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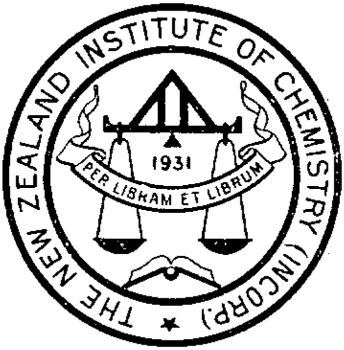
JOURNAL

of the

NEW ZEALAND INSTITUTE of CHEMISTRY



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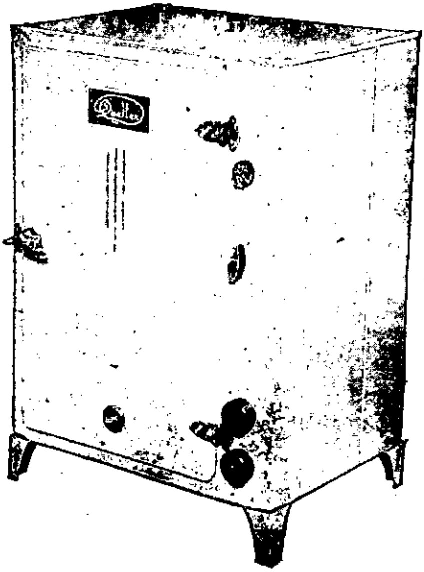

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NEW ZEALAND INSTITUTE OF CHEMISTRY

VOLUME X. AUGUST, 1946 NO. 3

EDITORIAL.

The abstracts of papers for the Conference which are published in this issue show a wide range of subjects for explanation and discussion. We find some of them slightly intimidating. The interests of New Zealand chemists are wide, and the membership of our Institute is now large enough for the Conference sections to meet simultaneously. A re-grouping of papers seems called for in some cases. A section on Theoretical Chemistry could include three of the papers of the University Session and those of Messrs. Brown and Green. Mr. Fastier's paper appears to be closely related to some of those in Section 4. Sufficient work is being done on New Zealand plant products to justify a special section. Such work is not closely related to theoretical chemistry which is now virtually a part of theoretical physics. We can imagine a division taking place, in the not far distant future, in what is traditionally the subject of Chemistry in the University, as the influence of physics grows, and the unification of theoretical principles increases. Such changes are inevitable as we delve deeper in to our problems, and some of us are already more at home with our physicist colleagues than in the now heterogeneous group covered by the term "Chemist."

Correspondence should be addressed to Dr. H. N. Parton, Canterbury College, Christchurch.

The address of the Hon. Secretary is P.O. Box 250, Wellington.

THE ANNUAL CONFERENCE
of
THE NEW ZEALAND INSTITUTE OF CHEMISTRY
and
The New Zealand Section of
THE ROYAL INSTITUTE OF CHEMISTRY OF GREAT BRITAIN AND IRELAND

will be held in Wellington, on August 27th-30th, 1946.

Places of meeting:—St. Francis Hall, Hill St., Wellington, N.1.
Biology Block, Victoria University College.

PROGRAMME.

AUGUST 27th, 10 a.m. St. Francis Hall.

Welcome by His Worship The Mayor of Wellington, Mr. Appleton.

Address to members of Conference by the Hon. D. G. Sullivan, Minister for Scientific and Industrial Research.

Informal Morning Tea.

AUGUST 27th, 2 to 4.30 p.m. St. Francis Hall.
(Tea break from 3 to 3.30 p.m.)

INDUSTRIAL SESSION. Chairman: Mr. H. G. Woolman, Reckitt & Colman, Dunedin.

1. Fuel Efficiency.	By V. Armstrong, Dominion Laboratory, Wellington.
2. Crushing and Grinding	By S. R. Siemon, Canterbury College, Christchurch.
3. Timber Preservation.	By N. L. Wright, Technical Consultant, Auckland.
4. Quick Freeze.	By M. S. Carrie, Wattie Canneries, Hastings.

AUGUST 27th, 8 p.m. St. Francis Hall.

PRESIDENTIAL ADDRESS. Chairman: Mr. R. L. Andrew, Director, Dominion Laboratory.

Dr. H. E. Annett, President of the New Zealand Section of the Royal Institute of Chemistry of Great Britain and Ireland, will deliver his Presidential Address entitled:—
"The Application of Scientific Principles to Practical Farming in New Zealand."

AUGUST 28th, 9.30 to 12.30 p.m. Victoria University College, Biology Block. (Tea break from 10.45 to 11.15 a.m.)

ANALYTICAL METHODS SESSION. Chairman: Dr. R. J. McIlroy, Canterbury University College, Christchurch.

5. X-ray Crystallographic Analysis of Clays in Soils.
   By J. Rogers, Soil Bureau, Wellington.
6. Application of the Spectrophotometer to the Problem of coloured complex Ions.
   By J. B. Brown, Public Hospital, Auckland.
7. Methods of Testing Soils for Corrosiveness.
   By G. D. Gemmell, Soil Bureau, Wellington.
8. The Citric Solubility of Serpentine Superphosphate.
   By W. E. Russell N.Z. Farmers Fertiliser Co. Auckland

AUGUST 28th, Afternoon.

