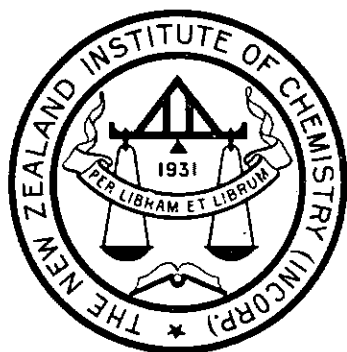


*W. G. Hughson*

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SEPTEMBER, 1945

NO. 3

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**ANNUAL CONFERENCE, 1945.**

The first conference held since 1940 drew a large number of chemists to Palmerston North from August 28th to the 30th, some 130 members of the Institute and of the Royal Institute of Chemistry, New Zealand Section, attending. Meetings were held in the Opera House, and the main addresses were given in the P.D.C. Ballroom. At the opening meeting His Worship the Mayor (Mr. A. E. Mansford) welcomed the Conference to Palmerston North.

On the evening of the 28th, Dr. H. E. Annett gave the Presidential Address of the R.I.C. (N.Z. Section), entitled "Sidelights on the Development of Agricultural Science." Sir Theodore Rigg expressed the thanks of the audience for an inspiring story, illuminated by anecdotes of personal experience. Dr. B. W. Doak was in the chair.

On the following evening, Dr. J. C. Andrews gave the Presidential Address of the N.Z.I.C. Dr. C. R. Barnicoat was chairman, and Mr. W. A. Joiner thanked the President for a review of Food Technology which the council, later, in response to many requests, decided should be printed in full.

**GENERAL MEETING.**

Dr. Andrews presided over the Annual Meeting of the N.Z.I.C., and the main business was his excellent review of the present position of the Institute, which has grown to achieve some recognition in official quarters as the body representing the chemical profession in New Zealand. The status now achieved brings new responsibilities, involving financial burdens heavier than can be borne by the present income. The discussion of the President's statement made it clear that the members present were prepared to face their responsibilities, and the Council was empowered to consider methods of increasing the Institute's resources.

Greetings were sent to Dr. W. P. Evans, Honorary Fellow and first President, and Dr. Andrews referred also to the loss

sustained by New Zealand chemistry, since the last Conference, by the death of Dr. H. G. Denham. He spoke of those members who served with the Forces and particularly of those who would not return. He took great pleasure in referring to awards made to two associates, the M.B.E. to Miss A. E. Lorimer, and the George Medal to Mr. R. Hurst.

#### PROGRAMME.

The programme, which is given below, consisted of Symposia on Physical Methods, Soil Plant and Animal Relationships, Fluorine, and Industrial Processes, with two selected papers. The papers of Messrs. N. O. Bathurst and W. L. Dearsley, who were unable to attend, were discussed, a brief introduction to the latter paper being given by Mr. F. H. Johnstone.

With the assistance of an interval timer with a definite but not too obtrusive ring, the discussions were kept to time with unusual efficiency. The programme reflected great credit on the Conference Committee, consisting of the President, the Honorary Secretary (Mr. W. G. Hughson), Dr. Dixon and Messrs. White and Lawrence, and a motion by Dr. F. G. Soper thanking them was carried with acclamation.

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#### LIST OF PAPERS.

##### SYMPOSIUM ON PHYSICAL METHODS.

- (1) Distillation for analysis and purification  
(physical method). M. D. Sutherland.
- (2) The application of Beer's law to filter type colorimeters.  
W. Metcalf.
- (3) Identification and determination of unsaturated fatty acids  
spectrophotometrically after isomerization by alkali.  
P. B. D. de la Mare.
- (4) Polarographic analysis. D. D. Perrin.

##### SYMPOSIUM ON SOIL, PLANT AND ANIMAL RELATIONSHIPS.

- (5) Chemical changes in soil following certain fertilizer  
treatments. A. J. Metson & H. S. Gibbs.
- (6) Molybdenum deficiency in a Wellington soil. E. B. Davies.
- (7) Some biochemical aspects of breadmaking. R. Stern.
- (8) The effect of dietary fat on the composition of depot  
fat with special reference to the bacon pig.  
F. B. Shorland.

- (9) Spoilage of butter due to metallic contamination. G. M. Moir.  
(10) A brief survey of the alkaloids of the Leguminosae. E. P. White.

#### SYMPOSIUM ON FLUORINE.

- (11) Fluorine survey of New Zealand soils. G. D. Gemmill.  
(12) Fluorine survey of New Zealand waters. G. Chamberlain.  
(13) Preliminary fluorine estimations in teeth of sheep showing excessive wear of the incisors. S. L. Dorofaeff.  
(14) Physiology of fluorine. Miss Harrison.

#### SELECTED PAPERS.

- (15) Microbiological methods for the estimation of vitamins of the B complex N. O. Bathurst.  
(16) Phosphatase levels in infants' blood (both those suspected of rickets and normal). Miss Weeber.

#### SYMPOSIUM ON INDUSTRIAL PROCESSES.

- (17) Chemical Engineering in New Zealand. S. R. Siemon.  
(18) Instruments for investigations into process control. G. Maskill Smith.  
(19) Paint and Specifications. L. Wilkinson.  
(20) Manufacture of high vitamin flour. E. W. Hullett.  
(21) Fruit and Vegetable dehydration. B. W. Doak.  
(22) Possibilities of manufacturing glucose in New Zealand. W. L. M. Dearsley.

#### VISITS.

On the 30th many members visited Massey College and the Plant Chemistry Laboratory, some film being shown at the former place. These and the other local arrangements were in the hands of the Palmerston North Committee, Dr. B. W. Doak (Chairman), Dr. C. R. Barnicoat (Secretary), Dr. Whitehead and Mr. C. V. Fife. Everyone attending the conference appreciated the excellence of the local organisation, which contributed largely to the successful revival of this most important event in the New Zealand chemists' year.

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#### INDUSTRIAL CHEMICAL ESSAY PRIZE.

At the Annual Conference, the President announced that the Essay Prize had been awarded to M. Fieldes (Associate) for his "Review of the Electroplating Industry in New Zealand." The examiners were agreed on the high standard of the winning essay.

**PRESIDENTIAL ADDRESS.**

**"Food and Food Technology,"** by J. C. Andrews.

Since food has been studied scientifically the chemist has been intimately concerned with it and can lay claim to the title "Guardian of the Food Supply," and I hope, this evening, to make a brief survey of some of the more important facts relating to foodstuffs and food processing. In doing so I hope to be able to show the importance of this subject, not only to New Zealand, but also to the problems of the world, and by stimulating some thought on this topic, lead to a greater appreciation of the vital necessity for a better approach on a more fundamental basis to the problem of adequate nutrition.

The World conflict in which we have engaged has thrown into relief many of the problems connected with food supply which in peace-time have often been passed over without due consideration of their importance. In the first place, I would suggest that an adequate food supply in any community may be a prime cause of human strife. During this war it quickly became apparent that the proper organisation of the food supply was going to be one of the most important factors in leading to final victory. The Allied Nations recognised this fact, with the result that the United Nations' Conference on Food and Agriculture was held at Hot Springs Virginia, on the 18th May 1943<sup>(1)</sup>. The initial declaration of this Conference emphasises the inadequate food supply of the world in the pre-war years and the war years. It was disclosed that there had never been enough food for the health of all people. This was considered unjustifiable on the grounds that we now have knowledge of the way in which an abundant food supply can be produced. It was also stated that the first cause of hunger and malnutrition was poverty due to an inability of the individual consumer to purchase an adequate supply. Consequently, no solution of world food problems is possible until there is an expansion of international purchasing power sufficient to provide a satisfactory food supply for all.

When the Conference came to consider some quantitative premises upon which to develop their deliberations it recommended that the dietary standards be based upon scientific assessment of the amount and quality of food in terms of nutrients which would promote health.

The following table, taken from Appendix I of the Report of the Food Conference is quoted as a widely accepted basis of dietary standards. It was drawn up by the National Research Council of the United States of America in 1942.

**TABLE I. RECOMMENDED DIETARY ALLOWANCES<sup>(1)</sup>**  
**FOOD AND NUTRITION BOARD NATIONAL RESEARCH COUNCIL U.S.A.**

	Calories	Protein Grams	Calcium Mg	Iron Mg	Vitamin A <sup>(1)</sup> I.U.	Thiamin <sup>(2)</sup> Mg	Riboflavin Mg	Niacin <sup>(3)</sup> mg	Ascorbic Acid <sup>(4)</sup> mg	Vitamin D <sup>(5)</sup> I.U.
<b>MAN (70 Kg)</b>										
Sedentary	2500	70	0.8	12	5000	1.5	2.2	15	75	(6)
Moderately active	3000									
Very active	4500									
<b>WOMAN (56 Kg)</b>										
Sedentary	2100	60	0.8	12	5000	1.2	1.8	12	70	(6)
Moderately active	2500									
Very active	3000									
Pregnant (later half)	2500	85	1.5	15	6000	1.8	2.5	18	100	400 & 800
Lactating	3000	100	2.0	15	8000	2.3	3.0	23	150	400 & 800
<b>CHILDREN UP TO 12 YEARS</b>										
Under 1 Year	1000/Kg	3 1/4/Kg	1.0	6	1500	0.4	0.6	4	30	400 & 800
1-3 Years	1200	4.0	1.0	7	2000	0.6	0.9	6	35	(6)
4-6 Years	1600	5.0	1.0	8	2500	0.8	1.2	8	50	
7-9 Years	2000	6.0	1.0	10	3500	1.0	1.5	10	60	
10-12 Years	2500	7.0	1.2	12	4500	1.2	1.8	12	75	
<b>CHILDREN OVER 12 YEARS</b>										
Boys 13-15 Years	2800	80	1.3	15	5000	1.4	2.0	14	80	(6)
16-20 Years	2400	75	1.0	15	5000	1.2	1.8	12	80	
Girls 13-15 Years	3200	85	1.4	15	5000	1.6	2.4	16	90	
16-20 Years	3600	100	1.4	15	6000	2.0	3.0	20	100	(6)

(1) See the good based which is far in planning practical diet: can be met by a good diet of mixed foods. (2) 1 mg of thiamin is equal to 10 I.U. (3) 1 mg of niacin is equal to 10 I.U. (4) 1 mg of ascorbic acid is equal to 10 I.U. (5) Vitamin D is usually fully necessary for older children & adults when not supplied from sources of whole or powdered milk. (6) The amounts of protein and calcium needed are 10% of those from human milk.

