others (1937), using radioactive P, clearly established, however, that tooth enamel—the hardest structure in the body—is a living, metabolising tissue. Other workers, using

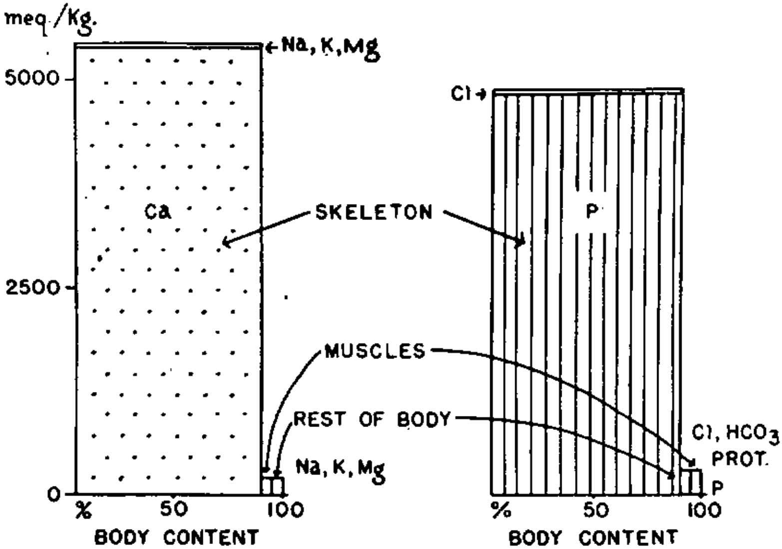

Fig. 1.—Distribution of Positive and Negative Equivalents in the Body (fat-free)—after Shohl.

X-ray diffraction techniques, have found that the Ca and P are combined in a lattice of the hydroxyapatite type. A number of other elements can replace Ca and P in the lattice—e.g., F—which gives a harder, more insoluble and resistant fluoroapatite structure.

These superficial remarks on the inorganic structural elements will, I trust, serve to introduce this group of elements, quantitatively the most important, into the classification scheme. They will also emphasise the fact that most of the mineral requirements of animals go to the hard tissues for growth and repair purposes.

In the animal organism only about 15% of the inorganic elements are concerned with regulating the fundamental life-processes themselves, and these elements will next be considered.

(ii) Elements present as functional group components: This group is somewhat vaguely defined, for like certain empirical schemes in chemical analysis, it has been arrived at "by difference." No element in this group participates as a metabolite in energy-exchange reactions, yet nearly all are concerned with regulating this vital chemical activity. Among the inorganic elements concerned with functional activities are those with a wide range of activities, e.g., Mg. Mg is the key element in photosynthesis, fundamentally important, directly and indirectly, to all forms of life. An Mg atom, in resonance with 4 N atoms of pyrrole groups constituting the porphin molecule, participates in the reaction of transferring the energy of sunlight in order that CO_2 may be reduced by water and linked up in molecules containing multiples of 6 C atoms, into carbohydrates. Mg is also of importance in several enzyme systems, in body fluids and in bones and teeth.

Several elements are concerned with the fundamental life-process of cell respiration; e.g., Fe is present in respiratory pigments such as haemoglobin of the higher animals; and Cu occurs in the bluish oxygen-carrying pigment haemocyanin of molluscs and gastropods and as the prosthetic group in two proteins of higher animals. One of these, haemocuprein, is present in mammalian blood. In the absence of this copper-containing protein the body will not manufacture haemoglobin even though copious supplies of Fe may be present. V is another element concerned with oxygen-transport and occurs in the respiratory pigment of the blood of tunicates and certain other marine animals. Respiratory pigments containing Fe and Cu are much more efficient than that containing V, and Fe and Cu occur in seawater in infinitely greater concentrations than V. It is surprising that an obscure branch of the animal kingdom should develop along such unorthodox lines, and the problem is difficult to explain by the evolutionary or, indeed, by any other theory.

K occurs mainly in the plastic tissues, where it is doubtless a functional element associated with proteins and as typical of these soft tissues as is Na of the body fluids or Ca of the hard structural tissues. The important activity of K in the transmission of nervous impulses is well known.

P is widely distributed in the body as a functional element and occurs chiefly in the PO_4 group. PO_4 groups occur in phospholipids which are essential parts of cell membranes apparently concerned with regulating the entry of fat-like substances into the living cell. Phospholipids are also prominent constituents of nervous tissue and blood. The PO_4 radical is involved in the metabolism of carbohydrates, fats, and proteins, all of which are believed to be phosphorylated while undergoing biochemical transformations. The best known function of the PO_4 radical is its ability to transfer energy during the enzyme-controlled, stepwise oxidation of the hydrogen atoms of metabolites in the course of cell respiration. The elucidation of this complex inter-related series of biochemical reactions is one of the outstanding achievements of pure biochemistry.

It has been reported fairly recently that Ba occurs in considerable concentration in the choroid (one of the linings) of the eye. If this finding is correct, it would appear that Ba will have to be regarded as an essential "trace" element.

Co occurs in various issues, and the presence of a Co atom in the "anti-pernicious anaemia substance," a specific metal-organic compound of molecular weight about 1600, is of particular interest. Efforts made to link up this substance with the prevention of "bush sickness" of ruminants have so far failed.

Before leaving the functional metals H ion must be considered. In addition to its obvious function of maintaining pH equilibria in biological systems, H^+ acts as a functional element in gastric juice, which contains HCl at a concentration of about 0.5% and has a pH of about 1.5. Its principal responsibility is apparently that of releasing from the inactive pepsinogen the enzyme pepsin. The amazing biochemical activity in certain specialised cells of the stomach wall resulting in the production of HCl by means of this essential reaction:—

$$NaCl + H_2O + CO_2 \longrightarrow \underset{\text{(gastric juice)}}{HCl} + \underset{\text{(body fluids)}}{NaHCO_3}$$

is being studied closely by a number of workers in overseas laboratories.

It is therefore apparent that functional group elements participate in a wide range of physiological activities and in many cases the fundamental biochemical changes occurring are still unknown.

(iii) **Elements maintaining activity of protoplasm:**

Protoplasm exhibits typical colloid properties. It is sensitive to changes in temperature, pH (normally maintained at about 7.4), osmotic pressure (normally about 6.8 atm.) and concentrations of inorganic salts, both relative and absolute.