Visits. Conference Members are invited to visit a number of local Laboratories and Works.

Council of the New Zealand Institute of Chemistry will meet at 2 p.m.

Sub-Committees will meet as arranged.

AUGUST 28th, 8 p.m. Victoria University College, Biology Block.

ROYAL SOCIETY CONVERSAZIONE.

Members of Conference are invited to be Guests of the Royal Society (Wellington Branch) at a Conversazione, to be held at Victoria University College, Biology Block, at 8 p.m.

AUGUST 29th, 9.30 to 12.30 p.m. St. Francis Hall. (Tea break 10.45 to 11.15 a.m.)

UNIVERSITY SESSION. Chairman: Mr. A. D. Monro, Victoria University College, Wellington.

9. Transport Number and Vapour Pressure Measurements in Relation to the Constitution of some Complex Ions.
   By R. A. Robinson, Auckland University College, Auckland.
10. The Solubility of Ionic Crystals.
   By H. N. Parton and M. L. McGlashan, Canterbury University College, Christchurch.
11. The Pharmacological Activity of Amidine Derivatives in relation to certain of their Physico-Chemical Properties.
   By F. N. Fastier, Otago University.
12. Liquid-Liquid Extraction.
   By W. S. Metcalf, Victoria University College, Wellington.

AUGUST 29th, 2 p.m. St. Francis Hall.

GENERAL MEETING of the New Zealand Institute of Chemistry (Inc.) followed at 4 p.m. by the

GENERAL MEETING of the New Zealand Section of the Royal Institute of Chemistry of Great Britain and Ireland.

AUGUST 29th, 8 p.m. St. Francis Hall.

PRESIDENTIAL ADDRESS. Chairman: Mr. J. L. Mandeno, Chairman of the Local Conference Committee.

Dr. J. C. Andrews, President of the New Zealand Institute of Chemistry will deliver his Presidential Address entitled: "The Scope of Science in the Dominion."

AUGUST 30th, 9.30 to 12.30 p.m. Victoria University College, Biology Block. (Tea break from 10.45 to 11.15 p.m.)

AGRICULTURAL AND BIOCHEMICAL SESSION. Chairman: Dr. H. O. Askew, Cawthron Institute, Nelson.

13. The Nature of the C_{20} unsaturated Acids of Animal Fats.
    By F. B. Shorland, Fats Research Laboratory, D.S.I.R. Wellington.
14. The Mustard Oil Glucosides of the Cruciferae, in relation to Taint in Milk and Cream.
    By F. H. McDowall, Dairy Research Institute, Palmerston North.
15. Adsorption and Desorption of Water Vapour on Collagen.
    By R. W. Green, R. Greenwell Ltd., Auckland.
16. Improvement of Rapid Methods of Tissue Testing.
    By E. B. Kidson and J. Heath, Cawthron Institute, Nelson.

The Conference officially concludes on August 30th, at 12.30 p.m.

AUGUST 30th. Afternoon.

VISITS will be arranged as required to Laboratories or Works.

GENERAL MEETING.

A General Meeting of the New Zealand Institute of Chemistry
will be held in the St. Francis Hall, Hill Street,
Wellington, N.1. on August 29th, 1946
at 2 p.m.

BUSINESS:—

Confirmation of previous Minutes, Palmerston North, 29-8-45.

Business arising from the Minutes.

President's Remarks. Dr. J. C. Andrews.
Empire Science Conference.
Membership of the Institute—Dr. S. N. Slater.
✓Standard Methods of Analysis—work of Sub-Committee.
Union Membership—attitude of Chemists.
xResearch and Routine Work—statement by Mr. R. L. Andrew.
✓Chemists Employment Committee.
Laboratory design—availability of information.
Greetings and General.

SUMMARIES OF PAPERS TO BE READ AT CONFERENCE.

PAPER No. 1

FUEL EFFICIENCY.

By V. Armstrong, Dominion Laboratory, Wellington.

There are a number of factors to be considered, not only in the boiler house but also in the factory, if efficiency is to be obtained in the combustion of fuel. To a greater or lesser degree these factors have to be considered whether burning coal, oil, coke or wood. Amongst these factors are such as:—

(1) Method and condition of firing.
(2) Construction of furnaces.
(3) Cleanliness of Boilers.
(4) Lagging and Insulation of plant.
(5) Housing of Plant.
(6) Unburned Coal.
(7) Air for combustion.
(8) Peak Loads.
(9) Steam and water losses.
(10) Working efficiency of plant.
(11) Instruments and records.
(12) Boiler House staff.

Time permitting a short film "Steam" will be shown covering the efficient utilization of steam.

PAPER No. 2

CRUSHING AND GRINDING.

By S. R. Siemon, Canterbury.

