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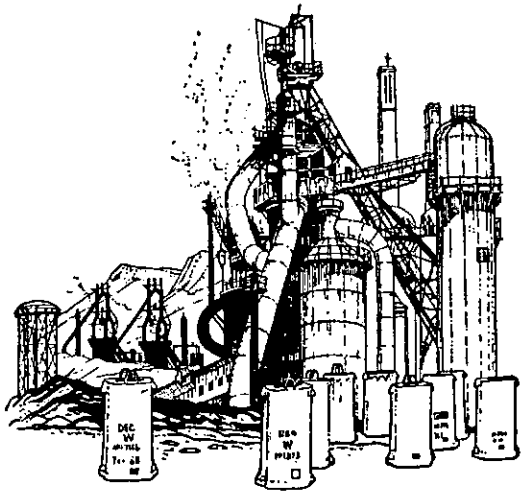

THE element iron is the most important of all metals and, next to aluminium, the most widely distributed. It has been estimated that there is an average of one cwt. of iron for every ton of the earth's crust. There are many different forms of iron ore, but only four—haematite, magnetite, limonite and siderite—are of industrial value. Most of the iron ore mined in England comes from the siderite deposits at Corby in Northamptonshire and the Scunthorpe district of Lincolnshire. Iron ore smelted in a blast furnace with coke and limestone becomes pig iron, the raw material from which cast iron, wrought iron and steel are made. Steel, the strongest metal in common use, is iron containing about 1% of carbon. Though iron is a newcomer compared with copper and bronze, more than 3,000 years ago it was used to make implements and weapons. Today it is an essential in the structure of civilization. Without it, there would be no railways, steamships, skyscrapers or machinery. Apart from its use in the construction of chemical plant, iron and some of its compounds are vital in certain chemical processes. I.C.I. uses iron as a catalyst in the production of synthetic ammonia, and iron pyrites—a sulphide of iron—in sulphuric acid manufacture. It also uses some of the oxides of iron to make pigments for the paint and rubber industries.

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EIGHTH NEW ZEALAND SCIENCE CONGRESS

The eighth triennial Congress of the Royal Society of New Zealand will be held in Auckland from May 17th to 22nd, 1954. Plans are well under way and, although as recorded elsewhere in this issue, Council of the N.Z.I.C. has decided to proceed with the usual Annual Conference at Nelson next August, there will be a strong chemical section at the Congress under the Chairmanship of our President-to-be, Dr. H. O. Askew. A committee representative both of the R.I.C. and the N.Z.I.C. is working on the programme under the chairmanship of Mr. Geo. Lambert, and with Dr. H. Bloom, of A.U.C. as Secretary. Chemists are also assisting in other ways. Professor L. H. Briggs, in his capacity as President of the Auckland Institute and Museum, is Chairman of the Organizing Committee, and Mr. R. E. R. Grimmett and Dr. R. H. Jackman, both of Rukuhia Soil Research Station, are Convener and Secretary respectively of the Committee for Section K, Soil Science.

Suggested symposia in which the Chemistry Section will be taking part are on the following topics:—Trace Elements; Insecticides; Radio-Carbon Dating and Related Topics; Geothermal Development; Substitute Fibres and Foods and their Effect on New Zealand's Economy; Wood Products (excluding Timber); Organization of Scientists in New Zealand; Aims and Values of Soil Analysis.

The exchange of views on these subjects with scientists from other sections should be most stimulating to all chemists who can attend. However, as Dr. Annett said at Dunedin, chemists can go to the *Conference* to hear papers on chemistry and to the *Congress* to hear non-chemical papers, and there is much of interest in the suggested programmes for the other sections to support this view. Members will shortly receive a detailed circular from the Congress Committee, and any information will be gladly supplied by the joint Hon. Secretaries, P.O. Box 9027, Auckland, S.E.1.

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WATER IN RELATION TO PASTURE PRODUCTION

By Dr. H. E. Annett, D.Sc., O.B.E.

Presidential Address to the Conference of the N.Z. Institute of Chemistry, August, 1953.

The general idea was that at this Conference special attention should be paid to the relation of Chemical Science to industry. It is probably expected that the President of a Scientific Society such as the N.Z. Institute of Chemistry should give a Presidential address which is serious and fundamental.

When you did me the great honour of asking me to become your President you took a grave risk. I am not by nature always serious and further I may be considered to be a chemist who has gone wrong, since I am farming. To those of you who are doing real scientific work at the Universities your job is to keep up to date with current scientific developments. I would suggest that it is easier for one doing that work to give the right type of Presidential address than for a hayseed like myself.

May I suggest that when some chemists turn their attention to practical problems they sometimes overlook the fact that the solution frequently entails common-sense more than deep scientific knowledge. I could instance several cases within my own experience. When during the first war supplies of medical opium could no longer be obtained from Turkey, it was essential that the reason for the low morphine content of Indian opium should be discovered so that, if possible, opium of higher morphine content could be obtained. For many years various chemists had been interested in this problem and at least one really good organic chemist gave it up in disgust. However, someone in England said it was in my line, and, in spite of protests, I had to take up the problem. The practical solution was simple, merely a matter of studying the method of lancing the poppy capsules and nothing to do with chemistry, though much subsequent work was done on the opium alkaloids. Within four months India was able to supply opium of high morphine content and the Indian Government made about £2 million pounds out of the work. On another occasion the problem of refining crude palm sugar required attention. About 500,000 tons of sugar are produced annually in India from palm juice. Most of it is consumed in the raw state. This raw sugar could not be refined by the usual methods in use for refining cane sugar to obtain a pure white product. The problem was solved by the use of litmus paper, which showed that palm juice is alkaline and not slightly acid as is the case with cane

sugar. The dark colour was produced by the action of the alkaline juice on the fructose present. In my earliest trial, in a Bengal village refinery, I persuaded the native sugar boiler to acidify the juice before boiling with the juice of the tamarind fruit, which grew in the village. Such a lovely product was produced that the natives thought I was using magic. Later we used weak sulphuric acid.

When considering the subject for my Presidential address someone suggested I should talk about something I had some knowledge of. There may have been more in this remark than at first appears. Anyway, it seemed sound advice. During the recent war I was called on to take up scientific work again and after my war work came to an end I was invited to help at the Soil Research Station then being established at Rukuhia. I agreed to do part-time work on the understanding that I took up a study of water in its relation to pasture growth. I have decided to take this subject for my address this evening. When one considers the enormous developments in Chemistry I felt it might appear out of place for me take such a simple subject as water for my address. But really, is it so simple after all? Only a few years ago anyone dealing with the subject of the relation of water to plant growth would not have considered it necessary to define what was meant by water. To-day the position is far different. In the early years of this century it was thought that water was a simple substance consisting of two atoms of hydrogen and one of oxygen. To-day we know that the composition of this medium is not so simple. It is probable that water from condensed steam and rain water does actually contain a large proportion of the H_2O as we used to know it. But it is known that water is one of the few substances whose liquid form is denser than the solid. In ice the molecules are combined in a way that involves a looser packing than in the liquid. As the temperature of the liquid approaches 0°C., there are doubtless formed an increasing proportion of these same molecules in the liquid. Much of the water we drink is a polymer of H_2O groups. It is recorded that experiments with plants watered with melted ice produced better growth than similar plants watered with water from condensed steam. In view, however, of the known effect of minute traces of various salts, it must be recognised that the observed difference may have been due to the presence of these in different proportions according to the previous history of the water containing them. Among practical gardeners there is a widespread belief that plant growth is greatly benefited by heavy falls of snow.

The complexity of water, however, extends much further than this. Various investigators have obtained evidence that the pro-

portion of D_2O affects plant growth. Normal water supplies contain only about one part of Deuterium oxide (D_2O) in 6,000 to 9,000. We also know now that the hydrogen isotope of mass 3, Tritium occurs in water in the proportion of about seven parts in ten thousand million. Some fruits, notably pineapples and tomatoes, yield fluid that contains a significantly higher proportion than usual of "heavy water." This points to selective capacity on the part of plants; the possibility that substances present in extreme dilution may be accumulated becomes of biological importance.

Experiments have been recorded in which growing plants have been supplied with "heavy water." They indicate a deleterious action when the water is present in relatively high concentrations but a stimulating effect when dilute. Many substances which are poisonous to plants, even in weak solutions, act as stimulants in very dilute solution. We know, too, of the astonishing effects of minute traces of vitamins on animal growth so that even the extremely low concentrations of heavy water present in normal supplies might be of great significance in the plant world.