Negatively-charged colloids, for example, are coagulated by mono-, di, and tri-valent cations in relative dilutions of roughly geometric relationships (Schulze-Hardy rule). This phenomenon is also manifest in living systems (in which protein is present as an anion) as the so-called "antagonism of ions." For example, the activity (irritability) of most tissues accords with the pseudo-equation

$$\frac{Na^+ + K^+ + OH^-}{Ca^{++} + Mg^{++} + H^+}$$

This phenomenon is observed even with milk proteins. Certain milks are "unstable," i.e., they coagulate when condensed and submitted to high temperatures for the final sterilisation. Addition of traces of certain inorganic salts adjusts the "salt balance" and a satisfactory commercial product is obtained.

The famous French physiologist, Claude Bernard, first emphasised the importance of the extracellular fluid—blood plasma and lymph—as the immediate environment of an organism. It replaces, and in its essential features still closely resembles, the external environment—seawater—of early forms of life. "The stability of this internal medium," he states, "is the primary condition of freedom and independence of existence." McCallum considered the establishment of this closed aqueous system the greatest forward step in the history of the animal organism, and therefore regarded the organ regulating this constancy—the kidney—rather than the brain, as the paramount organ of evolution!

In Fig. 2 the chemical composition of certain tissue fluids is represented in concentrations of milliequivalents/litre, the values for cations and anions being superimposed in separate columns.

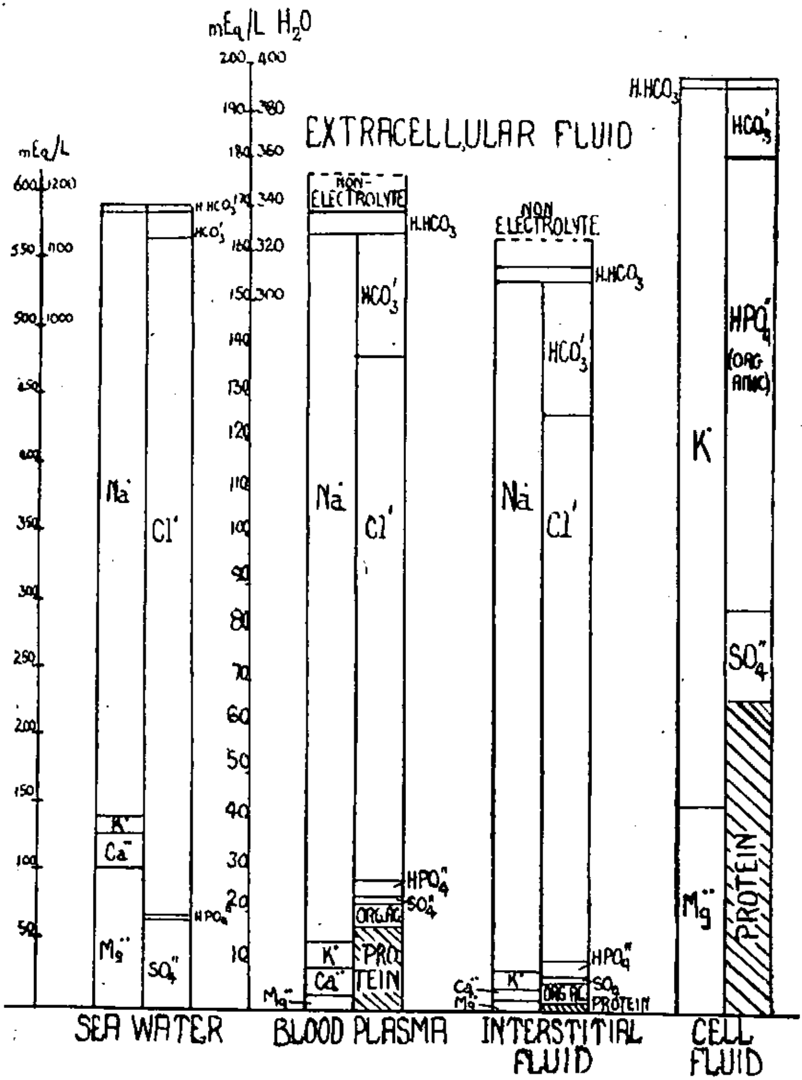

Fig. 2.—Distribution of Positive and Negative Equivalents in extra-cellular fluids—after Gamble.

Extracellular fluids (blood plasma and interstitial fluid) as well as blood cells, cerebro-spinal fluid, eye fluid and various transudates and milk are normally isotonic, i.e., in osmotic, ionic and acid:base equilibrium, with freezing points maintained close to — 0.545°C. This freezing point results from a concentration of solutes amounting to about 300 milliequivalents/litre.

In the histograms (Fig. 2) the importance of the protein anions and their accompanying balancing cations has been over-emphasised, as some of the K is bound to protein in an inactive form. When allowance is made for this, the electrolyte pattern of the plasma and cell fluid became almost identical with that of the simpler interstitial fluid, the ionic, acid:base and osmotic properties of which are satisfactorily accounted for by the proportions shown.

It is surprising to find how accurately the healthy body controls these physico-chemical properties of its "internal medium," yet the isotonic fluids of the body may vary widely in respect to proportions of individual ions (Fig. 2). The different body fluids recorded in Fig. 2 are separated from one another only by protoplasmic cell walls a few cell layers in thickness. This latitude in composition of isotonic biological fluids is further emphasised when the composition of cows' milk and its precursor blood are compared.

TABLE I.

Relation between the constituents of cows' blood and those of milk (after Kay).

(Quantities shown in mgm. per 100 ml.)