Hot Springs Conference Report, Page 40.

**TABLE II ANNUAL REQUIREMENTS PER PERSON<sup>(1)</sup> (Commodities as sold in retail markets.)**

COMMODITY	ECONOMICAL		COSTLY	
	Per Person	World Requirements <sup>(2)</sup>	Per Person	World Requirement <sup>(3)</sup>
GRAIN PRODUCTS	229 LB <sup>1</sup>	208 x 10 <sup>6</sup> tons	194 LB <sup>1</sup>	176 x 10 <sup>6</sup> tons
MILK (AS FLUID)	48 GALLONS 480 lbs <sup>(4)</sup>	96 x 10 <sup>6</sup> gals + 478 x 10 <sup>6</sup> tons <sup>(5)</sup>	53 GALLONS 530 lbs <sup>(4)</sup>	106 x 10 <sup>6</sup> gals + 473 x 10 <sup>6</sup> tons <sup>(5)</sup>
MATURE LEGUMINOUS SEEDS AND NUTS	24 LB <sup>1</sup>	22 x 10 <sup>6</sup> TONS	13 LB <sup>1</sup>	12 x 10 <sup>6</sup> TONS
VITAMIN C RICH FRUITS	79 LB <sup>1</sup>	72 x 10 <sup>6</sup> TONS	95 LB <sup>1</sup>	86 x 10 <sup>6</sup> TONS
LEAFY GREEN YELLOW VEGETABLES	79 LB <sup>1</sup>	72 x 10 <sup>6</sup> TONS	154 LB <sup>1</sup>	140 x 10 <sup>6</sup> TONS
OTHER VEGETABLES & FRUITS	119 LB <sup>1</sup>	108 x 10 <sup>6</sup> TONS	194 LB <sup>1</sup>	176 x 10 <sup>6</sup> TONS
MEAT, FISH AND POULTRY	90 LB <sup>1</sup>	82 x 10 <sup>6</sup> TONS	119 LB <sup>1</sup>	108 x 10 <sup>6</sup> TONS
EGGS	228 (NO) 28 lbs <sup>(6)</sup>	456 x 10 <sup>6</sup> 25 x 10 <sup>6</sup> tons <sup>(7)</sup>	276 (NO) 34 lbs <sup>(8)</sup>	552 x 10 <sup>6</sup> 31 x 10 <sup>6</sup> tons <sup>(8)</sup>
SUGAR	35 LB <sup>1</sup>	32 x 10 <sup>6</sup> tons	35 LB <sup>1</sup>	32 x 10 <sup>6</sup> TONS
FATS	51 LB <sup>1</sup>	46 x 10 <sup>6</sup> tons	51 LB <sup>1</sup>	46 x 10 <sup>6</sup> TONS
<b>TOTAL</b>	<b>1214 LB<sup>1</sup></b>	<b>1259 x 10<sup>6</sup> TONS<sup>(9)</sup></b>	<b>1419 LB<sup>1</sup></b>	<b>1416 x 10<sup>6</sup> TONS<sup>(9)</sup></b>

(1) Based on a world population of 2,000,000,000. (2) Assuming 1 Gallon of milk = 10 lbs. (3) Assuming 1 Egg = 2oz. (4) Statistical Yearbook of the League of Nations 1941-42 gives the annual world requirement as 1100 x 10<sup>6</sup> tons.

Annual World Requirement.

The technical commission on Nutrition of the League of Nations assessed the annual food requirements of the world at 1,100 million tons<sup>(2)</sup>. By making deductions from the National Council's figures, and assuming a world population of 2,000 million people, the annual food requirement in terms of what

may be thought necessary by the Hot Springs Conference is raised to over 1,250 million tons. A simple calculation will also show that the amount of food required annually for New Zealand, based on a population of 1,700,000 is approximately one million tons. New Zealand owes its economy largely to having available a substantial surplus of certain types of food-stuffs. For example, we export annually approximately 100,000 tons of butter and 300,000 tons of meat products. When these quantities are compared with world requirements it will be seen that they constitute a very small percentage and that there is plenty of scope for New Zealand to increase her exportable surplus of these materials without any risk of flooding the potential market. The main problem is to see that the potential market becomes an actual market. On the other hand, New Zealand does not produce an adequate supply of certain food stuffs for her own requirements. Some of these foodstuffs are produced to a limited extent, in other words, it has been demonstrated that they are capable of being produced in New Zealand, and one feels that more attention should be paid to the production of such materials so as to render the country less dependant on imported foodstuffs. Further, as more knowledge of nutrition is gained by the public there will be an increase in the consumption of certain types of foodstuffs, and a reduction of others, and our agriculture should at all times be sufficiently flexible to meet the consumer requirements. I believe, in the post-war period, there will be an increase in the consumption of fruits and vegetables. As far as vegetables are concerned, the country has shown that it can readily meet this requirement, but, in the case of fruit, more time is necessary to bring the crop to harvest, and consequently some incentive is necessary to bring about the expansion of our orchards. Apart from our own needs, we should also consider the possibility of making some contribution to the food supplies of the Pacific Islands, quite apart from our trade with other parts of the world.

It is generally agreed that it is desirable for each locality to produce the foodstuffs required by the local population, but the fact that certain areas are particularly adapted to the production of certain foodstuffs, while other areas are not, raises the problem of distribution. To bring about satisfactory distribution the following problems have to be overcome:—

(1) Financial.—Up to the present time this has often acted as a barrier against the rational distribution of foodstuffs to those who stand in need of them. Not only is this a major problem between countries, but it exists between individuals. Some part of it may be soluble by an expansion of purchasing.

power, but by far the greater problem lies in the education of the individual to utilise that power on a sound nutritional basis.

(2) Transport Facilities.—Satisfactory transport must be available to convey the food to those requiring it. This involves transport which is not only technically adequate, but is present at the right time in sufficient quantity.

(3) Processing.—Processing at the point of origin will be necessary in some degree or other to ensure satisfactory out-turn of the food at its destination. This must be of such a nature that it has a capacity sufficient to cope with the produce as it becomes available.

(4) Storage.—Suitable storage must be provided for holding the food against the time of consumption.

All the above problems require some consideration by the scientific world if solutions are to be forthcoming. In particular however, the processing of foodstuffs is essentially connected with scientific control, and it is in this field that the chemist must inevitably play a considerable part in the solution of food problems.

Apart from certain mineral salts, all foodstuffs are derived from the animal and vegetable kingdoms, and consist essentially of organic compounds. This means that they are compounds of carbon and J. G. Bennett in the first J. Arthur Reavell Lecture<sup>(3)</sup> has deduced that 1 year's production of foodstuffs involves the utilisation of  $55 \times 10^6$  tons of carbon. When this is compared with the "estimate of the quantities of carbon within the reach of man's exploring," it will be less than one 40 millionth of the total carbon within reach of man. Thus it will be seen that a year's food supply for man does not make any appreciable demand on the world's carbon content. It should also be noted that foodstuffs are essentially cellular in structure. This latter fact is of considerable importance and often imposes limitations on the methods to be adopted in the treatment of the foodstuff. The composition of cellular tissue varies from foodstuff to foodstuff and may also vary very materially in different parts of the same variety; for example, in the case of beef, the cell composition in lean meat is largely protein in structure whereas, in the case of the fatty tissue, fat accounts for the greater part of the cell material.

It is generally known that the composition of foodstuffs essential to the diet may be broadly classified as follows:—

(1) Moisture.—Moisture occupies by far the most important place in the composition of foodstuffs from the point of view of weight, accounting for some 70% of the weight of the

animal body and rising to as high as 90% in the case of certain fruits and vegetables.

(2) **Proteins.**—These are organic nitrogen compounds of complex structure. They are essential for the cellular development of both plant and animal, and must be supplied in adequate quantity and quality if satisfactory nutrition is to result.

(3) **Carbohydrates.**—These materials, namely the sugars and starches, occur in most foodstuffs to some extent though the amounts present in flesh products are relatively unimportant. In the form of starch, however, they occur to a major extent, in our cereal foodstuffs such as wheat, rye etc.

(4) **Fat.**—Fatty substances are very widely distributed throughout the food supply, but their major occurrence is in flesh foods. Nitrogen does not occur in the composition of carbohydrates and fats which are utilised by the body mainly as energy-producing substances in contradistinction to the double role of the proteins which not only may supply energy, but which also enter essentially into the cellular structure of the organism.

(5) **Mineral Substances.**—A large number of inorganic elements appear to be essential for both animal and vegetable life and occur, to a more or less degree, in foodstuffs. Some of these mineral substances are deposited to form, for example, bony structure, while others are associated with the cellular metabolism such as iron in haemoglobin, and magnesium in chlorophyll. In addition, certain elements appear to function in some more or less catalytic fashion e.g. manganese and cobalt.