Recent work on photo-synthesis has shown that water plays a part hitherto unsuspected. It used to be taught that solar energy was required to bring about a reduction of carbon dioxide to formaldehyde. This view received some support because of Emil Fischer's demonstration that formaldehyde can be polymerized, very inefficiently, to hexoses. It was unfortunate that the process of photo-synthesis could be represented so neatly since this masked the underlying ignorance of the processes involved. Recent work with isotopic carbon has now given a clearer idea of the mechanism of photo-synthesis. It seems fairly well established that the reaction which absorbs solar energy is not a fixation of carbon dioxide, but a splitting of water molecules. The hydrogen is stored up in the reduced form (XH_2) of an enzyme system, while the oxygen is liberated. The system XH_2 then takes part in the fixation of carbon dioxide.

Experiments with water and similarly with carbon dioxide each containing isotopic oxygen supplied to a photo-synthesizing plant showed that the oxygen evolved came from water and not from carbon dioxide.

So we see that water is not only a medium for carrying plant food from the soil to the plant, but is actually essential in the process of photo-synthesis.

I have said enough to indicate that the subject of water is not so simple as, at first sight, it appears.

The plant obtains its mineral food from the soil in the form of a water solution. The fact that trees over 300 feet high can draw water from the soil and transpire excess water through its leaves is a remarkable phenomenon, the mechanism of which is still not fully understood. For every pound increase in dry weight a plant must transpire through its leaves from 500lb to 1,000lb of water. We have found in our work at Rukuhia that under the most favourable conditions the daily production of dry matter per acre from pasture reached 100lb. This involves the transpiration through the leaves of probably 5,000 gallons of water per day per acre, or the equivalent of just over one-fifth of an inch of rainfall.

In New Zealand much investigational work has been carried out on the use of fertilisers and of better strains of pasture plants. Yet the study of moisture the limiting factor for pasture growth was largely neglected.

I had been attracted to this problem owing to the fact that during my first years of farming in New Zealand we suffered severely from summer droughts. In an article written in September, 1932, I suggested the use of spray irrigation to counteract this trouble. However, the general view was that with a rainfall of about 48in. there was no benefit to be expected from irrigation. When we started our soil moisture work at Rukuhia we initiated trials with spray irrigation, which have led to a fairly widespread adoption of the practice to-day.

Few people realise how much agricultural production in New Zealand is influenced by even short periods of drought in summer. The opinion seems to be widespread that Dairy production has been steadily increasing. Certainly up to about 1933 dairy production in New Zealand increased in spectacular fashion. In the ten years following 1923-24 butterfat production increased from 102,000 tons to 177,300 tons. Over the same period the numbers of cows in milk increased from 1,185,000 to 1,724,000. Over the next 18 years, however, ending in 1949-50 there was no such steady increase as can be seen by the accompanying table (1).

TABLE I.

Year	Tons butterfat manufactured	Cows in milk in 1,000's	Butterfat per cow lbs.	Do. (average of all cows tested Auck.	Prov.)
1932-3	177,300	1,724	230		
1933-4	190,500	1,816	235		
1934-5	183,000	1,828	224		
1935-6	192,300	1,823	240	259	
1936-7	203,500	1,805	254	265	
1937-8	195,100	1,764	247	259	
1938-9	178,700	1,724	229	226	
1939-40	192,300	1,719	247	263	
1940-41	208,200	1,759	262	277	
1941-2	195,300	1,757	246	249	
1942-3	181,700	1,715	234	244	
1943-4	172,900	1,648	232	250	
1944-5	192,800	1,679	254	280	
1945-6	166,300	1,662	221	217	
1946-7	182,300	1,658	243	260	
1947-8	186,500	1,714	241	259	
1948-9	204,200	1,747	259	279	
1949-50	210,500	1,846	253	271	
1950-51	222,000	1,898	260	281	
1951-2	225,760	1,907	263	286	

This table has been prepared from the figures given in the Annual Reports of the N.Z. Dairy Board. A study of the table brings out some interesting points. Away back in 1936-7, New Zealand produced 203,500 tons of butterfat and in 1940-41 208,200 tons, almost as much as the 210,500 tons produced in the 1949-50 season. It will be seen that there has been no significant increase in the number of cows milked or of their individual production over the 18 years ending 1949-50. However, it is important for the layman to realise that the production has been maintained in spite of the fact that some thousands of workers have left the land for easier and more highly paid jobs in the towns. The years 1950-51 and 1951-52 have shown an apparent increase in production, brought about by a small increase in the number of cows milked and by favourable seasons, and possibly by the use of penicillin in checking mastitis. The average production per cow, however, in these two seasons was equalled in the 1940-41 season.

Although there has been no increase in production over the 18 years referred to there have been large variations in production from year to year. Time allows reference to only one year, 1945-6, when production fell to 166,000 tons. That season had one of the driest summers on record and the drop of 26,500 tons (worth over £5 million) from the previous season was definitely due to drought conditions. My study of rainfall figures to which no detailed reference can be made here, shows that the large variations in production from year to year are definitely due to variation in summer rainfall. Over the 18 years my calculations show that shortages of summer rainfall have cost the dairy industry about £70 millions and the meat and wool industry has suffered probably no less severely.

Production figures from my own farm show that in a year of well distributed rainfall I obtain 42% of my production after Christmas, but in bad drought years only 28% of my total production is obtained after Christmas.

Our work at Rukuhia Soil Research Station has covered a fairly wide field. The meteorological section kept daily records of rainfall and of soil and air temperatures. An evaporimeter was constructed in order that daily records could be made of loss by evaporation from a free water surface. A drain guage of the Rothamsted type but on a smaller scale was constructed, and a second was built later. A column of undisturbed grassland was isolated from the surrounding soil and fitted three feet below the surface with a perforated steel plate with a funnel beneath. Drainage was collected below the funnel and measured daily. Regular analyses of the drainage water were made, but this aspect will not be dealt with here. In the high rainfall year 1948 with 55.36in. of rain, 43% was lost in drainage, but with lower rainfall in 1949 (40.1in.) and 1950 (39.2in.) drainage losses were 35% and 28% respectively. At the end of each year the total drainage was deducted from the rainfall. The difference gives the amount of water lost from the soil surface both by transpiration through the leaves and by evaporation from the soil surface. The latter loss is small from a good grass surface.

It is of interest that the loss of water from the pasture surface is fairly constant from year to year varying over our five years' records from about 26in. to 31in with a mean of 28.6in. Table (II.) summarises rainfall, evaporations from a free water surface, drainage and evaporation from the pasture surface over the five years.

TABLE II.

Year	Rainfall (inches)	Evaporation from water surface	Drainage	Loss from pasture surface
1948	55.36	36.50	24.04	31.32
1949	40.08	33.53	14.16	25.92
1950	39.09	43.17	11.21	27.88
1951	45.01	35.63	15.26	29.75
1952	50.90	34.02	22.88	28.02
			mean	28.58

The drain guages could not, however, provide information concerning daily losses of water from a pasture surface. Therefore, two special evapo-transpiration tanks were constructed each two feet deep. Each had 6in. gravel placed in the bottom and then filled with soil. Grass was grown on the surface of one and the other left bare. Water was fed to each through a pipe in the bottom, from a specially designed carburettor, by means of which the daily or even hourly loss from each tank surface could be measured. Mr. Noble was responsible for the design of the carburettor. In due course interesting results should be obtained from the evapo-transpirometers.

Loss by Evaporation from a Free Water Surface:

The loss by evaporation from a free water surface shows a much greater annual variation than that from a pasture surface. Over the five years, 1948-52, it varied from 30.88in. to 43.17in. In the winter months June, July and August the monthly evaporation varies from about 1in to 2in. During December, January and February it frequently rises above 5in. and in January, 1950, it reached 6.65in. Rothamsted results show that the potential loss of moisture from a pasture surface on soil at or near field capacity is approximately 0.8 of the loss from a free water surface. If the loss is not of that order then maximum growth is not being obtained. During our periods of summer drought when a free water surface is losing water at the rate of 4in. to 6in. per month, pasture growth at times ceases altogether and the loss of moisture from the soil surface is practically nil.

