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EDITORIAL

One of the chief difficulties with which any organisation in New Zealand has to contend is that of maintaining efficient contact with our small and widely scattered population. It is bad enough to be so far from the world's nerve centres of culture and industry, but when our scientists and technologists are sparsely dotted along a thousand-mile strip of land with only some half-dozen large centres of population the difficulties of gaining access to the world's advances in science are obviously great. There has been an unfortunate tendency on the part of some so-called " practical " men to treat slightingly the stream of current publications which pour from the world's learned societies. For a scientist to proceed with his own problems on the basis only of his training and experience without due consideration of contemporary researches in his own field is frequently a culpable waste of his employer's time. It is vitally necessary—and yearly becomes more so—that the chemist (for we shall narrow down the discussion to our own profession) should be at pains to secure and retain contact with all possible sources of relevant information as soon as possible after it is published. The absolute and irreducible minimum is that he should make time available to read systematically and regularly at least one of the world's great abstracting journals. It is surprising how often the clue to the next step in, or to the final solution of, a problem will be provided in this way when a great deal of wasted time may have otherwise been spent in unprofitable efforts. Neither in research nor in works practice, however, are the abstracts themselves usually sufficient, so that it becomes necessary to gain rapid access to original papers. What chemist in New Zealand has not experienced vexing difficulties in this direction?

We believe that the problem of meeting this need will ultimately be solved by the new technique of photography of technical documents. Already, for example, the Bibliofilm Service in the U.S.A. has created an efficient service by supplying microfilms of scientific articles at a trifling cost, and larger photostats at a greater, but still modest, price. Thus articles in any journal received by the library of the U.S. Dept. of Agriculture are now available at short notice, and a new service has recently been provided by supplying translations of articles in foreign periodicals on bibliofilm at about five cents. a page. A similar photostat service is operated by the Society of Chemical Industry in London and by the Société de Chimie Industrielle in Paris.

We are informed that the Alexander Turnbull Library in Wellington is shortly installing a camera for the taking of microfilm and that this will be available for service work.

Co-operation between libraries in these matters usually takes the form of loans, but many libraries naturally refuse to lend volumes from sets either difficult to replace or in frequent use, e.g., scientific periodicals; there are also such factors as possible loss or damage in transit, relatively high cost of postage on large volumes, and need of a volume during its absence.

No scheme can be of real value to our members unless there is available a catalogue or list of periodicals received throughout the country. The Royal Society of New Zealand issued such a catalogue in 1927, but that is now hopelessly out of date; the more restricted list circulated a few years ago by the Institute of Chemistry was a step in the right direction, but not sufficiently comprehensive. There are at present in process of preparation a list of periodicals received by the N.Z. University Colleges and also a compilation of the general, university and technical libraries of New Zealand. We ourselves are primarily interested in a list of periodicals which are of immediate or potential use to chemists in their daily work and would urge that early steps be taken in this direction. Further, there is urgent need, with the limited funds available in this Dominion, for certain libraries to abandon some of the commoner and/or less read journals and to arrange among themselves to subscribe to some of the journals which are not available at all in this country. In short, it is necessary to co-operate so that the funds available are spread over the widest possible area with a minimum of replication.

The greatest need, in our opinion, is for a cheap and efficient copying service to give our members rapid access to the literature. Photostats, at a shilling a page, would often exceed the cost of a whole volume and suitable cameras would be expensive for libraries to instal. The method of taking a print directly on sensitised paper by illumination from behind has been tried and found unsatisfactory for technical reasons. The best system is undoubtedly the microfilm at a couple of pence a page; its size renders it easy to post and to file away; the individual's outlay for a magnifying " viewer " is not large. Owing to the expense, however, of providing a camera for taking microfilm, it is probable that the best to be hoped for is one such camera in each large centre. Should this become possible, we can envisage a service whereby our Institute might guarantee the safety of volumes whilst removed from a library in that particular centre during the short period needed for copying. This appears to be the most practicable solution in sight. For a start, we propose, should the demand from our members be sufficient, to enter into negotiations with the Turnbull Library with the object of using their camera to provide microfilm copies of the technical literature available in Wellington, where we can guarantee its rapid return to the lending library. This would lay the foundation of a more complete documentation service for New Zealand's chemists; however that may be, this is a problem which, in the interests of scientific advancement and technical efficiency *must be faced.*

* * *

Physico-Chemical Symbols.

The attention of members is directed to the Report of the Joint Committee of the Chemical Society, the Faraday Society and the Physical Society on Symbols for Physico-Chemical Quantities and Conventions relating to their use (Chem. and Ind., *1937,* 860-865, *ibid.* 951). These symbols have been adopted as recommended practice in the publications of the above Societies and also in British Chemical Abstracts; thus it behoves all chemists in the Empire to become acquainted with their regular use. In an editorial, *Chemistry and Industry* writes: " The list has obviously been drawn up with great care and should be adopted by all chemists; we shall try to adhere to it rigidly but it may take some little time before we are familiar with it." Only a few examples need be mentioned here: Normal and Molar concentrations are expressed by N. and M., but separated by a hyphen (and no full stop) from a chemical formula which follows it. Metre, gram and litre are m., g. and l. with the following prefixes—k (kilo-, $10^3\times$), d (deci-, $10^{-1}\times$), c (centi-, $10^{-2}\times$), m (milli-, $10^{-3}\times$), μ (micro-, $10^{-6}\times$). Thus ml. denotes millilitre and μg., microgram; the use of γ to denote microgram is deprecated. Readers will have observed that this *Journal* has never used cc., preferring ml., and it is significant that the report contains no reference to cc. or cubic centimetre. Unfortunately we have found a few minor discrepancies and omissions in the Report. Nevertheless it is a most useful, authoritative and timely publication and we also shall try to adhere to it rigidly. Copies are obtainable (6d.) from the Assistant Secretary, Chemical Society, Burlington House, Piccadilly, London, W.1.

* * *

Binding Cases.

The Publications Committee has made enquiries on behalf of members for the supply of binding cases in which to keep their *Journals.* A sample of a suitable cover has been obtained from England and can be thoroughly recommended to hold securely a number of *Journals* in an attractive, strong and ingenious binding case. These have been quoted to us, complete with gold lettering on the back, at a special concession price which will enable them to be imported for members at about 3/6 each after paying exchange and Customs duty, etc., provided that not less than one hundred are purchased. This same binder is being sold in England for leading technical journals at 4/-, 4/6 and 5/- each, according to size. It is suggested that the first consignment should be made wide enough to take the numbers of our *Journal* which have already appeared and also up to the end of 1940. The method of affixing the separate numbers in the case does not involve punching holes, is extremely simple, and any one issue may be temporarily removed in a few seconds. We strongly recommend all members to seize this opportunity of preserving the early issues clean and intact. A post card to the Editor, indicating members' desire to purchase will enable the Committee to close on the offer if sufficient requests are forthcoming. It is not anticipated that it will be possible to repeat this offer at the price. The binder can be used also with any other journal whose dimensions are the same as, or smaller than, this one.

* * *

We welcome the appearance of a new journal published by the Australian and New Zealand Association for the Advancement of Science and entitled *The Australian Journal of Science.* The first issue appeared in August, 1938, and the publication will continue every second month at a subscription of twelve shillings per annum; the headquarters are in Science House, Gloucester Street, Sydney. It is perhaps unfortunate that the title does not indicate that the publishing association is the joint organisation of scientists both in the Commonwealth and in this Dominion. It may be said to resemble in form and purpose the venerable *Nature* of London; and that is surely sufficient praise and indication of its future value. We wish it a long and useful life.

Our Council continues to be active in the interests of chemists where inadequate remuneration is offered, and has delegated the President and the Acting Dominion Analyst personally to approach the employers concerned. In one recent case a Public Body advertised for a graduate chemist with experience to take charge of a laboratory and to be " responsible for the carrying out of all the testing and analyses required "—this at a salary of £250 to £300 per annum. Strong representations were made and it was emphasised that a commencing salary of £450 p.a. would be more adequate. It is understood that other similar cases are the subject of similar action at the present time.