(6) **The So-called Accessory Food Substances.**—Into this class fall the known vitamins, substances of organic composition which, in relatively small amounts, are essential for the proper functioning of the living organism. It should be pointed out here that, in the case of certain organisms, these substances may be synthesised from other material, for example, carbohydrate material, or may be formed by the action of the actinic rays of the sun upon the surface of the individual. The production of Vitamin-D in the human body can occur in this way. A further method, restricted to the animal organism, is the production of substances of this nature as the result of the activity of the intestinal flora.

In addition to the broad classification into the major groups outlined above, a considerable amount of knowledge has now been accumulated regarding the composition and chemical structure of substances falling into the different groups. In other words, a fairly useful qualitative analysis has

been achieved. While by no means complete, it has been sufficient to enable us to deal with the composition of foodstuffs on a semi-quantitative basis; indeed, sufficient quantitative data is available for us to lay down the amount and type of foodstuffs to be consumed to allow of a reasonably satisfactory diet. The recognition of this fact by the Hot Springs Conference allowed it to take such a basis for its deliberations. Each year will undoubtedly see the accumulation of new knowledge concerning the composition of foodstuffs which will make necessary modifications of the nutritional tables.

Considerable attention has been paid to the chemical composition of foodstuffs in the raw state and the same foodstuffs when prepared from fresh material for the table. In this way a considerable amount of knowledge has been acquired which enables us to assess the effect of various methods of processing upon the nutritive value of the processed foodstuffs. Some nutrients are relatively unstable substances and if the processing method adopted is unsatisfactory considerable loss of a particular nutrient may take place during treatment. If this loss occurs to a markedly greater extent than normally occurs in the proper cooking of the fresh material for consumption it is obvious that some review of the processing method is essential if the quality of the processed foodstuff is to be nutritionally satisfactory.

It would, be as well to consider the agencies by which deterioration and decomposition of foodstuffs occur. In the first place, it should be pointed out that certain foodstuffs occur naturally in a fairly stable condition and are capable of storage for reasonable periods without any treatment. It will usually be found that such materials have a relatively low moisture content and are protected by a reasonably impervious skin or envelope; grain crops and certain fruits are good examples falling within this category. Cellular activity during the growth of a foodstuff is dependent upon a series of enzymes. These substances, while themselves subject to very little actual change in composition, bring about progressive changes in the composition of materials entering the cell. In other words they may be looked on as organic catalysts. When the supply of foodstuffs to the cell has been reduced below a certain level or has ceased enzyme action still continues and brings about degradation of existing cellular material. In the case of certain leafy vegetables this will occur rapidly when a certain stage of "wilt" has developed due to loss of moisture from the leaf, resulting in certain cellular breakdown which liberates oxydising enzymes in the cell as occurs when the substances making up the chloroplasts are liberated and allow-

ed to mix with the cytoplasm. Under such conditions the peroxidase enzymes, as they are called, acting in conjunction with oxygen in the cellular tissue, bring about very rapid degradation of the cellular material. Thus, it will be seen that if a foodstuff is to be preserved, the processing it receives must, in some way, bring about the inactivation of the enzyme causing breakdown of the nutritive substances present. A second cause for the gradual deterioration of foodstuffs is the action of atmospheric oxygen. Where oxidising enzyme systems are present the rate of degradation, due to the presence of oxygen, is very rapid, but even if such systems have been inactivated or eliminated, oxygen brings about a slow deterioration of the foodstuff. The rate of this deterioration will depend on the chemical composition of the foodstuff, being more rapid in some cases than others. The development of off flavours in fats is a typical instance of this type of deterioration.

A third, and more commonly recognised agency, whereby foodstuffs suffer decomposition is the effect of micro-organisms. Such organisms include the moulds, yeasts and bacteria. Their action is to grow upon the foodstuff, digesting the chemical substances in the foodstuff and breaking them down into other substances usually simpler in composition. It will thus be seen that any successful method of food preservation must inactivate the enzyme systems, protect the foodstuffs from the action of atmospheric oxygen, and destroy the micro-organism population which may exist on and in the fresh foodstuff.

It is competent, now, for us to consider the various main methods of processing foodstuffs, and, in the light of the above, to examine the limitations of such methods in practice. Perhaps the oldest method of processing food for preservation is that of natural drying. The mechanism involved was simply the removal of moisture from the product by the heat of the sun. This had to occur at a rate greater than that at which decomposition of the foodstuff could occur due to the agencies mentioned above. Since an aqueous medium is necessary for the rapid action of enzymes and oxygen, the mere removal of moisture from the product will very materially slow down the rate of decomposition from these two causes. Furthermore, micro-organisms require fairly moist conditions for vegetative reproduction, and if these conditions are not present, micro-organisms either tend to die out or to sporelate. It will be appreciated from the outset that natural drying of food stuffs was hazardous, due to the vagaries of the weather. Consequently, this method resulted at times in large quantities of foodstuffs being lost due to decomposition occurring before the moisture content had been lowered sufficiently, or, what was more generally the case, a poor quality article was produced,

on account of the partial operation of the destructive agencies before the conditions for their operation became unsatisfactory. More recently, with the development of scientific knowledge, considerable attention has been paid to this method of preservation. Artificial means of drying were developed, which gave a more certain control over the rate of removal of moisture from the product. In addition, steps were taken to inactivate the enzyme systems prior to the operation of the artificial drying or dehydration, as it has come to be known. One of the earliest and most successful applications of this method of food preservation was that of the drying of milk. Milk powders are now an established commercial article.

The second method which results in preservation of foodstuffs is that of freezing. In colder areas natural refrigeration of foodstuffs has been practiced for a very long time. When one examines what occurs when cellular material is frozen, one finds that the result is very similar in nature to that which occurs when the substance is dried, insofar as the arrest of the destructive agencies are concerned. The conversion of the moisture in the cell to ice removes the medium for the active operation of both enzymes and oxygen, and at the same time dehydration of the micro-organisms and their substrate occurs, thus bringing about conditions which materially slow down the rate of decomposition. Here again natural refrigeration was somewhat uncertain and had its limitations, and man found that, by cutting ice in the winter and building ice storehouses, he was able to prolong the time during which the foodstuffs could be kept frozen into the hotter months of the year. The application of this method was, however, limited to those areas which became cold enough to produce ice during winter, but with the introduction of artificial refrigeration in the Nineteenth Century, the application of this method became world-wide. With the perfection of the refrigeration cycle, and scientific studies of the effect of refrigeration upon the material frozen, greatly improved frozen foodstuffs were produced. It is well known what a great debt New Zealand owes to the development of artificial refrigeration.

Of more recent years there have been new developments in this field with the introduction of processes for the Quick-Freezing of foodstuffs which results in a further improvement of the quality of the product. This is mainly due to the rate at which the cellular structure was frozen. When very rapid freezing occurs the ice produced is micro-crystalline in structure, and the action of enzymes and oxygen upon the product are more quickly curtailed. When slow freezing is carried out, large ice crystals are produced resulting in some puncturing of the cellular walls and breakdown of colloidal systems, so

that, on thawing, cellular fluids are lost by what is known as "drip," to the detriment of the product. The Quick-freezing process largely eliminates this defect.

The preservation of foodstuffs by pickling or salting is another method which deserves some consideration. The application of brine to a foodstuff such as meat brings about the partial dehydration of the cellular tissue due to osmosis, the cell walls functioning as semi-permeable membranes. In this way the salt concentration of the cell fluids is increased making conditions unsuitable for the growth of most micro-organisms and, at the same time, slowing down the chemical effects of the enzymes and oxidation. This is only partially true, inasmuch as fatty tissue in the cured or pickled state is still very liable to oxidation to produce rancidity. A similar type of mechanism is used in the production of glace fruits such as lemon peel and cherries, except that in this instance sugar replaces salt.

Again, certain fermentation processes are carried out in the presence of brine under controlled conditions whereby desired organisms are provided with conditions favouring their development at the expense of others. The production of saur kraut from cabbage is an instance of this method.

For a little over a century the preservation of food by canning has been, perhaps, the most important method used. It was discovered by Nicholas Appert in France at the time of the Napoleonic Wars. In his original initial successful experiments Appert used glass containers and his main difficulty lay in obtaining a sufficiently effective seal after filling the bottles. But, by careful manipulation, he was able to preserve successfully a wide range of foodstuffs. When the information reached Great Britain, a tin-plate container was used for the first time. The knowledge of this method of food processing spread rapidly and was taken up by the United States of America. About 1900, George W. Cobb Senior introduced the "Sanitary" style of can successfully in the United States, and this improvement in the container gave a great stimulus to this method of food preservation, with the result that it is now probably the most important used.

United States statistics for the year 1942 show that the total pack of the principal vegetables and soups amounted to 253 million 855 thousand cases of 2 doz. No. 2 cans.

The extent to which canning has captured the food preservation field is largely due to the certain control which can be obtained over the agencies bringing about decomposition. The processing or heat treatment of the foodstuff in a sealed container not only brings about the destruction of micro-organisms, but also inactivates the enzyme system, and, in a properly filled container, little or no oxygen is present for

damage to occur to the product from this source. So effective has the method been that tinned foodstuffs opened after 100 years were still in an edible condition<sup>(4)</sup>.

