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JOURNAL

of the

NEW ZEALAND INSTITUTE OF CHEMISTRY

EDITORIAL

With this issue we change to a quarterly publication; the remaining three issues for 1938 are set down for June, September and December. The Publications Committee has previously emphasised the difficulties—very real but not always apparent—in establishing such a publication under our particular conditions, but these difficulties are now regarded as mainly overcome and we enter upon a new phase of activity.

At the Auckland Conference in 1937, the opinion was expressed that the scope of the *Journal* was too ambitious; at the Christchurch Conference in January of this year the emphasis lay chiefly upon the necessity for frequent and regular issues, a recommendation in this connection being forwarded to Council. As far as we can judge, the views expressed in Christchurch did not entirely coincide with the views expressed in the 1937 questionnaire, which was not limited to those attending and speaking at a meeting. Council considered the whole position on February 8th and directed that a bulletin be published four times a year "containing matters of interest to members of the Institute, notes of Council proceedings, research activities, correspondence and contributed articles," and that this be published in a size uniform with the *Journal*. The Publications Committee then asked if the resolutions implied an actual change of name from "Journal" to "Bulletin," but the members of Council considered that the title might remain as before. We ourselves consider this a most important point since we must take the long view and provide for growth in the future; moreover we are already known as the "Journal" in Great Britain, America, France, Germany, Italy and Japan. Since the publication of the American Chemical Society's index of periodicals abstracted, our inquiries from overseas have increased.

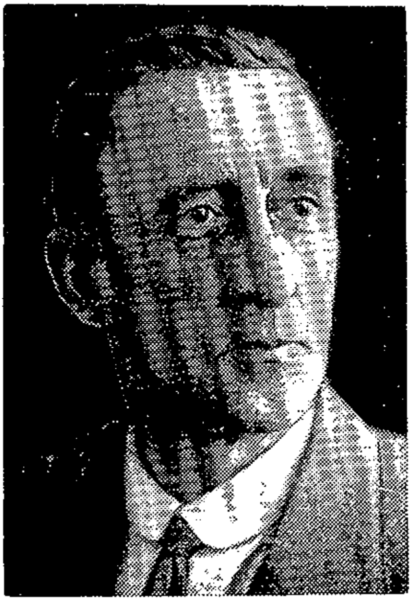
To sum up the position, this Conference Number is the first of four which the Committee must produce this year. The task is gladly accepted, but it is obvious that we can publish only the quality and quantity submitted to us for publication by the four branches.

* * *

An account of a discussion on the teaching of chemistry in schools will be found under the Otago Branch notes. Such a subject appears a proper one for an opinion from the Institute and we would welcome expressions of opinion from our members. We have reason to believe that much so-called practical work consists of demonstrations by the master, rather than individual work by the pupil, and that far too much stress is laid on a neat practical note book, with a decided bias for form rather than content. The over emphasis of pneumatic chemistry and pneumatic experiments with somewhat archaic apparatus may well give a false picture of the daily work of a chemist. One wonders how often the Dominion Laboratory uses a bee-hive shelf and a gas jar! The fault may lie in the syllabus, but may well be only part of a tradition, and if so the adoption of new text-books might rectify the position. We have a copy of Glendinning's *Inorganic Chemistry for Secondary Schools* which appears to eliminate many of the faults mentioned, and provides experiments which can be performed by boys in school laboratories without elaborate equipment.

Copy for the June issue should be in the hands of the Editor before 1st May, 1938.

NEW ZEALAND CHEMIST HONOURED.



SIR THEODORE RIGG
K.B.E., M.A., M.Sc., F.I.C., F.R.S.N.Z., F.N.Z.I.C.

The New Zealand Institute of Chemistry has much pleasure in congratulating Sir Theodore Rigg on his receipt of the honour of the Knighthood in the New Year Honours. Much of Sir Theodore's eminent career is familiar to all our members. His keenness, kindliness and wide scientific interests have made him a much respected member of our community, but there are many aspects of his varied career which may well be recounted.

Sir Theodore was born on the 6th April, 1888, at Settle, Yorks., England. Coming to New Zealand at an early age, he was educated at Newtown School and Wellington College, where he gained several scholarships and prizes for science subjects. Proceeding to Victoria College with a Turnbull Scholarship he took a science course under Professor T. H. Easterfield, and obtained First Class Honours in Physical Chemistry in 1911. During this period he was associated also with the Chemical Laboratory of the Department of Agriculture under Mr. B. C. Aston, F.I.C.

He was awarded a Jacob Joseph Scholarship for post-graduate work and continued studies in connection with the chemical composition of Montan wax and beeswax.

In 1912 he was awarded an 1851 Science Exhibition Scholarship which enabled him to proceed to Cambridge University. He was entered at St. John's College as a research student and proceeded to a research degree, working under the late Professor T. B. Wood in the School of Agriculture. The subject of his thesis for the B.A. degree by research was "The Soils and Crops of Bedfordshire." His scholarship was extended for a third year, arrangements being made to undertake soil research under Sir John Russell, of the Rothamsted Experimental Station. The Great War, 1914-1918, interrupted further research and it was not until 1919 that work was taken up again at the Rothamsted Experimental Station.

During the period of the Great War he undertook relief activities for war victims. During 1914-15 he was in charge of Agricultural Reconstruction for the Society of Friends in a portion of the territory devastated by the Marne Battle. In 1915-16 he was in charge of the Serbian Relief Fund of civilian relief for refugees on the Adriatic Coast, during the retreat of the Serbian army through Montenegro and Albania. From 1916 to 1919 he was organizing Secretary for the relief expedition of the Society of Friends in connection with the care of Russian refugees and starving Moscow children.

At the conclusion of the War, he widened his experience by a period in the United States, working with the Soils Bureau of the Department of Agriculture, and with Dr. Lyon, Soil Chemist at Cornell University. In 1920 he was appointed Agricultural Chemist to the Cawthron Institute, which at that time was being organized under Professor T. H. Easterfield, and in 1924 he was appointed Chief of the Agriculture and Chemistry Department, a position which he has retained to the present time. In 1927 he was appointed Assistant Director of the Institute, and on the retirement of Professor Easterfield, succeeded to the Directorship in December, 1933.

At the Cawthron Institute, he has been responsible for the development of the soil and mineral deficiency investigations for which the Institute has gained a wide reputation. For some years his chief work was on the soil survey of the Nelson district, the first detailed soil survey made in New Zealand. This work has proved invaluable in following up the many problems associated with Nelson soils.

The elucidation of the Glenhope bush-sickness problem, the spectacular success with cobalt salts and the exploration of cobalt deficiency in different parts of the South Island have all been conducted under his general direction. Similar work in regard to the use of borax in the control of " internal cork " of apples and " brown heart " of swedes was another of the striking features of the work so successfully carried out in his department during recent years.

His work has not been confined solely to chemical problems but has included a wide series of investigations relating to the manurial treatment of fruit trees, pastures and farm crops. He has been closely associated with the development of much poor land in the Nelson district, particularly the Pakihi lands of the West Coast.

In the development of the soil and mineral deficiency studies at the Institute he has had the assistance of an enthusiastic team of chemists and field officers, among whom particular mention must be made of Dr. H. O. Askew, Dr. J. K. Dixon and Miss E. B. Kidson.

In addition to his work at the Cawthron Institute, he has been closely associated with the organization of agricultural research in the Department of Scientific and Industrial Research. He has been a member of the New Zealand Research Council ever since its inception in 1926, and in recent years has acted as Deputy Chairman. He is a member of several sub-committees appointed by the Research Council for the co-ordination of agricultural research, and is Chairman of the Land Utilization and Cobalt Committees.

He has taken a prominent part in the organization of the Soil Survey Division of the Department of Scientific and Industrial Research and was the first Director of this Division. The Reconnaissance Survey of the volcanic ash showers of the Central North Island territory was one of the very interesting investigations carried out by the Division under his general direction.

At the request of the Lands Department he continues to act as Scientific Adviser in connection with the large-scale development of Pakihi lands at Westport. He has acted as President of the Nelson Philosophical Society; President of the Agriculture Section of the Dunedin Science Congress in 1934; Vice-President of the Chemical Section of the Auckland Science Congress in 1937. At the Australian and N.Z. Congress in Auckland he had the rare distinction of delivering the Liversidge Lecture. His subject, " Soil Deficiencies in N.Z.," enabled him to discuss in detail boron and cobalt deficiencies in different parts of New Zealand.

He was elected a Fellow of the Institute of Chemistry in 1925, and a Fellow of the Royal Society of N.Z. in 1932.

Overseas he has represented New Zealand at the International Soil Congress held in U.S.A. in 1927, and at the Imperial Agricultural Conference in England during the same year.

This is a record of which the Institute is proud; the record of a man, whose life is being spent in studying and adding to the fertility of the soil. In congratulating Sir Theodore, all chemists will agree with Jonathan Swift "that whoever could make two ears of corn, or two blades of grass, to grow upon a spot of ground where only one grew before, would deserve better of mankind, and do more essential service to his country, than the whole race of politicians put together."

THIS JOURNAL.

All communications regarding this *Journal* should be made to *The Editor* either direct or through a local Branch Editor.

Members and others are invited to contribute articles or general matter of interest to the profession in New Zealand; these will be welcomed at all times. It is intended to publish the next issue of this *Journal* in June, 1938.

Notice to Authors: 1. Unless all material submitted for publication is in typescript or very legibly written, the Publications Committee can accept no responsibility for inaccuracies and may reject the manuscripts. Diagrams and chemical formulae should be sparingly employed.

2. References to the literature are to be arranged as shown in this issue of the *Journal*. Titles of reference books must be given in full, with edition and date. As to current periodicals, the only abbreviations acceptable are those adopted as an international standard by the International Union of Chemistry. These are used by the (British) Bureau of Chemical Abstracts and by the American Chemical Society. A complete reference index of journals and official abbreviations may be found in the last issue of American Chemical Abstracts for 1936, Vol. 30.

3. An author desiring extra copies of the *Journal* to which he has contributed an article should inform the Editor of the number required when submitting his manuscript.

CORRESPONDENCE.

(To The Editor).

Sir,—

In your last issue an article entitled "Crystallisation of Iron Oxide at High Temperatures," described the formation of a micaceous form of iron oxide by fusion of amorphous iron oxide with a soda-borax flux, and the suggestion was made that micaceous iron oxide might similarly have arisen in nature by contact of iron oxide with basic rocks such as limestone, given the necessary heat and volatile compounds. A reply has since been received from Dr. Norman L. Bowen, of the Geophysical Institute of Washington, as follows:—

> "I have received your letter of July 30th with the enclosed sample. My colleague, Dr. Posnjak, has prepared a sodium ferrite $Na_2O.\ Fe_2O_3$, by a procedure not unlike that followed by you in the preparation of the substance submitted. This ferrite is attacked by water and gives finally a flaky form of iron oxide which is a pseudomorph after the original sodium ferrite. Your product is probably the same general sort of material showing various degrees of attack by the water with which you leached out the fluxes. My colleague, Dr. Merwin, has measured roughly the refractive indices of your sample and finds that it has higher indices than the unleached sodium ferrite but much lower indices than Fe_2O_3, observations which are in accord with the above-stated conclusion as to the nature of your product."