Constituent.	Blood Plasma.	Milk.	Ratio (approx.) Blood: milk.
Casein	Nil	2800 – 3000	—
Lactalbumin	Nil	350 – 450	—
Globulin	1200 – 2000	50 – 150	1 : 0.1
Lactose	Nil	4600 – 4900	as sugar. 1 : 80
Glucose	45 – 60	traces	
Fat (as fatty acids)	150 – 300	3000 – 4000	1 : 15
Ca (total)	10 – 12	120 – 140	1 : 12
K	16 – 20	120 – 180	1 : 9
Cl	270 – 300	90 – 120	1 : 0.4
Inorganic P	4 – 6	60 – 80	1 : 15
Total acid-soluble P	4.2 – 6.5	65 – 90	1 : 15

The thin layers of cells lining the alveoli of the mammary gland are notably permeable to certain water-soluble dyes and oily tainting-substances, yet they act as exclusive boundaries to the blood constituents. Milk fat, casein and lactose are entirely different from blood fat, protein and carbohydrate (glucose). In most other respects, too, milk is entirely different in composition from blood, yet the isotonicity of milk with blood is continually maintained. This constancy is not regulated entirely by the inorganic constituents—the proportions of which, in milk ash, may vary considerably (Table II).

TABLE II.

Variations in the Composition of Ash in Milk (after Rogers).

Constituent.	Ranges of values recorded by 5 investigators, per cent.
K_2O	18 – 29
CaO	20 – 29
Na_2O	3 – 11
MgO	1 – 5
P_2O_5	22 – 29
Cl	12 – 16
SO_3	3 – 4

—but depends rather on a balance between all solutes, in particular the inorganic salts and lactose. The Cl-lactose ratio in milk varies considerably according to individuality of the animal, its health and stage of lactation, but automatic adjustment of proportions and amounts of lactose and inorganic salts under all conditions ensures constancy of osmotic properties and, therefore, of freezing point. This constancy of freezing point is of great comfort to food analysts and dairy chemists who depend on it implicitly as the basis of the only satisfactory test for added water in milk.

The inorganic elements, then, actively participate in regulating life processes, and a fuller knowledge of their activities will open the way to a more complete understanding of the foundations of life. Ionic exchanges in living tissues across protoplasmic boundaries are, at least in part, under hormonal control, and the elucidation of this relationship will doubtless prove most difficult. The use of radioactive inorganic elements may prove to be the key for opening up this fundamentally important field of biochemical research.

(iv) **Elements essential for enzyme systems:** It has been known for many years that certain metals are associated with enzymes, as co-enzymes or activators, and recent work indicates that these metals are, in some cases, part of the enzyme itself.

In this connection, the most widely studied enzymes are the exopeptidases (amino- and carboxy peptidases [Fig. 3]*), and certain specific dipeptidases which complete the hydrolysis of peptides to amino acids in the intestine.

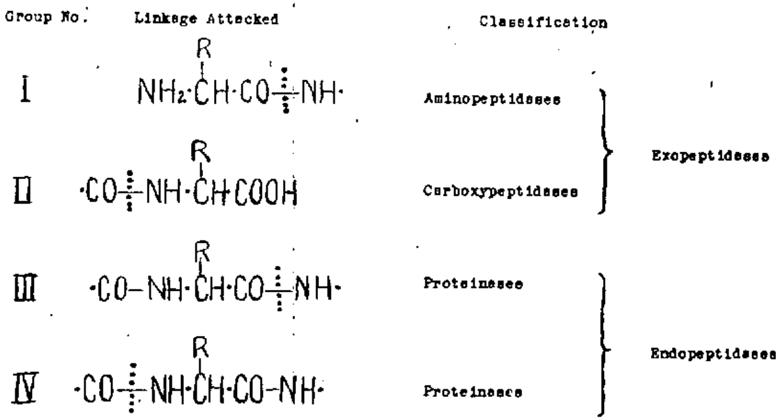

Fig. 3.—Classification of Proteolytic Enzymes (Bergmann-Fruton).

Johnson and co-workers (1942 onwards) showed that peptidase activity is greatly increased by addition of certain metal ions, notably Ca, Mg, Mn and Co, and it now appears that the function of these metals is to form a complex between the enzyme-protein and the substrate. These enzymes are regarded as metalloproteins, with metals linked in true chemical combination, for their activity is inhibited by removing the metals by means of dialysis or by the action of typical metal-poisons such as sulphides or cyanides.

It is well established by spectroscopic studies of suitable enzyme systems that the first stage of enzyme activity is the formation of an enzyme-substrate complex. Cobaltous ions are, for example, highly specific activators of glycyl-glycine peptidase and the first stage in the formation of this metalloprotein enzyme is the appearance of a well-defined spectroscopic complex.

Emil Smith considers that the Co^{++} is bound in a six co-ordinate complex—i.e., cobalt exercises its maximum power of co-ordination, and that the polar groups of the substrate, glycyl-glycine, are bound in the manner shown (Fig. 4). This is proved by the following observations:

*Amino-peptidases split off terminal amino acids with free *a* $—NH_2$ groups; carboxy-peptidases attack terminal amino acids with free —COOH groups.

Glycyl-glycine substrate.	Formation of Spectroscopic complex.	Hydrolysis of substrate.
Unchanged substrate	Yes	Yes
Amino group—one free hydrogen replaced by methyl	Yes	Yes
Amino group—both free hydrogens replaced by methyl	No	No
Sensitive imino group—hydrogen replaced by methyl	No	No
Carboxyl replaced by amido	Yes*	No

The combination between Co^{++} and substrate is brought about by chelation. The complex formed (Fig. 4) is a typical chelate compound of cobalt with 5 membered rings. By contrast, this particular cobalt-containing enzyme does not form a 6 membered ring with alanyl-alanine, consequently no enzyme-substrate complex is produced and there is no hydrolysis of the dipeptide. The absolute specificity of this metalloprotein for glycine is completely explained.

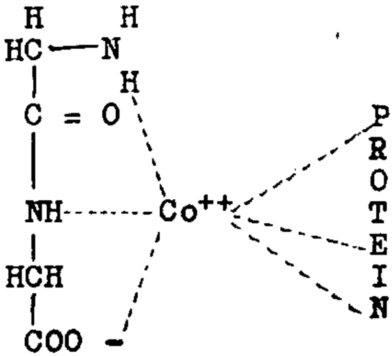

Fig. 4.—Enzyme-substrate complex of cobaltous metalloprotein and glycyl-glycine.

The substrates for carboxy peptidases (Fig. 3) on the other hand need not contain free NH_2 groups. By means of experiments similar to those described for glycyl glycine it has been shown that the metal (in this case Mg) combines with the =O of the free —COOH and of the =CO group, but not with N at all.

*Shift of the absorption band shows that this combination differs from that of Co^{++} and glycylglycine.