Effective Rainfall:

Prescott, Trumble and others in work at the Waite Institute, Adelaide, consider that rainfall is effective during any given

period of time if, on the average, it is greater than one-third of the evaporation from a free water surface. Using monthly data, they plotted on a map the distribution of stations according to the number of effective rainfall months, that is, those in which the rainfall was greater than one-third of the evaporation from a free water surface. They concluded that regions with 1-5 months of "effective rainfall" are quite good for grazing stock,, sheep or cattle, but are speculative for agriculture. Our Rukuhia records show that over the years 1948-1953 the rainfall was effective by Prescott's standards in every month from April to November. The rainfall was not effective over this period during only six monthly periods, viz.: December, 1950, January, 1950, February, 1951, and March, 1950, 1951 and 1952. Judged by Australian standards, New Zealand would appear to be a farming paradise. In order to judge the effectiveness of our rainfall it would appear we should have to adopt another standard. The soil moisture work at Rukuhia should help us to do this. In general, however, it appears that on most Waikato soils whether they be sandy, loam, clay loam or peat, the soil needs a full inch of rainfall every 10 days in order to maintain satisfactory pasture growth. I have already referred to the fact that an unirrigated pasture surface at Rukuhia loses on an average by evaporation and transpiration about 28in. of water annually. The inch of rainfall every ten days mentioned as the requirement for good pasture growth, would equal about 36in. per year. The rate of growth falls off rapidly in the dry summer months on unirrigated pasture. In the last six years the monthly rainfall has been less than 3in. on 28 occasions out of the 72 months. It was less than 2in. on 13 occasions. The majority, though not all, of these low rainfall months were in the summer period.

Where a pasture has been irrigated in the summer, spectacular increases have been obtained in dry years and on an irrigated pasture the loss by evapo-transpiration would certainly be higher than the 28in. we have recorded for unirrigated pasture.

Moisture content of unirrigated and irrigated soils during drought period:

Regular determinations of moisture content on our irrigated and unirrigated plots have been carried out throughout the year. Usually the determinations were made in every 4in. level down to three feet. Table (III.) gives the figures obtained during a period of drought.

TABLE III.

Moisture per cent. in soil during drought, March 6th, 1947.

Depth	Unirrigated plots		Irrigated plots			
			1in. waterings		½in. waterings	
	A	B	C	F	D	E
0in.- 4in.	16.3	18.9	50.2	47.3	43.2	43.8
4in.- 8in.	21.6	32.8	54.6	66.1	49.8	57.2
8in..12in.	22.6	38.7	57.2	61.8	50.7	49.3
12in.-16in.	28.8	38.7	50.9	56.9	45.4	46.4
16in.-20in.	29.5	39.4	51.0	52.3	42.2	49.3
20in.-24in.	30.2	39.6	49.2	46.4	39.0	49.3

Note.—On this soil, plants wilt when moisture falls below 20%. At 0in.-4in. the moisture content of the soil was below wilting point on the unirrigated plots and the pasture was burnt up, yet particularly on plot B there was ample water for growth at the 4in.-8in. level. It seems that on this soil type grass must have ample water in the top 4in.

These results show that even in a most intense drought only the top 4in. of soil on the Hamilton clay loam dries out to wilting point. At 4in.-8in. there is sufficient moisture for fair pasture growth and at 8in.-12in. on plot B the moisture level is sufficient for quite good growth, yet the pasture dried out.

Mr. Noble carried out much work on soil moisture estimation using resistance blocks, but although useful results have been obtained certain drawbacks exist in the use of the method. He has done preliminary work on soil moisture estimated by the use of (a) the Resistivity method, (b) Tensiometer and (c) Thermal conductivity methods.

Effect of Irrigation on Pasture Growth:

Our irrigation experimental area was sown down in Autumn, 1946, on an area which had been under vegetable cultivation in wartime. The area was divided into six plots each just under half an acre. At first two plots were treated as unirrigated controls. Two plots received applications by overhead sprays of ½in. per acre and the remaining two of 1in. per acre. Irrigations were made at about 10-day intervals. Irrigations commenced in December, 1946, and the summer was very dry. In the first autumn the unirrigated plots became very weedy containing up to 80-85% weeds, mainly pennyroyal. The plots receiving 1in applications were practically free from weeds. In the spring the

unirrigated plots still contained about 20% of weeds. After the first season it was apparent that although ½in. waterings were giving results, the rate was too low for satisfactory growth. Pennyroyal and flat weeds were taking control on the unirrigated plots. It was decided to eliminate the control plots, production from nearby experimental plots providing growth data for comparison.

Irrigation was applied at three different rates, viz., 1in., 1½in., and 2in. at each application, there being duplicate plots of each treatment. It was found that applications of 1½in. made at 10-day intervals and applied at a rate not exceeding 1in. in three hours gave good results. Two-inch applications under sheep management on Hamilton clay gave no apparent increase over 1½in. applications.

Table (IV.) gives figures relating to production for the four years 1948-1952 for the plots receiving 1½in. applications, except for the year 1950-51, the figures for which year are for the plots receiving 1in. applications.

TABLE IV.

Yearly dry matter produced by pasture with and without irrigation lbs. per acre:

Plots	1948-49	1949-50	1950-51	1951-52
Irrigated	14,900	14,215	11,560	11,830
Unirrigated	12,360	12,930	8,030	9,700
% increase with irrigation ...	20	10	45	22

The mean increase for these four years is 25%, which is roughly the figure we obtained in the two previous years, which were mainly exploratory. So that over six years spray irrigation has resulted in about 25% increase of dry matter. Sheep grazing hours recorded over the period showed increases slightly less than the above figures obtained by mower measurement. It must be remembered that irrigation was only applied during the summer period and the above increases are for the whole year. The percentage increase from irrigation over the summer period is of course far greater as shown in Table (V.).

TABLE V.

Effect of irrigation on production during the summer period. Lbs. per acre D.M.:

Irrigation period	1948-49 16/12/48-12/4/49	1949-50 27/12/49-18/4/50	1950-51 21/12/50-27/4/51	1951-52 31/12/51-24/4/52
Irrigated plots	7,000	4,600	5,200	3,990
Unirrigated plots	3,600	1,850	2,150	2,120
Increase %	95	140	140	85

The mean increase for the four years is 120%. This is not all the story, however, since good production was maintained throughout the dry weather on the irrigated plots and hence stock feeding on them would receive no check in feed. On the unirrigated plots production frequently fell to a point where stock would suffer and hence production would be affected.

Further over a period of three to four weeks in January and February, 1950, there was no growth at all on the unirrigated area, whereas the irrigated area was producing feed sufficient to feed fully four cows per acre. It is to be noted that under irrigation our maximum production is obtained in February, whereas under farm conditions peak production comes at the end of October. This is apparently due to the fact that temperatures are highest in February and in the presence of ample moisture higher dry matter production is possible at that time.

Effect of Pasture Growth on Soil Moisture

Evidence has been obtained that a really good pasture sward can stand up to drought conditions far better than a poor one. This may be partly due to the fact that on a poor sward more soil is exposed from which water is lost by direct evaporation. A more important explanation is offered later.

In the season 1948, no irrigations were applied after the 26th February, because changes were being made in the equipment. From that date up to the 10th April practically no measurable growth occurred on the unirrigated plots. Yet throughout that period the pastures irrigated up to 26th February continued to give good growth at round about 30lb to 40lb of dry matter per acre per day. Soil moisture determinations were carried out at the end of March on these plots, and it was found that the top four inches contained 30-35% moisture. After such a dry spell one would have expected the soil to be very dry. Russian workers at Odessa found that the temperature of the soil beneath a good pasture was much lower than that under a poor one. Because of this lower temperature, they claimed that soil moisture

had been increased by what they called internal dew. They calculated that from this source a good pasture drew from the atmosphere as much as 50% of the rainfall. However, it is probable that some of this increase in soil moisture is due to condensation of moisture vapour moving up from below.

Mr. Sears has kindly supplied me with information concerning soil temperatures recorded at the Grassland Division, Palmerston North. He compared soil temperatures at four inches depth under bare ground, under a closely grazed sward and under a leniently grazed sward. During the summer months temperatures are at times almost seven degrees F. lower under grass than under bare ground and in January, 1949, the temperature under a leniently grazed sward was almost four degrees F. lower than under a closedly grazed sward. Elsewhere differences as great as 13 degrees have been observed between soil temperatures beneath a good and poor sward. Such a drop in temperature under grass might easily result in heavy deposit of internal dew as the Russians call it, or in condensation of moisture vapour rising from below.