From the above communication it appears possible to get an anhydrous and flaky iron oxide by dissociation of sodium ferrite, but whether this artefact is really of the same crystal form as the natural micaceous oxide, and even whether its quite dramatic formation *en masse* under the conditions previously described is anything new, are points still in doubt.

J. J. S. CORNES.

(To The Editor).

Sir,—

What is the attitude of the N.Z. Institute of Chemistry towards the Centennial Celebrations? Are we to ignore the occasion, and in turn to be ignored, or is there any way in which the Institute can proclaim at that time that chemical science in New Zealand has both a past and a future?

Obviously nothing can be attempted which would unduly embarrass the very limited funds of the Institute. One suggestion I would make is that with the help and co-operation of members representing the various research organizations and industries the *Journal* might compile and publish an authoritative historical record of the contribution of chemical science towards the development of the Dominion during the first century of its history.

Other correspondents may have better suggestions to offer.

H. RANDS.

THE BIOLOGICAL DISTRIBUTION AND SIGNIFICANCE OF ZINC.

R. E. R. GRIMMETT.

Among the minor elements in nutrition it may be claimed with confidence that zinc is now assured of a recognized place. In recent years the rather widespread occurrence of physiological diseases of economic plants in the United States, British East African possessions, Australia and elsewhere, which have been shown to be associated with a deficiency of zinc in the plants and the soils on which they are growing, has focussed attention on this element from the point of view of plant nutrition. Well-known examples of plant disorders due to zinc deficiency and curable by the application of zinc either in the form of sprays or soil dressings are "rosette" of pecans, "bronzing" of tung, "chlorosis" or "frenching" or "mottle leaf" of citrus, and "white bud" of maize. Several brief reviews of these diseases have been published [1], [2].

The most prominent effects of zinc deficiency are restriction or cessation of growth often resulting in the production of abnormally shaped leaves and shoots, and interference with the development of chlorophyll leading to mottling and other forms of chlorosis.

Although the occurrence of a zinc deficiency disease in animals has not yet been established, a large mass of data has been accumulated by various investigators, notably French, Japanese, and American, demonstrating the occurrence of zinc in appreciable quantities in almost all organs of all normal animals in which it has been sought, including representatives of many of the phyla and classes of the animal kingdom. Zinc has been found to be present in the largest amounts in bone, pancreas, hide and hair, reproductive organs (especially when in functional activity), liver, kidney, spleen and blood, the total amount in the body of a man for example, being little less than the total amount of iron. It is especially attached to and concentrated in the nuclei of cells, so that any tissues showing great nuclear divisional activity (or karyokinensis) such as is associated with growth or reproduction, are usually rich in zinc. Experiments have shown that there is apparently a regulatory mechanism in the body controlling the supply of zinc to such tissues, at least in certain cases. The presence of a fairly large and uniform content of zinc in the pancreas has for some time been the cause of speculation as to its association with the carbohydrate metabolism regulating function of that organ which acts through the secretion of a substance, the concentrated extract of which is well-known as insulin. All active preparations of insulin contain some zinc. Canadian workers have demonstrated that the addition of zinc to insulin increases, prolongs and smoothes out its action.

It is fairly certain that zinc plays some critical part in the phenomena of reproduction but whether this is apart from its apparent universal activity in the processes of nuclear division is still uncertain.

In 1926 Lutz [3] and Drinker and Collier [4] gave excellent summaries of work to that date on the normal occurrence of zinc in biological materials. Lutz, using his urobilin fluorescence method, claimed to have obtained much more accurate figures than previous investigators and his figures showed on the whole, much smaller contents of zinc in animal tissues.

Soils and waters in general contain small amounts of zinc, figures quoted ranging from 0.03 to 11 mg. per kilo. while debris from the ocean floor is rich in zinc, up to 108 mg. per kilo. being found. All plants contain zinc in smaller or larger amounts, e.g. trees and other plants on zinciferous soils from 1% to 13% of the ash, and on non-zinciferous soils from 2 to 135 mg. zinc per kilo. dry weight. Other vegetable products are listed as containing the following amounts mg. per kilo. of zinc (fresh material): Potatoes 2.3, starch 1—35, corn 25.2, wheat 26—84.8, barley 26.7, oats 31.7—49.3, rye 17.1, rice 14.6, dry peas 34.5, wheat bran 139.2, cocoanut oil 12.5—40, yeast 414.8, malt 11, oranges 1, carrots 4.9, spinach 9, lettuce 1.3, cabbage 1.98.

Animal products and organisms are reported to contain the following amounts: Marine organisms (conch, crayfish, sea cat, tunicate) 24—532 mg. per kilo. dry matter, oysters (wet weight) 26—2,298. Other authors have reported figures for zinc in oysters between these limits, 100—200 mg. per kilo. being probably about the average. Cod liver oil contains 23—40 mg. per kilo. Delezenne found the blood and organs of serpents to contain 30—53 mg. per kilo., while the venom of serpents contained large proportions of zinc, the concentrations being roughly in the order of toxicity of the venom.

Fowl, blood 20—23; liver 67—76; muscle 27; eggs, white minute quantities; yolk 4—56.7.

Milk, cow 2—5.4; goat 2.3; human 1.3—13.7.

For the tissues and organs of some of the mammals the Table I which is combined from Lutz and from Koga [5] gives values found by a number of investigators. Lutz also gives figures for hair and for bone as follows:

Hair, cat 224.1 mg. per kilo., man 163.

Bone, rat 178.4, cat 125.9, man 100.8.

TABLE I.

Normal Concentration of Zinc in Tissues of Various Animals: Summary of Results Reported in the Literature.

(Concentration of Zinc in mg. per kilo.)

	Man	*Cattle*	*Dog*	*Horse*	*Rabbit*	*Cat*	*Rat*
	20.8 4.8—5.8	5.3—5.7 21.4 5.1	18.4—22.5 4.0—5.0	15.1	19.0—26.1 38.0	4.2—5.1	5.4—7.5
	10.0—76.0 39.0—145.0 52.0—145.5 115.0 33.6—68.3 219—288*	58.0—84.0 35.5—83.3 42.0 43.0	42.5 36.0	339.0 75.0	19.3 30.0—135.0 45.0—48.0 75.0—90.0*	27.1—61.7	18.2—23.8 77.6
	68.0 19.5—49.0 36.0—174.0*	24.0	30.0	57.0	43.0 32.0	12.2—15.7	11.0—19.0
	42.0 10.0—12.7 27.0—73.0*	13.5	23.0—29.0	45.0	—	7.1—18.8	27.7—43.1
	6.1—7.1	—	10.3	39.0 11.0	36.0	12.4—16.2	15.6—33.3
	5.2—15.7 8.3 11.0 10.6—12.5 36.0—84.0*	9.0 17.0 (Calf)	87.0—92.0 6.1	43.0—62.0	31.0—64.0 33.0—45.0*	9.0—10.0	10.4—20.7
	16.0—76.0 8.0—10.3	18.3	—	214.0—227.0	38.0—76.0	5.7—11.8	8.5—23.1 21.0 (gray rat)
	12.6—15.6 48.0—103.0*	—	4.0	15.8 71.0	45.0 45.0—69.0*	—	—
	25.6—36.0 47.1—51.5	21.0 26.3 25.0—37.0 46.0—52.0 26.0—50.0 46.8—50.4	20.0 43.1	29.0 55.0—60.0	20.0 17.0—23.0 33.0—42.0*	21.0—21.3	7.2—17.3
	55.0—156.0* 97.0—164.0	23.0	48.0	—	—	231—277	—
	—	—	—	—	31.0—49.0 12.0—45.0	31.1—36.5	22.2—34.5 25.0—42.0 (mice)

*Figures here indicate zinc in mg. per kilo. *on dry material.*

It is thus seen that the organs richest in zinc (apart from hair, of which there is some doubt) are bone, liver, pancreas, kidney, and spleen. Muscle, heart, brain, lungs, contain less though still notable amounts. The zinc in blood is nearly all concentrated in the white corpuscles as has been shown by Koga, Delezenne and others. Lutz states that the total zinc content of a normal man weighing 70 kilos is about 2.2 gm. compared with the figure of 2.8 gm. for iron in the same subject.

Sylvester and Hughes [6] in a recent paper using a new and apparently very sensitive method* involving extraction of zinc with the organic reagent diphenylthiocarbazone (dithizone) in chloroform, and titration with thiosulphate of the iodine liberated in a complex reaction in presence of ferricyanide, present figures for the zinc content of a number of foods. Their table is as follows:

TABLE II.

Food.	*Remarks.*	*Zinc p.p.m.*
Loganberries		4.5
Raspberries		3.5
Apples	Peel	0.26
Apples	Flesh	0.33
Carrots		3.1
Potatoes		1.8
Beetroot		7.4
Spinach		7.1
Cabbage 1	Outside leaves	3.7
,,	Inside leaves	4.2
,, 2	Outside leaves	2.6
,,	Inside leaves	2.1
,, 3	Outside leaves	3.4
,,	Inside leaves	4.0
Cabbage lettuce	Outside leaves	3.3
,, ,,	Inside leaves	2.9
New-laid eggs	Whole	10.0
,, ,,	White	Nil
,, ,,	Yolk	23
,, ,,	Yolk	29
Coffee beans	Brazilian	4.5
,, ,,	Costa Rica	5.5

*This method has been subject to careful trial by Miss E. M. Wall, of the Chemistry Section, Dept. of Agriculture, and found to give better recoveries and more consistent results than any method previously used.

Food.	*Remarks.*	*Zinc p.p.m.*
Cocoa nibs	Ceylon	34
" "	Arriba	54
" "	Java	41
" "	Accra	40
Indian Tea 1		25
" " 2		31
" " 3		42
White flour		6.5
Wholemeal flour		25
Wheat germ 1		140
" " 2		145
Wheat bran 1		98
" " 2		82
" " 3		74
" " 4		112
" " 5		108

Comparing these figures with the more reliable of those given by Lutz and Koga it is seen that the agreement is remarkably close. Special attention may be drawn to the exceptional richness of wheat germ in zinc. Whether there is any connection between this and the presence of a high content of vitamin E (both zinc and vitamin E having importance in reproduction) may be a cause for speculation.

Drinker and Collier [4] bring together much evidence bearing on the role of zinc. Cristol found that tumours frequently contained more zinc than the tissues from which they sprang. The amount of zinc was parallel to the degree of karyokinensis, the more rapid the evolution of the tumour, the greater was the zinc content. It is concluded that the zinc content is a function of the cellular and nuclear activity.

Bertrand, with Vladesco, Benzon and Nakamura, working with herring showed that during sexual activity the testicles and milt contained more than twice as much zinc per 100 gms. dry matter as the muscles and skeleton. At other times they contained less than half as much. They also found that in man the prostate is the richest gland in zinc in the body and that semen may contain 0.2 per cent. of zinc on the dry matter. They conclude that zinc plays a very important and general role in the body and some part in the function of reproduction.