* * *

The twenty-fourth meeting of the Australian and New Zealand Association for the Advancement of Science is to be held at Canberra from 11th—18th January next. Although we have received no official information, we understand that Professor H. G. Denham of Canterbury University College, is to deliver the Liversidge Lecture. We are informed that a representative of the American Association will be present and also Professor N. V. Sidgwick and Dr. H. G. Wells from Great Britain. Professor Denham has been asked to act as official delegate of the N.Z.I.C.

* * *

Associates elected:

Green, R. A. W., c/o Sutherland & Co., Tanners, Onehunga, Auckland.
Hurst, R., Canterbury University College, Christchurch.
Ridland, W., King's College, Auckland.
Slater, S. N., University of Otago, Dunedin.
White, E. P., Victoria University College, Wellington.

* * *

The achievements of Lord Rutherford in the field of science are too well-known to need elaboration here. His epoch-making discoveries in the field of atomic physics won for him during his lifetime world-wide recognition. His death in 1937 came at a time when he was undoubtedly on the verge of further important discoveries, but sufficient had already been achieved to ensure for him for all time a position of honour on the roll of fame, along with scientists of the calibre of Newton and Faraday. Less is known of Rutherford's outstanding successes as a leader of men so strikingly exemplified by his term as head of the Cavendish Laboratory at Cambridge, where he attracted to himself a team of research workers, reminiscent of that school of research brought together by W. H. Perkin at the Schorlemmer Laboratory in Manchester towards the end of last century.

A detailed biography of Rutherford has yet to be written, but the attention of our readers is drawn to an excellent Obituary written by Dr. E. Marsden, entitled "Baron Rutherford of Nelson, 1871-1937," and published in the *Transactions of the Royal Society of New Zealand*, Volume 68, 1938 (June). Following this article appears a comprehensive bibliography, listing about three hundred papers and books by Rutherford, and compiled by Dr. C. M. Focken, Beverley-Mackenzie Lecturer in Physics, University of Otago. Dr. Focken has in addition published a memorial booklet entitled "Lord Rutherford of Nelson—A Tribute to New Zealand's Greatest Scientist" (Whitcombe & Tombs Ltd.).

Both publications are warmly recommended to our readers.

* * *

Review: "THE CHEMISTRY OF SYNTHETIC SURFACE COATINGS," by Dr. Wm. Krumbhaar. pp. 200. New York: Reinhold Publishing Corporation. Price 20/- net.

Coincident with the advent of synthetic resins into the field of surface coatings has been a rapid increase in knowledge of the chemical and physical processes involved.

Though the fundamental chemistry of the reactions that take place in the varnish kettle are even yet imperfectly understood, the author in this volume presents, in a manner that carries conviction, an outline of the reactions most probably taking place. Though some of the basic conceptions may not, as the author admits, be as yet capable of experimental verification, they provide for the varnish chemist an extremely useful working hypothesis.

In the simple oil-bodying process the principle of ester-interchange is stressed and extended further to oleo-resinous varnishes, while the maturing of fossil-resin varnishes in storage tanks is explained as a gradual interchange of fatty and resinous acids between the molecules, until an equilibrium of the various mixed esters is produced.

Of equal importance to ester-interchange is "molecular polymerisation," giving rise in the varnish kettle to cross-linked or ring-shaped molecules, a process essential to the production of technically valuable varnishes. The same conception is extended to the oil or resin modification of phthalic or phenolic resins and explains how the vulnerable spot in the linseed or wood-oil molecule, represented by the double bonds, may be eliminated by combination with complex phenolic resins, giving rise to a product of increased durability.

From the point of view of those intersted in the durability of paints and varnishes, chapter four, on the " Physical Chemistry of Surface Coatings," is probably the most valuable portion of the book. The problems of adhesion, film permeability, and blooming of varnish films are fundamentally dealt with, and it is explained how by measurement of the distensibility and tensile strength of a film its mechanical properties can be clearly and correctly described.

The author's remarks on the influence of climatic conditions upon the durability of paint films are of particular interest to New Zealand, whose climate is characterised by high humidity, many hours of highly actinic sunshine, and rapid variations in temperature. To counteract such influences, especially in roof paints, which are widely used in New Zealand, the addition of both elastic phthalics and water-resistant phenolics are advised by the author.

An extremely interesting chapter is that on drier chemistry. Present knowledge of driers is still largely confined to their accelerating action upon film formation by oxidation, little being known as to their effect upon the drying of films that are formed mainly by polymerisation, though certain synthetic resins are believed to act as " polymerisation catalysts."

A special chapter is devoted to the fundamentals of the composition and application of printing inks with reference to the possibilities offered by synthetic resins.

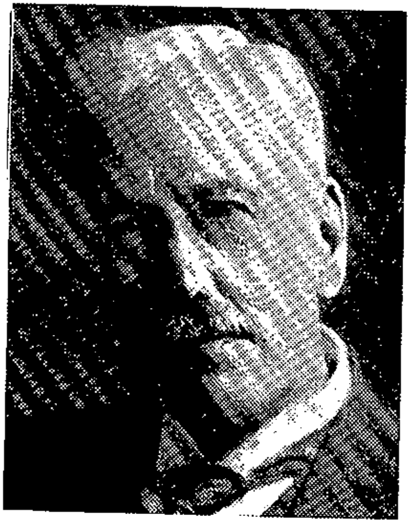
A feature of the book is the large number of excellent microphotographs taken under the direction of Dr. A. V. Blom, head of the Swiss Bureau of Standards.

A classification of synthetic resins, with particular reference to those of use for paints and coatings, is outlined in an appendix and numerous practical examples given of the application of synthetic resins in the formation of a wide variety of varnishes, enamels and lacquers.

An important omission from the book is the absence of any bibliography referring the specialist back to the original papers. Also, those expecting to find in the book a *detailed* account of the chemistry of surface coatings may find the title somewhat misleading, as the emphasis lies rather upon modern chemical conceptions.

The book can be strongly recommended not only to chemists interested in the theoretical aspects of surface chemistry, but also to those engaged in the investigation of paint problems, or in the manufacture of paints and varnishes.—L.R.L.D.

AN APPRECIATION.



SIR THOMAS EASTERFIELD,
K.B.E., M.A., Ph.D., F.I.C., F.R.S.N.Z., F.N.Z.I.C.

It is our great pleasure to congratulate Professor Easterfield on his receipt of the honour of knighthood. Institute members all over the country will join with us in feeling that not only has our foremost senior member been honoured, but that with his honour and that of Sir Theodore Rigg, the profession of chemistry has received most welcome recognition.

Now, when we come to ask ourselves why we have such pleasure in congratulating Sir Thomas, and to ask that question as scientific men, there comes to mind the fact that there is such a thing as the Easterfield tradition, and that that tradition is the story of a great professor of chemistry and a great founder of a research Institute. The Victoria College tradition rests on a firm tripod of three attributes—breadth of knowledge, ease of manner, and ability to inspire research. No man can properly hold a chair without at least two of these, and the three have seldom been combined as fully and as fruitfully as they were with Sir Thomas. "One never came away from a lecture feeling that one's beaker had scraped the bottom of his pool of knowledge," said one old student. "He used to stand with his finger tips resting on the lecture bench making one feel that a new aspect of our civilisation was being explained to us." "He always made a lecture topical and a subject appear easy." For eight years after his arrival he lacked a proper laboratory: two rooms with trestle tables serving at first not only for instruction but for research. In those days there were not even proper sinks, the test-tubes having to be washed in a bucket in the back yard; yet he inspired Aston, Bagley, Robertson, Bee and Miss Taylor to publish papers from such a laboratory. At the same time his work with various public bodies and manufacturing interests was being prosecuted, and he was preparing and publishing papers both in the *Transactions of the N.Z. Institute* and in the *Journal of the Chemical Society,* and lecturing not only in chemistry, but in physics. For it was not until 1909 that a separate chair of physics was inaugurated at Victoria College.

The years from 1909 to 1914 must have been comparatively easy years, free from the extra work entailed by physics, and during this time research activity was again to the fore. With the war came work on the Munitions Committee: not merely advisory work, but hard laboratory work on a semi-manufacturing basis. The Defence Department was short of searchlight carbons, and Easterfield planned and supervised their manufacture from ground gas carbon, tar and lamp black. Faced with a shortage of morphia, a cargo of contraband opium was salvaged and he and his students extracted the large quantity of morphia that was required.