During the summer of 1950 a strawberry grower near Hamilton lost most of his crop through drought. He had strawed the crop, but some of the straw had not been properly threshed and a good crop of wheat grew. Under this wheat he obtained quite a fair crop of strawberries. The wheat was covered with heavy dew on many mornings, so in this case we also seem to be experiencing a temperature effect.

Spray Irrigation for Frost Prevention:

This method has been used successfully in Australia for prevention of damage to valuable crops from frost. At the East Malling Research Station in England, research with water sprinklers as a means of protecting fruit tree blossoms from frost damage has been going on since 1933. By means of a thermostat the sprinklers are automatically turned on when the temperature falls. The theory behind this work is of interest. It is that when water freezes latent heat is given out to the plant around which the water has been frozen. After the water freezes, the temperature inside the plant rises several degrees and remains at this point until, say, the next day's thaw. It is calculated that 20,000 gallons of water will produce when frozen enough heat to boil 1,600 gallons of water. Dr. Rogers, who is in charge of this work, states that this method is really a case of *borrowing* the heat from the next day. Although in theory one-thirtieth of an inch of water per acre hour (or 750 gallons per acre) should

be sufficient to counteract the heat lost by radiation, in practice one-tenth of an inch an hour is needed to protect plants from 6.5 degrees of frost in the screen. The speed of rotation of the rotary sprinklers is important as the sprinkled blossoms must not be allowed to fall below the danger point between successive revolutions of the sprinklers.

I have tried in the short time allowed for this address to give you a brief outline of the soil moisture work at Rukuhia. The fundamental work is continuing. Although I am no longer on the staff of the station, I look forward with interest to seeing the results of this work.

No reference has been made to the valuable work being carried out at Rukuhia on peat soils by Messrs. Elliott, Thompson and others. The development of peat soils is largely a matter of controlling the subsoil water so that it can be held within the root range. In the past much damage has been done by over-draining these soils. Much work has been done to determine the optimum depth at which subsoil water should be maintained and in methods of keeping it at that level. In the future it is likely that our peat soils, at present largely unutilized, and frequently a menace from fires, may become very valuable for the production of vegetables and special crops.

Applications of Results to Practical Farming:

It is satisfying to know that many farmers have been convinced of the value of spray irrigation in the dry summer period. The plant on my own farm almost paid for itself in the first season of installation.

I am now in the fortunate position that a dry summer makes no difference to my production. Great improvements have been made in equipment and in operation, so that time involved in operation of plant is now very small.

Our experiments at Rukuhia showed us that a farmer need only have about 15% of his farm under spray irrigation. On my own farm with 75 to 80 cows I have 14 acres under irrigation, and this has proved ample to carry the stock through the driest of summers.

There are many indirect benefits accruing from the use of spray irrigation. The growing of green feed to provide against a dry summer is no longer necessary and this saves me £100 to £150 per year. One farmer who did not find it necessary to use his plant in the past favourable season states that he saved fully £150, since he had not planted any crop for green feed in

summer as he knew he could depend on irrigation if the summer proved to be dry. It is found, too, that pastures irrigated in summer show a steady improvement yearly as weeds disappear. Weeds mainly come in on the dry bare patches left where the grass and clover die out in summer. We do not have to feed out silage in summer and save it for winter feed. Further, in a dry summer stock suffer severely from under-feeding. With irrigation available the condition of the stock is maintained, and in consequence they milk much better in the subsequent season. One critic of spray irrigation recently stated that great increases shown by certain farmers in the summer production could not have been wholly due to irrigation because the production before Christmas also showed big increases on the same farm. He had not been aware of the fact that this increase was probably a carry over from the previous season. This rather tends to confirm the scepticism I have for the statistician who, to my mind, wants careful watching when he tries to apply his methods to practical farming operations.

Some hundreds of farmers have now installed irrigation plants and I have yet to meet one who is really dissatisfied.

The main use hitherto has been on dairy farms, but gradually more and more sheep and cattle farmers are becoming interested as the later lambs particularly receive a severe check during a summer drought.

One of our leading Waikato farmers during the past season which was not a very dry one, estimates that his extra returns from lambs and cattle, obtained as a result of using spray irrigation, amounted to £1,000.

Another well-known cattle farmer with 30 acres under spray irrigation after allowing for all labour costs and interest on plant and costs of pumping, showed a net return of £59 per week over the 10 weeks during which the plant was used. He proposes to increase the area under irrigation to 50 acres in the coming season.

These few examples are given to illustrate that the scientific work undertaken at Rukuhia is leading to important results in the farming field.

IMPRESSIONS FROM CONFERENCE

Conference was a great success. We were met at the station by the Conference Committee and with something approaching American hustle and bustle were guided to a waiting bus. This much over-loaded vehicle took the delegates to Carrington Hall, where rooms were swiftly allocated and an excellent dinner served—a standard which was maintained throughout our stay. The hospitality at the Hall was aptly illustrated by Dr. Dixon at the Official Welcome. He explained that the young lady whose room he was occupying—in her absence—had supplied a bottle of a well-known brand of fruit salts with the invitation to use as and when required.

The Official Welcome was a bright event. The speakers were brief, and the evening culminated in the "award" of several "medals" to the chairman, Mr. Keys, to the great amusement of all.

The next day saw the beginning of the sessions with the Symposium on the "Economic Aspect of Chemical Science." The lectures were stimulating and created a great deal of formal and informal discussion. The papers in the subsequent sessions had been carefully prepared with a view to the time limit of delivery and none gave the impression of being seriously cut. The Chairmen of the sessions are to be congratulated on the manner in which they controlled the speakers. The smooth running of the sessions did much to create the very favourable impression one gained of Conference. It was apparent that a great deal of organisation had been done by Committeee-men and participants.

Dr. Bottomley's paper, "Hydrogen Peroxide Oxidation of Aromatic Compounds," created a great interest. In the ensuing discussion it appeared evident that the practical applications of the method in analysis are likely to be further studied. The biochemical papers by several of the workers in the Biochemistry Department, University of Otago, also stimulated a great deal of interest and the lecturers were all very pleased at the response they evoked when I saw them later.

It is understood that certain of the discussion groups proved to be very convivial gatherings. In one, at least, the word was passed around and an all-male gathering was achieved. However, a considerabel amount of serious import was discussed in spite of this handicap. The tours were much enjoyed and Invermay was very popular despite the warning of the prevailing condition underfoot.

Professor Emeleus created a very deep impression on all at Conference. His lecture, "Radio-activity in the Service of Man" was of absorbing interest to all present. Few visiting scientists have created such a personal impression as well. His quiet informality and the evident interest he showed in all at the Conference and the work of the N.Z. chemists left all with the hope that he will return to this country again in the not too distant future. Such guests are all too few.

It was a pity the two Presidential Addresses were on the same evening. Such good material requires time for digestion.

The dinner was a "bang on" show—good food, good liquor and good company. Perhaps the smoothest piece of organisation of the whole conference was the presentation of a copy of Mr. C. V. Smith's book, "From N. to Z," to Professor Emeleus a few minutes after he had admitted to never having read it. The gathering afterwards was very cheerful and it was with regret that all went our several ways at a late hour. All were agreed that the conference was a great success and that the Otago Committee are to be congratulated.—W. J. Wilson.

MORCOM GREEN AND EDWARDS' PRIZE

The annual prize offered for the encouragement of original work by young chemists in pure and applied chemistry has this year been awarded to a chemist of the Dept. of Scientific and Industrial Research.

Dr. Marsh.

The prize donated by Messrs. H. H. Edwards, F.N.Z.I.C., and Morcom Green, and awarded to members of the N.Z. Institute of Chemistry, has been won by Dr. B. B. Marsh, M.Sc., Ph.D., A.N.Z.I.C., of the Meat Research Section of the Dominion Laboratory, D.S.I.R.