A method which has developed recently for short-time storage of foodstuffs is that of chilling. Its success depends chiefly upon careful control of conditions. The successful transportation of chilled meat to the United Kingdom is a familiar example to us; less familiar, perhaps, is the success which has attended the chilled transportation of vegetables in North America. This method depends for its success on the slowing down of cellular activity and the maintenance of high sanitation, so as to avoid an undue load of micro-organisms.

With the increasing use of the various methods of preservation of foodstuffs, it became apparent that many of the foods marketed were either adulterated or preservatised using chemical substances which were detrimental to the health of the consumer. The existence of such conditions forced the Governments of the various countries to introduce laws and regulations covering the commercial production and distribution of foodstuffs. One of the most notable figures in this field was Harvey W. Wiley, the United States' Chemist, who was largely responsible for the comprehensive Federal Food, Drug & Cosmetic Act, passed in 1906, and known in that country as "The Wiley Act". Since that date fairly comprehensive food and drug regulations have been introduced into all civilised countries and, as scientific knowledge and the technique of food processing developed, amendments to the original Acts were made, gradually eliminating those substances which were known to have detrimental effect upon health. In addition, definite standards of sanitation were laid down for establishments handling foodstuffs with the result that, today, processed foodstuffs have now reached a very high standard. In fact, it has been said that the safest food that one can consume today is that from a can.

I wish now to consider some of the technical aspects of food processing, in respect to their dependence upon simple scientific facts and operations which, in the broader field of chemical engineering have been termed Unit Processes. The chemical engineer is not necessarily acquainted with food processing, but the successful food technologist is necessarily something of a chemical engineer, inasmuch as he has to apply unit operations to the processing of foodstuffs. Some idea of the extent to which food processing is tied to unit type operations is given in Table III. This table is a modification of one issued by "Food Industries"<sup>(5)</sup> and shows how extensively the same unit process is used throughout the food processing industries.

**TABLE III**  
**UNIT OPERATIONS IN FOOD PROCESSING INDUSTRIES.**

	Selection and Storage of Materials.	Preparation, Heating and Cooking.	Size Reduction.	Mixing and Blending.	Mechanical Separation.	Heat Treating.	Refining.	Cooling.	Freezing and Drying.	Air Conditioning.	Measurement.	Insulation.	Heat Control of Steam, Water, Power, Temperature, etc.	Electrical Equipment.
<b>BAKERY PRODUCTS</b> - <i>Bread, cake, biscuits, etc.</i>	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●
<b>BEVERAGES NON-ALCOHOLIC</b> - <i>Coke, cornflakes, cereal, ka-ka, etc.</i>	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●
<b>BEVERAGES ALCOHOLIC</b> - <i>Wine, whisky, distilled alcohol, etc.</i>	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●
<b>CONDIMENTS</b> - <i>Sauces, gravies, extracts, seasonings, pickles, vinegar, etc.</i>	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●
<b>CONFECTIONERY</b> - <i>Candies, chocolates, biscuits, etc.</i>	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●
<b>FISH</b> - <i>Fresh, frozen, canned, salted, smoked, etc.</i>	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●
<b>FRUIT</b> - <i>Fresh, frozen, canned, dried, etc.</i>	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●
<b>GRAIN PRODUCTS</b> - <i>Flour, meal, bran, etc.</i>	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●
<b>MEAT</b> - <i>Fresh, cured, canned, etc.</i>	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●
<b>MILK PRODUCTS</b> - <i>Milk, cream, butter, etc.</i>	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●
<b>SUGAR</b> - <i>Cane, beet, etc.</i>	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●
<b>VEGETABLES</b> - <i>Fresh, etc.</i>	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●
<b>MISCELLANEOUS FOOD PRODUCTS</b> - <i>Spices, etc.</i>	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●	●●●●●●●

Time will not permit of an extensive examination of this table, but it will be profitable to consider a simple example of the way in which the information may be applied to a particular problem. Under the heading of "Mixing and Blending" the following types of plant must be considered: Mixers; sifters; sieves; blenders; kneaders; beaters; dissolvers; agitators; refiners; emulsifiers; homogenisers; conges; colloid mills and stirrers. For the sake of argument let us assume that we are attempting to prepare a soup powder from dehydrated vegetable powders, plus a thickening agent and certain flavouring materials. It will be obvious that since all the ingredients are powdered only certain types of the machines listed above can be of use. Also, the proportions of the vari-

ous ingredients used and the total output required will have a bearing on the question. It is usual, unless there is some other objection, to mix the ingredients progressively, starting with those which constitute the smallest part of the mix. For example, in our assumed case, let us suppose that the formula for the soup powder was:

Dehydrated potato powder	35%
„ carrot „	25%
„ cabbage „	15%
„ onion „	12½%
Thickening agent (flour)	10%
Salt	2%
Mixed spices	½%

In this instance the mixed spices should be thoroughly mixed with the salt and the resulting mixture then mixed with the thickening agent, and so on, until a complete mixture is produced. Such a procedure ensures that the spices being the smallest ingredient, are thoroughly blended through the final product. Having satisfied ourselves, from laboratory and organoleptic tests that our product is right, how do we go about setting up plant for its manufacture?

The first consideration is that of the quantities likely to be required. If the market is to be tested with the product, some type of pilot plant will be required. This can quite conveniently be pictured as a rotating horizontal cylinder with internal baffles made from a metal drum with, perhaps, a much smaller unit for mixing the smaller ingredients, or to avoid this latter plant, we may make a large mix of the flour, salt and spices and store this mix, adding the required amount to each mix of powdered vegetable. Such an approach will probably tide us over the initial production period, so long as we have proved that the material of which the pilot plant is constructed has no deleterious effect upon the product. Let us assume that the product proves popular and the business is expanding rapidly and appears to justify full-scale plant for the manufacture of the product. Such a step is going to involve considerable capital, and before making any commitments, it is very necessary that the industrial chemist should examine every avenue of information both as regards this problem of mixing the ingredients and such other operations, e.g. packaging, that the production of the article will involve.

Reference to Table 111 shows that all foodstuffs listed involve mixing and blending in the processing in one way or another. Eliminating those which do not apply to our problem, such as beverages, the industrial chemist will make himself familiar with the mixing and blending operations used in other

food processing plants. If he is not satisfied with the information obtained he may then study mixing operations as applied to substances other than foodstuffs, but generally speaking, he is most likely to find the answer to his problem inside the food industry. However, it is just possible that he will not find a satisfactory answer, and he may then be compelled to fall back on the inventive genius of the chemist and engineer, to produce plant which will give the desired result.

It may be well asked what constitutes a satisfactory specification upon which to base the purchase of plant. I believe it should be based on the following factors:

(1) Suitability.—It should be able to produce a product of the desired quality. It presupposes that it is constructed of suitable material and performs its operations so efficiently that an article of even and standard quality is possible.

(2) Capacity.—The plant must be of the required capacity, i.e. it must have sufficient capacity to produce the required annual output having regard to time lost by breakdown, repair, overhaul and cleaning.

(3) Mechanical Suitability.—The plant should be constructed in a sound way and of material which will give it sufficient strength for a good working life. The best engineering material for its construction may not be suitable on account of contamination of the product and compromise may be necessary, but in most cases, it is unwise to sacrifice quality of product except as a last resource. The drive, etc. of the plant should be as simple as possible and the controls placed so as to make its operation easy.

(4) Relation To Other Plants.—Processes may be batch or continuous, and this factor must be carefully considered so that the machine will fit in to the flow of production without causing a bottleneck of any description.

(5) Labour.—A point often overlooked in the installation of plant is the convenience of the operator and the maintenance staff. Plant should be so installed that the operator can control the plant with the minimum of inconvenience. With regard to maintenance, lubrication should be effective and easily applied, and the dismantling of the plant, when necessary, should be as simple as possible.

(6) Cost.—It is admittedly false economy to buy cheap plant which will not fulfil the purpose required, but this does not mean that the most expensive plant is necessarily the best, or that the most suitable plant on other counts is going to prove the most economical. The first question to be considered is the duration of daily operations. Some plant will operate

continuously and other only intermittently. Naturally, plant expected to operate continuously for any long period must be of good construction and give reliable performance. Consequently, a higher outlay is justified than if the plant were only to be required to operate for short periods at a time. Careful consideration should also be given to the capital cost in relation to the operating cost. For example, if two machines were under consideration, one costing £4000 and the other £5000, the former requiring two operators and the latter one operator, while the power consumption of the former was half that of the latter, some careful consideration would have to be given to these facts and others bearing on the question before a decision could be arrived at.

(7) Obsolescence.—Plant value is depreciated annually, making possible replacement at some future determined time. Meanwhile, however, a new process or machine becomes available which renders the old machine obsolete. It is generally good policy to make some provision for this eventuality. This may be done by purchasing cheap plant for short life and replacing later, but it may be bad policy inasmuch as the plant will probably not be satisfactory on other grounds. Consequently, it becomes evident that the greatest possible care is necessary in the purchase of the most suitable plant in the first instance if the bugbear of obsolescence is to be minimised. In other words, the food technologist must keep abreast of the latest developments so as to avoid the installation of plant which is either obsolete or likely to become obsolete.

Foodstuffs are essentially commodities with a fairly steady demand and as such should reach the consumer at the lowest possible price. Hence there is a responsibility on all connected with the food industry to maintain all possible efficiency and this can only be achieved by a wide knowledge and constant study of developments. It is a truism that when food becomes a luxury, human suffering and strife are only around the corner.