It was in 1919 that the Thomas Cawthron Commission obtained a ruling from the Supreme Court on the legality of the establishment of a research institution and proceeded to appoint Professor Easterfield as Director of the new institution. He proceeded to gather round him the staff which is making Cawthron a large factor in the economic life of the Dominion. For himself it meant a change of orientation with his energies directed to agricultural rather than pure chemistry. Two special subjects he made his own, the reclamation of the Pakihi lands of the West Coast and abnormal purine metabolism in sheep. It was fitting that in 1933 on the eve of his retirement, Professor Easterfield should be invited to deliver the Cawthron Centenary Lecture on the "Achievements of the Cawthron Institute." But the greatest achievement of the Institute is still being implemented and probably lies not only in the volume of scientific research published and being published, but rather in a change of direction of men's minds—from the traditional empiric method of viewing nature to the scientific and exact method of observation and experiment. This change in the outlook of men is fast being implemented, and in the acceleration of this change lies the real meaning of Sir Thomas's work.

NOTES ON FOODSTUFF COLOURS AND THEIR IDENTIFICATION.

ROY GARDNER.

The legal position in respect to the use of colouring-matter in foodstuffs in New Zealand is fixed by regulations made by the Governor-General in Council, under the Sale of Food and Drugs Act, 1908. Regulation 11, paragraph 1, states: " The addition of a flavouring substance or of a colouring substance to any article of food, except as specifically permitted by these regulations, is hereby prohibited." Specific permission is given in later clauses for the use of artificial colouring-matter in various classes of foodstuffs but such permission is in general subject to two restrictions—firstly, that the presence of an artificial colour must be declared, in the manner laid down by the Regulations, and secondly, that the colour used must be one of those falling within the definition given in paragraph 3 of Regulation 11, of a " harmless colouring-matter." There are, however, certain exceptions: for example, declaration is not required in the case of confectionery, and sausage skins may be dyed with Bismarck brown, which is not a " harmless colouring-matter " within the definition of Regulation 11, paragraph 3).

The substances deemed to be " harmless colouring-matters " for the purpose of the Regulations are: caramel, cochineal, chlorophyll, saffron, " every innocuous vegetable colour extractive " and a number of specified coal tar colours which may conveniently be called here " the permitted coal tar dyes." It is with these permitted coal-tar dyes that this paper, for the most part, deals.

Prior to December, 1933, there were only ten permitted coal-tar colours, but an amending regulation of that date gave a much extended list of thirty-four dyes, the identities of which are defined by reference to their numbers in Rowe's Colour Index, 1924 (except for the American dyestuff Fast Green FCF, which is not given in the Colour Index). It is further laid down that any colouring "sold or intended" for food colouring must be labelled with its name "or names" and its Rowe's Index number if it has one.

The list of colours is practically identical with that of the Victorian Regulations, but it is difficult to see on what principle it is made up. It is generally accepted that dyestuffs containing sulphonic acid groups are readily eliminated from the system and are harmless, while strongly basic dyestuffs are in general to be avoided for foodstuff purposes. Most of the permitted colours are sulphonic acids, but the list includes also magenta, rhodamine B, three eosines, auramine, brilliant green, turquoise blue G and methyl violet. Of these auramine and turquoise blue G are strongly basic but so far as I have been able to discover, neither is in use for foodstuff purposes in New Zealand. Methyl violet is the only purple shade included (there were none prior to 1933) and there are no browns. Brown shades can be made by mixing certain of the permitted colours and there are such mixtures on the market but they are not suitable for every purpose, and it is to be feared that non-permitted brown dyes are sometimes used.

Analysts dealing with foodstuffs are called upon from time to time to determine whether a given sample is artificially coloured and if so, whether with one of the permitted colours, and it is often desirable to identify, if possible, the colour used. These questions are not often easy to answer. Helpful information is given in several works, including *Allen's Commercial Organic Analysis* and the *A.O.A.C. Methods of Analysis*, but none of the published schemes covers the whole of permitted colours on the New Zealand list.

An attempt was therefore made to remedy this deficiency by tabulating the behaviour of the permitted colours under those tests which appeared most suitable for the purpose, and the table is given as an appendix to the present paper. The tests chosen are all in common use for the purpose and are applicable to such small quantities of the unknown dyestuff as are ordinarily available in a food analysis. The results have been obtained by working through the tests with samples, believed to be genuine, of the various dyestuffs and checking by such published matter as was available. The "permitted" list includes two oil-soluble yellows which are almost insoluble in water; these are not included in the table. No spectroscopic data are given, though there is no doubt that these would be very helpful in some cases.

It is very useful to have a set of dyeings made from known concentrations of the pure dyes. With such a set of patterns in conjunction with the data given with this paper it is, in my opinion, possible to distinguish all the permitted dyes from one another and from the great majority of the non-permitted dyes. No doubt there are cases in which non-permitted dyes could not be distinguished from similar permitted dyes, but it is at least possible to distinguish the permitted members from the more undesirable dyestuffs.

I have pleasure in acknowledging the great assistance given by the several dyestuffs manufacturers and their agents who have been most obliging in supplying data and samples. This applies particularly to Messrs. Ellis and Manton and Messrs. Brunner Mond & Co. (Australasia), agents for the I.C.I. Dyestuffs Group; to Messrs. Dyes and Chemicals Ltd., agents for the I.G. Farbenindustrie; to the Society of Chemical Industry in Basle and their agents, Messrs. R. Bryce & Co. Ltd., and to Messrs. Fritzsche Bros. of New York. I also acknowledge gratefully the assistance given by the Dominion Analyst and his staff for access to literature.

METHOD OF EXAMINATION AND TABLES.

EXTRACTION FROM FOODS, Etc.: The dyestuff is first brought, if necessary, into aqueous solution. If the material under examination is wholly or partly solid, it may require to be boiled with acid or alkali before the dye is thoroughly extracted. Alcoholic liquids should be de-alcoholised by evaporation.

It is recommended that tests 1, 2, and 3 (a) be applied in the solution and the dyestuff, if necessary, then purified by an appropriate method suggested by these tests. For example the dyestuff may be extracted by amyl alcohol from acid solutions and the amyl alcohol then shaken with ammonia solution, or successive pieces of wool may be boiled with the original solution and the dye recovered by boiling the wool with acid or ammonia. It is usually possible to concentrate and purify any synthetic dyestuff present and a mixture of colours can sometimes be separated more or less completely into its components by these methods.

The tests should then be repeated and any other required tests made on the purified solution.

1. EFFECT OF ACIDS AND ALKALIES: The solution is neutralised, if necessary, and five equal portions placed in similar vessels. Dilute (2N) acid or alkali is added, about one part to ten of solution, as follows:—

(a) Hydrochloric acid
(b) Acetic acid
(c) No addition
(d) Ammonia
(e) Sodium hydroxide.

Any alteration in colour is noted, the middle (neutral) tube being used for comparison.

2. EFFECT OF IMMISCIBLE SOLVENTS: (a) *Amyl alcohol* —Portions of the solutions from the last test are shaken with an equal volume of amyl alcohol and the colours of the two layers noted. If the colour appears to be extracted from acid solutions, the amyl alcohol layer from these is removed and shaken with aqueous alkali, or *vice versa.*

(b) *Ether*—Solution from tests 1 (a) and 1 (d) are similarly treated with ether. Note that in several cases the ethereal solution of the dyestuff is colourless and the extraction may not be noticed unless the ether is separated and re-extracted with aqueous alkali or acid as the case may be. In preliminary separations ether should be tried first, any ether-soluble material completely extracted, using several portions of ether, if necessary, and the residual solution then tried with amyl alcohol.