Dr. Marsh was educated at Petone West and Hutt Valley High Schools, and at Victoria University College (1943-46) obtained his M.Sc. with Honours in Chemistry. He joined the Fats' Research Laboratory of the D.S.I.R. in 1947, and in August of that year he was seconded to the U.K. D.S.I.R. to collaborate with scientists of the Food Investigation Organization in a study of whale-meat for human consumption. During this time he was eight months aboard the floating factory-ship "Balaena," whaling in Antarctic waters. Later he was granted extension of time to study the biochemistry of muscle and meat, and was seconded to the Low Temperature Research Station, Cambridge. He was awarded the degree of Ph.D. (Cantab.) in 1951, and returned to New Zealand to take up his present appointment.

I.C.I. PRIZE

The prize donated by Imperial Chemical Industries (N.Z.) Ltd., to the member of the N.Z. Institute of Chemistry, who has contributed most to the development of some branch of chemistry during the last five years as judged by published work, was awarded on 25th August to Mr. L. Hartman, M.Sc. (N.Z.) B.Chem.Eng. (Lwow) of the Fats' Research Laboratory, Department of Scientific and Industrial Research.

Mr. Hartman.

Polish born, Mr. Hartman at the age of 16 served as a volunteer in the Polish-Russian war in 1920. He graduated as Bachelor of Chemical Engineering at the Polytechnic of Lwow, and engaged in a career of a works' chemist in the fat, soap and related industries. This occupation took him to many countries, and in 1940 the N.Z. Government requested him to take charge of the stearic acid manufacture. Having completed the most urgent part of this work, Mr. Hartman volunteered for service in the N.Z. Armed Forces. After his release from the Army, he first obtained a position with a large paint-manufacturing firm, but in 1948 joined the staff of the Fats' Research Laboratory. There, under the direction of Dr. F. B. Shorland (an earlier winner of the I.C.I. Prize), he found the opportunity for research activity.

In his present work, Mr. Hartman has been able through his industrial experience to contribute to the solution of several theoretical and practical problems in the wide field of fat chemistry. Two patents have been taken out on Mr. Hartman's work. His papers appeared in the chemical journals of New Zealand, Englnd, America and France, and some of them have been "highlighted" in the U.S.A. review literature. His work has included improvements in the recovery of vitamin A from fish livers, fat-splitting and distillation of fatty acids, and refining, stabilising and testing of edible fats such as tallow.

MR. H. RANDS, M.A., B.Sc., F.N.Z.I.C.

Mr. Rands.

Mr. Harry Rands, the third member of the Institute to be elected to the Honorary Fellowship at the May meeting of Council, was educated at the Methven (Nth. Canterbury) Public School and at the Christchurch Boys' High School. In 1908, he started at Canterbury University College as the holder of a Gammack Scholarship and in the course of a brilliant career extending over six years, he completed the M.A. and B.Sc. degrees, won the Exhibition in chemistry twice, the Hayden Prize in chemistry, the Sir George Grey Scholarship, and a Government National Research Scholarship. Under this last award he undertook research under Prof. W. P. Evans, on New Zealand brown coals, with special reference to their use as gas producers.

Mr. Rands then had a few years in the teaching profession as Science Master at Marlborough High School and at Waitaki Boys' High School. He was rejected for military service on account of defective eyesight, and in 1917 he left for England in order to find some kind of war work, and on the strength of a letter of introduction to Sir Ernest Rutherford, who was then doing research at Manchester on the detection of submarines, he became assistant to Prof. H. B. Dixon in the Department of High Explosives. This work involved the testing of T.N.T. and picric acid produced in a number of factories in the Manchester district. He was then appointed to the research staff of Brunner Mond & Co., and was put in charge of an experimental pilot plant for the production of nitric acid by the catalytic oxidation of ammonia. All the necessary data for the construction of a large-scale plant had been worked out, when the end of the war saw the abandonment of the project.

In January, 1920, he was appointed Chief Chemist to the Wellington Gas Co. Ltd., and served there until his retirement this year for health reasons. At the time of his appointment, there were probably not more than half a dozen chemistry graduates in the whole of New Zealand industry, and he has had the satisfaction of seeing this number steadily grow through the years. In his own company the output of gas and accompanying by-products trebled during his period of service, and he conducted a great deal of research in the production of road tars to various specifications, as well as the other by-products of the gas industry, creosote, paints, insecticides, weed-killers, etc. He took part in the negotiations which led to the passing of the Gas Regulations Act in 1924.

Mr. Rands was an active member of the Wellington Chemical Society and was Chairman for two years. He also served on the Committee of the Wellington Branch of the Institute for a number of years. He was first Secretary of the Gas Institute of New Zealand, and took over this position again for five years during the last war. On his retirement his services to that body were marked by the conferment of Honorary Life Membership.

MINUTES OF COUNCIL

Minutes of a Meeting of Council-in-Person held in the Students' Executive Room of the University of Otago, Dunedin, on Tuesday, August 25th, 1953, at 10 a.m., and an Adjournment held in the same room on Friday, August 28th, 1953, at 9 a.m.

Present: Dr. H. E. Annett (President) in the Chair; G. S. Lambert (Auckland Delegate); Dr. E. B. Davies (Waikato Proxy); Dr. A. T. Johns (Manawatu Delegate); Dr. L. G. Neubauer (Wellington Delegate); Dr. M. L. McGlashan (Canterbury Delegate); O. H. Keys (Otago Delegate); W. G. Hughson, Hon. General Secretary-Treasurer.

Apologies: Apologies were received from Dr. H. O. Askew, Vice-President; R. E. R. Grimmett (Waikato Delegate); A. P. Oliver, Assistant Secretary; H. K. Palmer, Registrar.

Minutes: The Minutes of the previous Meeting, M 608-610, were taken as read and confirmed, subject to the addition of the following (see A 299/2), which had been omitted from Item 4.3, M 608: "Authors *are entitled* to receive, free of charge, 25 reprints of papers or (at the option of the Editor) complete copies of the issue. These, and any extra copies required, must be applied for prior to publication. NOTE: The last three words may not be specific enough. Council should perhaps fix a time (say one month) prior to publication.

Conference, 1953: Mr. Keys, the Chairman of the Conference, 1953 Committee, reported that all was in order for the Conference to be held at the University commencing that evening.

Conference, 1954: It was reported that:

(1) Informal communications between Manawatu Branch and Dr. Askew, of Cawthron Institute, had resulted in an agreement to invite Council to hold Conference, 1954, in Nelson.

(2) Dr. Briggs, Chairman of the Organising Committee of the 8th Science Congress to be held in Auckland, May 17th-22nd, 1954, under the auspices of the Royal Society, invited the N.Z.I.C. to hold its Annual Conference as part of the Congress in May and to forego the usual August Conference. (see A 301/1).

Mr. Lambert spoke very strongly in favour of alternative No. (2) and was supported by Manawatu and Canterbury. Dr. Davies considered Waikato would favour the same procedure.

The President, the Otago and Wellington Branches and the Hon. General Secretary spoke in favour of continuing the August Conference, but accepting the invitation to run the Chemical Section of the Auckland Congress in May.

At the adjourned meeting the Vice-President, Dr. Askew, supported this latter view.

No vote was taken at the Council Meeting on the 25th, because the question was in the Agenda for the General Meeting, and it was decided to reconsider the matter subsequently.

Resolved: THAT Council hold an adjourned meeting on Friday, August 28th, at 9 a.m.

On the 28th August at the adjourned meeting of Council, it was announced that, after willing discussion at the General Meeting, by a vote

of 30 to 19 (total attendance was only 58), it was decided to recommend Council to maintain the August Conference and, as an Institute, to offer to organise the Chemical Section of the Auckland Congress in May, 1954. Council after a further lengthy consideration of pros and cons, considered a motion by Auckland and a Notice of Motion by Otago.

The Auckland Motion, seconded by Canterbury, "THAT a summary of all information be forwarded to Branches and that the question of Conference, 1954, be deliberated on at the November, 1953, meeting of Council," was *Lost*. (Voting: Auckland, Canterbury, Manawatu for the Motion; other six against it).

Resolved: THAT Council accept the invitation from Dr. Askew and his associates in Nelson to hold Conference, 1954, in Nelson, but that we co-operate fully with the Royal Society Congress in Auckland in May, 1954.

(NOTE: The Wellington Branch Committee will collaborate with Nelson members in organising Conference, 1954).

Examinations Committee.—Resolved: THAT applicants for the Laboratory Assistants' Examination, who are not working under a Chemist, be eligible to sit the examinations and that the Examinations Committee be asked to prepare suitable amendments to the L.A.C. regulations for distribution to Branches with the Agenda for next meeting.