Referring once more to Table III, it is of interest to consider briefly some of the headings given under Unit Operations. Some are essential to all food industries, such as Packing, Power Transmission etc., and are basic to factory operations. Others again may be more important in food processing than in other industries. Refrigeration is such a unit operation. Generally speaking one usually finds considerable attention paid to one or more of the unit operations involved in a particular food industry, and insufficient attention devoted to others. In this country, particularly, quite inadequate attention is paid to the Measurement and Control Process Variables. A good deal of rule of thumb is still practiced with inevitably

poor results. This may be due to our isolation from the major industrial centres of the world. In these areas there are available extremely reliable recording and controlling instruments for almost any required process. These are gradually being introduced into the food processing industry in this country, but their application is as yet by no means extensive or complete. So certain, for example, is the operation of these instruments in the control of canning operations that the State of California will not permit a can produced in that State to be offered for sale unless the retorting or processing of the batch has passed the State Inspector who checks the processing conditions from the chart of the recording thermometer which it is necessary to install on every retort used for the production of canned foods in that State. The provision of recording, controlling thermometers on the retorts in the canning section of the Government Food Processing Factory at Pukekohe at the beginning of this year is, as far as my knowledge goes, the first case of the application of these instruments to canning procedure in this Dominion, yet, in many areas where quality canned foodstuffs are being produced, their use is considered absolutely essential for success.

In one New Zealand factory where conditions were anything but good I found that the Company had a very low percentage loss of canned goods. When I learned the processing conditions the answer was obvious. The company, in order to play safe, grossly overprocessed the goods. The result was a very second-grade product, coming from first-class raw materials. Good instrumentation of their retorts would have helped them to improve their goods and would have reduced the amount of steam used.

The use of air conditioning in the processing of foods is as yet in its infancy. Often a product suffers deterioration on account of the conditions under which it is packed. Conditioning of air has been found necessary in the packing rooms in dehydration factories to avoid uptake of moisture by the product from the time it leaves the dehydrator until sealed in its package. However, it should be appreciated that air conditioning confers other benefits than the mere reduction in humidity and control of temperature. In a good system considerable amounts of the dust and micro-organisms are removed from the air by passage through suitable filters, solutions or sprays. Consequently, if a foodstuff is sensitive to atmospheric conditions, or if it is being produced in an area where air-borne contaminations occur, the use of air conditioning should receive serious consideration.

Sanitation is always important in the food industry and

must always be uppermost in the mind of the food technologist. Every phase of factory design and operation must be considered from the point of view of maintaining clean and sanitary conditions, both in the factory and its environs. The kind of foodstuff being prepared will determine the methods of cleansing which can be adopted. Obviously the use of the steam hose is unsuitable in a flour mill. Education of staff in elementary hygiene is most desirable and the chemist has the responsibility of setting the standard and the example.

Heat is used a great deal in food processing and a knowledge of the principles of heat transfer and the properties of steam is usually an essential prerequisite to the proper operation of a food factory. It often happens that heat in the form of steam is applied to procure a certain result, which may not be achieved in practice. This failure may often be due to some defect in the installation and before making other changes a careful check should be made of the steam system to see that it is functioning as planned. Valves that leak, non-return valves installed the wrong way around, steam traps with only half the necessary capacity, etc., often give rise to those baffling failures which occur from time to time.

I must pass now to a consideration of the future of the food processing industry; the developments which are likely to occur, and the outstanding problems of a technical nature still requiring solution. If the aims expressed by the Hot Springs Conference of 1943 are to be achieved, to any degree there must be a great expansion of the food processing industry and to this end it will be profitable for a continuance and expansion of research in these fields to be actively pursued.

As you all know, a course in Chemical Engineering is now being established at Canterbury University College, and I hope the day is not far distant when a Chair of Food Technology can be established by the University of New Zealand. When one considers the importance of foodstuffs in the national economy of New Zealand, it is a cause of wonder to me that such a Chair has not been established earlier, and if there is in the community anyone who wishes to benefit the people of this Dominion there can be no better objective than the endowment of a Chair of Food Technology. I have heard it stated that such a Chair would conflict with the work on the Nutritional Aspects of Food now handled by the Home Science Department of the University of Otago, but I can only say that I cannot see any possibility of this, as their functions would be complementary, not overlapping, and would ultimately strengthen each other. There is a great need for more fundamental knowledge of foodstuffs, and in particular a more complete elucidation

tion of the nature of enzymes is urgently needed. Another basic need, both in the animal and vegetable fields, is the necessity to produce raw material suited to the various food processing operations. We have probably in this country achieved more in the case of animals than in the case of plant products. Something has undoubtedly been achieved in the case of wheat and the development of Cross 7 is an eloquent tribute to the work of the Wheat Research Institute. We have, however, a long way to go as yet in the case of fruit and vegetables. Fortunately, the demands of war have focussed our attention on these products, and it is to be hoped that a study of modern methods of cultivation and selection will result in more suitable raw materials being available to the factories in the future. To achieve this result some changes in our farming practice and marketing of the raw material may be necessary.

When a fuller knowledge of the science of genetics is applied to the raw materials for food, new varieties or breeds will be produced, having characteristics more suitable for human nutrition, and their introduction may necessitate changes both in our farming and processing practice. We must always be alert to take advantage of any such developments. It is becoming more and more necessary for food processing plants to handle only the best of raw material if good products are to result.

Inside the factory itself developments involving changes in technique and better control of existing techniques are foreshadowed. In this connection packaging offers a very fruitful field for the reason of the growing shortage of certain packaging materials and the introduction of many new types. Cellophane was the forerunner of these, which include rubber-like materials such as Pliofilm, Koroseal and Cry-o-vac, certain classes of plastic materials, greatly improved fibre boards, and aluminium containers. Artificial refrigeration is now capable of many new developments and its application to many products in new ways is bound to develop in the future. It may mean changes in our existing freezing industry, but it may also make possible export markets for new food products from this country. For example, the distribution of quick-frozen vegetables to the Pacific Islands from this country is a definite possibility, quite apart from the possible development of quick-frozen foodstuffs for our own use. The use of air conditioning is also likely to be extended and developed, giving more certain control over conditions inside the food factory. With this can come greater control by the more extensive use of industrial instruments and it should be pointed out that many applications of electronics are possible in food proces-

sing. The use of high vacua is now commercially practical and the molecular still has already been exploited for the concentration of Vitamin A from natural oils. Radiant heat has been applied experimentally to the drying of dehydrated food-stuffs and while too expensive as yet to remove the bulk of the moisture, is useful in removing the final few percent. of water required. An extremely interesting application of high frequency current for the production of heat, though it is as yet only experimental, is in the processing of canned goods. If it can be perfected and placed on a commercial basis it can readily revolutionise the canning industry.

Other possible advances may no doubt suggest themselves to those familiar with food processing, but sufficient has been given above to indicate possible advances. Some new fundamental knowledge of a foodstuff may bring in its train a new approach and radical alterations in the methods adopted for its preservation.

Some mention should be made of the great success which attended the rationing and distribution of foodstuffs on a scientific basis in the United Kingdom during the war period. The Minister of Food, Lord Woolton, based food rationing on the advice given him by nutritional authorities, headed by Sir Jack Drummond. A comparison of the diet in the United States of America, Canada and the United Kingdom is given in Table IV, and it shows that, in spite of the great shortage of food which existed in the United Kingdom, a fairly good standard was maintained. No essential element of the diet fell to a dangerously low level, though of course, palatability suffered and the pangs of hunger were not entirely blunted. I cannot do better than quote Lord Woolton in this connection<sup>(7)</sup>:

"We were saved from starvation by the application of scientific knowledge to the problem of securing the right foods, not to satisfy our appetites but to give us nutrition . . . We must never return to starchy satisfaction and forget that food is the fuel of human health."

Here we have a magnificent example of what can be achieved in the solution of a food shortage problem, but it should be realised that even under the stress of war the people of the United Kingdom had a better diet from a nutritional point of view than the inhabitants of many countries ever enjoyed in the pre-war years. If we have the will to apply ourselves to the task, not only can we assist in the solution of world food problems, but also we can improve our own diet. Much can be done in New Zealand if all contribute their share and realise that continued effort is necessary for its achievement.

**TABLE IV.** Estimated Supplies of Nutrients Available for Civilian Consumption.  
(Per head Per Day)

	SUPPLIES PRE WAR			SUPPLIES 1943			PERCENTAGE CHANGE 1943 COMPARED WITH PRE WAR.			SUPPLIES IN CANADA 1943 U.S.A. CANADA U.K.		
	U.S.A. (3080)	CANADA (3020)	U.K. -	U.S.A. (3130)	CANADA (3120)	U.K. -	U.S.A.	CANADA	U.K.	U.S.A.	CANADA	U.S.A.
<b>CALORIES</b>	3228	3124	2984	3283	3223	2827	+2	+3	-5	86	88	98
<b>PROTEIN</b> - ANIMAL (gm)	51	49	43	56	57	40	+9	+15	-7	72	71	102
VEGETABLE (gm)	36	39	38	39	40	47	+3	+3	+23	121	116	104
TOTAL	89	88	81	95	97	87	+7	+10	+7	92	90	103
<b>FAT</b> (gm)	132	122	130	138	133	113	+5	+9	-13	82	85	97
<b>CARBOHYDRATE</b> (gm)	420	417	372	413	409	366	-2	-2	-2	89	89	99
	(380)	(390)	(375)	(385)						(98)	(95)	(103)
<b>CALCIUM</b> (mg/ml)	868	830	694	996	956	1054	+15	+15	+52	106	110	76
<b>IRON</b> (mgm)	14	15	13	16	16	16	+14	+10	+27	103	99	104
<b>VITAMIN A</b> (IU)	6486	6133	3563	6979	6783	3882	+8	+11	-	56	57	97
		(+700)			(5000)					(72)	(74)	
<b>ASCORBIC ACID</b> (Vitamin C) (mgm)	99	56	112	106	61	127	+7	+6	+13	120	208	58
<b>THIAMIN</b> (Aneurin or Vitamin B <sub>1</sub> ) (mgm)	18	19	12	24	20	19	+37	+5	+60	79	95	83
		(14)			(21)					(88)	(105)	
<b>RIBOFLAVIN</b> (mgm)	20	18	16	23	21	21	+18	+13	+30	89	98	90
<b>NIACIN</b> (Nicotinic Acid) (mgm)	18	17	18	20	19	19	+14	+8	+3	92	100	92

*Notes* (1) The figures in the above table are national averages and should not be taken to represent the actual supply received by each individual consumer. No allowance has been made in the above figures for the substantial losses of some nutrients which may occur in storage, preparation and cooking.