3. DYEING TEST: (a) *On Plain Wool*—25ml. of solution is acidified with acetic acid, a piece of white flannel about an inch square added and the solution boiled for ten minutes. The fabric is removed, washed with cold water until no more colour is lost, and examined. It is then cut into three parts. One piece is boiled for a few minutes with each of several successive quantities of about 10 ml. of 1% ammonia solution and another piece is similarly treated with 1% hydrochloric acid. Colours of solutions and of fabric after treatment are noted. If the dyestuff is one that is decolourised or the colour much lightened by acid or alkali, it may be necessary to treat the extracted fabric and the solution with sodium acetate solution or acetic acid in order to be able to decide whether extraction of the colour has taken place. Both extracted pieces, after adjustment of acidity, if necessary, are compared with the unextracted piece. A slight colour in the first lot of acid or alkali may be disregarded if the colour of the dyed piece is not appreciably altered.

Of the permitted dyestuffs, only turquoise blue and auramine fail to give satisfactory dyeings under the above conditions. If the presence of either of these or of other basic dyestuffs is suspected a further dyeing should be made from solution made distinctly alkaline with ammonia.

(b) *On cotton*—In a few cases information of value may be obtained from a test similar to the above except that a cotton fabric (which should have been well boiled with water to remove dressing) is used. Most basic dyestuffs will colour cotton more or less, but only a few acid dyes will give more than a faint uneven colour.

(c) *On Alum-Mordanted Wool*—The wool is prepared as follows: White flannel is washed in hot water, then boiled for half-an-hour in 2% alum solution, wrung out, dropped into boiling 1% sodium acetate solution and again boiled for half-an-hour, then well rinsed in cold water. It can be dried, cut up into inch squares and kept for use. The wool is dyed from acetic acid solution and boiled with ammonia as in (a) above. Any difference in colour between the plain and the mordanted wool is noted, especially after the ammonia treatment. None of the permitted coal-tar colours shows any mordant effect but the test is valuable for detection of certain vegetable colours, e.g., cochineal.

4. REDUCTION TEST: To a few millilitres of dyestuff solution a few drops of 30% acetic acid are added, followed by a small quantity of zinc dust. The solution is then boiled for a minute or two (or longer if decolourisation is incomplete). The zinc is allowed to settle and any residual colour noted immediately. The solution is then filtered through a small paper, cooled and well shaken up with air. If the original colour does not return, the solution is divided into two parts—one is treated with excess ammonia and the other with a few drops of N/1000 potassium permanganate solution. (Any colour due to unreduced permanganate is not likely to interfere but if such interference is suspected the permanganate can be eliminated by filtration through paper).

5. COLOUR WITH CONCENTRATED SULPHURIC ACID: A few drops of a suitable purified solution of the dyestuff are evaporated to dryness on a watchglass and a drop or two of concentrated sulphuric acid added.

KEY TO ABBREVIATIONS, ETC., IN TABLE.

NAMES OF DYES: These are synonyms under which the dyes are known to be on the market at present.

I.C.I. = Imperial Chemical Industries Ltd.

I.G. = I.G. Farbenindustrie Aktiengesellschaft.

S.C.I.B. = Society of Chemical Industry in Basle.

1. TEST 1: U = unaffected. Sl = slightly. Dec. = decolourised.

2. TEST 2: S = (usual behaviour of sulphonic acid dyes). Not extracted by ether from acid or alkali; not extracted by amyl alcohol from neutral or alkaline solutions but extracted completely or nearly so from hydrochloric acid solution.

SP = as above, but extraction by amyl alcohol from HCl incomplete. (Residual colour in water layer comparable with colour in alcohol layer).

SL = As above, but extraction by amyl alcohol from HCl only slight (colour in alcohol layer less than in water layer).

G = (usual behaviour of carboxylic acid dyes). Extracted by ether from acid, not from alkali. Extracted by amyl alcohol completely from HCl and partly from alkaline solutions.

B = (usual behaviour of basic dyes). Extracted by ether from alkali, not from acid. Extracted by amyl alcohol more or less completely from both acid and alkali.

N = Not extracted by ether and not appreciably extracted by amyl alcohol from acid or alkali.

3. TEST 3: A = (usual behaviour of acid dyes). Wool dyed from acetic, stable in HCl, stripped by ammonia. Cotton not dyed. No mordant effect.

AC = as above, but also dyes cotton.

F = (most basic dyes). Dyes wool from acetic, stripped by HCl, not ammonia.

4. TEST 4: D = (usual behaviour of azo dyes). Decolourised; colour not restored by air, alkali or permanganate. (Slight yellow colours are ignored).

T = (usual behaviour of triphenylmethane dyes). Decolourised. Colour not restored by air, but restored by permanganate.

E = (behaviour of acid eosines, etc.) Decolourised. Colour restored by air but not developed until made alkaline.

R = Decolourised. Colour returns in air.

Note: All results quoted were obtained with 1 in 10,000 solutions of dyestuffs. Numbers in brackets refer to notes following table.

Rowe No.	SYNONYMS.	TEST 1 Acids	TEST 1 Alkalies	TEST 2	TEST 3	TEST 4	TEST 5
31	Geramine 2GS (I.C.I.); Amido Naphthol Red G (Raspberry Red) (I.G.); Kiton Red G, AF (S.C.I.B.)	U	Sl darker and yellower alkalies	SP	A	D	Red
57	Lissamine Red 6BS (I.C.I.); Amido Naphthol Red 6B (I.G.); Kiton Red 6B, AF (S.C.I.B.)	U	Orange-brown in alkalies	SL	A	D	Red
79	Edicol Ponceau RS (I.C.I.); Ponceau 2R, AF (S.C.I.B.)	U	U ammonia Sl darker and yellower in NaOH	S	A	D	Red
80	Ponceau 3RZ (I.G.); Ponceau 2RE, AF (S.C.I.B.)	U	U ammonia yellower in NaOH	S	A	D	Red
85	Benzyl Bordeaux B, AF (S.C.I.B.)	U	Sl yellower ammonia orange-brown NaOH	S	A	D	Blue
179	Edicol Carmoisine WS (I.C.I.); Brilliant Carmoisine OZ (Raspberry Red), (I.G.)	U	Sl yellower	S	A	D	Violet
184	Edicol Amaranth AS (I.C.I.); Naphthol Red S (I.G.); Amaranth No. 10 AF (S.C.I.B.)	U	Darkened alkalies	SP	A	D	Blue-violet
185	Cochineal Red A (I.G.); Ponceau 6R (S.C.I.B.)	U	U ammonia brown NaOH	SL	A	D	Violet
225	Thiazine Red R (I.G.)	U acetic; HCl yellower then violet ppt.	U	S	AC	D	Violet-red
280	Croceine Scarlet 3BDS (I.C.I.)*	U	Darker NH_3 Brown NaOH	S	A	D	Violet

*Not sold as foodstuff colours.

Rowe No.	SYNONYMS.	TEST 1 Acids	TEST 1 Alkalies	TEST 2	TEST 3	TEST 4	TEST 5
677	Magenta, Fuchsin Basic (various letters)	Dec. HCl bluer acetic	Dec.	B	F	T	Yellow-brown
749	Edicol Rose (I.C.I.); Rhodamine B (I.G.); Rhodamine B, AF (S.C.I.B.)	U	U	B	F(1)	(1)	Yellow
771	Eosine BN (I.G.); Eosine DWC, AF (S.C.I.B.)	yellower	U	G	A	E	Yellow
773	Edicol Erythrosine AS, (I.C.I.); Erythrosine B, AF (S.C.I.B.)	yellower	U	G	A	E(2)	Yellow (2)
777	Rose Bengale B, AF (S.C.I.B.)	to pink without fluorescence	U	G	A	E(2)	Yellow (2)
150	Edicol Orange IS (I.C.I.); Orange S (I.G.)	U	Red	SP	A	D	Orange-red
151	Orange II Z (I.G.); Orange R or II (S.C.I.B.)	U	Red	S(3)	A	D	Red-violet
10	Edicol Naphthol Yellow F.Y.S.; Naphthol Yellow S (I.G.); Naphthol Yellow S, AF (S.C.I.B.)	HCl very pale green; Sl greener acetic	U	S	A	(4)	Nearly colourless
640	Edicol Tartrazine AS or NS; Tartrazine Spec. Pure (I.G.); Tartrazine AF (S.C.I.B.)	U	Sl redder	SP	A	D	Yellow
655	Auramine OZ (I.G.); Auramine O, AF (S.C.I.B.)	U	U ammonia Dec. NaOH	B	(5)	(5)	Colourless
662	Brilliant Green conc. (I.G.); Solid Green O, AF (S.C.I.B.)	HCl yellow; acetic yellower green	lighter ammonia NaOH Dec. and ppt.	B	F	T	Orange-yellow
666	Edicol Green GS (I.C.I.); Guinea Green B (I.G.); ? (S.C.I.B.)	HCl yellow-green; U acetic	Dec.	S	A	T	Orange-yellow
670	Light Green SF yellowish, XX (I.G.)	as 666	as 666	SP	A	T	Yellow
–	Fast Green FCF	HCl yellow-green; U acetic	blue	SP	A	T	Yellow
289	Coomassie Navy Blue 2 RNS (I.C.I.); *? Cloth Blue (Fast) AF (S.C.I.B.)	lighter, redder	U ammonia NaOH lighter violet	(6)	A	D	Blue-green

*Not sold as foodstuff colours.