Aminopeptidases (Fig. 3) contain either Mg or Mn and the combination is apparently only between metal and free $—NH_2$ groups and N of the peptide bond—a free —COOH is not required.

Thus we have an explanation in terms of metal binding with substrates of the highly specific differences between carboxy-, amino-, and di- peptidases.

This poly-affinity concept, first suggested by Bergmann in 1936, implies the existence of correct steric relationships between polar groups of the substrate and the side chain branches of the enzyme. Such powerful steric effects modify the enzyme-substrate combination, but the chelate ring formation between metal and polar groups of polypeptides is extremely strong and is considered to be the dominating reaction. In support of this is the finding of Neuberg and Mandl, who have recently shown that metal ions of known importance in biological systems (Zn, Co, Ni, Cu, Mn and Fe) could not be precipitated as sulphides when amino acids or polypeptides were present. This extremely strong intramolecular co-ordination involving metal and polar groups must be similar to what occurs in enzyme-substrate complexes of the polypeptides, and it would appear that the function of the protein moiety of enzymes, combined in true chemical combination with metals, is to make the metals even more elecropositive than they normally are. This powerful electropositive combination between protein and metal of the enzyme would induce a strong electronic pull by the metal through the chelated polar groups of the substrate, producing an electronic distortion at the sensitive peptide linkage. This, according to Emil Smith, lowers the free energy of activation permitting catalytic hydrolysis of the peptide bond in neutral solution. In the absence of an enzyme capable of weakening the peptide bond by distorting the normal stable electronic configuration, hydrolysis proceeds only in strongly acid or alkaline solution.

By no means all enzymes are metalloproteins. The related endopeptidases* contain no metals and are not inhibited by metal poisons such as HCN. There are, however, other enzyme systems in which metals such as Ca, Mg, Mn and Zn are regarded as activators or co-enzymes, and it is not unlikely that the metals may really be part of the enzyme. All these metals show marked tendencies to form chelate rings, which is the initial reaction in peptide hydrolysis.

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* Such as pepsin and trypsin, enzymes which attack polypeptides at certain specific groupings within the molecule.

These findings regarding the specificity of the three types of peptidases present a rather beautiful confirmation of the "Lock and Key" theory of enzyme action propounded by Emil Fischer about 50 years ago. They also represent a distinct advance in the attempt to explain that mysterious process called "life" by means of chemistry.

Finally, I would like to bring my remarks to a focus by attempting to correlate biological activities of elements with their classification in the Periodic Table (Bohr's arrangement). The following features are of interest:—

1. The close association in the table of C, H, O and N which form the organic plastic and storage tissues (proteins, fats and carbohydrates).
2. The limiting of the metals concerned with regulating ionic and osmotic functions to those with small, active ions, Na and K, and to lesser extents Ca and Mg, in groups I and II.
3. The restriction of the metals utilised in structural components, bones and teeth, to a small number, principally Ca (and Mg) of group II and to slight extent Na and K of group I.
4. The association with metalloprotein enzymes of the elements B, Mg, Ca, Zn, and Co, which are less active than the alkali metals in organic combination and more prone to form chelate ring structures.
5. The fact that metals concerned in respiration, i.e., oxygen transport and catalytic oxidation of the H of cell metabolites, are certain transition elements (V, Fe, Co, Cu (Mo, possibly restricted to plants)). Transition elements exhibit characteristic catalytic properties because of their incomplete inner group of electrons.
6. The confining of elements making up anions which balance the metals in physiological media to the electronegative series, i.e., O with P ,C and S to form phosphate, carbonate and sulphate radicals and Cl.

and 7. With the exception of the halogens, the restriction of biologically important metals to the regular (i.e., left hand) groups of the Periodic Table.

Elements of known biological activity are close to one another in the periodic table, and it may be surmised that it is unlikely that elements remote from them will prove of importance in biology—such elements are, in fact, mostly "poisonous." This is a relative and vague term, but in cases where toxicity of elements has been studied critically with specific organisms, notably the fungi, it has been found that toxicity is a periodic function. Toxicity to fungi increases with atomic weight of elements within any group, and increases towards the centre of the periodic table, being less at either end.

It is interesting to find that the "biological significance of the metals" depends on their chemical properties. Life is, of course, made up of chemical processes, and the periodic table has a significance even when applied to biology.

CONFERENCE, 1951

Hamilton, August 20th-22nd

Plans for Conference are well in hand. All members of the Institute should have received by now a circular from the conference secretary regarding accommodation and other essential details. If this has not reached you please communicate at once with:

The Conference Secretary,
Box 490,
Hamilton.

You are reminded that replies should be posted by April 27th.

Rail transport is not very convenient for those living south of Hamilton. Trains leave Wellington at 3 p.m. and 7.15 p.m. and arrive at Frankton at 4.20 a.m. and 6.50 a.m. On Saturday, only the 3 p.m. train runs. The committee recommends that all who can do so travel by the 7.15 p.m. train on Friday, August 17th. The entertainments committee will be arranging outings and excursions for Saturday and Sunday; in addition members will be feeling fit when Conference opens.

The meeting of Council-in-person will be held on Sunday and the committee suggests that this would be a convenient day for any groups of chemists wishing to discuss special topics. If you are interested in having such groups arranged please write to the Conference secretary.

Although this year's Conference is to be shorter than last year's, the programme committee has arranged to devote approximately the same time to original papers. There is still time for you to offer a paper if you have not already done so.

There will be a Conference booklet containing summaries of papers, programme, maps, etc. The detailed programme will also be published in the August issue of the Journal (but not summaries of papers).

CONFERENCE COMMITTEE, 1951

Back row: R. J. Lancaster, W. G. Whittlestone, J. L. Grigg, F. B. Thompson, R. H. Jackman.

Front row: D. D. Perrin, N. T. Clare, E. B. Davies, F. E. Mason.

A CHEMICAL WOOD-PULP INDUSTRY FOR NEW ZEALAND

Chairman's Address to the Auckland Branch.

Reasons why it was necessary to make a substantial technical investigation before establishment of an industry in New Zealand for the conversion of Pinus radiata trees to kraft pulp and paper were outlined by Mr. A. W. Mackney, chief chemist for N.Z. Forest Products Ltd., in his chairman's address to the Auckland branch, on March 6th.