(2) The figures in brackets following those for calories and carbohydrates (U.S.A. and Canada) and for Vitamin A and Thiamin (U.K.) indicate the approximate values if calculated with the same nutrient factors as for the other countries. For these nutrients the methods of estimation in the 3 countries are not entirely comparable. For other nutrients this difficulty does not arise and the figures may be regarded as comparable.

I have attempted to cover a very large field but one which, I feel, must, in some aspect or another, be of interest to everyone. It may be that I have attempted too much and have not discussed in sufficient detail one or another of the technical aspects of Food Technology, but I excuse myself on the grounds that addresses of this nature should, if possible, reach a larger audience than members of the two Institutes. Furthermore, it is surely of value at a Conference where detailed research papers are being presented, to be able to relax and gain some more generalised picture of some important phase of our work as chemists. My only apology is that I feel that I have not been able to present the subject as well as it deserves.

- (1) United Nations Conference on Food & Agriculture, 18th May 1943. Final Act & Section Reports.
- (2) Statistical Yearbook of the League of Nations 1941-42.
- (3) J. G. Bennett — Coal & Chemical Industry. 1st J. Arthur Reavell Lecture, 1944.
- (4) Drummond, Lewis & Macara. Chemistry & Industry, 57, 808, 827, 914.
- (5) Flow sheets of the Food Processing Industry. "Food Industries."
- (6) Osman Jones, "Modern Methods of Food Preservation," 2th-Streatfield Memorial Lecture, 1945.
- (7) The Rt. Hon. Lord Woolton. "Science & Reconstruction in Britian," International Industry, Vol. 26, No. 3, 89 (1945).

**REPORT ON COUNCIL MEETING OF JULY 5th.**

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The President, Dr. J. C. Andrews, occupied the chair. Others present were, P. White Auckland; D. H. Freeman, Wellington; S. H. Wilson, Canterbury; J. K. Dixon, Otago; L. Wilkinson, Assistant Secretary, and W. G. Hughson, General Secretary-Treasurer.

The Vice-President was unable to attend.

**ELECTION TO FELLOWSHIP:**—A discussion took place on the standard for the election of persons to the Fellowship. It was recommended that Branches consider adding to Rule 9 a further clause. The suggested clause provides that persons who:—"have obtained in the opinion of the Membership Committee the requisite degree of merit after being engaged in important analytical, industrial, consulting or other work of a general or specialised chemical character" shall be eligible for the Fellowship.

**SALARIES OF CHEMISTS:**—Dr. J. K. Dixon as representative of the Institute but more particularly as the representative of Government Chemists was appointed a member of the sub-committee which prepared the general case for the Professional Groups and was also appointed witness to appear before the Consultative Committee on behalf of the Scientific Officers' Group. A resolution of appreciation for the work done by Dr. Dixon and other members of his committee in preparing and presenting salary claims was passed by Council.

A copy of the claims has been sent round the various Government Laboratories and is now in the hands of the General Secretary from whom it can be borrowed for short periods.

**CHEMISTS' EMPLOYMENT REGISTER:**—The Register is now firmly established and all members have received a statement of its aims and objects. The cost for this financial year will be borne by the two Institutes; thereafter an annual charge will be levied on all members desirous of receiving notification of vacancies.

**FINANCIAL:**—The President has prepared a financial review of the Institute since its inception and this will be circulated to Branches preparatory to further consideration of the problems during the period of the annual Conference at Palmerston North.

**JOURNAL:**—It was decided to increase the number of Journals ordered per issue in order to be able to supply new members with the complete series for the year. Local members are also asking for the Journal and other requests are coming from advertisers and from abroad.

**ANNUAL CONFERENCE:**—It was decided to send Conference Programmes to firms advertising in the Journal and to offer sets of Conference papers to members not attending Conference at a cost of 5/- per set of 24 papers.

The Conference Committee has estimated the Conference fee covering hire of halls, cyclostyling of papers, morning and afternoon teas, etc. at £1 per member. This fee was agreed to by Council.

**CHEMISTS IN INDUSTRY:**—In a letter from Dr. Dixon to the General Secretary suggestions were made as to ways and means of recruiting graduate chemists to Industry. This letter will be circulated to Branches and discussed more fully at Conference.

**EXPENSES TO MEMBERS OF COUNCIL ATTENDING MEETINGS:**—It was resolved that this matter be considered by Branches and discussed at Conference, at the meeting of Council-in-person.

**MEETING OF COUNCIL-IN-PERSON:**—Annually a meeting of Council-in-person is convened where delegates from the Branches attend and are allowed approved travelling and accommodation expenses. It was decided that the Council meeting set down for August 30th at Palmerston North, should be the annual meeting of Council-in-person but that delegates should be allowed expenses for one day only, and travelling expenses.

**LABORATORY ASSISTANT'S CERTIFICATE:**—With the recognition of this certificate by the Public Service Commissioner a number of applications have been received to sit the examination. It was decided that a pass in Matriculation in the current year would be accepted in lieu of Theoretical Chemistry. It was also decided that passes in University subjects would be accepted for the certificate.

**EVIDENCE OF ACADEMIC QUALIFICATIONS:**—The Membership Committee is to be asked to consider how applicants can supply, most satisfactorily, evidence to academic qualifications when submitting applications for enrolment as members of the Institute.

### ELECTION OF FELLOW.

Mr. N. L. Wright, Consultant, Auckland, was recently elected a Fellow of the New Zealand Institute of Chemistry. Mr. Wright was for a long period Scientific Liaison Officer for the Department of Scientific and Industrial research in London. He is a Fellow of the Royal Institute of Chemistry and holds the Diploma of the Imperial College of Science and Technology London.

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### ELECTION OF ASSOCIATES.

Council has much pleasure in announcing the following newly elected Associates:—

Mrs. D. D. Perrin, Assistant Chemist, Dairy Laboratory, Wallaceville, was formerly engaged as Chemist's Assistant at the Government Laboratory in Christchurch. Mrs. Perrin who was a graduate of Canterbury College, was known to many as Miss Wood.

Mr. D. D. Perrin, Assistant Biochemist, Wallaceville, graduated M.Sc. in Chemistry in 1944. He was University Senior Scholar in Chemistry in 1943.

Mr. A. P. Oliver B.Sc. who is now engaged as Chemist to Greenwell's Ltd. Auckland, graduated from Victoria College in 1940. He spent two years with the Chemical Section of the Agriculture Department and four years with the N.Z. Navy on radio-physics.

## BRANCH NOTES

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### AUCKLAND BRANCH.

The speaker for May was Mr. C. W. Firth, M.Sc., A.M.I.C.E., late geologist to the Superior Oil Co., in N.Z., who spoke on the subject "The Search for Oil in New Zealand."

Mr. Firth stated that the source of oil was to be found in marine animal life particularly Polyzoa growing under sheltered conditions. Oil had been produced artificially in the laboratory from organic matter, and these experiments had thrown a good deal of light on the origin of oil in its natural state. Coal was derived from vegetable matter and not animal life as is oil. The difference between asphaltic and paraffin base oils is that the former is an intermediate stage in the production of the latter. Asphaltic base oils were long neglected because they required different methods of refining, cracking and hydrogenation, but once these problems had been overcome they were highly prized because they gave more high-octane petrol.

For oil to become available, there must be source rocks which give rise to oil, and almost any marine strata may do this, and secondly, some structure by which the oil may be trapped, a domed stratum, a fault where source rocks run up against impervious rocks, or an overlay. New Zealand had a very large number of oil seepages, but most of the oil has already gone. The conditions in the various areas of New Zealand were described. Small quantities of oil exist at Kotuku in Westland, and at Moturoa in Taranaki, but nowhere else in these provinces. Petroleum is definitely found in Taihape and Taumaranui, but only in faint traces.

For detecting oil in rock, the rock is triturated with acetone, filtered into a test-tube, and distilled water added. The slightest trace of oil, gives a cloudiness in the liquid. Prospecting for oil in New Zealand had been encouraged by the Petroleum Act, 1937 which granted concessions to prospectors, and was given a further impetus by the great need for oil for military purposes after Pearl Harbour.

The speaker outlined the methods of prospecting. These included detailed surface surveys, micropageological examination of drillings, and geophysical methods. The chief of these latter was the seismic method, which involved setting off charges of special dynamite at a depth of about 200 feet, and measuring the time taken by the earthquake waves, reflected

from strata lower down, to reach geophones stationed at certain points on the surface. During drilling, resistivity of the various rocks is measured and recorded electrically, and yields useful information.