Bertrand and his associates also experimented with feeding mice on zinc free diets. They found that under comparable conditions the mice lived longer when deprived of iron than when deprived of zinc.

From 0.15 to 0.3 mg. of zinc ingested during the entire course of one experiment sufficed to prolong its duration 25 to 50 per cent. (unfortunately the rigorous purification for zinc destroyed most of the vitamins and all the mice succumbed in the long run).

Drinker and Collier sum up this: "The importance of zinc in the development of Aspergillus niger; the chlorosis which develops when corn is deprived of zinc; the parallelism between the zinc content and the rate of growth of certain cells, and between the zinc content and the activity of certain cellular secretions; the high zinc content of substances, such as yolk of egg and milk, which represent the normal sources of nutriment for developing organisms during periods of extremely active growth; the high zinc content of spermatic fluid; and, finally, the more rapid death of animals on a zinc free diet than that of animals on a similar diet to which a small amount of zinc has been added—these facts constitute convincing experimental evidence of a biologic importance of zinc."

In the last few years a considerable amount of work on zinc in nutrition has been carried out by Japanese investigators. Among other publications those of Dr. A Koga (7) and of Dr. N. Miyake (8) on the content of zinc in isolated nuclei, and of Koga (9) on the content of zinc in the milk of human, cow and goat, at different periods of lactation and the distribution of zinc in animal organs, and of A. Akao (10) on experimental proof of the role of zinc in reproduction, may be specially noted.

Akao, using silkworms from which the ovaries can be removed during the chrysalis stage, found that the zinc content of the "Haemolymph" increased to over four times that in the haemolymph of non-castrated females (i.e. from approximately 100 to 400 mg. per kilo. dry matter). It would appear that some mechanism exists in the body to supply zinc through the blood to the ovaries at the time when preparation for reproduction by the rapid growth of egg cells is or would be proceeding. This is good evidence for the essential nature of zinc, as the supply of zinc is apparently subject to active or positive control and is not merely carried passively as an impurity.

Koga found that human colostrum was three times as rich in zinc (6 mg. per kilo) as milk during the first year of lactation.

Koga (1934) using the calcium zincate and polarographic methods determined zinc in the organs of a number of different animals. His table of results (translated, Table IV) is appended.

These figures compare quite closely with those of Lutz for rat, cat, and man. In particular the figures for Koga's dog are very similar to those for Lutz's cat (Table V appended).

Scott [11] found that all samples of insulin contained zinc, that it was impossible to remove all the zinc from the insulin without destroying it, and that to prepare crystalline insulin a sufficiency of zinc or the allied metals cadmium, nickel, or cobalt must be present. He was unable to detect cadmium, nickel or cobalt, however, in insulin to which these metals had not been added.

Rabinowitch, Foster, Fowler and Corcoran [12] have carried out clinical trials with modified insulin. They first found that addition of protamine to insulin delayed and prolonged its action. Secondly it was found that the addition of zinc to this protamine insulin greatly delayed, increased and smoothed out its action. Addition of zinc to ordinary insulin also prolonged its action but in some cases where an excess of zinc was added the action of the insulin was inhibited altogether (0.4% of zinc in the insulin had an inhibitory effect, 0.2% considerably less). The protamine zinc insulin used contained 1 mg. zinc per 500 units (0.01%). As an example of the effect of the protamine zinc insulin, "insulin wasters" whose blood sugar was still high when fasting even with three daily injections of ordinary insulin, had in 70% of analyses made, a normal or subnormal blood sugar 24 hours after one daily injection of the protamine zinc insulin. The following table shows results obtained on ten such patients:

TABLE III.

(Rabinowitch.)

	Regular Insulin	*Protamine and Insulin*	*Protamine Zinc and Insulin*
Total number of analyses	80	80	80
Normal blood sugars:			
Number	4	21	58
Per cent. of total	5.0	26.2	72.5
Average blood sugar (per cent.)	0.285	0.189	0.131
Average daily dose of insulin (units)	46.5	78.2	59.4

These investigators also spectrographically examined a number of commercial samples of insulin and found zinc present in all cases, the amounts varying from 0.0087 to 0.06 mg. per 500 units. It is claimed that the zinc is bound in the form of a salt of the insulin. They suspect an intimate relationship between the zinc and the action of the insulin and also that zinc may act as a binding agent between insulin and protamine.

TABLE IV.

Comparisons of Figures for Zinc in Various Animals.

(Koga. 1934)

Zinc in mg. per kilo. of Fresh Material.

	Cattle	*Dog*	*Goose*	*Tortoise*	*Frog*	*Ophicephalus*	*Oyster*
Liver	34.5	20.9	67.5	51.7	23.7	33.2	Whole animal 60.1
Pancreas	34.8	55.8	41.7	*48.1			Hepatopancreas 65.7
Spleen	27.6	29.7					Mantle 70.2
Kidney	18.9	13.8	20.0	*10.6	*16.9		Gills 134.8
Stomach		10.9	32.0	21.0	20.2	22.2	Muscle
Intestine		14.9	44.0				Other 115.4
Heart		14.5	23.8	*25.2	*18.8		
Lungs		10.6	13.1	15.3	*24.7		
Brain	13.5	16.6	*10.3	*6.6			
Muscle		30.5	22.1	41.4	32.2	6.8	
Testicle	13.6	*11.1	*11.1				
Ovaries				29.8	99.0		
Oviduct				12.1			
Suprarenal	24.4						
Thyroid	19.5						
Lympatic peritoneal	29.0						
Submaxillary	13.1						
Blood	4.4		9.8†	14.2†	22.2†	7.3†	

*Figures obtained by the polarographic method.

†These figures were published elsewhere.

TABLE V.

A Comparison of the Normal Average Concentrations of Zinc in the Tissues and Organs of the Rat, Cat, and Man.

(Lutz, 1926.)

Tissue	*Concentration of Zinc in Milligrams per Gram*		
	Rat	*Cat*	*Man*
Blood	0.0067	0.0046	0.0052
Gastro-intestinal tract	.0151	.0191	.0113

Tissue	*Rat*	*Cat*	*Man*
Pancreas	—	.0248	.0124
Liver	.0207	.0411	.0549
Kidney	.0144	.0141	.0350
Spleen	.0363	.0126	.0113
Lung	.0236	.0145	.0068
Testis	.0149	.0085	.0089
Brain and spinal cord	.0134	.0094	.0083
Muscle	.0136	.0211	.0302
Hide	.0338	.0391	—
Hair	—	.2241	.1630
Bone	.1784	.1259	.1008
Total animal	.0294	.0332	—

REFERENCES.

(1) ANON., "Some Minor Mineral Fertilizer Materials." *Bull. Imp. Inst.*, 1936, *2*, 212.

(2) JACKS, G. V., AND SCHERBATOFF, H., "Soil Deficiencies and Plant Diseases." *Imp. Bur. Soil Sci.*, 1934, *Tech. Communication* No. 31.

(3) LUTZ, R. E., "The Normal Occurrence of Zinc in Biologic Materials: A Review of the Literature, and a Study of the Normal Distribution of Zinc in the Rat, Cat, and Man," *Jour. Indust. Hygiene*, 1926, *8*, 177.

(4) DRINKER, KATHERINE R., AND COLLIER, ELLEN S., "The Significance of Zinc in the Living Organism," *Jour. Indust. Hygiene*, 1926, *8*, 257.

(5) KOGA, A., "Repartition du zinc dans les organes des animaux," *Keijo Jour. Med.*, 1934, *5*, 97.

(6) SYLVESTER, N. D., AND HUGHES, E. B., "The Determination of Zinc in Foods," *Analyst*, 1936, *61*, 734.

(7) KOGA, A., "Récherches recentes sur la question de la teneur en zinc de noyaux isolés," *Keijo Jour. Med.*, 1934, *5*, 80.

(8) MIYAKE, N., "Separation de noyau et sa richesse en zinc," *Keijo Jour. Med.*, 1933, *4*, 247.

(9) KOGA, A., "Teneur en zinc du lait de femme, de vache et de chèvre a différentes periodes de lactation," *Keijo Jour. Med.*, 1934, *5*, 106.

(10) AKAO, AKIRA, "Preuve experimentale sur le rôle du zinc dans la fonction de reproduction," *Keijo Jour. Med.*, 1935, *6*, 49.

(11) SCOTT, D. A., "Crystalline Insulin," *Biochem. J.*, 1934, *28*, 1592.

(12) RABINOWITCH, I. M., FOSTER, J. S., FOWLER, A. F. AND CORCORAN, A. C., "Clinical Experiences with Protamine Zinc Insulin and Other Mixtures of Zinc and Insulin in Diabetes Mellitus," *Canad. Med. Assn. Jour.*, 1936, *35*, 239.

ANNUAL CONFERENCE, 1938.

The Annual Conference, in conjunction with that of the New Zealand Branch of the Institute of Chemistry of Great Britain and Ireland, was held in Christchurch on January 20th and 21st. Some twenty-five members attended, not a large muster from a membership one hundred and sixty, but those present made the Conference successful by their consistent support of all the activities which had been arranged. The first function was morning tea at Beath's tea rooms on January 20th, when the Chairman of the Christchurch Branch, H. N. Parton, welcomed the visitors. After morning tea the Council of the N.Z. Institute met at the Wheat Research Institute.

The Annual Meeting of the N.Z. Institute was held in the afternoon, in the Physics Department of Canterbury College, through the courtesy of Professor F. W. G. White. When the Report and Balance Sheet had been adopted, the main business arose from a letter on the subject of the *Journal,* from W. A. Joiner. Considerable discussion followed. All were agreed on the unsatisfactory nature of the present position, and on the undesirability of increasing the number of publications dealing with original work. J. Melville, supported by H. N. Parton, moved that the *Journal* be abandoned. The majority opinion favoured a news bulletin, issued as frequently as practicable, and a motion recommending the Council to adopt such a bulletin was finally carried. It is relevant to point out that a similar scheme was advocated at the 1937 Conference, but that the motion carried then was much less definite. The present recommendation comes unanimously from a small number of members, but a number which can be said to be fairly representative. No speaker referred to the postal ballot, as far as the reporter's memory goes.

Following this discussion, G. A. Lawrence delivered his Presidential address on "The Chemist and the Community."

H. N. Parton opened the first of the two discussions, on "The Status of the Chemist." To the question what should that status be, his answer involved a brief discussion of the length of training of the chemist, compared with that required in other professions, medicine, engineering, and accountancy. Asking what the status of the chemist is in New Zealand, he presented the analysis of some fifty replies to the questionnaire sent out prior to the Conference, remarking that the poor response seemed to show that chemists are not interested in their status. The analysis indicated that those employed by the Government are rather better off than those in industry, though the small numbers available render generalisation difficult. Some reasons why the chemists' status is not satisfactory were suggested, among them lack of combined effort to press their claims. Finally, it was suggested that lack of a policy by senior members directed towards improving the position of some of the younger men who are not being fairly treated, might result in an undesirable split in the Institute.