Rowe No.	SYNONYMS.	TEST 1 Acids	TEST 1 Alkalies	TEST 2	TEST 3	TEST 4	TEST 5
518	Diamine Pure Blue FF (I.G.); Direct Sky Blue GS, AF (S.C.I.B.)	U	Sl redder	S	AC(7)	D(7)	Green-blue
661	Turquoise Blue GS (I.C.I.)*	HCl bright green; U acetic	U ammonia NaOH greener blue	B(8)	F(8)	T	Yellow
707	Cotton Blue II NZ conc. (I.G.)	U	ammonia Sl lighter; NaOH brownish red	(9)	AC	T	Red-brown
1180	Edicol Indigo Carmine XS (I.C.I.); Indigotine X spec. pure (I.G.); Indigotine conc. AF (S.C.I.B.)	U	U ammonia NaOH greenish-yellow	N	A	R	Blue
680	Methyl Violet (various letters)	HCl green; acetic blue	U ammonia NaOH redder and brown ppt.	B	F	T	Yellow
861	Induline (various letters)	U	Sl redder	N	A	R	dull blue
865	Nigrosine WL (I.G.); (and various letters)	U	Sl redder	N	A	R	dull blue

*Not sold as foodstuff colours.

NOTES:

(1) Rhodamine solutions have very strong fluorescence. Dyes cotton much bluer shade than wool from acetic. Decolourised zinc and acetic, colour returns slowly in air, immediately with permanganate.

(2) Erythrosin and Rose Bengale in reduction test give fluorescein; after addition of ammonia solution is yellower with strong green fluorescence. Solutions in conc. sulphuric acid evolve iodine on heating.

(3) Orange II is also partly extracted by amyl alcohol from ammonia but remains completely in water layer with NaOH.

(4) Naphthol Yellow is decolourised. In air a salmon-pink colour develops.

(5) Auramine gives practically no dyeing on wool from acetic, but dyes bright yellow from ammonia. Zinc dust decolourises; no colour returns in air but permanganate gives blue.

(6) Coomassie Navy Blue is completely extracted by amyl alcohol from acids and also from sodium hydroxide, partly extracted neutral or ammonia, all amyl alcohol solutions dark blue. Not extracted by ether.

(7) Dyeings with blue FF are incompletely stripped by ammonia. In reduction test a slight pink colour returns in air.

(8) Solutions of turquoise blue G in ether or amyl alcohol from caustic soda are yellow to brown; amyl alcohol solutions from acid blue. Dyeing from acetic is feeble, a much deeper colour is dyed from ammonia solution.

(9) Extracted partly from acids, nearly completely from alkalies by amyl alcohol (blue from acids, pale blue from ammonia, red-brown from NaOH). Not extracted by ether.

THE BRANCHES.

AUCKLAND.

THE IMPACT OF SCIENCE ON INDUSTRY AND SOCIETY— *E. Marsden.* Dr. Marsden referred to the increasing interest by overseas scientific associations in the subject of impact of science on industry and on society. The general trend of discussions indicated that the scientist had also the duty as a citizen of taking an active part in giving advice on these matters. He emphasised the fact that industries were becoming increasingly chemical and that human activities generally were becoming more and more dependent upon advances in chemical science. The war had forced the world on to a chemical basis and the indications are that the future will bring the dominance of another force, i.e., the biological and biochemical.

The speaker stated that industry was no longer relatively static, with periods of change at long intervals, but was now in a state of continuous progressive change and must be organised, serviced and administered accordingly. The maintenance and improvement of standards of living in the country depended mainly on the efficient functioning of industry and the proper exploitation of national resources of all kinds and the part which could be played by industrial chemists was of outstanding and vital importance. Particularly was this so in regard to any hopes we may have of the rapid development of new industries.

In expressing his conviction that the chemist will undoubtedly play a large part in the future industrial development of New Zealand, the speaker referred to certain difficulties in introducing this necessary chemical influence and process control into industry, due chiefly to the small size of most of the operating units, the problems of technical education of foremen, and the effective training of chemical engineers.

At the request of several members present, Dr. Marsden briefly outlined some of the work at present being done by the Department of Scientific and Industrial Research. In addition to their routine duties members of the staff of the Dominion Laboratory found time to do a certain amount of investigational work on such problems as the optimum conditions for the gas storage of fruit, kauri gum esterification, the toxicity of ragwort and mineral deficiencies. Mention was also made of some of the valuable work being done by the Dairy Research Institute, Wheat Research Institute, Wool Manufacturers' Research Association, Leather and Pelt Research Association, Tobacco Research Association and the Plant Chemistry Section.

In conclusion, the speaker stated that we live in a period of rapidly changing industrial activity—an age in which our people are made aware of new and desirable goods and amenities which many now consider capable of much wider distribution. In these changes there is great opportunity for the development and exploitation to the common good of our national resources. We need the technical knowledge to adapt ourselves and our industries to these changes, and the organising ability to extend present industries and create new ones on a sound technical foundation. Otherwise a large proportion of the fruits of changing industry may go to overseas investment.

We must admit the difficulties of our small population, scattered market and high transport costs. Nevertheless, we need to apply the attitude of research which is essentially that process of thought which analyses a problem, breaks it down into its parts for solution and then interprets the results in keeping with the total problem.

Discussion: Dr. Andrews said in connection with the lecturer's early remarks, he had felt for some time that there existed a great need for a school of Biochemistry in one of our Universities. The biochemical section of the Otago University did not suffice as it had a definite medical bias. The development of most of our primary industries naturally involve biochemical problems and at present we have to look overseas for our trained men. Without doubt, men brought up in this country would have a better understanding of the problems involved than those imported from overseas Universities.

Professor Worley agreed with Dr. Andrews' remarks, but in addition said he would like to stress the need for a training in chemical engineering in this country, as the present difficulty is, that the chemist cannot see behind the machine and the engineer cannot see behind the products; whereas a combination of both trainings would produce technicians of great value to our industries. Professor Worley said that he regretted the fact that large firms seemed unwilling to give University students in chemistry simultaneous practical experience in their own laboratories by allowing them to work there during vacations. However, he wished to pay a compliment to the pioneering work done by graduates of the college who had gone into industry and set up laboratories in the face of apathy and even hostility on the part of certain works executives and foremen. It was a credit to them that these men had succeeded in spite of the fact that at that time, there were no existing laboratories where they might have obtained practical training and experience.

Dr. Andrews, replying to Professor Worley, stated that it was not through lack of interest that industrial firms were disinclined to permit students to obtain practical experience in their laboratories but on account of the fact that most industries were now covered by legislation which fixed wages, hours of work and accident insurance to such an extent that they were not prepared to take the risk involved in providing the facilities for practical experience referred to by Professor Worley.

Dr. Briggs said that the policy of the University must be to train students along broad and general lines, and pointed out that they could not specially train students for industrial work. They can only provide the fundamentals, and industry must provide the practical experience. However, he wished to emphasize the necessity for a school of biochemistry in New Zealand and stated that the demand for biochemistry will increase in the future and that otherwise the need will have to be met overseas.

Mr. S. Irwin Crookes outlined and compared the facilities for a training in chemical engineering both in the United States of America and in England. He also raised the question of a stagnant population and considered that our material advancement must increase hand in hand with the population.