(NOTE: Dr. Dixon suggested such candidates might be under the supervision of a member of the Institute working in the neighbourhood).

Journal.—Resolved: THAT the nomination of Mr. G. M. Wallace as Editor of the Journal for 1954 be recommended to the Annual Meeting of Council in November.

Resolved: THAT in view of the Editor's report, Council invite the Manawatu Branch to consider the editing of the Journal commencing in 1955.

Professional Status Committee: Dr. Dixon questioned the figure for two years' experience required by R.I.C. in Appendix A, the table accompanying the P.S. Committee report. It was referred to the Committee for consideration.

Otago raised the question of defining a Biochemist.

Resolved: THAT Mr. Keys obtain a full statement regarding a recent appointment and that this and any other information be forwarded to the Professional Status Committee for consideration.

Standards Committee.—Resolved: THAT the nomination of Mr. G. A. Lawrence to the Standards Council for the two years ending 31st March, 1955, be confirmed.

Salaries Committee.—Resolved: THAT in view of difference in starting salaries, the Salaries Committee be asked to prepare a case for submission to the Public Service Commissioner by the Institute showing why starting salaries for Chemists should be as attractive as for other professions.

U.N.E.S.C.O.—Wellington Branch was asked to nominate to the November Meeting a representative to replace Mr. B. E. Swedlund on the Science Sub-Commission of the National Commission of U.N.E.S.C.O.

Food Parcels.—Dr. Dixon announced that the whole scheme was now being wound up on account of high postage rates and changed conditions in England. Over four years, 155 parcels have been sent to a total value of £139.

Resolved: THAT we place on record our appreciation of the work of Dr. Dixon in running the Parcels' scheme.

Prizes.—The President and Vice-President as examiners, were unanimous in recommending that the I.C.I. prize for 1953 be awarded to Mr. L. Hartman, of the Fats' Research Laboratory, D.S.I.R., Wellington, and that the Morcom Green and Edwards prize for 1953 be awarded to Dr. B. B. Marsh, of the Dominion Laboratory, D.S.I.R., Wellington.

The entry of Dr. A. D. Campbell, of the Chemistry Dept., Otago University, for the latter prize was highly commended.

Easterfield Award.—The Regulations governing the Easterfield Award had been sent to the R.I.C. Council in Great Britain by the N.Z. Section of the R.I.C. for amendments. Certain suggestions for amendments had been received and these had been referred to the members of the Combined Committee and to the General Meeting of the N.Z. Section of the R.I.C.

Resolved: THAT the amended Regulations be endorsed and forwarded to the Council of the R.I.C. for re-drafting in appropriate legal phraseology.

Membership, Associate Applications.—Resolved: THAT having examined the applications and other reports from the Membership Committee, Council enrol the following as Associates of the N.Z. Institute of Chemistry:—

On August 25th, 1953:

Howard Charles CLARK, A.U.C.
Alan McCallum FORRESTER, N.Z. Refrigerating Co. Ltd., Islington, Christchurch.
Arthur Harry LEWIN, Cadbury, Fry, Hudson Ltd., Box 890, Dunedin.
Frank William OXLEY, Reckitt & Coleman Ltd., Forth St., Dunedin.
Roger UNDERHILL, c/o. Waikato Breweries Ltd., Box 34, Hamilton.

On August 28th, 1953:

Phyllis Margaret ASHWIN, c/o. Dominion Laboratory, Wellington.
Edward George BOLLARD, c/o. Plant Diseases Division, Auckland.
Joseph BRUECKNER, Dept. of Pathology, Medical School, Otago University.
Zosim DEMCHENKO, c/o. Lever Bros., Ltd., Petone.
Zinaida DEMCHENKO, Potteries & Ceramics Assn., Private Bag, Lower Hutt.
Clarence Desmond Burson JONES, c/o. Box 490, Hamilton.

Resignations.—Resolved: THAT, subject to the return of their Certificates, resignations from the following members be received:—

S. B. Bowyer, Levin; R. V. Perryman, Leeds; T. G. Macartney, N.S.W.; D. U. Strang, Dunedin; W. I. Taylor, University of New Brunswick, Nova Scotia; G. D. Gemonel, M.I.T., Cambridge, U.S.A.; H. D. Kerr, Dunedin.

Application for Leave.—Resolved: THAT leave with remission of subscription be granted for 12 months with right to re-apply for extension at the end of the period to:—B. E. Swedlund, V.U.C., Wellington; L. D. Swindale, Soil Bureau, D.S.I.R., Wellington.

Royal Society.—Dr. Neubauer reported that he and Dr. Dixon had attended a meeting to discuss possible schemes for a unified body to represent scientists in New Zealand. Detailed minutes of that meeting are being made available and copies will be sent to Branches for consideration at next meeting.

Resolved: THAT this Council favours the idea of some form of closer liaison with the Royal Society and other scientific bodies.

Overseas Visitors' Fund.—Canterbury's suggestion was approved, but there was some doubt as to how firms would respond.

Resolved: THAT Canterbury Branch be asked to form an *ad hoc* committee to explore further the possibilities of such a scheme and to report again to the November meeting of Council-in-Person.

Visit of Professor Emeleus.—This was proceeding according to plan and expenses should total less than £150. Branches are asked to forward accounts in this connection immediately to the Registrar.

Income Tax.—The question of approaching the Income Tax Authorities for remisison of tax on subscriptions to the Institute was held over to the November meeting.

Resolved: THAT in view of the information received regarding the liability of the Institute for payment of Income Tax on such items as advertising in the Journal, the Registrar be instructed to furnish returns to the Income Tax Department covering the last two years and that a request be made at the same time for remission of taxation, pointing out that the Institute is a non-profit organisation and drawing attention to relevant Rules.

List of Members.—Resolved: THAT we approach the Association of Scientific Workers with a proposition that our Institute be supplied with approximately 500 copies of th combined List of Members at a cost not exceeding the cost of publishing our own List of Members. Failing such, that we proceed with the publication of our List independently.

Rules.—Resolved: THAT the Rules be finalised and ratified as soon as possible as a matter of urgency.

Registrar.—Auckland Delegate considered we did not require so highly paid an officer as a fully qualified Accountant.

Dr. Dixon thought we should explore the possibilities of more voluntary work and so reduce the fee and enable contributions to other funds (e.g., Overseas Visitors). Auckland suggested the appointment of a Treasurer as a separate office.

The Hon. General Secretary suggested a Secretary to the Membership Committee to handle the large number of procedures each application must pass through.

Resolved: THAT the resignation of the Registrar as tendered on A 297 be accepted as from December 31st, 1953, and that the Wellington Delegate (Dr. Neubauer), the Assistant Secretary (Mr. A. P. Oliver), and Mr. C. G. W. Mason, be appointed a sub-committee to explore the possibility of obtaining a suitable person in Wellington to commence on a salary of £120 per annum.

Resolved: THAT it be a recommendation to Branches to consider the amendment of the Rules to allow the appointment of a Treasurer as distinct from the Hon. General Secretary, and that Branches explore and report on the possibilities of recruiting and using voluntary assistance either in Wellington or in other Branches.

Minutes of a General Meeting of the Institute held in the Chemistry Lecture Room, Otago University, Dunedin, on Thursday, August 27th, 1953, at 3.45 p.m.

Present: 58 members under the Chairmanship of the President, Dr. H. E. Annett.

Apologies: Apologies were received from Professor Evans, Professor Slater, G. A. Lawrence, K. M. Griffin, F. J. T. Grigg, R. E. R. Grimmett, J. A. D. Nash, H. J. Wood, A. P Oliver, Dr J C Andrews, J L. Mandeno, I. S. Hunt, and S. G. Brooker.

Welcomes.—A welcome was extended to Professor Emeleus, from Cambridge, and to a Fullbright Scholar, Dr. Donald S. Farner, from Pullman, Washington, U.S.A.

Minutes.—The Minutes of the previous General Meeting held in Wellington on 26/8/52, M 592-595, were taken as read and confirmed.

President's Remarks.—Prizes: The President stated that we were indebted to Messrs. I.C.I. (N.Z.) Ltd., for the supply of Silver Medals to accompany the cash prize offered each year through the Institute for outstanding work in Chemical Research. Medals had been inscribed and were presented to past winners of the prize: Dr. L. H. Briggs, 1949; Dr. B. Shorland, 1950; E. P. White, 1951.