"Pinus radiata is a raw material which has never yet been used in a commercial chemical pulping industry," said Mr. Mackney. "It is a native of California, where it exists in limited stands on the Monterey peninsula. As the tree there lacks good form and rapid growth, it is not used either for lumber or pulp production." Mr. Mackney added that the large-scale planting of the species in New Zealand arose through observation of the very rapid growth of trees planted for shelter belts at the end of last century. Because of such growth, the species in New Zealand might well possess abnormal characteristics, physical and chemical. Accurate and reliable information concerning the many physical and chemical properties of the wood therefore had to be accumulated.

After describing with the aid of slides the properties of the wood and its fibre, Mr. Mackney mentioned that the kraft or sulphate wood-pulping process was more or less standard. It consisted in brief of treatment of the wood chips with a solution containing caustic soda and sodium sulphide. The resultant pulp had properties of outstanding strength, making it well suited to the manufacture of high-grade wrapping and bag paper.

Mr. Mackney explained that the pulp mill now being established by his organisation at Kinleith would derive approximately one-third of its raw material from the adjacent sawmill in the form of slabs from the outsides of logs. These slabs, coming from the larger butt logs, provided long-fibred material. Round logs, from the tops of trees, which would be debarked and fed also to the pulp mill, had a somewhat shorter fibre. It had been found that a very high grade kraft paper could be made from a combination of these components. Such paper responded well to the standard tests for tearing, bursting and tensile strengths. Obviously, pulp and paper of varying specifications could be made by varying the component of slabwood and roundwood.

Two major by-products of the kraft pulping process resulted from the resinous constituents of the wood, namely, sulphate turpentine and sulphate soap, the latter derived from the tall oil.

After the lecture, two 16mm. films, "March of Pine" and "Exotic Forests of New Zealand," were screened. "March of Pine," produced for N.Z. Forest Products, illustrated the growing uses of Pinus radiata timber, and also the expanding new industries creating and using wood by-products being established by this company.

BOOK REVIEW

A TEXT-BOOK OF ORGANIC CHEMISTRY, by Julius Schmidt and H. Gordon Rule. Revised and Edited by Neil Campbell, 1950. Pp. 947. Gurney and Jackson, London.

The appearance of a new edition of such a well-known text-book as Schmidt's "Organic Chemistry" is always a matter of interest. The old "Schmidt" was marked by a fairly long theoretical introductory section, followed by a descriptive treatment of the subject. Dr. Campbell, in revising the book, has retained this arrangement but has also incorporated additional theoretical matter in the main text at appropriate points. In his main task of presenting a balanced account of a wide subject he has succeeded admirably. Such excellent features of the old "Schmidt" as the section on heterocyclic compounds are still excellent in their revised form, and the completely new material is well presented. The treatment of molecular orbitals, for example, is easy to follow, and the final section on the use of isotopic organic compounds in the study of reaction mechanisms serves as a useful introduction to an important field of study.

Unfortunately the general excellence of conception is marred by many minor inaccuracies and half-truths. These will cause no difficulty for the experienced reader, but for the student just commencing the serious study of the subject they do detract from the value of the book.

There are many useful reading references given, both to original papers and to the authoritative review articles, and these are in the main well up-to-date.

Modern general methods of synthesis and transformation are adequately dealt with, but the form in which the Poundorf reduction is given, involving the use of ethyl alcohol, is not the usual one, and while Oppenauer's name appears in the author index there is no reference by name to the method in the text on the page cited, although an example is given.

There are several obvious slips of spelling and grammar and examples of non-technical words used without proper regard for their accepted meanings that point to hurried proof-reading.

It may be fairly said, then, that the new "Schmidt" is fundamentally a worthy successor to the old, and if opportunity can be provided for an editorial elimination of minor blemishes it should be fully acceptable as a standard text to both students and teachers and to those requiring an authoritative general review of the subject.

The book is handsomely printed and bound.

S. N. SLATER.

Dr. R. C. BARNICOAT.

A short biographical sketch of Dr. C. R. Barnicoat, the author of the main article in this issue, was published on page 20 of our February, 1951, issue. Dr. Barnicoat is going to Australia in May to attend the meeting of the Australian and New Zealand Association for the Advancement of Science in Brisbane.

NEWS AND NOTES

Those who knew Mr. Ivor Ting, Associate, will be shocked to hear that he has been reported missing from the "Rangitiki" while homeward bound from Europe, and while the matter is still under investigation, there seems to be little hope of his being found alive. Mr. Ting, a New Zealand-born Chinese, took his B.A. degree in French and chemistry, and proceeded to honours in chemistry. While on the staff of the Fats Research Laboratory, he was awarded a French Government Scholarship to study at the Institut de Recherches pour les Huiles et Oleagineaux in Paris, where he stayed for two years, and he was on his way to resume his place at the Fats Research Laboratory when he was missed. He had already showed considerable promise as a chemist, and the loss to the Laboratory is a sad one. The Editor joins his colleagues and friends in expressing sincere regret because of the loss of a valuable member of the Institute and the chemical profession.

Dr. J. C. Dacre, Associate, who took honours at Auckland and later worked with Prof. Raistrick at the London School of Hygiene and Tropical Medicine, has joined the staff of the Dairy Research Institute.

Mr. W. E. Dasent, Local member, has transferred to the staff of Victoria College, Wellington, from Massey College, Palmerston North.

Mr. R. L. Andrew addressed the Wellington Branch at its November meeting and delivered a most interesting lecture on the life of the first Colonial Analyst, William Skey. It is hoped that the material collected by Mr. Andrew may soon be offered in the form of a book.

The interim committee of the proposed New Zealand Section of the Oil and Colour Chemists' Association arranged a meeting of potential members in Wellington on 28th February last, when the speaker was Mr. Creswell Walter, A.M.T.C., Chief Chemist to the S. N. Rodda Pty., of Melbourne. His subject was "The particle size of pigments used in the paint industry," and proved very interesting. There was a lively discussion and the meeting seems to augur well for the success of the new Section, whose relations with the Institute are most cordial, and profitable for both bodies.