Dr. Marsden, replying, agreed with those speakers who had pointed to the lack of biochemical training in this country. In regard to the provision of practical training he instanced the Technological Institute of Massacheusetts, where students spent their post-graduate year by visiting six industrial firms, spending some time in each, studying flow-sheets and investigating more fully one stage of the manufacture at least, thus becoming familiar with industrial conditions and the relation of investigation thereto. This scheme apparently worked very well.

THE HEALTHY PLANT—*G. H. Cunningham.* From time immemorial the medicine man has been essential to the community. To-day he is a recognized unit, in New Zealand there being about one doctor for every 1500 of our population. The welfare—especially health, of man is influenced by his environment, particularly his foods. These are in turn influenced by the plants he grows for himself and his stock, since literally " all flesh is grass."

The health of these essential plants has until recently been quite ignored, for man in his queer, illogical way has assumed for himself alone the privilege of disease. Diseased plants mean diseased or unthrifty animals and man. Moreover, epidemics of plant diseases have completely changed the politics of many nations, profoundly modified early migrations, and sometimes changed the agriculture of a region. It seems incredible that the lawlessness of the most lawless country in the world—the United States—is due indirectly to ravages of one fungus. Yet such is the case; for the Irish famine of 1842 was caused by a fungus disease destroying the potato crop, leading to migration of over 100,000 Irish peasants to America. From these have descended the American politician, police, and Tammany!

Man has only with difficulty realized that plants are living entities. They breathe, eat, sleep, die and even copulate, as does man. They exhibit the same idiosyncrasies as to preferences of diet and climate; suffer attacks by insects, fungi, bacteria and viruses. More, they suffer, too, nutritional disturbances and deficiency diseases.

Yet a brief twenty years ago in New Zealand was pioneered development of studies of plant diseases and their control. And only during the past three years have we been able to develop this work on an effectual scale. We are not alone in this lack of appreciation of the significance of plant disease; for during this same period, or a little longer, every progressive country in the world had developed or enlarged its plant protection services, until to-day many thousands are engaged on the problem of trying to produce and maintain a healthy plant. We have recently learned that plants may suffer deficiency diseases. In the text books on plant nutrition plants are said to require but ten essential elements for their growth—C, O, H, N, S, P, Ca, K, Mg, Fe. We now know that many additional elements are essential, though required in such minute quantities that they formerly escaped detection in ash analyses.

One of our own officers, Mr. Atkinson, has recently demonstrated that an obscure disease of apples named corky-pit may be remedied by applying boron to the tree. Another, Mr. Taylor, has shown that in Auckland a mottle-leaf condition of citrus may be remedied by application of manganese. His work is the more interesting in that overseas workers have remedied a similar trouble by applications of zinc, which does not appear to work with us. Many new avenues are being opened up in this field; and who will say where it will end, or in what manner lack of rare elements in the plant cover affects health of stock and man living in that region?

Our work has been directed mainly towards protecting plants against attacks from insects, fungi, bacteria and viruses. Plants differ from man and his animals in that they are anchored to the soil. Diseases are therefore carried to the plant by external agencies such as wind, water, insects or animals including man. They may also be carried *with* the plant when it is set out, in or on tubers and bulbs, nursery stock and seeds. Measures of protection are directed towards eliminating methods of carriage, or preventing attack by covering plants with materials designed to protect or destroy attacking organisms.

It is my intention to-night to discuss these agents, as their use and application offer many interesting chemical, physical and mechanical problems. Chemical dusts or steeps, gases and even hot water are used to destroy diseases carried with seed, tubers, bulbs or nursery stock. Application processes vary from simple dusting, which any farmer can employ, to the complex hot water or vacuum fumigation processes, which call for application by the specialist.

Knowledge of the life cycle of the attacking organism is a necessary prelude to treatments of this type. For example we have two common wheat smut fungi, one carred in spore form on the exterior of the seed coat, the other interiorly in the form of resting mycelium. The first may be combated by dusts of approved type, or by hot water; but the second can be destroyed by hot water alone. Choice of the material is also influenced by its effects upon the vitality of the seed. With hot water treatment temperatures must be held carefully within specified limits, for each disease, as failure to control or injury to germination follows deviation even by a couple of degrees. Seed must be initially in good condition. Choice of a fumigant used in the vacuum process is influenced by the product being tested. Gases behave quite differently under low pressure conditions, and in consequence an entirely new technique is being evolved to that of fumigation under normal atmospheric pressure. Our major problems arise to-day in protecting orchards and field crops, nursery and market gardens against the unwelcome attentions of the hosts of pests and diseases which assail them.

Practically all of the many scores we have to deal with have been introduced from overseas, and new ones are being introduced each year. Owing to the peculiarities of our climate we cannot safely apply in New Zealand, safeguards used overseas. For this reason we have to make careful studies of all agents—called therapeutants—used, and ascertain their behaviour towards all plants and plant pests and diseases. All field therapeutants are applied as dusts or sprays, the latter practice predominating owing to the better coverage secured. Until recently relatively few materials were employed, but of recent years there have been dozens of new ones introduced to the New Zealand market.

One of the most profitable forms of chemical exploitation of mankind is the manufacture and sale of patent medicines. Some are undoubtedly valuable; but the great bulk are sold presumably on the principle that if they are not actively deleterious to man they might possess some value—at least to the manufacturing chemist. Recently the chemical manufacturer has discovered the plant protection field, and in consequence scores of products are, or have been marketed which are quite worthless for the purpose for which they have been sold. When we commenced work on this phase of plant protection eight years ago, we found that about 75% of all such products on our market were either valueless for disease control, or too unsafe to apply to our plants. We have had to add, therefore, to our lists of pests and diseases, the unscrupulous chemist! To-day we test all plant therapeutants offered for sale on this market. We have introduced a system of certification which enables the man on the land to select from all offered, those which have proved satisfactory under test. Lists are published twice a year and distributed to all growers.

Providing this protection to the man on the land involves our Division in a tremendous amount of work. It has been, in fact, partly responsible for our removal to Auckland. Alone of the possible research areas of the Dominion, Auckland provides a climate that allows us to grow for testing purposes all plants cultivated in New Zealand. Further, the climate is so favourable to pests and diseases that we can be sure of securing all those attacking plants and plant products in this country.

Tests are made both biologically and chemically. Biological tests are being conducted at the Plant Diseases Division area at Mt. Albert where we are establishing a modern laboratory and research farm. They are in the ultimate the only exact measures of our requirements, as may be realized when you consider we have to test for control of diseases, effects on the plant, effects of environment, problems of combined syrays, etc. Many therapeutants cannot, in fact, be measured chemically, a good example being the organic mercurials now used for seed disinfection. Chemical and/or physical tests are used to check purity of the products for purposes of certification. Such work is carried out at the Dominion Laboratory in Wellington, where we have available the services of a chemist who specializes in this phase. He has had in numerous cases to evolve specialized technique to meet our demands for exact measurements. We select where possible certain requirements, derived from biological tests, with which any product must comply before it is certified. These necessarily vary with the purposes for which each is used.

As examples in point, we deal with the common therapeutants on the following lines:

Sulphur—particle size, purity, dispersant (if colloidal).

Lime sulphur—polysulphide content.

Lead Arsenate—ratio PbO/As_2O_5, water soluble arsenic, particle size.

Bordeaux mixture—deal with components

Hydrated lime—purity, particle size, available calcium hydroxide.

Copper sulphate—purity.

Plant Extracts—

Nicotine—nicotine content.

Pyrethrum—pyrethrin content, solvent, or filler.

Derris—rotenone or total ether extract.

Petroleum Oils—

Complex problem, as oils are used on deciduous and evergreen trees and have to be made for summer and winter applications. Factors considered are viscosity, volatility, iodine value, oil content, and type of emulsifier.

For those insidious diseases, the viruses, there is no satisfactory therapeutant control. We have to breed resistant plants, and evolve methods of freeing crops from such diseases. The same applies with most field crops and their diseases.

WELLINGTON.