Mr. C. W. K. Brandt's medal for 1952 will be forwarded to his widow.

The winner of the Prize and Medal for 1953 was Mr. L. Hartman, of the Fats' Research Laboratory, D.S.I.R., Wellington.

The Morcom Green and Edwards Prize for 1953 was won by Dr. B. B. Marsh, of the Meat Section of the Dominion Laboratory, Wellington.

Faraday Society.—The President had received an invitation to attend the 50th Jubilee Anniversary celebrations. He had forwarded greetings, which were graciously acknowledged.

A.N.Z.A.A.S.—It was noted with pleasure that Sir Theodore Rigg, a Past President of the Institute, had been nominated as President-elect of the next meeting of A.N.Z.A.A.S in Canberra in January, 1954.

Certificates.—Associate Certificates were presented to:—

Dr. Harvey, V.U.C., Wellington.

Mr. H. G. Ivory, Dominion Laboratory, Christchurch.

Mr. J. J. Molloy, Hawkes Bay Farmers' Meat Co.;

and a Laboratory Assistant's Certificate to: Miss Mason, Dominion Laboratory, Dunedin.

Other Certificates were posted.

Associates Newly Elected.—The President announced that Council had enrolled five new Associates the previous day, viz.: R. Underhill, Hamilton; F. W. Oxley, Dunedin; A. M. Forrester, Christchurch; A. H. Lewin, Dunedin; H. C. Clark, Auckland.

He also stated that six more applications would be considered on the following day.

Obituary.—As a mark of respect members stood when the President announced that during the year the Institute had lost one of its foundation members in Mr. R. M. Bruce, of the Patents Office, Wellington.

Thanks.—Concluding his remarks, the President thanked all those members who had carried out voluntary work on the many committees of Council.

Conference, 1953.—The Conference Secretary, Mr. W. Broughton, reported generally and said that the residential hostel was accommodating 58 members of Conference and was proving a great success.

Conference, 1954.—Dr. Askew formally invited the Institute to hold Conference, 1954, in Nelson. Dr. Briggs and Mr. G. S. Lambert said that Auckland was arranging the 8th New Zealand Science Congress for May 17th-22nd, 1954, in Auckland. The programme was outlined in full and the suggestion made that we hold the Annual Conference of the N.Z.I.C. in conjunction with the Royal Society Congress. Quite a lengthy discussion ensued and finally a motion was moved by Mr. G. S. Lambert (Auckland) and seconded by Dr. M. L. McGlashan (Canterbury) :—

THAT this General Meeting of members recommends to Council that we forego the usual August Conference in 1954 and that the Institute Conference be held in conjunction with the Royal Society Congress in May, 1954, in Auckland.

The motion was voted on by a show of hands and was *Lost* by 30 to 19.

Resolved: on the motion of Mr. G. S. Lambert, seconded by Dr. Briggs:

THAT it be a recommendation to Council that the invitation from Dr. Askew and his Associates at the Cawthron Institute to hold Conference, 1954, in August in Nelson be accepted with thanks.

NOTE: Although it was not included in the Resolution, the point had been made in discussion that the N.Z.I.C. would at the same time lend all support to the running of the Royal Society Congress in Auckland and would organise the Chemical Section. It should also be noted that Dr. Briggs and Mr. S. G. Brooker, two of our most prominent members, are holding important positions on the Congress Organising Committee.

Examinations Committee.—Mr. O. H. Keys (Chairman) reviewed the year's work and mentioned the new Syllabus.

Journal.—The Editor had submitted a very interesting report, which is set out in full in the Agenda. Mr. G. M. Wallace will be nominated as Editor for 1954 and Council will consider asking Manawatu to take over the Journal when convenient.

Professional Status Committee.—This Committee has been concerned with comparing standards of admission to the various Commonwealth Institutes of Chemistry. The work is proceeding.

Standards Council.—Mr. G. A. Lawrence will again represent the Institute for a two-year period on the Standards Council.

Standards Institute Committee.—Two letters were received from C. L. Stonyer, who has now taken charge of all Standards work for the Institute. Some Committees have not met during the year, but our representatives have been asked to comment on specifications.

Mr. Tingey reported that there have been five Technical Committee meetings, and two full meetings of the Paint and Coatings' Section. Mr. Stonyer had reviewed 17 specifications and there has been two meetings of the Chemical Sectional Committee.

Salaries.—No special activity beyond the publication in the Journal of the summarized findings from last year's questionaire.

U.N.E.S.C.O.—It will be necessary to replace Mr. B. E. Swedlund, who has represented us on the Science Sub-Commission and who has been granted leave of absence to study in England.

A great deal of material is received from U.N.E.S.C.O., but very little of it is of direct interest to the Institute.

Employment Officer.—Mr. Borthwick reported that a number of requests for assistance both from New Zealand and abroad had been received and attended to.

Food Parcels.—Dr. Dixon reported that circumstances in Great Britain and increased postages has led to the decision to abandon the scheme. Dr. Dixon was again thanked for his long service on this job.

Medical Advertisements.—Mr. James reported that there had been no complaints with regard to advertisements during the year.

Vote of Thanks.—at this stage of the meeting Mr. M. S. Carrie Moved: THAT all sub-committee reports be received and that our thanks be recorded to the officers concerned. Dr. F. McDowell *seconded* the Motion, which was CARRIED by acclamation.

Registrar.—A letter from the Registrar had been set out in full in the Agenda, showing how the hours of work had increased and how the present fee was insufficient to cover increased costs.

Dr. Annett explained the attitude of Council; Dr. Dixon suggested more voluntary work by members, and Mr. Lambert advocated the appointment of a Treasurer as distinct from the Hon. General Secretary. The matter was left in the hands of Council.

Financial Statement for nine-months' Period.—A Statement was submitted by the Registrar for the first nine months working to July 31st. Branches were asked to get all subscriptions paid promptly before the end of the financial year.

General Meetings.—Dr. Dixon MOVED and Dr. Davies SECONDED: THAT it be a recommendation to next Conference Committee that more time be allowed for General Meetings so that policy matters and other important interests could be discussed more fully. CARRIED.

Mr. Keys explained that time was crowded this year because of special arrangements for a Lecture by Professor Emeleus.

In closing the Meeting, the President again thanked members for their reports and for their efforts on behalf of the Institute.

Mr. A. L. Odell, Auckland University College, left recently on Sabbatical leave to study for his Ph.D. at University College, London.

Mr. C. C. Roberts, Inspector of post-primary schools, Canterbury, has been seconded to U.N.E.S.C.O. to undertake development work in the Phillipines.

Professor F. G. Soper has been appointed Vice-Chancellor of the University of Otago and also Chairman of the Professorial Board.

Dr. H. E. Annett, our President, addressed a very interested audience at the Auckland Branch in July, his subject being "A Chemist Gone Wrong."

CARBON-14 METHOD OF PREHISTORIC RESEARCH

The recently-discovered method of accurately dating prehistoric objects by their radio-activity has had practical application in New Zealand. Charred wood buried beneath volcanic ash has shown the times when this country was subject to violent volcanic activity.

Scientists of the Dominion Physical Laboratory and the Dominion Laboratory, Dept. of Scientific and Industrial Research, have for some time been developing the new method of isotopic research by which the age of prehistoric organic matter can be determined with very much greater accuracy than has previously been possible. Living matter maintains a constant balance of the rare radio-active isotope carbon-14 and the ordinary isotope carbon-12, but at death gradually loses the carbon-14 at a known rate by radio-activity. By measuring the amount of this activity scientists can tell the age of the fossils—to within a small margin of error—that were living up to 20,000 years ago.

In the Department's geological and soil structure investigations in the Taupo area, this method has provided valuable information by dating the period of the last violent volcanic activity in this area. The fossilized remains of the vegetation destroyed by the Taupo pumice showers showed that this activity occurred in 1800 and 3,000 years ago. Soil structure investigations, seismic research and geological knowledge will all be helped by the accurate dating of this period.