R. O. Page agreed in broad outline with the first speaker but pointed out some difficulties, notably that of employers having to carry a chemist during his early years before his value had been fully developed. R. L. Andrew stated that during the last two years conditions in the Government Service had been much improved and gave the salaries agreed to by the Public Service Commissioner for University graduates. G. A. Lawrence referred to the practice of some consultants in charging fees which are too low and which reflect on the profession.

An excellent general discussion followed. Some speakers were opposed to the claim that a M.Sc. should be able to command a salary up to £300 per annum, on the ground that years of experience were required to make him really useful in industry. In reply to this, J. Melville considered that in view of the expense involved in a University training, industry should be asked to wager, in effect, on the value a graduate would ultimately have, by paying him a decent starting salary. J. Packer said that the recognised minimum salary for a M.Sc. in Australia was £300 per annum. The New Zealand Institute should aim at the same figure. He moved that where positions were offered to qualified chemists at salaries which the Council considered too low, action should be taken to have the remuneration increased. In a discussion on possible action, R. A. Robinson suggested direct approach to the employer concerned first, then some sort of publicity, possibly through the press, if that failed.

The motion was carried unanimously, as a recommendation to the Council.

Only a short time was available for the second discussion on "The Training of Laboratory Assistants." M. C. Franklin said that the discussion was closely linked with the first, as the employment of laboratory technicians to carry out routine work would release the qualified chemist for more important work, and assist in increasing his value and hence his status in industry. He discussed the work such technicians could do, and asked for support for a movement to have them trained.

J. Packer said that the University would not be concerned in the training of such technicians, as he considered it was a task for technical schools, while T. A. Glendinning explained what could be done in the technical schools and detailed some of his experiences in helping students who might be considered of the type required. Most of them were unfortunate. The general opinion was that chemical laboratories in New Zealand could not support such assistants and R. L. Andrew pointed out that the training of such cheap labour might react unfavourably on qualified men.

The evening was devoted to the Annual Meeting of the British Institute and the Presidential address by F. H. V. Fielder. This address which, like that of G. A. Lawrence, considerably impressed the Conference, is to be published, and it is hoped will be available to all New Zealand chemists.

Friday, January 21st, was devoted to three excursions. The Wheat Research Institute was visited in the morning, where the Director, Dr. F. W. Hilgendorf, explained the organization of the work. E. W. Hullett, Chief Chemist, described some of the methods used in testing bread quality and the advances being made constantly to help the miller provide the baker with a consistent product. Members were then shown over the Institute's Laboratory.

In the afternoon the works of the Davis Gelatine Company were inspected, W. G. Arneman explaining the processes involved in making glue and gelatine. A visit to the Christchurch Gas Company's Works followed, W. O. R. Gilling acting as guide. Particular interest was taken in the treatment of by-products, especially the benzol plant.

The Annual Dinner was held at the New City Hotel, the two Presidents and twenty-two members being present. A picture party and finally supper followed.

The Conference was well reported by the local press, satisfactory reports of the Presidential addresses and the discussions being published. The Christchurch *Star-Sun* had a leader on "Degrees of Ability," commenting on the discussion on the status of the chemist, which rather misinterpreted the attitude of the Institute to wage friction. On account of this a letter was written to the Editor by the local Committee and published on January 24th.

During the Conference, congratulations were extended to Sir Theodore Rigg on his Knighthood, and good wishes expressed to W. Donovan and C. G. Mason, both of whom have been recovering from illness.

The 1938 Conference was concerned in quite a large measure with the position of the chemist in industry. We hope that the 1939 assembly will be able to look back on something important achieved by the Institute as a whole for those chemists, whether full members or not, who require the assistance of an organized body.

THE CHEMIST AND THE COMMUNITY.

(*Presidential Address*).

As this is the first meeting of the Institute since my election to the Presidency, last December, allow me to express my thanks for the honour conferred on me. As one following in the footsteps of such able men as our past Presidents, my chief consciousness at the moment is one of inadequacy but you may be assured of my best endeavours to render all the service I can in the interests of the Institute, its members and the community at large.

The importance of chemistry to the community cannot be overestimated and it is by co-operation of the members of the profession such as is exhibited in this Institute that the best service to the community can be given. We are fortunate in New Zealand as compared with some other countries that we have not the multiplicity of organisations with much the same objects. My hope is that our Institute will be able to afford adequate representation of all workers in chemical science. Every modern progressive country to-day is increasingly dependent upon the work of the scientist but it is not always realised that this country is as much dependent upon science as any other. After the decline of the first flush of gold finds, New Zealand would have lapsed to a position of exporting a few imperishable farm products had it not been for the science of refrigeration. In short, refrigeration has placed the country on the map and made the products so important to our well-being and prosperity that science, especially the science of chemistry, has had to be applied to every phase of our productivity. It is fortunate that science above all things is international and knows no boundaries. In our work of improving our products, increasing our productivity, and improving methods of transport and distribution of perishable foodstuffs, we are able to make use of knowledge gained by scientific research in all parts of the world.

As a professional body, chemists are perhaps less closely knit than many other bodies of professional people. It is said that this is due to the diversity of activity of chemists working in different spheres; and to the fact that the majority of chemists are employees in Government service, municipalities or private firms. That does not appear to be an adequate reason for any lack of unanimity of purpose. The progress of the science and the welfare of the community at large depend on the efforts of chemists in all phases of the profession whether they be teachers, pure research workers, industrial research workers, chemists in Government or private employ, consultants or analysts. The scientist, whatever his particular field, is part of the vanguard, the scout of modern civilisation whose job is reconnaissance and the gathering of valuable information.

It is unnecessary to say that the teacher has the biggest part and wields the greatest power in deciding the future relationship of the chemist to the community. In the main it may be said that the teacher is dealing with good material, for as a general rule the student who has the desire and the courage to undertake the necessary drudgery of study to fit himself for the profession must of necessity be of the right type and made of the right stuff to keep up the high traditions and be possessed of initiative and judgment.

I will not attempt to deal with the education of the chemist, a matter which is outside my province. It will be sufficient to say that, like any other system of education, it is the laying of the foundation upon which to build the superstructure of experience. The graduate who decides to take up a career in chemistry, like any other graduate starting out on a specialised career, finds that his knowledge is still far from complete. Buffon once said: "Let us collect facts in order to have ideas." That is what education means to us, a systematised collection of facts, a basis on which we develop our powers of observation and deduction. A speaker recently said that many people did not see what was going on around them because they failed to keep their eyes open. This is only partly true because the eyes may be wide open but unless they have the experience to see, the observations may be worthless. It is our interpretation of what we see that counts.

"The jewel that we find, we stoop to take it, because we see it, but what we do not see we tread upon, and never think of it." And so it is only through our training plus experience that we are able to interpret things in the right perspective and proportion. In a recent address, Professor Thorpe gave the following equation: Knowledge plus Experience equals Wisdom. "The first," he said, "can be passed on from one generation to another, but the second can only be acquired personally, yet the two are essential to wisdom." A man may accumulate a vast amount of book knowledge but unless he develops his faculty for independent thought and action he is likely to become a mere machine. Chemistry above all sciences requires continual study even to keep up with the general trend of progress.

I have taken as my subject, "The Chemist and the Community." As one of the first essentials, the chemist has a duty to the fellow members of his profession; that is, the working together for the common good. One sometimes hears the question: "What benefit do I get by belonging to the Institute?" A superficial examination may not reveal any material benefit: a *Journal,* the right to attend meetings to hear certain papers read and the privilege of paying an annual fee. This is a narrow view to take. Belonging to the Institute, or for that matter, any other Society does not necessarily mean direct benefit to the individual, it is really a question of what benefit will it be to the profession as a whole and the community at large. A much hackneyed saying, but nevertheless true, is that "What one gets out of an organisation is in proportion to what one puts into it." And we may agree with Shakespeare when he said: "The fault, dear Brutus, is not in our stars, but in ourselves."

A body such as the Institute must have a beneficial influence in the community. It is able to speak for the profession with one voice. It promotes the high status of the profession; it is the medium by which members are brought together and it enables them to get personal contact, exchange ideas, and so broaden their outlook. Membership is therefore not so much for personal benefit but as a force for promoting the advance of chemical knowledge to deveop and maintain the prestige of the profession. As a result of this our organisation becomes an essential part of the basal fabric of modern civilisation.

Quite apart from professional organisations such as this Institute, every chemist should wherever possible take part in the management of various bodies outside science, not only to maintain contact with the practical problems of the community but for the sake of the broadening influence. The practice of chemistry with its attendant necessity of continual study to keep up with the trend of modern progress tends towards a narrow specialisation and the production of the recluse and as an offset to this tendency contact with other activities is of undoubted benefit.

To the curious and those with an aptitude for fundamental research there is a constant urge to dig more deeply into the hidden mysteries of science. Robert Boyle in his *Sceptical Chymist* (1661) said that the practice of chemistry was to "find out the nature, to see into what principles things might be resolved and of what they are compounded." The astronomer by means of his telescope and the scientist with his microscope can probe worlds of beauty far removed from the naked eye; so the chemist with his knowledge of molecular structure can visualise a beauty far removed and beyond the ken of the uninitiated. Not a beauty of form, nor of sound, but a beauty of the symmetry of reaction and order of things which can only be appreciated within the mind itself. We know, of course, that many chemical reactions bring about a type of beauty discernible to the eye, but it is the train of unseen reactions which bring about or are involved in a physical manifestation that are the most fascinating study. Balzac said: "To live in the presence of great truths and eternal laws—that is what keeps a man patient when the world ignores him, and calm and unspoiled when the world praises him." Take, for instance, one phase of metabolism of plant life which is as yet imperfectly understood, the synthesis of sugar from simple substances like carbon dioxide and water, the process of elaboration to more complex sugars, migration in the plant and conversion to starch and finally, when conditions warrant it, the conversion of the starch back to sugar either as a part of the general metabolic process in the plant, or as a part of the process of nutrition of the young plant in the sprouting of the seed. Then again, going to the other end of the scale, we have the elaborate chemical processes in the metabolism of the animal which are being revealed to us by the delicate and beautiful experimental work carried out by the biochemist on living tissues: work, it may be said, which is not only revealing to mankind a more intimate knowledge of the functions of the various tissues but also building up a fund of knowledge as to the cause of functional disorders and diseases. Take, for instance, one phase only of the nitrogen metabolism of the liver—the combination of the amino acid ornithine with carbon dioxide and ammonia to form citrulline, the combination of citrulline with another molecule of ammonia to form the amino acid arginine and finally the break-down of arginine by the enzyme arginase resulting in the production of urea and the regeneration of ornithine which is ready to repeat the cycle. This work in the biochemical field demonstrates the beautiful co-ordination of chemical reactions which takes place as a part of the vital functions in the living tissues and brings us closer to the work of the Great Architect. As Alexander Findlay recently said: "Science does not destroy the beauty of nature—it gives it significance."