We understand that a portion of a large army store at Lower Hutt, with a floor space of 30,000 square feet, is being converted into chemical engineering research laboratories, as an extension of the Chemical Engineering Section of the Dominion Laboratory. The main function of the new establishment will be to carry out industrial processes on a pilot-plant scale.

Mr. D. J. Ross, of the Dominion Laboratory, hopes to complete his Ph.D. in London in June.

Mr. N. H. Law, who was elected a Fellow at the November meeting of Council, holds the M.Sc. degree with 1st Class honours, and is an F.R.I.C. (Class E). He holds the position of Senior Chemist in charge of Meat Research at the Dominion Laboratory. From 1937 to 1946, he was with the laboratories of Boots Pure Drug Company, England. He is Secretary to the New Zealand Section of the R.I.C.

Mr. A. K. R. McDowell, who was elected a Fellow at the same meeting, is a research chemist with the Dairy Research Institute, Palmerston North. He holds the degree of M.Sc., and has recently published the results of a lengthy study of the Vitamin A potency of New Zealand butter. He was previously with the Coal Survey.

Prof. F. G. Soper has been granted study leave during 1951. He will be representing the University of Otago and the University of New Zealand at the quincentenary celebrations of the University of Glasgow in June. He has also received a grant from the Carnegie Corporation enabling him to spend ten weeks in U.S.A. on his way home to New Zealand.

Dr. M. Irwin has resigned from the Chemistry Department at Otago to take up the position of Research Physical Chemist at the National Dental School, Dunedin. Dr. G. A. Bottomley, of Leeds, has been appointed to the Chemistry Department staff at Otago University.

Mr. A. C. Holmes is now General Manager of Dairy Products Ltd., Edendale, while Mr. J. W. Dryden has gone to the Kapuni factory as Manager. Mr. A. D. Wilson, an Otago graduate, has been appointed works chemist at Edendale.

Mr. D. McClure, Associate, previously technical manager, Amalgamated Brick and Pipe Co. Ltd., New Lynn, Auckland, has commenced private practice as a consulting technologist, specialising in ceramics, refractories, and general industrial technology.

Writing from the University of Rochester, New York, where he holds a U.S. Public Health Service research fellowship for cancer research under Professor B. A. Tarbell, Dr. G. A. Nicholls, Associate, says: "The University of Rochester, although within the limits of Rochester city, is quite spread out and consists of a college of arts and science (for which there is a men's campus and a women's campus), a very excellent school of music and an almost equally good school of medicine and dentistry. An interesting commentary on the strength of the post-graduate section of the chemistry department here is the fact that that there are about fifty people working for a Ph.D. degree and eleven post-doctoral fellows, whereas there are only twelve to fifteen students at the N.Z.U. stage III level."

The Canterbury Branch held its First Meeting for 1951 on February 13th to hear Dr. P. C. Carmen speak on "Some Aspects of Chemistry in South Africa.." Dr. Carmen was on a private visit to New Zealand and the meeting was well attended, especially considering it was not the usual meeting night.

Miss A. P. Camden-Cook has been transferred from Wellington to the Government Laboratory, Christchurch.

Dr. and Mrs. Brian Painter and Mr. A. J. D. Robb, all of Dunedin, are now resident in Christchurch.

Mr. Paul Maling has joined the staff of the Canterbury Frozen Meat Co. at Belfast.

Mr. F. B. Hurst, of the Government Laboratory, Christchurch, has been transferred to Wellington.

COUNCIL MEETING—23rd FEBRUARY, 1951

ITEMS FROM THE MINUTES

Mr. P. R. PARR took the chair for the first time as President and Prof. SLATER made his first appearance as Vice-President.

A new paragraph was added to the MINUTES of the previous meeting recording that no action would be taken over joint subscriptions for husband and wife.

The result of the POSTAL BALLOT being 166 votes for, 1 against and 1 informal, a new WAIKATO BRANCH was definitely constituted with headquarters at Hamilton. A conference of Waikato and Auckland members is to be held to discuss the boundaries of the new Branch.

Council regretted the delay in the publication of EXAMINATION RESULTS and considers that in future results should be announced not later than December 31st.

JOURNAL.—Council approved the principle of exchanges with major libraries, and considered the main proviso should be the quality of the material offered rather than the language. Council approved the principle of Local members, other than students, being required to take the Journal, and for this purpose paying the Local member's subscription plus 7/6d. per annum.

A draft STANDARD SPECIFICATION covering timber preservation was referred to our representative, Mr. C. G. Mason.

Dr. V. Armstrong was appointed the Institute's official representative at the Diamond Jubilee meeting of the American Chemical Society to be held in New York City in September.

The following were elected ASSOCIATES:—

Mrs. Carlotta Juana Alton, B.A. (California), Assistant Chemist, Animal Research Station, Wallaceville.

Richard Harry Jackman, B.Sc., Ph.D. (Iowa), Chemist, Rukuhia Soil Research Station, Hamilton.

John William McChesney, M.Sc., Science Master, Otago Boys' High School, Dunedin.

John Frederick Martin, B.Sc., A.R.A.C.I., Grafton, Auckland.

The Institute has offered to co-operate in any way possible with the proposed New Zealand Branch of the OIL AND COLOUR CHEMISTS' ASSOCIATION.

Branches are asked to send all suggestions regarding changes in the rules to the President by April 30th.

The ROYAL INSTITUTE OF CHEMISTRY advised that it was prepared to reduce the subscriptions of members of the R.I.C. in New Zealand who were also members of the N.Z.I.C. by £1/1/-, or 10/6d. if under 25 years of age. Council recorded its deep appreciation of this offer, and will organise the administration of the scheme.

£50 was transferred from the General Account to the TRUST FUND.

A special committee consisting of Prof. Slater and Messrs. Hughson and Oliver was set up to confer with the New Zealand section of the R.I.C. with regard to the awarding of a lecture prize to be known as the *Easterfield prize.*

LABORATORY ASSISTANTS' EXAMINATIONS
1950 PASSES

THEORETICAL CHEMISTRY

Miss E. L. Wiseman, Miss L. E. Newman, J. W. Dickinson, M. L. O'Callaghan, Miss J. S. Taylor, S. W. Gatfield.

PRACTICAL CHEMISTRY

Miss S. M. Mason, L. S. Bush, R. D. Woolf, N. C. Ashman, M. L. O'Callaghan.