DISTILLATION FROM THE CHEMICAL ENGINEERING STANDPOINT—*W. A. Joiner* (Chairman's Address). The subject covers an important example of the application of science to industry and of the application of fundamental knowledge to the design of industrial plant. The industrial value of science is, perhaps, nowadays taken for granted in the older and more industrialised countries but in younger countries such as our own this factor is often lost sight of.

Modern chemical industry is extremely diverse in character, but just as work in a laboratory is made up of a number of more or less simple operations such as precipitation, filtration, distillation, etc., so in like manner industrial processes consist of similar "unit operations" which are common to most industries. A process which is comparatively simple to perform in the laboratory may present a difficult problem when an attempt is made to carry it out on a commercial scale owing to the limitations imposed by costs, materials of plant construction, economic handling of heat and similar considerations.

Distillation is one of several processes for separating materials which depend on differences in volatility of the constituents of a mixture. In distillation separation becomes possible only when the composition of the vapour differs from that of the liquid from which it arises. It is important, therefore, to find out the principle which governs the relationship between the composition of the vapour and that of the original mixture of liquids. This relationship depends on the nature of the mixture to be distilled. In the usual case of mutually soluble liquids, Raoult's Law holds approximately in certain cases. Where its application is possible the calculations necessary for the design of plant are considerably simplified. In other cases recourse must be had to direct experiment.

The often tedious laboratory process of fractional distillation is carried out in modern fractionating plant with remarkable ease and efficiency. Such equipment constitutes an excellent example of the joint application of fundamental knowledge and experience to an industrial problem.

The remainder of the paper is devoted to a consideration of the theory of the fractionating column and the main factors in the design of an industrial unit. The application of a knowledge of heat transfer and the flow of liquids and gases in the design of a typical bubble cap column is discussed.

In conclusion it is pointed out that within recent years it is becoming increasingly realised that progress can only be made if such processes are studied from a fundamental standpoint and the knowledge so gained applied to plant design and layout. Unfortunately the necessary physical and chemical data are not always available and, although the gaps in our knowledge are gradully being filled in, there still remains an extensive field for research in this direction.

THE LUNDEGARDH FLAME EMISSION METHOD OF SPECTRAL ANALYSIS OF INORGANIC SUBSTANCES IN SOLUTION—*E. B. Davies.* The lecturer opened his remarks with the impressive statement that by the technique referred to in the title one could estimate the exchangeable bases (Ca, Mg, K, Na, Sr, Mn) in sixteen soil extracts in about nine working hours at a cost of less than one penny per estimation. In addition to the saving of time and tedium associated with ordinary methods, trouble due to unsuspected impurities in reagents and risk of losses in transferences, and the possibilties of contamination are avoided. The method was developed by Prof. Lundegardh, a botanist who, while requiring chemical data, did not wish to be side-tracked into devoting time and energy to orthodox routine chemical operations. It was through contact with the Macaulay Institute for Soil Research, Aberdeen, that the lecturer had experience of Lundegardh's apparatus and technique. This consists briefly in passing a current of air carrying the atomised solution under examination into the base of a bunsen type burner burning acetylene gas. The heat of the flame activates the atoms of the elements from the solution and the spectrum of the flame is photographed. By comparing the density of the appropriate spectral lines on the plate with similar photographs of standard concentrations an estimation can be made of the various elements in the solution. This solution may be made up from various acids either mineral or organic and thirty-two elements can be estimated by the method mainly from Groups I, II and VIII of the periodic table. Interference of spectral lines from mixtures, e.g., Zn and Hg is rare and in general the density of a line is independent of other elements present. The disturbing effect of Al on Sr and Ca in this respect is overcome by a small modification of procedure. Rapidity and convenience of photography is specially provided for by devices as precise as they are ingenious. Six standards and six unknowns can be photographed on one plate and forty-four exposures can be made in seventy-five minutes by relatively unskilled manipulators. By means of Lundegardh's specially adapted photometer the density of a single line in all forty-four spectrograms may be measured in twenty minutes. The principle of the photometer depends on measuring E.M.F. produced by a thermocouple when an image of a line on the illuminated plate is focussed on it. This gives a measure of the combined density of the line plus the density of the background due to the continuous spectrum of the acetylene flame. The background density is also measured in a position adjacent to the line. From Lambert's Law the density of the line itself is given by the ratio of the combined density to the background density. This greatly simplifies procedure as in forming the ratio the effects of many variables in photography and illumination are eliminated. The concentration of the unknown can be determined by interpolation of its line density on the curve obtained by plotting the densities of the standards against their known concentrations. Ample comparisons of duplicate determinations and of results from spectral and chemical analysis were given and inspired confidence in the method. For such workers who continually require routine determinations of the above nature, as for instance in soil analyses, there must be an interest in the concluding argument that the initial cost of the apparatus—something like £600—is well worth while and soon recovered.

ABSORPTION SPECTROSCOPY AND SOME APPLICATIONS TO CHEMISTRY—*F. B. Shorland.* Absorption spectroscopy has recently become of paramount importance as a rapid method for the identification and estimation of naturally occurring complex organic compounds. It affords a physical criterion which can often supplement the description of a substance which is identified otherwise chiefly by its physiological activity.

The absorption of radiant energy from transmitted light over specific regions of the spectrum by a homogeneous medium such as a solution, is a resonance phenomenon, the implications of which are covered by the quantum theory. It is now generally accepted that an absorption band, which indicates that light of a particular wavelength has been absorbed, is due to the acquirement of higher energy levels by molecules or molecular aggregates. The laws of Lambert and Beer relating to light absorption give the basis for a quantitative expression of observed effects. In measuring absorption light from a single source is divided into two beams. By means of a series of optical devices the observer can see a selected small range of spectrum from each of these two beams. The lower half of the field is reduced in intensity by absorption due to the liquid examined. The other half, by rotation of a polarising prism, is reduced to an equal intensity, its reduction being calculable from the angle of rotation. For bands in the ultraviolet considerable modifications, including photographic technique, must be introduced.

Absorption spectroscopy has played an important part in developing our knowledge of the nature and occurrence of Vitamin A. The intensity of the blue colour reaction of liver oils with antimony trichloride is quantitatively associated with the presence of Vitamin A. This blue intensity has also a close correlation with that of absorption by these oils at an absorption band in the ultraviolet. This correlation is apparent in materials of low potency only if the unsaponifiable fraction is examined in both cases. The saponifiable constituents have an inhibitive action in the antimony tri-chloride test, while in the ultraviolet region they superimpose absorption over that of the vitamin.

For rich concentrates and halibut, ling and groper oils, it is possible to convert the spectroscopic readings into international biological units by simple multiplication. The factor may reasonably be called a constant and where discrepancies occur as in cod liver oils it seems reasonable to infer that the presence of an additional growth promoting factor is responsible for the higher value. Thus the spectral absorption technique has supplied data supporting the inference that animal substances other than Vitamin A may have the same physiological functions. Similarly the establishment of our knowledge of the physiologically potent substance known as factor A_2—which has the biological reactions and is a homologue of Vitamin A—is closely associated with the use of absorption spectroscopy.

CANTERBURY.

MAJOR TRENDS IN AGRONOMIC RESEARCH—*M. M. Burns.* The lecturer dealt with a variety of subjects, including base exchange, soil colloids, nutrient deficiency and soil erosion, and indicated the enormous problems which still await the agricultural chemist.

RESEARCH IN THE WOOLLEN MANUFACTURING INDUSTRY—*F. G. Soper.* Dr. Soper dealt with the work of Astbury and Speakman, who have built up a very interesting hypothesis of the structure of keratin fibres based on X-ray determinations. The lecturer gave an excellent description of the present ideas on the subject and showed how this somewhat academic research work was being directly applied in the industry.

A collection of various types of yarn and cloth made from the staple fibres proved very interesting.

THE TEACHING OF CHEMISTRY IN SCHOOLS—*T. W. C. Tothill.* The speaker favoured a general course in physics, chemistry and biology for the first two years in the secondary school and suggested that in the third year one of these three should be dropped, depending on future probable specialisation which should take place in post matriculation years.

He also sketched a course of chemistry which he would substitute for the present one. It would relate chemistry as closely as possible to the world around us and include such subjects as the elementary chemistry of soil, the carbon cycle, industrial processes, etc.