The scientist of 100 years ago carried out his work for the sake of finding out the nature of things and to satisfy that restless curiosity which is and always will be a dominant feature of the human mind. The scientist of the present day is no less curious than his predecessor of old, but the possible results of his work have taken on a new significance. The products of scientific discovery must not be allowed to dominate man—man must develop a higher order of intelligence to prepare and meet advance in knowledge. To be forewarned is to be forearmed; discovery, gradual as it is, causes a certain amount of dislocation and distress in the established order of things. In order to minimise this dislocation we must be continually preparing for what is to come by an intelligent estimation of what is likely to result from scientific discovery. In an address two years ago at Dunedin, I issued a warning concerning the likely advance in the production of artificial wool and in this connection I am glad to see that Governments have moved in the matter of promoting within the Empire a more co-ordinated effort in wool research and publicity, but there are still some who are inclined to underestimate the chances that this substance is likely materially to affect natural wool. We in New Zealand, depending as we do so largely on the production of wool, and in view of the fact that it is so largely bound up with our meat production, cannot afford to ignore such a vital point. I am not suggesting that there is need for panic. Artificial wool is not likely to replace the natural article but it may in the future affect our sales. Artificial wool may not be satisfactory at the present stage of its development, its production may be costly, but past experience of similar ventures must lead us to the conclusion that these difficulties are likely to be overcome in the future. In this connection it is interesting to turn back the pages of history and read what Sir Henry Roscoe had to say in 1881 in the first Presidential address to the Society of Chemical Industry regarding artificial indigo. "At the present moment artificial indigo cannot compete in price with the natural dye-stuff. This, however, is scarcely to be expected as it is not more than twelve months since Baeyer's discovery was made—Baeyer's discovery will have the wholesome effect of putting the indigo planters on their mettle."

Within about two years of Roscoe's address, 400,000 acres were put out of cultivation in India as a result of the competition of artificial indigo. The growers were not prepared for this. They and those interested in the existing indigo industry had done everything in their power to belittle the success of the artificial product by such arguments that it would never be produced cheaply enough to compete with the natural product; that its colouring and lasting properties were inferior to the natural product. In short, everything was done to combat artificial indigo except searching for ways and means of improving the natural product or looking into the question of finding a substitute crop to grow on the land used for growing indigo. The consequence was that a serious dislocation took place in India and it was some years before a state of balance was established. There is an old saying that "When one door closes, another one opens." At the present time it is said that casein is the main raw material for the production of artificial wool. In addition to milk New Zealand produces many other nitrogenous substances which may in the future become suitable for the production of artificial wool. Preparation for a competitive product does not necessarily mean only establishing protection for the product which is likely to be replaced, but also a wise review of the possibility of consolidating the position of the threatened product, improvement of quality and reducing the cost of production. Preparation also includes a review of the possibilities of supplying a raw material for the production of the competitive product and as a last resource of producing something in place of the threatened product.

It is well known that new scientific discoveries cause a great deal of dislocation in industry. We find that machinery and plant often become obsolete and in many cases the workers are affected and the prosperity of a whole district or country is seriously interfered with by such changes. This dislocation is often the result of not being prepared for change, not following and keeping up with the trend of industrial progress, and in many cases deliberately turning a blind eye to the possibilities of modern discovery. Very few industries have spectacular beginnings such as to cause the world to sit up and take notice. The development is usually gradual and it is only when costs and quality become competitive that the man in the street begins to take notice. Take, for instance, the modern automobile industry. Those of us who knew the early products of this now tremendous industry could not in our wildest dreams have visualised the enormous progress made in a period of thirty to forty years and the tremendous influence which it has had on all phases of human existence. Then again, take the rayon industry. Robert Hooke predicted the production of artificial silk in the 17th century. It took Cross and Bevan about twenty years of long and painstaking research to bring the project to anything like perfection and it is doubtful whether even they visualised the enormous development of the industry as we know it to-day.

The failures in the early stages of a new project are likely to lull the unsuspecting community into the belief that the new product will never become competitive. The consequence is that valuable time is often lost preparing for changing conditions. At a meeting of the British Association last year Sir Josiah Stamp suggested that "the training of the scientist includes no awareness of the social consequences of his work." That may be true but with the most intelligent review of the whole question, it is not always possible to be aware of all the likely consequences of the result of a piece of research work. As an example let us take the hydrogenation of the fatty oils. It is possible that the workers responsible for the commercial success of this process were more concerned with the hardening of such oils as cotton seed oil and the like, and in all probability they never thought of the hundreds of thousands of tons of whale oil which would ultimately be procured and hardened by the selfsame process. Yet it is this source of supply that has probably had the greatest effect on the tallow and edible fat market of the world. Just how long this competition will last is difficult to say, but from reports of the whale population of the seas it would seem that the same thing is happening as happened to the penguins and seals which were at one time so abundant in the southern seas but which were so ruthlessly exploited for the sake of their oil that they were well-nigh exterminated. If this is the case there may be a reduction in the production of hardened whale oil.

It is by keeping the community in touch with scientific developments and an intelligent interpretation of the trend of things that the scientist can reduce the impact to the community to the smallest possible degree.

One sometimes hears the opinion expressed that the scientist speaks in a different language and therefore fails to make his work appreciated by the general public. I think we have every justification for believing that the public is becoming more science-conscious, for in the press and the popular printed word generally we find scientific and quasi-scientific articles which are being more and more appreciated by the public. The type of thing to be deplored is the modern radio thriller and certain of the high speed detective novels whose authors run away with the most fantastic chemical and other scientific methods of detecting crime: the type which tends to give quite a false idea and lead the public to believe that the criminal investigator is a super scientist who, by a simple test tube experiment, a casual glance through a microscope or magnifying glass, is able to solve the crime.

It is perhaps more in the industrial and business world that a link is required—a liaison between science and industry. When we examine most of the industries we find that the operations have a scientific basis. Take the dairy, freezing, gold mining, woollen and tanning industries. The men in charge of the various operations in any of these industries would be better for some training in the science of the particular job. In some of the older industries, gold mining, dairying and freezing in particular, New Zealand owes a debt of gratitude to the old departmental managers and foremen. In the absence of preliminary training, scientific advice and little information from abroad, they had to work out their own processes because in many cases they were working under conditions peculiar to New Zealand. If some scheme of training on broad lines could be inaugurated it would result in a better understanding, a better linkage between science and industry. It is surely better when an agriculturist is advised to apply such and such a fertiliser for this or that crop, for him to know why such a treatment is necessary and desirable. Some concern has been felt at the drift of the best brains from New Zealand because of the limited openings. In my opinion, on account of the smallness of the country and its industries we cannot hope entirely to eliminate this drift nor is it desirable that we should, but by a more scientific basis of training of foremen and those in charge of operations in industry, I can visualise a better appreciation of the value of research in industry and as a consequence fuller utilisation of the services of some of the people who now look further afield to find outlets for their talents. In any case the scientist should be careful to present his information to the public in as clear language and as free from technical jargon as possible.

A letter which I received some time ago conveys some idea of how the public view the chemist. It ran:—"Dear Sir: These days chemists can invent anything and I want something invented for me. It should be a simple handy thing such as could be used in the garden or house." This letter perhaps gives an exaggerated idea of the opinion of the public at large towards the chemist, but it is a fair indication that the chemist is regarded as some sort of wizard with a specially developed insight into things quite outside the sphere of the layman. Every endeavour should be made to dispel such an erroneous idea and let the public know that the average chemist is just an ordinary hard working individual applying his special knowledge to the problems which come within the ambit of his operations. It should be known that there are few spectacular discoveries made through chance or accident, that the usual course in chemical investigational work is a laborious process which requires tenacity of purpose, often long hours of thought and labour at the bench. It is in this respect that the chemist is at a disadavantage as compared with other professions. The chemist may spend days, nay even weeks or years, working on a problem; the practical work involved in elucidating the problem may be all thrown down the sink, or in the end as a result of his work he has a few figures to show for his labours. Contrast this, for instance, with the architect whose work involves the preparation of plans, the culmination of which is a building which the passer-by can see and to which the architect can point with pride and say "I designed that building." Or the engineer who can say "I control the operations of this plant. I designed this plant." Even the lawyer has the satisfaction of having his work brought to the public notice through the columns of the press.

Chemists and scientists generally are often accused of being conservative. Is it not the duty of any scientist for that matter to be conservative? He must be sure that his theories and opinions are founded on the strongest possible basis before being passed on to the community. Conservatism in this respect may tend in some instances to restrict and retard progress. It is better sometimes to hasten slowly. The public are often impatient for results of research; it is because it does not realise the work necessary in prosecuting a particular line of research. When a research worker starts on a problem he cannot guarantee to have results within a certain time; he cannot guarantee any result; he can only use his imagination and ability and work, strive and hope for the best. He may be lucky and gain his objective quickly, on the other hand solution of the problem may be long deferred. The relation of the chemist, or for that matter any scientist, to the community is an important one. He is the servant on whom the community depends for his contact with scientific development and the adoption and use of scientific methods in the interests of mankind. All communications of scientific discovery to the public should be made with moderation and reserve. In speaking of this we all know that some phases of modern advertising are full of extravagance. Everyone is familiar with the patent medicine which will cure anything from toe-ache to ptomaine poisoning. A newer type of advertising is a statement to the effect that the preparation is made with "chemically pure ingredients," and then we have the well-known beverage which is "tannin-free." Some of these statements are, of course, made deliberately, others as a result of ignorance on the part of the advertisers. The genuine manufacturer, making and selling products on a strictly ethical basis and with a genuine desire to give service to the community, is surely entitled to some protection from these extravagant methods of advertising. Control of such methods of advertising is one of the legitimate functions of the Governments, but chemists in the employ of manufacturers and consultants can do a great deal to help eradicate this type of advertising and should not hesitate to point out inaccurate, misleading and extravagant statements in advertising matter.

A lecturer in a recent address said that we have to fight orthodoxy. Do we have to fight orthodoxy? Cannot we bend or remould that which we call orthodoxy in order to modernise it and bring it into line with present-day needs? What we now call orthodoxy may at one time have been revolutionary and we should at this stage of the history of mankind be intelligent enough to bring about change without unduly upsetting the established order. John Ruskin said: "When we build, let it be such a work as our descendants will thank us for, and let us think as we lay stone on stone, that a time is to come when those stones will be held sacred because our hands have touched them, and that men will say as they look upon them, See! this our fathers did for us."

It is easy to smash orthodoxy but unless we are fairly sure that we have something better and well tried to replace it, there is nothing gained and there may be a great deal lost. The world to-day is full of people smashing orthodoxy but the question is whether it is being replaced by something better. Man must learn to build before he attempts to smash. Pasteur once said: "Two opposing laws seem to me to be in contest, the one law of blood and death, forcing nations to be always ready for battle, the other a law of peace, work and health, whose only aim is to deliver man from the calamities which beset him. The one seeks violent conquest; the other the relief of mankind. The one places a single life above all victories; the other sacrifices hundreds of thousands of lives to the ambition of a single individual. Which law will prevail God alone knows, but of this we may be sure—that science will obey the law of humanity, and will always labour to enlarge the frontiers of life."