ELEMENTARY PHYSICS

D. W. Hornsby, L. S. Bush, J. W. Dickinson, R. D. Woolf, Miss S. M. Mason.

METALWORK

J. W. Dickinson.

WOODWORK

L. S. Bush.

PHOTOGRAPHY

Miss V. V. Russell.

LIBRARIANSHIP

Miss E. L. Wiseman.

ELEMENTARY MICROBIOLOGY

Miss J. F. Fisher, Miss J. P. Cook.

GLASSBLOWING

D. W. Hornsby.

ELEMENTARY CALCULATIONS

Miss L. E. Newman, D. W. Johnston, Miss M. C. Greig, Miss V. V. Russell.

BOOKS RECEIVED

ORGANIC CHEMISTRY, by Louis F. Fieser and Mary Fieser. 2nd Edition, 1950.1125 pages. London: George G. Harrap. 42/-.—The second edition of this well-known book has been brought thoroughly up-to-date with references up to 1949. It is not surprising that the authors have included a new chapter on reaction mechanisms in view of the present emphasis on physical aspects of organic chemistry. The other new chapter on heterocyclic compounds still leaves an important group rather inadequately treated. However, this is perhaps a matter of opinion, and in other respects the book is an excellent piece of work. The statement of various topics is clear and straightforward, and there is an absence of the irritating practice of merely mentioning a compound without any further details. A very large amount of information has been included in a digestible form and there is a remarkable freedom from errors. Each chapter is followed by a short reading list, and there are many references in the text giving a name and date only, e.g., "R. Robinson (1947)." The reader, if he wishes, can easily obtain further information from the abstracts that are now so readily available and complete. A more general use of such a system with a consequent very considerable saving of space might be considered. There is a very full index. The price is almost too good to be true.

PHYSICO-CHEMICAL CONSTANTS OF PURE ORGANIC COMPOUNDS, by J. C. Timmermans, Director of the International Bureau of Physico-chemical Standards, Brussels. 693 pages. 1950. Amsterdam: Elsevier Publishing Co.; distributed in the British Empire by Cleaver-Hume Press, London. £4/15/-.—The opening paragraph of this book says: "This work records as completely as possible, those physico-chemical constants of organic compounds which have been measured with sufficient care to warrant their acceptance as data established with a precision worthy of contemporary science." The monograph on each compound lists methods of obtaining it in a state of purity, followed by criteria of purity and tables of reliable physical data. The number of compounds having data sufficiently reliable to be chronicled is about 650, while for a further 500 where the data may be reliable but are unconfirmed, references only are given. It is rather a sobering thought that of all the vast number of known organic compounds, such a small number make the grade and such common specimens as acetalydehyde and amyl acetate fall by the wayside. Nevertheless we have here a basic core of data on organic compounds, the fruits of a quarter-century's careful work by Prof. Timmermans and his colleagues at the International Bureau. It is obvious from the number of Prof. Timmermans' own observations recorded in the book that he is well qualified for his task and figures given will command respect. There is a full bibliography with references to January, 1950. The printing is good, but the price seems high.

ENCYCLOPEDIA OF CHEMICAL TECHNOLOGY. Volume 5, Di– to Explosions. Edited by R. E. Kirk and D. F. Othmer. 992 pages. 1950. New York: Interscience Encyclopaedia Co. $20.00 (Agents for Australasia, Angus and Robertson, Sydney).—The fifth volume of this important work is on the same lavish scale as its predecessors, which it follows with commendable promptitude. It is hoped that further volumes will appear at intervals of seven months. Notable articles in this issue are Dyes and Intermediates, Application and Evaluation (119 pages); Diffusion (57); Electrochemistry (54); Electronics (54); and Electrification (41). It is surprising that Distillation receives only 33 pages while the logic of some of the articles seems a little hard to follow. For instance, the article on "Esters, Organic," contains notes on the preparation, properties and reactions of esters as a class, followed by a table of the physical properties of about 240 individual esters, and concludes with monographs on the esters of aliphatic alcohols and formic, acetic, propionic, butyric, stearic and aceto-acetic acids. The other esters will almost certainly be discussed under other headings, but the selection here seems a little arbitrary, and the user may not be able to find the others until the index volume appears at the end of the series. The "Encyclopedia" will undoubtedly be a useful work of refernce; just how good cannot be decided until the series is nearer completion.

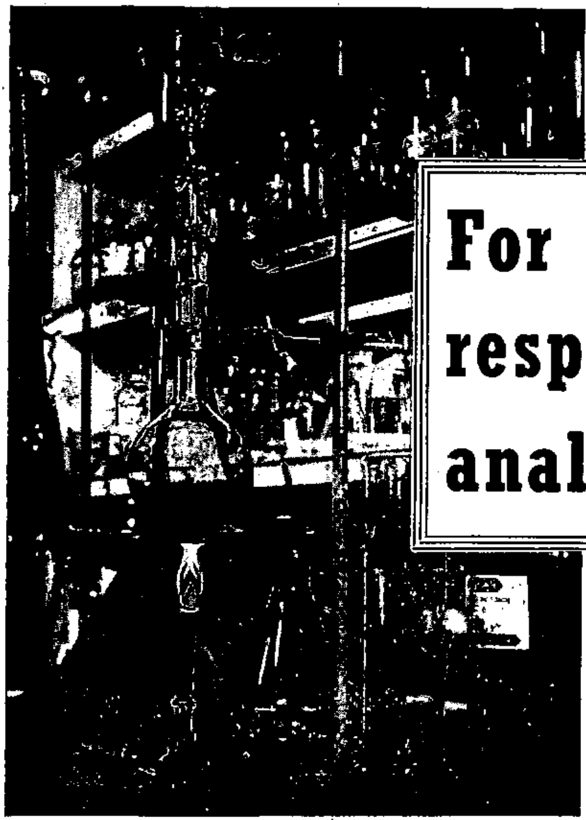
INDUSTRIAL ELECTROCHEMISTRY, by C. L. Mantell. McGraw-Hill Book Co. Inc. (New York). 3rd edition, 1950. Pp. 781. The theoretical sections are very weak and references to original matter rather out of date, but in general the practical section is up to date and well written. The book can be recommended as giving a good account of the applied side of industrial electrochemistry.—H.B.