Discussing methods of drilling, Mr. Firth stated that under good conditions, modern high tensile steel drills can excavate a hole 18 inches wide at the rate of 100 feet per hour. While drilling, a colloidal bentonite mud is forced in through the centre of the drill. This lubricates the drill, seals the sides of the hole, and floats off the chips. Samples can be taken out with core barrels at appropriate depths, without removing the drill, and can be quickly examined for foraminifera. He concluded by saying that there was very little prospect of any spectacular discovery of oil in New Zealand.

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The June meeting was addressed by Mr. D. McClure, of the Research Dept., Amalgamated Brick and Pipe Co., New Lynn, on "Ceramics."

In a general survey, the speaker covered the whole field of ceramic manufacture in New Zealand, which was a surprisingly wide one, and illustrated it with various exhibits from his own works and those of other manufacturers. He emphasised the difficulties with regard to insufficient and inexperienced man-power and the need for keeping up production with which they were faced in the manufacture of very large quantities of table ware at New Lynn. The meeting concluded with a display of personal pottery by Dr. Briggs.

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The July meeting was addressed by Mr. F. H. Sagar, M.Sc. of the Physics Dept., A.U.C., who dealt with "Low Temperature." The speaker pointed out first the need for accurate methods of measuring temperature at levels far beyond the range of the ordinary Mercury in glass instrument, and the devices used were:—The constant volume hydrogen and helium thermometers; the constant pressure hydrogen and helium thermometers; vapour pressure thermometers, and finally, instruments depending on the variations in electrical resistance with temperature. He discussed the limitations of each method, and then went on to describe methods for obtaining very low temperatures. The lowest temperature so far secured was by de Haas in 1935, viz., .005°A. was obtained by making use of the fact that certain salts, particularly gadolinium sulphate and alums give out heat when placed in an intense magnetic field. If this heat is continuously withdrawn, a large measure of cooling can be secured. Mr. Sagar concluded by pointing

out the value of research at low temperatures in verifying the fundamental laws of Physics, and was accorded a hearty vote of thanks.

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#### PERSONAL NOTES.

Mr. H. D. Orchiston has left the New Zealand Farmers' Fertiliser Co., for Morcom Green Ltd., Onehunga.

Mr. P. D. Horne has returned from New Plymouth to the Auckland Laboratory of the New Zealand Farmers' Fertiliser Co.

Mr. George Dingley has returned to civil life from his appointment with the Commonwealth Ministry of Munitions.

Mr. A. W. Mackney of Forest Products, Penrose, is at present in Australia.

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#### WELLINGTON BRANCH

"Chemists in the Indian Service," was the title of a talk by Dr. H. E. Annett in June. The lecturer did not attempt to give an account of actual Scientific work in India. He dealt with the method of entry into the service, conditions within the Service and with chemical work in general, though mainly with the work of the chemist in the Indian Agricultural Service.

The development of scientific services, as such, in India dates back to only a matter of about 40 years. The Indian Civil Service could only be entered as a result of a very difficult competitive examination. The members of this became either administrative or judicial officers. The need for specialist officers in Engineering, Education, Forestry, Agriculture etc. was soon recognised, and in time, as the numbers of these officers increased, they were organised into separate Services, such as the Indian Education Service, Indian Forestry Service, Indian Agricultural Service and so on. The conditions for entry into the Indian Agricultural Service involved the possession of an Honours Degree of a British University, as well as appearance before a special Selection Committee. In the early days, pay and prospects were much less attractive in the later years of service of members than those obtaining in the Indian Civil Service as such. Conditions were however soon improved, so that the man in the Indian Agricultural Service was placed in a position which compared favourably with those obtaining in the Indian Civil Service.

Reference was made to the practice of granting study leave available overseas to Research officers. In many scientific departments in various countries, the time arises when a scientific man must sacrifice his scientific career, in order to take promotion to an administrative post, because he would otherwise lose heavily financially. Frequently, in such a case, scientific work suffers. This position was overcome, in the Indian Agricultural Service, by the establishment of a Selection Grade to which a man, whose work was recognised as being above the average, could be promoted after 15 years service. The Selection grade carried higher pay and pension, and appointment to a Directorship of Agriculture would mean very little financial benefit to a scientist who was already in the Selection grade.

Early experiences in Chemical work at the Agricultural Research Institute at Pusa were described. At that time there was no gas or electricity or up-to-date water supply. Gradually however, up-to-date Research Laboratories were built at Pusa and at various Provincial centres throughout India. It was stated that in later years facilities for the scientific worker in India were at least as good as those obtaining in England. Excellent scientific libraries were established in every centre and few overseas workers had access so readily to such good libraries.

The assistants were mainly Indian and many of these proved themselves so capable that they now hold posts in the Imperial Service. Tribute was paid to the work of the late Dr. J. W. Leather who took such great care in the training of many of these men who afterwards rose to important positions.

Most of the work was published in *Memoirs and Bulletins* in India itself. In some ways this was unfortunate since many workers overseas did not have access to these and much excellent scientific work done in India is unknown to outside workers.

The Agricultural Chemist, besides being responsible for routine work and Research work on his particular problems, was usually also Professor of Chemistry in his local Agricultural College. So that he combined teaching with his other work. In the early days he had to work at almost any Agricultural problem, but gradually planters established their own Research stations and financed them from their own funds. The Indian Tea Association built up a very successful organisation under the direction of Dr. H. H. Mann, who had been a member of the Indian Agricultural Service. His work put

the tea industry on its feet. The Indigo Research Station also carried out excellent work and could have saved the Indian indigo industry but the planters would not take advantage of the advice offered. In recent years numerous up-to-date sugar cane factories have been established throughout northern India. One of the largest combines wisely obtained the services of Noel Deer, one of the best known men in the sugar world at the time. He was paid well and this policy of selecting a good man and paying him well amply justified itself.

The talk made reference to various humorous episodes which occurred during the career of the lecturer.

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Some twenty members of the Branch paid a visit to the Ford Motor Co's works at Lower Hutt during July, and after being entertained at morning tea by Mr. Jackson, the General Manager, were conducted through the plant and shown the Company's war-time activities which include the reconditioning of war-worn jeeps, the manufacture of hand grenades, and the assembly and testing of shell fuses.

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#### PERSONAL.

At the August meeting, Wellington Branch Book Prize for the best first-year student in Chemistry of Victoria University College was presented to Mr. A. G. McDiarmid.

Mr. J. A. D. Nash, who has been acting as Liaison Officer of the D.S.I.R. in Australia; has returned to Wellington.

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#### CANTERBURY BRANCH.

The Canterbury Branch is devoting its 1945 programme to a series of lectures on possible developments in New Zealand industries. As it was felt that such discussions usually fail through lack of appreciation of economic factors, it was decided to begin the series with a talk on "Economic Aspects of Industrial Development in New Zealand." This was given at the April Meeting by Flying Officer C. G. F. Simkin, Senior Lecturer in Economics at Canterbury College, at present in the Meteorological Office at Wigram.

He began with a consideration of markets for home production which can be expanded in four main ways; by pop-

ulation increase, by raising the level of real income, by opening export markets further, and by replacing imports in the home market. National increase in population is small, and large scale immigration unlikely, we are certainly not entitled to count on it. An increase in real income depends partly on increasing farm exports by finding new markets, since British demand is unlikely to increase if only because of population difficulties. It depends also on our own industrial expansion, and hence on technological estimates of the type which are to be discussed in the lecture course. Colin Clark estimated that New Zealand's real income increased by 2.7 per cent per year between 1925 and 1937, but estimates of future increase are complex and uncertain. It would be rash in view of the emerging competition of synthetics with our exports to base any plan of industrial expansion on an optimistic estimate of the growth of real income. The prospect of export markets being found for our secondary industries is not bright, distance from any potential customers and high transport costs being serious handicaps.

The securest prospect for developing New Zealand manufactures seems to be in replacing imports on the home market. In the period 1935-39, imports averaged £48M per annum, and the output of secondary industries £62M (excluding those processing primary products). If our secondary industries could completely oust imports, they would expand by 75-80 per cent. This upper limit is however fantastically high, as the following table shows. Only one quarter of our normal imports are consumers' goods, a fact which will surprise those who imagine that the bulk of our imports are semi-luxury articles. The bulk of our normal imports are materials and equipment needed to keep our local industries going.

Mr. Simkin discussed the table in detail, without any comfort for optimists being discernable. Possible expansion is seen in the textile and clothing industries, provided they can weave cotton, linen, silk and rayon. Other likely industries are wine spirits and tobacco, cosmetics and patent medicines, canned fruit and jams. To a lesser extent the engineering industries may further develop assembly plants, for household equipment mainly but perhaps also for industrial machinery. Ceramics, glass, leather, paints and varnishes, paper and rubber give some prospect. No spectacular developments seem likely, but the cumulative effect of many small expansions can lead to appreciable industrial progress.

Substitution of imported goods will lead to a fall in the standard of living unless New Zealand manufacturers can produce the same quantity and quality of goods at the same price

as the imports they replace. This is not a great deal to ask since our manufacturers are sheltered by high transport costs for imports as well as by duties up to 150 per cent, and in recent years by an expensive and dubiously efficient system of import control, which has created an acute danger that the New Zealand consumer will be forced to pay through the nose for a limited range of inferior products, and be cut off from any reasonable hope of enjoying the standard of living offered by the world markets. The industrial development of New Zealand is by no means the same thing as the economic progress of the country. If industrial planners are unmoved by consumer difficulties, they would do well to note the danger of too much industrialisation on their own schemes. The bulk of our imports are equipment and materials which are elements in manufacturing costs. If local industries are developed at the expense of this class of imports, the danger emerges that, not only will the standard of living suffer, but industrial expansion itself will run foul of rising costs, caused by dearer or inferior local products replacing cheaper or superior imports. A similar danger arises in regard to the export industries. If industrial expansion raises export costs too far, it will reduce export receipts and so the funds available to purchase the imported materials on which our secondary industries so heavily depend.