An interesting discussion following the lecture indicated that several teachers have had considerable success with the teaching of electronic ideas in quite junior classes.

METHODS OF INVESTIGATION IN PLANT CHEMISTRY—*J. Melville.* The lecturer dealt with the synthetic power of the green leaf and its importance to the animal kingdom. The various nitrogenous fractions and methods of isolation were touched on. Stress was given to the limited extent of plant chemistry due to lack of technique and methods.

RESEARCH—*R. M. Barrer.* The speaker, a former student of Canterbury College, and now of Cambridge University, covered a very wide field under the above title. The inter-relationship between academic and industrial research was fully discussed during the address and, in reply to questions, brief outlines were given of several lines of research and modern problems.

PERSONAL NOTES.

A number of Branch members were present at a dinner held at Coker's Hotel when the guests of honour were Mr. H. C. Holland, of Woolston Tanneries, and Dr. J. Melville. Mr. Holland left at the end of August to spend two years at the University of Leeds, studying problems of the leather industry. Dr. Melville has left the Wheat Research Institute to study plant problems at the Plant Research Station at Palmerston North. The good wishes of members were conveyed to them by Mr. T. H. McCombs, M.P., and Dr. R. O. Page. Our loss of Mr. Holland is only temporary. He has played an important part in the work of the Branch, as secretary and member of the committee and we look forward to his return after a useful and, we hope, pleasant experience abroad. In Dr. Melville we lose our secretary, and those who attended the Annual Meeting last January know we have lost a reliable and efficient organiser. During his two years in Christchurch, we have appreciated him as lecturer, as well as Branch secretary, and he has left with the best wishes of all members.

Mr. L. H. Bird, of the Wheat Research Institue, has been appointed to fill the position of Branch secretary.

Members had looked forward to the visit of Professor Alexander Findlay. We share with Professor Findlay regrets that indisposition during his stay in Christchurch prevented the delivery of his lecture on "Science and the Community." His membership of the Council of the Institute of Chemistry of Great Britain and Ireland shows that Professor Findlay is one of those who maintain the close connection between the chemical schools of the university and the chemical profession, which is of great benefit to both. To the student he is known as the author of one of the best introductory texts of physical chemistry, several works of a historical character, and the best known English text on the phase rule. To the present day New Zealand students of chemistry in the University, he is perhaps even better known as their external examiner. These different phases of Professor Findlay's activities made his visit one of particular interest, and our regret at not hearing him even keener.

As noted above, our lecturer for August was Dr. R. M. Barrer, of Cambridge University. Dr. Barrer was the 1851 Exhibition Research Scholar of the New Zealand University in 1932. During his residence in Christchurch as a student at Canterbury College he took part in two symposiums of lectures given to this branch. From 1932 till last year Dr. Barrer was engaged in research at the School of Colloid Science under Professor Rideal, investigating reactions on solid surfaces. A year ago he was appointed Research Fellow at Clare College and is continuing his work as well as teaching there.

OTAGO.

FIFTY YEARS OF CHEMISTRY. The members of the Otago Branch of the Institute were privileged to hear an inspiring address, in which Professor Alexander Findlay traced the phenomenal development of chemistry during the past fifty years.

"Fifty years ago," said Professor Findlay, "my interest in chemistry was first aroused, at a time when many chemists considered that little remained to be known, especially in inorganic chemistry. This complacent stagnation was banished by Rayleigh and Ramsey's brilliant discovery of the rare gases, which forms one of the most romantic episodes in the history of chemistry. This discovery revitalised chemical research and marked the commencement of fifty years of astounding and intensive development in chemical theory."

A further impetus came from the work of Becquerel, Madame Curie, Sir J. J. Thomson and Lord Rutherford on radioactivity, which culminated in the elucidation of the structure of the atom by Rutherford. Professor Findlay paid a tribute to the genius of Rutherford and said that he hoped that New Zealand chemists would seek inspiration from Rutherford's brilliant career in chemistry.

In the realm of physical chemistry Professor Findlay pointed out the significant advances made in this eventful period of fifty years. From the theories of solution established by Arrhenius, van t' Hoff and others, had developed the Debye-Hückel theory of strong electrolytes and the activity concept of G. N. Lewis. Heterogeneous chemical equilibria became of paramount importance due to the thermodynamic derivation of the phase rule by Willard Gibbs. The lecturer then traced the development of Bohr's quantum theory and modern wave mechanics from the Rutherford atom.

In organic chemistry, too, tremendous strides were made in theory, especially of molecular structure. Emil Fischer's work on the sugars and proteins and the work of Perkin and Kekulé and many others was dealt with by the lecturer. He also sketched an account of the recent work on hormones and vitamins and modern developments, such as resonance, resulting from wave mechanics.

During his survey of the advances made in these fifty years, the lecturer showed how enormous had been the effect of them upon the structure of industry. The address left one with an inspiring vision of the advancing front of chemistry.

Dr. Gardner, on behalf of the Otago Branch, in moving a hearty vote of thanks to the lecturer, said that it seemed almost incredible that such amazing developments could have been observed by a scientist who even at the present time was hardly past the prime of life.

A SURVEY OF SULPHURIC ACID MANUFACTURE—*P. Rouse.* Although the contact process for the manufacture of concentrated sulphuric acid had made such rapid progress in recent years, the older chamber process was still necessary for the increasing demand of " chamber acid " for fertilizers, etc. Mr. Rouse had recently toured Great Britain, where he said there had been a steady improvement in the efficiency of the chamber process. Efficient sulphur burners were largely replacing pyrites burners and the former were rendered even more efficient by controlled mechanical feed.

The lecturer described the uses, advantages and disadvantages in the Glover tower and the Gay Lussac tower and compared the efficiency of composite and single sets. Various means were adopted to introduce the nitrous fumes into the system. The old " potting system " was becoming obsolete. In some works nitric acid manufactured by the Oswald process was fed in over the Glover tower, while in others a sluice of nitrate was fed either into the chamber or into the contact tower. The latter process gave an impure product containing sodium bisulphate but this was not serious for certain products.

The ideal method gave a continuity of nitrous fumes without action on the lead chamber.

The general efficiency of a plant had been found to be dependent to some extent on the season, mainly due to changes in temperature. The improved Mills-Packard plant was provided with temperature control by a series of water coolers which acted internally, on the liquid spray above the reacting gases to give a very high efficiency.

THE CHEMISTRY OF APPLE STORAGE—*J. T. Holloway.* Apple growers suffer a considerable annual loss through their inability to control fully the biological processes responsible for the ripening and ultimate death of the tissues. The speaker traced the stages of growth, multiplication of cells, cell enlargement, the maturing period, senescence and finally the process of breakdown. These stages, together with the accompanying chemical changes, have been correlated with respiratory activity and the amount of carbon dioxide produced.

The fate of the sugars in the process of ripening has been a study of special interest; it was concluded that the vital point in these changes is the permeability of the cytoplasmic membrane to fructose.

It is known that ripe apples give off a volatile substance (now identified as ethylene) which catalyses the ripening process. This gas is used commercially to accelerate the ripening of bananas and certain other fruit.

The concentrations of carbon dioxide and oxygen in connection with apple storage need to be controlled. This has involved a complex study of respiration. Refrigerated gas storage involving such controlled atmospheres is now in commercial use.

The storage life is also affected by the nature of the orchard soil, especially with respect to its nitrogen content. The permeability of the cytoplasmic membrane has now been shown to vary with the pH of the cell sap, depending on the malic acid content.

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Members of the Otago Branch were invited to attend a Morning Tea on Saturday, September 10th, at 11 a.m. in the Library of the Chemistry Department of the University of Otago. The guest of honour was our esteemed visitor Professor Alexander Findlay, who, at the conclusion of the pleasant social function, delivered an address to members of the Chemical Club and of the Institute of Chemistry.

THE JOINT ANNUAL CONFERENCE.

The Joint Annual Conference of the Institute of Chemistry and the Institute of Chemistry (Great Britain and Ireland) will be held at

PALMERSTON NORTH, 26th and 27th JANUARY, 1939.

The General Secretary will issue details shortly.