This method of prehistoric dating originated in America only within the last few years, and when physicists and chemists of the Department commenced its practical application, very little information had been published on the develpoment of the technique. Complicated and precise methods of preparation of the samples were devised and Geiger-Muller apparatus for counting the rate of radio-activity called for the design of special equipment. A high degree of purity of the sample, free from detectable radio-activity other than carbon-14, must be achieved, and this has to be deposited in a uniform layer on the inside of the electronic tube. The very sensitive counter is shielded from extraneous gamma rays by several tons of lead and cast iron. This does not, however, prevent the penetration of the cosmic rays that are continually bombarding this earth. The effect of these is calculated, however, by surrounding the tube containing the carbon-14 with a ring of tubes that record the cosmic-ray penetrations, but show a difference on the records. Allowances can then be made. New Zealand's physicists and chemists are making a valuble contribution to the development of this new branch of scientific resarch, the application of which will help, amongst others, the anthropologist, the geologist, the soil scientists, the zoologist, and (in the detection of faked "antiques") the police.

Dr. W. A. McGillivray, Massey College, has recently gone to England on a Nuffield Fellowship. His headquarters will be at the National Institute for Research in Dairying, near Reading.

Dr. M. L. McGlashan, chairman of the Canterbury Branch, has resigned his position as Senior Lecturer in Physical Chemistry at Canterbury University College, to take an appointment in the chemistry department at Reading University. Dr. McGlashan intends leaving New Zealand towards the end of the year.

ERRATA

Mr. N. T. Clare has advised that the following correction should be made to his paper in the June issue:—

Page 64, second paragraph, second sentence, should read: "The total ash and particularly calcium and phosphorus are low in colostrum and increase as the milk flow becomes established, in contrast to the gradual decrease in these mineral constituents in the ash of the colostrum of the dairy cow."

BOOK REVIEWS

MICRO-WAVE SPECTROSCOPY, by W. Gordy, W. V. Smith and R. T. Trambarulo, 446 pages, 1953, published by John Wiley and Sons, Inc. (New York), eight dollars.—H.B.

INTRODUCTION TO SOLID STATE PHYSICS, by Charles Kittel, 396 pages, 1953; published by John Wiley and Sons, Inc. (New York), seven dollars. A very useful and up-to-date account of the properties of solids, including discussion of energy, elastic constants and lattice vibrations of crystals, magnetism, super-conductivity and electron theory of metals; and imperfections in solids. The standard is suitable for final year B.Sc. and Honours course in Theoretical Chemistry.—H.B.

CHEMICAL CONSTITUTION, by J. A. A. Ketelaar, Professor of Physical Chemistry, in the University of Amsterdam, 398 pages, 1st English Edition, 1953, published by Elsevier. Distributors, Cleaver-Hume Press Ltd. (London), 40/-. A very important book for the teaching of Theoretical Chemistry at final year B.Sc. and Honours standard. The sections discussed are: (1) The periodic system of the elements—the four types of bonding. (2) The ionic bond; (3) The atomic bond; (4) The metallic bond, and (5) van der Waal's bonding. This book will be particularly appreciated by those who wish to obtain an authoritative account of valence bond and molecular orbital methods without having the mathematical experience or time required to read the original papers on these subjects. Inter-dispersed with the qualitative sections, are quantitative treatments of these topics printed in smaller type—these can be omitted at first reading especially by readers who do not possess the necessary mathematical background. The examples given are modern, e.g., the chemistry of the trans-uranic elements, cyclo-octatetraene, azulene, tropolone and the theory of colour are discussed. At the end of each chapter the author gives a list of books and original papers for further reading. In addition numerous modern references appear throughout. This is a book which should be in the library of every chemist.—H.B.

RADIO-ACTIVE ISOTOPES, by W. J. Whitehouse and J. L. Putnam 424 pages, 1953; published by the Oxford University Press, 50/-. The title to this publication does not seem to be the most suitable as discussion of the production and properties of radio-active isotopes occupies only about half of the book—a more adequate title might have been "The Practice of Radio-chemistry." Much of the material has appeared elsewhere—for example the section on Geiger and scintillation counters appears unnecessary in a book of this scope. The most important chapters are: Some applications of

Radio-active isotopes and the manipulation of Radio-active material. As is usual with Oxford books, the publishers are to be commended on the excellence of the production.—H.B.

HUMOR IN DER TECHNIK. Vol. I. By W. Dorn and K. Luetgen. 328 pages; 1949. 16 DM. Vol. II. By A. Tillmann, 305 pages; 1953. 16.60 DM. Essen: Vulkan-Verlag Dr. W. Classen. These two volumes break new ground and there should be good scope for collections such as these of humorous stories, sketches and poems with a technical flavour. The word "Technik" has been stretched a little and the material covers a wide field. The books are internationad in scope and include material from English and American writers and artists and about savants from those countries. Typical are drawings by Heath Robinson, and the story of Einstein"s encounter with Rita Hayworth, who is reported to have done "what she could to make his mouth water." The material seems to vary a good deal in quality and some of the stories are a little stale, but the illustrations alone will supply several god laughs.

ORGANIC CHEMISTRY, AN ADVANCED TREATISE. Edited by Henry Gilman. Vols. III. and IV. Pages 1-1,245; 1953. New York: John Wiley and Sons. Eight dollars, 75 cents per vol. The second edition of volumes I. and II. of this very well-known work was published in 1943; now, after a lapse of 10 years, a series of reviews on various topics in organic chemistry, considered by Prof. Gilman to be of value to advanced students, have been collected in two further volumes. The following subjects are discussed: The Study of Organic Reaction Mechanisms, by Paul D. Bartlett, Harvard; Applications of Infra-red and Ultra-violet Spectra to Organic Chemistry, by Foil A. Millen, Pittsburgh; Lipids, by J. C. Cowan and H. E. Carter, Illinois; Organic Dyes, by H. W. Grimmel, Rhode Island; Some Aspects of Chemotherapy, by H. R. Ing, Oxford; Antibiotics, by Lee C. Cheney, New York; the Terpenes, by R. H. Eastman and C. R. Noller, Stanford; Heterocyclic Compounds, by R. H. Wiley, Kentucky; Starch, by W. Z. Hassid, California; Explosives, by G. F. Wright, Toronto; Reactions of Organic Gases under Pressure, by W. E. Hanford and D. E. Sargent, New York; and Oxidation Processes, by W. A. Waters, Oxford. It is good to see that two British chemists have been asked to contribute. Though some of these subjects will be less studied than others, there is bound to be an instant demand for these volumes. Among teachers of chemistry hope will arise for a new edition of the earlier volumes.

The fifth and last volume of *CHEMISCHE TECHNOLOGIE,* which was first mentioned in these columns in April, 1952, has been published by the Carl Hanser Verlag, Munich, at 74.50 DM. This book deals with metals and metallurgy and with general topics such as the control and economics of various chemical processes, the production of steam and patents. The book is well produced and copiously supplied with diagrams.

CHEMISTRY OF CARBON COMPOUNDS. Edited by E. H. Rodd. Vol. II., Alicyclic Compounds. Part A, pages 1-487; 1953. Elsevier Publishing Co. (London: Cleaver Hume Press), £4 /4/-. This work was originally planned for five volumes, but it would appear that its scope will be larger as both the first two volumes are being issued in two parts, all of which are sizable volumes. This will reduce to some extent the number of people who can afford the larger work, but those who stretch their purses will not regret it, because the fuller work will be so much the more comprehensive. Vol. IIa. deals with all alicyclic compounds except

the terpenoids and steroids, which have been retained for IIb. IIa. includes the carotenoids and has a long chapter on open chain and cyclic polymers derived from olefines, including natural and synthetic rubbers. The greater part of this book is written by Prof. R. A. Raphael, of Glasgow. The printing and binding are good and there are few errors, and this can be as confidently recommended as its predecessors. Despite the comprehensive nature of this work and the great deal of factual information contained, the various contributors have skilfully picked out the interesting as well as the salient points so that the work is readable and not merely a reference authority.

Volume II. (L to Z) of the *CHEMIE-LEXIKON.* by Hermann Roempp, completing the set first mentioned in our April issue, has been published by the Franckh'sche Verlagshandlung (84 DM.). It confirms the good impresion gained by its predecessor. It is up-to-date with references to 1952, and the major articles contain lengthy bibliographies, which enable the user to find information which cannot be included in the "Lexikon." This must be an exceedingly useful reference book for German chemists, and can be used with much profit by others as there is nothing of quite the same scope in English.

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