The world to-day is full of wreckers, people with such singleness of purpose that they fail to take heed or try to see the consequences of their actions. The community is entitled to expect that the scientist above all will communicate only those things which have received searching examination from all angles. Perhaps the finest tribute which could be paid to any scientist, and the thought which I would leave with you to-day, was contained in a recent editorial in the Journal of the Society of Chemical Industry on the death of Lord Rutherford: "In his scientific work he was scrupulously honest, he did not delude himself or the world by careless or unreliable experiments or deductions."

THE BRANCHES.

AUCKLAND.

OFFICERS, 1938: *Chairman*: P. R. Parr, *Secretary*: J. Ricketts, c/o Brown Barrett Ltd., P.O. Box 36, Newmarket.
Committee: L. H. Briggs, R. T. D'Anvers, G. B. Jones, F. H. V. Fielder.
Branch Editor: R. T. D'Anvers.

Papers read, 1937—

"The Manufacture of Synthetic Resins."—*Dr. Wm. Krumbhaar.*
"Modern Laboratory Design."—*General Discussion.*
"Rubber Industry."—*C. J. Inglis.*
"Modern Methods of Grading Milk."—*L. S. Spackman.*
"The Manufacture of Glass."—*W. Kerns.*
"Research Activities of Auckland University."—*Miss Bartrum, W. S. Taylor, R. Culford-Bell, G. Dingley, W. Wright, G. C. De Ath.*

THE RUBBER INDUSTRY—*C. J. Inglis.* The rubber industry, from its inception about 1820, furnishes perhaps the best illustration of the effect of science on industry. To quote a single example, the time of vulcanisation alone has been reduced from about ten hours to, in some cases, about four minutes.

The incorporation of sulphur has a very pronounced effect. The addition of 2½% produces a perfectly vulcanised product, whereas 25% yields a hard, black, resinous material called vulcanite. These $C_{10}H_{16}S_2$ respectively, the former isoprene molecules being highly two percentages correspond to the molecular formulae $(C_{10}H_{16})_{10}S$ and polymerised.

Practically every conceivable substance has been at some time or other tried as a filler, but those in most common use to-day are lamp-black (for black motor tyres), zinc oxide (for white rubber), talcum, china clay and magnesium carbonate, this latter, by virtue of a similar refractive index to rubber itself remaining invisible.

Laboratory work in a rubber mill involves the testing of raw materials and of the finished product. Most of these latter are of a physical nature and involve artificial ageing, abrasion tests, etc. In the case of large manufacturing concerns many tests are done under working conditions such as road and weather tests on motor tyres.

In concluding a most comprehensive lecture the speaker dealt briefly with the synthesis of a rubber-like material from butadiene.

The uses, limitations and advantages of this over the natural product were discussed; its chief advantage being its resistance to oils, which leads to its use in lining petrol pipes, and in rollers for printing presses where the oil base of the ink causes the natural product to swell.

THE MANUFACTURE OF GLASS—*W. Kerns.* North Auckland sand was stated to be second to none in the world for the manufacture of glass, and New Zealand limestone to be eminently suitable. The only material imported in any quantity is soda-ash, with lesser amounts of selenium, cobalt and manganese for use in decolourising the glass. After describing the different varieties of glass, the speaker outlined the processes whereby different colours and effects could be produced. Crystal, in spite of popular opinion, is one of the softest of glasses.

The automatic machinery used to-day has, over a period of a few years, increased the output per operative from about 36 dozen a day to about 500 dozen. Owing to this resultant cheapening of process the glass manufacturer has, to a considerable extent, invaded the territory of the cannister maker, and in this connection the speaker was not very optimistic regarding the future of canned beer. Two possible future developments of the glass industry were mentioned; glass bricks, which are finding their way into architectural design both for factories and residences, and glass fabric which is being manufactured to a limited extent to-day.

WELLINGTON.

OFFICERS, 1938: *Chairman*: W. A. Joiner; *Secretary*: J. A. D. Nash, c/o Dominion Laboratory, Sydney Street, Wellington, N.1.

Committee: W. G. Hughson, K. J. McNaught, O. H. Keys.

Branch Editor: F. G. Caughley.

Papers read, 1937—

"The Drying Oils used in Paints" (Chairman's Address).—*L. R. L. Dunn.*

"Synthetic Resins in Paints, Varnishes and Lacquers."—*Dr. Wm. Krumbhaar.*

"The Advance of Petroleum."—*M. L. H. Stewart.*

Odds and Ends Evening.

"Soils and Fertiliser Problems of the Nelson District."—*Sir Theodore Rigg.*

"Biochemical Changes in Butter."—*G. M. Moir.*
"Standardisation."—*A. S. Prime.*

THE DRYING OILS USED IN PAINTS—*L. R. L. Dunn.* Drying oils function as the "binder" or film-forming ingredient of paints. The formation of this film during drying and its subsequent disintegration have been studied with a view to perfecting the production of hard, solid, but elastic films. Vegetable oils are commercially the most important of this class and consist of mixed triglycerides of various derivatives of stearic acid containing up to three ethenoid linkage. Industrially pre-eminent is linseed oil from the seed of *Linum usitatissimum* by one of the following processes: (1) Cold Pressing; (2) Hot Pressing; (3) Solvent Extraction. Hot pressing is the most popular method and is followed by purification of the product from water and "foots." The latter are removed by passing the chilled oil through filter-presses, the product being much used in paints.

This "raw" oil may be purified of remaining organic impurities by sulphuric acid treatment and sufficient free fatty acid is produced to lower the surface tension and make the oil a suitable medium for grinding pigments. To convert the raw oil to a state fit for varnish-making it is treated with caustic soda to remove colouring matter and phospholipoid substances which cause voluminous precipitates at the high temperatures necessary for the conversion of raw oil to "stand oil." Stand oils, which are a product of polymerisation in the absence of significant oxidation, are used for the best varnishes and enamels. The large size of the molecules enables these oils to dry to a solid film with a minimum of oxygen absorption, thus giving durability and gloss. The high viscosity and slow-drying properties have been overcome in the industry by various expedients. "Boiled" oil is produced by heating raw oil with soluble driers in the presence of oxygen until oxidation produces the required viscosity. It is much used in paints, giving high gloss and rapid drying.

The more important substitutes for linseed oil, are perilla, soya bean and fish oils. Perilla oil from the seed of a Japanese plant can be used, except for minor limitations, as an equivalent for linseed. Soya bean oil, however, is only a semi-drying oil, and is used as an additive to, rather than a substitute for, the chief drying oils. Fish oils contain some highly unsaturated components, but these are offset by large proportions of saturated and mono-ethylenic compounds which reduce the drying properties, so that they can rarely be used alone. The non-drying element, however, serves as a plasticiser in paints for roofs and structural steel.

Tung oil is much used in paints, although when used alone its extremely rapid drying leads to surface defects. It confers added waterproofness when used with linseed, but its chief use is for quick-drying varnishes in conjunction with ester gum or synthetic resins. Its almost specific ease of combination with maleic anhydride provides a test for purity. Oiticica oil from Brazil is in many ways identical with tung oil, but less waterproof. A catalytic dehydration at the hydroxy group of castor oil has been developed in Germany to give a substitute for tung oil.

Tung oil, consisting as it does largely of the simple triglyceride of elaeostearic acid is the most suitable subject for studying the mechanism of film formation by drying oils. Morrell and Davis have examined the reaction between maleic anhydride and elaeostearic acid, and by analogy explain the polymerisation of simple oil molecules. Hilditch and Scheiber, assuming a re-arrangement of double bonds to form conjugated systems, extended the explanation to linseed oil. However, the rise in acid value during the stand oil process indicates that condensation also occurs. It is this latter type of reaction combined with oxidation which gives rise to decomposition products which lower the resistance of the film to water and alkalies.

Controversy surrounds what is known of the function of oxygen in producing the solid " linoxyn " molecule. It is generally agreed, however, that peroxides are first formed at the ethylenic linkages, and that they become modified to give a structure still capable of polymerisation and condensation changes. The oxidised molecules act as catalysts and stimulate the complete conversion of the oil to a solid film.

THE ADVANCE OF PETROLEUM—*M. L. H. Stewart.* The modern car and more especially, the modern aeroplane engine is dependent on petroleum. Aeroplanes capable of 300 miles per hour are now in production. The increasing efficiency of these engines with concurrent increase in bearing pressures, speeds, and temperatures, calls for an oil with (1) high resistance to sludging, (2) low viscosity change with temperature, (3) minimum carbon deposition, (4) low pour points. Oils produced from conventionally refined crudes are not entirely satisfactory in such properties and whilst blending produces an improvement, it can only be considered as a compromise. By solvent refining it is possible to produce from widely different lubricating oil stock oils having viscosity indices and oxidation stability equivalent to or exceeding those of Pennsylvanian origin, whilst retaining the low carbon forming characteristics of naphthenic base distillates.

The hydrocarbons present in lubricating oil stocks may, for practical purposes, be divided into two classes: (1) Paraffinic—constituents of predominantly open chain structure, and (2) Naphthenic—components which appear to be essentially cyclic compounds of high carbon hydrogen ratio. These terms, although not precise, serve to distinguish between those constituents of lubricating oil having satisfactory physical and chemical properties such as high viscosity index, high oxidation stability, low viscosity gravity constant and those constituents which are inferior in these respects.

Distillation effects separation of the hydrocarbons on the basis of boiling point or molecular weight but does not otherwise differentiate between chemical classes. Such separation may be effected by solvent extraction. Selective solvents used in extraction processes are compounds which, when mixed with the lubricating stock at a suitable temperature, form two liquid phases. The naphthenic constituents are invariably more soluble, and hence are concentrated in the solvent phase. In selective extraction the solvent and lubricating stock are mixed under conditions ensuring efficient solvent oil contact. The two phases are allowed to separate, are withdrawn, and the solvent is removed by distillation or other means. The oil obtained from the solvent phase is termed *the extract* and that from the hydrocarbon phase is known as *the raffinate*.

The chief properties necessary for a commercial selective solvent are:—

(1) *Chemical Stability.*—The solvent must be stable in storage and under operating conditions, and must not react chemically with the oil processed. (2) *Good Selectivity.*—The solvent must be capable of effecting a sharp separation between paraffinic and naphthenic constituents. (3) *Adequate Solvent Power.*—The solvent should be capable of dissolving a reasonable amount of naphthenic oil. The solvent power may be increased by raising the extraction temperature, but this is only effected at the expense of selectivity. (4) The two phases formed must be capable of sharp separation, this being facilitated by a reasonable gravity differential between the solvent and the stock treated. (5) The solvent should be easily and completely recoverable from the raffinate and extract phases, this being effected, in practice, by distillation. Lesser requirements (affecting plant design) are: Low specific and latent heat (i.e., less heat), low vapour pressure (lower losses), and low toxicity and corrosion power. The main solvents in use are sulphur dioxide, sulphur dioxide-benzole, nitrobenzene, phenol, cresylic acids, chlorex (dichloro-ethyl ether),

furfural, crotonaldehyde, acrolein, and propane. The solvent/oil ratio, used in extraction processes, is largely dependent on the selectivity and solvent power of the solvent. The solvent power increases with increase in temperature whilst the selectivity diminishes. For any given solvent and extraction the solvent/oil ratio will vary according to the type of oil processed and the yield and characteristics of the raffinate required.