More important however are the reactions on our major market—Britain. The British people must export or die, they must export their manufactures to import food, and must buy from those who buy from them. It may be argued that industrial expansion is worth some sacrifice in our living standard because it will protect us from depressions. We should have to sacrifice it very far to obtain a substantial degree of economic stability by this method, and better means exist. Depressions here are produced by slumps in exports, and can be avoided by stabilising exports. The British Government has expressed its anxiety to enter into long term supply contracts with the Dominions to promote greater economic security. Such contracts promise great advantages to New Zealand, but are unlikely to be granted if we are determined on a mutually damaging policy of self-sufficiency.

These remarks must not be construed as a condemnation of any industrial expansion or industrial planning here, but the limitations and complexities of the problem must be understood. The growth of an informed technical opinion is highly desirable, if only to correct the propaganda of ignorant enthusiasts and axe-grinding vested interests. Serious and responsible planning can help to prepare us for the economic ad-

justments which will be forced on us if our export trade is damaged by the competition of margarine and staple fibre.

A vigorous discussion followed. Commenting later on some of the points raised, Mr. Simkin said that advocates of industrialisation sometimes argue that we can make our sterling go further, and inflict no harm on Britain, if we import materials for local industries instead of finished-goods. This argument is valid only if such an expansion can be effected in our consumption of manufactures that funds previously used to import finished goods are exhausted by the purchase of materials. Such an expansion would require either a reduction in the relative prices of local manufactures through an increase in the efficiency of local industries as compared with their overseas rivals, or else an arbitrary and uneconomic diversion of consumers' expenditure and productive resources towards manufacture (e.g. by ration controls, subsidies, manpower direction etc.). But if this expansion were not effected imports would fall off, and various mechanisms would operate to equate exports and imports at a lower level.

VALUE OF IMPORTS AND HOME PRODUCTS IN £M.

Category	1938		1941		
	Imports	Local Prd'n.	Imports	Local Prod'n.	
<b>A. Consumers' Goods</b>					
1. Food	2.1	55.9	1.3	70.3	(56.3)
2. Beverages	1.7	6.4	1.9	9.5	
3. Tobacco	0.8	..	0.0	..	
4. Clothing &c	3.1	7.3	0.5	14.3	(10.0)
5. Household Equipment	3.0	2.0	1.2	2.4	
6. Other	4.0	..	2.0	..	
Sub. Total	14.7=27%	71.6=63%	6.9=14%	96.5=62%	(76)
<b>B. Equipment</b>					
1. Transport	8.3	5.9	2.6	4.5	
2. Other	7.8	1.7	5.8	2.6	
Sub. Total	16.1=29%	7.6=7%	8.4=17%	7.1=5%	(5.7)
<b>C. Manufacturing Materials</b>					
1. Textile Piece Goods	3.2	..	5.5	..	
2. Other	11.4	7.9	14.6	13.2	
Sub. Total	14.6=27%	7.9=7%	20.1=41%	13.2=9%	(10.6)
<b>D. Building Materials</b>					
Sub. Total	4.1=7%	8.9=8%	2.4=5%	10.3=7%	(8.6)

**E. Other**

Sub. Total	5.9=11%	18.4=16%	11.4=23%	28.1=18% (22.1)
<b>Total</b>	55.4	114.4	49.2(37.8)	155.6(122.5)

1941 figures in brackets give values corrected to 1938 basis.

On June 1st, Dr. R. J. McIlroy gave a talk on, "The Utilisation of Forest Products."

The major industries using wood are as follows:—

(1) building, which uses natural wood, plywood, resin-bonded plywood, compressed wood pulp, wood impregnated with urea plastics, lignin plastic sheets, composition of sawdust and cement etc.; (2) the cellulose industries, (a) pulp and paper (b) cellulose derivatives such as rayon and plastics; (3) wood carbonisation, yielding methanol, acetic acid, acetone, and charcoal; (4) acid hydrolysis, giving sugar, alcohol, food yeast and stock food; (5) alkaline hydrolysis, giving vanillin for perfumes, flavourings and dye intermediates. In addition hydrogenation may have possibilities.

The speaker discussed pulping methods in detail, pointing out that the presence of resins in New Zealand pines is a disadvantage when the sulphite process is used but may be overcome by treatment of the pulp with steam. The "sulphate" process, which uses as chemical liquor sodium sulphide and caustic soda, is quite suitable for resinous woods. Kraft paper is manufactured by this process. Forty-five per cent of all wood pulp made in the United States is "sulphate" pulp. In yield, quality of pulp, and cost the "sulphate" process has proved superior to the older sulphite process.

The utilisation of by-products of the pulping industry was considered by Dr. McIlroy. The relief gases from the digester are probably not of commercial importance in a small plant. The waste liquor contains sugar and lignin. Production of alcohol from the sugar is practiced in Europe but has not proved economic in America where cheaper sources of alcohol are available. It would probably be uneconomic in New Zealand.

Lignin, in the speaker's opinion, deserves more attention as a raw material. Normally the lignin from waste pulping liquor is burned as fuel, its somewhat remarkable properties being overlooked. It is resistant to strong acid and alkali and has possibilities as a structural material in chemical plant. Lignin condenses with aldehydes and with aniline to form a thermo-setting plastic. Lignin has been used in America as an

extender or filter for phenolic plastics. Alkaline fusion of lignin yields vanillin but at present the market for this product does not appear to be large enough to absorb all the vanillin which could be produced from waste liquor.

In Germany before the war lignin was incorporated in soil as a soil improver. Being an important constituent of humus lignin absorbs moisture readily. It also absorbs neutral salts and may thus prove useful for the retention of fertilisers and their gradual release to the plant roots.

Some cellulose products including rayon and some of the newer textiles and plastics based upon cellulose derivatives were briefly discussed.

Wood carbonisation is carried out in Southland but the main products are threatened by synthetic processes, methanol by the water-gas method, acetic acid by the product from starch fermentation and from acetylene.

The Bergius and Scholler processes for wood saccharification were outlined. The speaker quoted from a critical survey of the Scholler process recently conducted by American workers which indicated that the process could not operate under peace-time conditions unless a considerable return was obtained from by-products. In Europe, on the other hand, scarcity of other forms of raw material made wood saccharification an economic proposition.

In conclusion it was urged that the sulphite and sulphate pulping methods should be tried on a pilot plant scale using New Zealand pines as raw material; a suggestion which was received with little enthusiasm by the audience.

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### OTAGO BRANCH.

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At the April meeting of the Otago Branch, Dr. N. L. Edson spoke on "The Biological Oxidation of Glucose."

Since glucose is burnt completely by the great majority of respiring cells, the mechanism of biological oxidation has been the subject of much enquiry. There are two distinct methods of degradation:—

A. Oxidation without prior cleavage, the possible sequence of changes being as follows:—Glucose — Glucose-monophosphate — Phosphohexonic acid — 2. Keto-phosphohexonic acid — Pentose-monophosphate — Tetrose-monophosphate — Pyruvate —  $\text{CO}_2$  and  $\text{H}_2\text{O}$ . This method of katabolism is uncommon,

confined to micro-organisms, and no more than partially understood.

B. Oxidation following phosphorylation and cleavage (fermentation) into two molecules of triosephosphate or phosphopyruvate. This is the usual pathway of breakdown in animal, plant and microbial cells. The brilliant and daring hypothesis of carbohydrate oxidation, the Tricarboxylic Acid Cycle, put forward by H. A. Krebs incorporates in a single theory the following facts:—(1) The  $C_4$  — dicarboxylic acid catalysis of Szent Gyorgyi, (2) the oxidation of iso-citric acid to  $\alpha$ -keto-glutaric acid by iso-citric dehydrogenase (Martius and Knopp), (3) the function of aconitase which catalyses the equilibrium, citric acid = cis-acconitic acid = iso-citric acid, (4) the condensation of pyruvate (or triosephosphate) with oxaloacetate to give citrate (Krebs), (5) the oxidation of  $\alpha$ -keto-glutaric acid to succinic acid and  $CO_2$  (Krebs), and (6) the catalytic effects of citrate and other intermediates of the Cycle on glucose oxidation (Krebs). Work with  $C_{13}$  tracer (Evans and Slotin) has shown that the primary condensation product is probably not citric but acconitic acid. One turn of the Cycle leads to complete combustion of one molecule of triose. The Cycle, though not immune from criticism, gives a unified conception of the breakdown of glucose in muscle mince, on which most of the experiments were done, and affords a possible explanation of the production of citric and succinic acids by micro-organisms and, by extension, of the synthesis of certain amino acids by plants.



The Institute as a whole is not responsible for statements and opinions appearing in this Journal.

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Stands, various, etc.

Besides the regular types of apparatus, our workshop staff is capable of making up special apparatus to customers' own designs. In all our work the best materials are used and good workmanship is given first place in every phase of assembly. Repair work is also undertaken.

The oven depicted above is one of our standard high temperature electric ovens, triple-walled and well insulated, made in various ranges up to 200°C. The standard sizes are 10" x 10" x 12"; 12" x 12" x 15" and 15" x 15" x 18" inside, the greater figure being the height in each case.

Other types to order.

Incubators are made in the same style and of the same sizes, but are water jacketed.

Enquiries and requests for quotations will be very welcome.

**GEO. W. WILTON & CO. LTD.**

156 WILLIS STREET,  
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63 SHORTLAND STREET,  
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