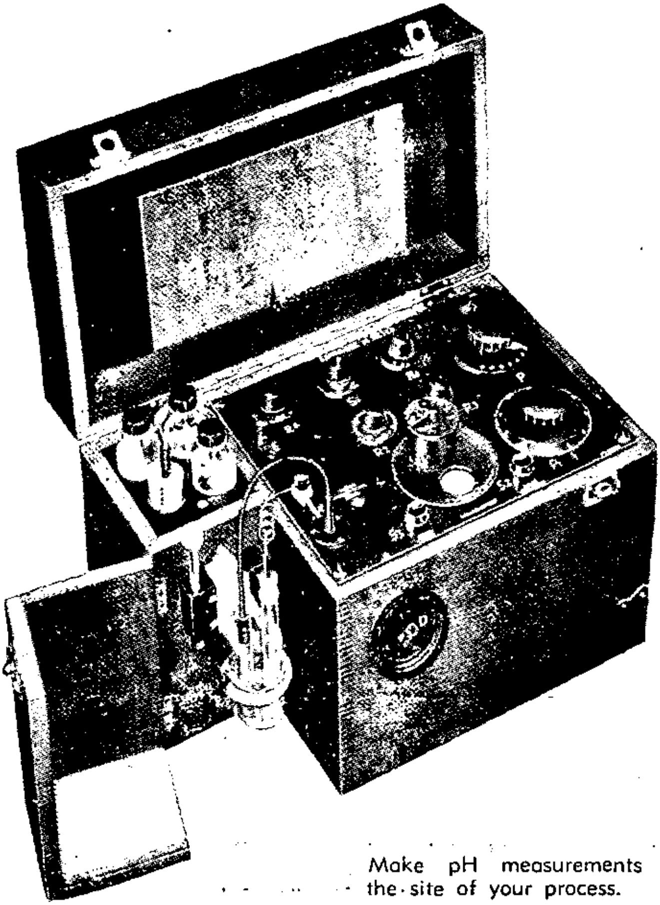
CHEMICAL KINETICS, by Keith J. Laidler, Associate-Professor of Chemistry at the Catholic University of America. The McGraw-Hill Book Co. Inc. (New York). Pp. 408. $5.50.—A stimulating, modern treatment of the subject. It can be recommended for students and others interested in the field.—H.B.

STRUCTURAL CHEMISTRY OF INORGANIC COMPOUNDS, Vol. 1, by W. Hückel, Professor of Pharmaceutical Chemistry at Tübingen University—translated by L. H. Long. Elsevier Publishing Co. Ltd. Distributed by the Cleaver-Hume Press (London). 1950. Pp. 437; £3/10/-.—A book which attempts to systematise the chemistry of inorganic compounds by considering their structures. Chapter I seems very out of place and should have been omitted in a book of this type, as it is a history of early chemical discovery. Subsequent chapters deal with the co-ordination theory of chemical compounds, the periodic system of the elements and structure of the atoms, methods for investigating chemical bonding and a discussion of the chemical bond. The book is deficient in references to recent work (out of the German literature) because of the inability of the author to gain complete access to non-German literature owing to "unfavourable external conditions." The translator has contributed by adding some of the more recent references. It is still too early to judge whether the author is likely to succeed in his aim to systematise Inorganic Chemistry —such judgment would better be left until the appearance of Vol. II.—H.B.

COLLOID SCIENCE, Volume II—Reversible systems; edited by H. R. Kruyt. The Elsevier Publishing Co.; distributed by the Cleaver-Hume Press (London). 1949. Pp. 753. £4/10/-.—This book would better have been titled "Topics in Colloid Science," as it does not purport to be a complete treatise on the subject but rather a collection of monographs on certain restricted and isolated topics. The authors are J. J. Hermans, P. H. Hermans, H. G. Bungenberg de Jong, R. Houwink, J. Th. G. Overbeek and H. L. Booij. The topics discussed include the formation and structure of macro-molecules—determination of their molecular weight—micro-molecular sols, with and without electrolytic character, respectively—solid macro-molecular systems—crystallisation—co-aceveration—flocculation—reversal of charge phenomena—complex colloid systems and gels. The book is fully documented and well illustrated. It should be found useful by research workers in the fields discussed, but to the general chemist and student of chemistry is of very limited value.—H.B.

CHEMICAL THERMODYNAMICS, by F. D. Rossini, Professor and Head of Department of Chemistry at the Carnegie Institute of Technology. John Wiley and Sons Inc. (New York). 1950. Pp. 514. $6.00. —An excellent treatment of Chemical Thermodynamics, starting from first principles and covering a wide field. Naturally, the whole field cannot be covered in great detail in a book of this size with the inevitable result that certain topics (e.g., statistical dynamics) can only be briefly summarised. The first five chapters deal with fundamental quantities and definitions and in the next twenty-five chapters the theoretical side of Chemical Thermodynamics is dealt with, the topics being arranged in a logical order rather than the order of their development or discovery, e.g., Carnot's theorem is deduced from the entropy function and the discussion of statistical dynamics precedes that of the third law of Thermodynamics. The last five chapters deal with special applications and illustrations of thermodynamical calculations, together with tables and sources of thermodynamic data. The book is well documented and contains 167 problems which should be of great value to students. It can be recommended as being more than usually interesting, logical and concise.—H.B.





'Perspex'

'Perspex' acrylic resin is one of the most versatile and attractive of the new synthetic materials which the British chemical industry has yet produced. Since I.C.I. chemists discovered it in 1932, this crystal-clear plastic has found hundreds of uses as varied as the transparent parts of aircraft, electric light fittings, chemical plant, and corrugated sheets for roof lighting. 'Perspex' is made from acetone, of which one method of manufacture is based on molasses, a by-product of sugar manufacture. The first step in making it is to produce a water-white liquid called methyl methacrylate. The next is to polymerise this liquid—that is, to cause its molecules to join in long chains. The result is polymethyl-methacrylate which is sold under the proprietary name 'Perspex'. Although only half the weight of glass, 'Perspex' is extremely tough, and its development was a timely achievement of the British chemical industry. In 1939 it was adopted for the transparent parts of all British fighting aircraft, and today new uses are constantly being found for it.

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