The maximum temperature which can be employed in extraction is limited by the fact that complete miscibility of solvent and oil is possible in the majority of cases at sufficiently high temperatures. For efficient extraction, the temperature employed must be such as to secure a satisfactory balance between selectivity and solvent power. It is dependent on both the solvent used and the stock treated; paraffin base residuals requiring a higher temperature than naphthenic distillate stocks. Whereas moderate temperatures reduce heat requirements, higher temperatures enable viscous stocks to be handled with ease. Distillate stocks are more readily treated by solvent extraction, residual oils, particularly those of asphaltic character, offering greater difficulties. Residual stocks are more efficiently dealt with by selective solvents of high solvent power. The raffinate obtained from a given stock, in general, exhibits lower specific gravity, reduced carbon residue, improved oxidation resistance and increased V.I. compared to the original stock. The colour is improved with resultant reduction in the finishing treatment to produce marketable products, while in the case of sulphur containing stocks, the sulphur content is considerably reduced.

The characteristics of the raffinate obtained will be determined by the efficiency of extraction, but more particularly by the type of stock treated and the raffinate yield. The quality of the raffinate is improved in inverse proportions to the yield obtained. The use of wax-bearing stocks does not affect solvent extraction, but since the wax (of extreme paraffinic nature) is concentrated in the raffinate, and asphaltic constituents are removed in the extract, the pour point of the raffinate is higher than that of the original oil. Although the raffinates so obtained are, in general, more readily dewaxed than the original stocks, against this must be set the factor that dewaxing losses on the raffinate are of far greater economic importance than in the case of the untreated oil. Many solvents have been investigated for the selective extraction of lubricating oil stocks, but only a limited number have been utilised in commercial processes.

The various solvent processes were described in detail, lantern slides being used to explain the various processes and to show the improvement in the quality of oils obtained. The lecture concluded with a short account of the increasing chemical bias of the petroleum industry, such chemicals as the ketones, alcohols and corresponding esters being among the more important of the chemicals now produced commercially. Reference was also made to the production of ammonia using petroleum gas as a source of hydrogen.

ODDS AND ENDS EVENING—R. L. Andrew read two papers, one on Iodised Salt and the other on Aspirin. All those tablets of aspirin available to the public in New Zealand which were tested were found to conform to the requirements of the British Pharmacopoeia and appeared to differ solely in respect of time taken to disintegrate in water. J. A. D. Nash briefly described experiments made to determine the efficiency of a device sold as " Scalebuoys " for the softening of water. An interesting instance of corrosion of a deep-sea cable was outlined by L. R. L. Dunn, who stated that the causative agent was found to be the phenolic substances present in the impregnated jute wrapping. The evening concluded with the screening of a film entitled " Enough to Eat." The film, with Professor Julian Huxley as the commentator, dealt with nutritional problems at present attracting attention in Great Britain.

BIOCHEMICAL CHANGES IN BUTTER—*G. M. Moir.* As a background to his subject the lecturer outlined the development of present-day methods of butter manufacture in New Zealand, which are based on the pioneering work of the Danes. Biochemical changes are manifested in rancidity, and flavours known as " fishiness " and " tallowiness." Rancidity is due to the hydrolysis of glycerides by excessive acidity, and is a rare fault in New Zealand butter. Fishiness may arise from conditions favouring oxidation or hydrolysis such as excessive acid or salt, catalytic metallic contamination, and auto-oxidants of bad types of bacteria. The effects of bacteria were the first to be recognised, but when pasteurisation was introduced and starters omitted, fishiness was still existent and led to the revelation of chemical oxidation.

The chemical origin of fishiness has been traced to the lecithin in butter. When the choline radical is hydrolysed it splits off trimethylamine which is the seat of the fishy flavour. The hydrolysis is not readily provoked but its production is easily obtained from choline in the presence of peroxides and a ferrous salt. This fishiness can be attributed partly to hydrolysis and partly to oxidation, a conclusion which is supported by supplementary evidence. The defect is successfully avoided by neutralisation of excess acid, pasteurisation, omission of starters, and elimination of contamination by iron or copper. Talloweiness is traced to the peroxidation of double bonds, mainly in olein, leading to the production of aldehydes and ketones. These reactions pass through a period of induction to a markedly self-catalysing stage with a rapidly accelerating production of undesirable compounds. Butter must be kept in the state covered by the period of induction.

The rigorous application of precautions against oxidation, especially by neutralisation of cream with sodium bicarbonate, leads, however, to a flat flavour. This disadvantage has been overcome by a return to the controlled use of bacteria in starters. Harmful organisms have not a favourable medium for growth in butter and can be avoided by salting and general cleanliness. The worst type are those having a lipolytic action.

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ANNUAL DINNER.—The Wellington Branch inaugurated a new function which it is intended should become an annual event. This dinner was held at the Empire Hotel on October 12th, 1937. The chief guests were the Hon. D. G. Sullivan, Minister of Scientific and Industrial Research; Dr. E. Marsden, Secretary to that Department, and Mrs. Marsden. The Chairman of the Branch, Mr. L. R. L. Dunn, presided, and Miss E. M. Wall acted as hostess.

The following toasts were honoured: *The King* (The Chairman); *The N.Z. Institute of Chemistry* (The Hon. D. G. Sullivan; Emeritus-Professor W. P. Evans); *Kindred Societies* (R. E. R. Grimmett; Dr. E. Marsden); *The Ladies* (M. L. Stewart; O. H. Keys).

With an attendance of thirty-five members with their wives and friends, the dinner was a thoroughly enjoyable and successful function.

CANTERBURY.

OFFICERS, 1938: *Chairman*: H. N. Parton; *Secretary*: J. Melville, Wheat Research Institute, Christchurch.

Committee: M. C. Franklin, M. M. Burns, C. G. W. Mason.

Branch Editor: H. N. Parton. *Hon. Auditor*: G. D. Law.

During the 1937 session this Branch was particularly fortunate in securing as lecturers either chemists from outside Christchurch, or local speakers with recent overseas experience. We take this opportunity of expressing our appreciation to Messrs. R. L. Andrew and M. L. Stewart, both of Wellington, and Mr. S. Abdon of Sweden, who brought to us their experiences gained outside the confines of our own usual orbits. We hope in the future to be similarly favoured by more members of the other branches.

Dr. M. C. Franklin took for his Chairman's address the subject "Agriculture's Debt to Chemistry," tracing the methods by which the effect, cause, and cure of a number of deficiency diseases had been worked out by the chemist. The means by which the study of nutrition of farm animals is leading to better utilisation of foods were discussed. Dr. Franklin also detailed recent developments in the types of plant and chemical factors involved in the drying of herbage which are likely to lead to more efficient pasture utilisation.

Mr. R. L. Andrew, Acting Dominion Analyst, dealt with the "Sale of Foods and Drugs Act" in New Zealand. He gave a short historical introduction surveying the development of the Acts dealing with the sale of food and drugs, showing that regulations were first introduced to stop the gross adulteration of nearly all foodstuffs. A number of instances of adulteration and fraudulent practices with regard to labelling were given. Figures were given proving that strict supervision and heavy penalties had resulted in raising the standard of milk sold in New Zealand.

Mr. S. Abdon, a visiting cereal expert from Sweden, lectured on recent advances in cereal chemistry to an audience which included representatives of milling and baking interests. He showed how the desire of the various wheat producing countries to achieve economic independence had led to intensive research directed towards producing good flour from the local cereal without imports of foreign grain.

Mr. M. L. Stewart, Chief Chemist to the Shell Oil Company, discussed modern petroleum refining, detailing the plant design developed for handling the four main types of crude oil, and describing the methods of sulphur elimination and removal of unstable hydrocarbons. The address was illustrated by charts and slides.

Dr. H. G. Denham reviewed the work of a number of overseas research stations which he had recently visited, particularly the Greenwich Fuel Research Station, the Building Research Station at Watford, and the Hydrogenation Plant at Billingham. Recent advances in the synthethic resin, rubber, and plastic industries were also described.

Mr. T. H. McCombs, M.P., spoke on recent work of the Department of Scientific and Industrial Research, illustrating by a diagram how the work of the twelve main committees was interconnected and subdivided to achieve the maximum amount of co-operation. The more important lines of work were detailed, and some of the outstanding achievements enumerated.

Dr. M. M. Burns described the tung oil industry, the sources and uses of this increasingly important product being dealt with. Aleurites Fordii, the source of ninety per cent. of the oil produced, can only be grown with complete commercial success in China. Chemical and physical properties were given showing why the oil was particularly suitable for blending with other vegetable oils for varnishes.

At the last General Meeting of the year Mr. J. A. Wicks, a member of the legal profession, criticised the proposed Registration Act, and a valuable discussion gave members an opportunity of understanding the meaning and importance of the various clauses.

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PERSONAL NOTES.—The Canterbury Branch has been strengthened during 1936 and 1937 by the addition of several men with overseas training.

Dr. J. Melville joined the staff of the Wheat Research Institute in 1936. Graduating from Otago University, he held a Post Graduate Scholarship at Imperial College, University of London, studying biochemistry under Professor Chibnall. In 1934 he was awarded a Commonwealth Fellowship and carried out biochemical research under Dr. H. B. Vickery at the Connecticut Agricultural Station, and at Yale University. He is now Secretary of this Branch.

Dr. M. M. Burns, graduating in Botany from Canterbury College, also held a Post Graduate Scholarship, and studied soil chemistry at the Macaulay Institute at Aberdeen. He obtained a Commonwealth Fellowship in 1934, and continued research at Cornell University. He is now attached to Lincoln College and is acting on the local committee of the Institute.

Mr. G. O. Morrison graduated from Canterbury College in 1930, and for six years gained experience in the printing ink industry in Toronto, Canada. He was a member of the Canadian Institute of Chemistry.

The Branch has also sustained a loss, in the person of Miss Joan Bull. For seven years Miss Bull was responsible for the supper without which our meeting would be incomplete. She was elected to the associateship of the Institute in 1935, and from 1935 to 1937 was demonstrator in the Chemistry Department at Canterbury College. Last August she left us to become Mrs. J. S. Fitzgerald. Dr. J. S. Fitzgerald, now with the Department of Scientific and Industrial Research in Australia, is an ex-Secretary of this Branch.

During the year Mr. W. O. R. Gilling, of the Christchurch Gas Company was elected a Fellow of the Institute.

Dr. R. O. Page, an ex-Chairman of the Branch, was appointed to the Council of Scientific and Industrial Research. Canterbury chemists, who know Dr. Page well, are sure of the wisdom of the appointment.

Dr. H. G. Denham spent 1936 in a very busy and valuable tour of Great Britain and America. His place in scientific reesarch in New Zealand is too well known for elaboration here to be necessary.

Mr. E. W. Hullett, of the Wheat Research Institute, has just returned from a strenuous tour of America, Britain, and Europe. We hope to hear more about it in the 1938 session.

Mr. R. V. Peryman, a local member, has been appointed to work under Professor Soper at the Wool Research Association in Dunedin. His position at the Wheat Research Institute has been taken by Mr. L. H. Bird.

OTAGO.

OFFICERS, 1938: *Chairman*: G. Bagley; *Secretary*: C. L. Carter, University of Otago, Dunedin.
Committee: Prof. F. G. Soper, L. H. James, R. M. Bruce.
Branch Editor: C. L. Carter.

Papers read, 1937—

"Oxidation-Reduction Indicators" (Chairman's Address).—*F. G. Soper.*
"Chemical Impressions from Abroad."—*H. G. Denham.*
"The Teaching of Chemistry."—*K. W. R. Glasgow and G. B. Beath.*
"Recent Developments in Biochemistry."—*N. L. Edson.*
Current Researches at Otago University: "Synthesis and Constitution of Azulene" (*S. N. Slater*); "Molecular Configurations of Dibasic Acids" (*R. W. Munro*); "Transformation of Aromatic N-halogen Amines" (*G. C. Israel*); "Essential Oil of Matai" (*J. T. Holloway*); "An Attempted Synthesis of 1-methyl-6-isopropyl Phenanthrene" (*T. H. Kennedy*).

OXIDATION-REDUCTION INDICATORS—*F. G. Soper.* This subject is one of growing interest dating originally from Ehrlich's biochemical work on the reduction of various dyes by tissues and on the analytical side from Knopp's use of diphenylamine as an internal indicator in the ferrous sulphate-potassium dichromate reaction. Such indicators are now extensively used in chemistry, especially in the biochemical and analytical fields as well as in agriculture and brewing. These indicators, e.g., indophenol and methylene blue are coloured substances of quinonoid structure which can be reduced to colourless leuco compounds capable of re-oxidation. The oxidation-reduction process must be reversible so that the amount of coloured substance present indicates the oxidising-reducing properties of the solution under examination. Much of the work on these substances has been done by J. Mansfield Clark, who has shown that oxidation-reduction indicators not only show the end-point in titration but also the intensity of the oxidising-reducing properties of a solution.

Since oxidising substances have an affinity for electrons, the tendency of an ion to become oxidised or reduced can therefore be determined by the electrode potential of platinum or any other noble metal immersed in the solution.

This electrode potential may be measured by the potentiometer. As would be expected, the potential of the platinum varies with the ratio of ferric to ferrous ions in the solution; thus $E = E_0 + 0.058 \log \frac{[Fe^{\cdot\cdot\cdot}]}{[Fe^{\cdot\cdot}]}$, where E_0 is the standard oxidation-reduction potential of the particular ion pair. A knowledge of the different electrode potentials enables one to ascertain when one system will oxidise another. By reference to the oxidation with potassium permanganate it is shown that the hydrogen ion concentration affects the potential, so that an oxidation in acid solution may be reversed in alkaline solution.

Other similar indicators include quinone, in which the system may be represented:—

$$\text{quinone} + 2H^{\cdot} + 2e = \text{hydroquinone}.$$

Such indicators will themselves form oxidation-reduction systems with definite electrode potentials. Sometimes the indicator is used as the titrating solution as oxidising or reducing agent, e.g., methylene blue.

Towards the end of a titration, the potential of the system changes rapidly and this causes a corresponding sharp change in the colour of the indicator. This effect was clearly illustrated by an electrometric titration of ferrous solution by potassium dichromate using diphenylamine as indicator. One drop near the end-point increased the potential .3 volt and changed the colour of the indicator.

The lecture was illustrated by slides showing various oxidising-reducing systems, and typical indicator curves. The use of the indophenols were of increasing value in biological work. Of especial interest was the demonstration of the titration of ascorbic acid present in lemon juice using 2 : 6-dichlorophenol-indophenol as indicator and a buffer of sodium phosphate.

CHEMICAL IMPRESSIONS FROM ABROAD—*H. G. Denham.* As examples of research laboratories maintained by industrial firms Professor Denham referred to those of the L.M.S. Railways, and "Lyons." Among the problems recently investigated at the former was the cause of steel abrasion between the rail and the locomotive wheel. It was shown that abrasion could be diminished by using different steels in the rails and in the wheels. At "Lyons," progress had been made in investigations into the spreadability of butter and also the testing of coffee. The speaker then outlined the production of petrol from coal and low temperature tar by I.C.I. at Billingham and compared the process with the "Fischer" method as used in Germany for the conversion of water gas into petrol.

The fruit research station at East Morley was actively engaged in plant disease prevention and in the study of the effect of various fertilisers on plant growth. Following on the discovery by a Russian scientific expedition of many new varieties of potatoes in South America, varying not only in carbohydrate and protein content, but also in frost resistance, it had recently been decided to send a British expedition to South America for the same purpose. At the Cambridge low-temperature research station discoveries of importance had been made in connection with the cold storage of eggs, mutton and beef. The study of antioxidants for preventing the decomposition of fats and of the effect of traces of copper were giving valuable results. It had also been ascertained that pigs fed on fish-meal deposited as depot-fat, the higher unsaturated fatty-acids of fish fats; this knowledge should cause the elimination of fish-meal as a diet for pigs, if due consideration were given to the flavour of pork and bacon.

What had impressed him most, however, was the development taking place abroad in the production of plastics particularly at the Mellon Institute in U.S.A., and at Teddington in England. Achievements mentioned were unbreakable optical glass; a plastic with the resiliency of rubber, made from methyl ethyl ketone and formaldehyde; resins of the glyptal type; and resins for use in furniture and for the manufacture of divers articles, such as dentures for artificial teeth, water softeners, varnishes, gramophone records and chemical plant.

THE TEACHING OF CHEMISTRY—The first speaker, *K. W. R. Glasgow,* opened the discussion with an appeal that all specialists should take stock of their own particular subjects, particularly at this time when the whole educational system of the country is under review. He deprecated an attitude of blind partisanship and self-interest and stressed the point that a psychological understanding of the pupils concerned is essential before a system of education in science or any other type of subject is introduced. In support of his views he quoted examples of statements by English chemists which indicated that however advanced they might be in the study of chemistry, they still adhered to what are now entirely discredited psychological views. In discussing the attitude of pupils towards secondary school subjects he quoted examples to show how the average child tended to treat each subject as a water-tight compartment and indicated ways in which the various items in the curriculum could be co-ordinated and welded into a more unified whole.

The next aspects of the problem dealt with were those of the justification that exists for the teaching of chemistry as a school subject, and the criteria by which it is possible to judge of the success of such teaching. Our social, economic and military safety and progress were shown to be very largely dependent upon the training of an efficient body of industrial and research chemists, and yet at the same time it had to be realised that less than one per cent. of the entrants to our post-primary schools ever proceeded to take a degree in which chemistry was an advanced subject. Evidence from a variety of sources was adduced to throw light on the problems that presented themselves. Statistics were quoted to show that the mental ages of pupils entering post-primary schools might differ by as much as six years, and that where society as a whole demanded an unsuitable examination qualification the weaker pupils ran a risk of being driven to a hatred of a subject by endless repetitions. Schools that were not unduly circumscribed as to curricula by the demands of an examination syllabus could and did educate their pupils in a more truly liberal fashion. It was very doubtful whether the young adolescent was mentally equipped to deal with unduly abstract problems, and that led to too much emphasis being laid on the importance of isolated factual material, and too little on the necessity for inculcating sound habits of observation and the recording of observations, to say nothing of habits of scientific truthfulness and the ability to see problems when they existed.

In conclusion, the speaker dealt with a number of proposals relevant to the subject under discussion, including such topics as the teaching of a more general approach to science in the first year of post-primary work and in the lower second and third year classes, the ideal method of recording laboratory observations, the question of accrediting in chemistry for external examinations, the training of chemistry teachers and their essential qualifications, and finally the possibility for co-operation between research laboratories and industrial firms on the one hand and the University on the other hand with regard to more complete training of the undergraduate in chemistry.

G. B. Beath.—One of the most important aims in the teaching of chemistry is the inculcation of the scientific spirit in the younger pupils. A knowledge of chemistry and other natural phenomena was necessary in order to appreciate and understand one's environment.

It is evident that the child was often considered too much as a little adult seen through the teacher's own eyes, and as an image of the instructor. More attention should be paid to the vision of the pupil in his own image. A training in chemistry for children was valuable as a branch of mental education that would assist in eradicating many cramping and soul destroying superstitions regarding natural phenomena.

Science teachers should have facilities for conferring at frequent intervals and discussing problems of class-room technique and method of presentation. One of the greatest difficulties encountered by a teacher of chemistry was his isolation and inability to keep in touch with modern research and recent developments in the subject. The publication of an annual journal containing articles by science masters and authorities on particular branches of science would be of great assistance in this direction.

As only a small minority of secondary school pupils continued the study of chemistry at the University, the secondary school chemistry should be made suitable for the majority who would never enter the University. In spite of the stress of public examinations, science masters would do well to provide more interesting chemistry lessons and create in the pupils a desire to continue study in this important subject.

Dr. R. Gardner, in complimenting the opening speakers, drew attention to the meaning of the term " general science " which he considered should be reserved for those provinces belonging equally to all the sciences. He contended that a short series of lectures on the logic of scientific method could be usefully taken by all science undergraduates. Such a course would, of course, be unsuitable for young pupils. The present tendency seemed to be to apply the term "general science" to a mixture of odd bits of a number of sciences. He thought it better from a teaching point of view to begin with one branch of science (he thought chemistry the most suitable by reason of its having both qualitative and quantitive aspects) and to treat it broadly. When carbon dioxide is being dealt with, for instance, its importance in both animal and vegetable physiology should be dealt with clearly and in some detail. This might be difficult to do when time was short and preparation for examination was made the primary aim of teaching. The speaker had recently been interested in trying to trace out the effects of science teaching on people engaged in industry and two things had struck him particularly forcibly. One was the necessity for some scientific knowledge on the part of most people engaged in industry. In New Zealand at present we had plenty of highly trained chemistry specialists, but a lack of people to make the link between the specialists and the industries—people engaged in industry who recognised a chemical problem when they met it, who could call in the specialist where he was needed and make intelligent use of his report when they got it. The other thing that had struck him was how few people in industry had a sound idea of making an experiment. Any well-planned science course should inculcate the idea of the control experiment and the notion of varying one condition at a time and noting the effect. He had more than once been called in to solve a process difficulty when the solution really called for no technical knowledge beyond the method of setting an experiment or of making a deduction from data already available. This seemed a reflection on the science teaching of the past.

RECENT DEVELOPMENTS IN BIOCHEMISTRY—*N. L. Edson.* For many years physiologists have studied the chemical functions of living tissues by removing from the animal body organs such as the heart, the liver or the kidney, which can be kept alive if the blood-vessels are "perfused" with an artificial nutrient fluid the composition of which resembles that of blood. This method of investigation was cumbersome. In 1924 Professor Otto Warburg, of Berlin, introduced the "tissue slice technique" for the purpose of studying the respiration of cancerous tissues. Warburg found that the soft tissues of a recently killed animal can be kept alive for several hours if they are cut into thin slices, about 0.3 millimetre thickness, and

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