Gross, working with a frictionless drop weight machine, has shown that fracture surface produced is proportional to power consumed i.e., Rittinger's Law fits the results from this apparatus. The work to be described was directed to the same end using commercial type machines, in this case a small Dodge Jaw Crusher and a Ball Mill.

Measurements were made on a quartz bonded sandstone, marble and coal. Power consumed by the Direct Current Motors was measured on a recording wattmeter with variable chart speed (Esterline Angus). Sizes of larger particles were measured by sieving into seven fractions and calculations based on a mean diameter. Finer sizes were measured by the method of Lea and Nurse based on the Kozeny Equation, which gave a value for specific surface, hence a weighted mean diameter.

The results indicated that:—

1. Rittinger's Law, at least qualitatively, fits the production of surface in these two machines.
2. The effects of internal surface production and friction losses do not affect the results appreciably for big reductions in size (over 10:1 in the Ball Mill).
3. As in metals, the proportion of internal surface is probably dependent on speed of deformation.
4. The value of specific surface in permeability apparatus measurements depends on the porosity of the bed.

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PAPER No. 3

TIMBER PRESERVATION.

By Nevill L. Wright, Technical Consultant, Auckland.

TIMBER RESOURCES OF N.Z.: Brief discussion of the past history of timber from the time when large areas of valuable timber were destroyed to open up country for farming, up to the present time when the supply of durable timbers is low and still declining. This shortage has resulted in a much needed integration of timber resources, leading to a search for efficient and economic methods of rendering the larger supplies of native sapwoods and Pinus Radiata immune from attack by destructive agencies.

DESTRUCTIVE AGENCIES: Description of the main wood destroying agents, including borer insects, notably anobium and ambeodontus, termites and fungi.

PERMEABILITY OF TIMBER: Effective timber preservation is dependent on whether non-durable timbers can be economically treated. Refractory timbers such as Australian hardwoods are very difficult to treat, but all the largely available sapwoods and Pinus Radiata are permeable or easy to treat.

CLASSES OF PRESERVATIVES:—

1. Creosote.
2. Spirit solubles such as metallic naphenates and pentachlorphenol.
3. Water solubles such as zinc chloride or chromated zinc chloride and Wolman Salts.

METHODS OF APPLICATION.

1. Brush and spray treatment.
2. Hot and cold soaking and cold dipping.
3. Pressure impregnation.

SPECIFICATIONS in New Zealand, etc.

ESSENTIAL REQUIREMENTS for EFFICIENT PRESERVATION:

1. Availability of effective preservatives.
2. Availability of modern pressure plants.
3. Efficient operation of such plants by experienced specialist staff.
4. Availability of a team of specialists for research, continuous supervision of plant operation, and of servicing—all combining to ensure efficient service at the lowest possible economic cost.

MODERN PLANT AND PROCESS: Description of plant being erected in the Dominion, and method of use.

PAPER No. 4

QUICK FREEZE.

By M. S. Carrie, J. Wattie Canneries, Hastings.

Quick freezing is a method of food preservation by which the foodstuff is cooled rapidly to a temperature of approximately 0°F and is stored at that temperature until it is consumed. This rapid cooling results in the formation of very small ice crystals and minimises damage to the cell structure of the foodstuff. The frozen product is sealed into moisture-proof packages in order to avoid dehydration during storage. Since the raw material can be processed when thoroughly ripe, and quick-freezing has less effect on the flavour, colour, texture and palatability of the fresh product than has any other method of food preservation, it is the nearest approach to a perfect method known at present.

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PAPER No. 5

X-RAY CRYSTALLOGRAPHIC ANALYSIS OF CLAYS IN SOILS

By J. Rogers, Soil Bureau, Wellington.

Introductory remarks outline the principles of X-ray Crystallographic analysis and its part in determining the structure of the minerals in the colloidal fractions of soils. An illustrated description of the Metropolitan—Vickers "Raymax" crystallographic X-ray unit located at the Dominion Laboratory is followed by details of its use. Some of the topics discussed are the preparation of specimens, times of exposure, development of film and methods of identification of the diffraction patterns obtained. Slides of the diffraction patterns of the type minerals and the clays from New Zealand soils are shown. In conclusion a summary of the scope and limitations of the technique will be given.

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PAPER No. 6

APPLICATION OF THE SPECTROPHOTOMETER TO THE PROBLEM OF COLOURED COMPLEX IONS.

By J. B. Brown.

An investigation has been made of the cause of the blue colour developed by cobalt chloride solutions on the addition of other chlorides, specifically calcium and lithuim chloride, at higher concentrations. Spectrophotometer measurements have been made at different concentrations and they will be discussed with the object of ascertaining if they can be used to distinguish between the alternative theories of hydration and complex ion formation which have been advanced to explain this development of a blue colour.

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PAPER No. 7

METHODS OF TESTING SOILS FOR CORROSIVENESS

G. D. Gemmell, Soil Bureau, Wellington.

This paper discusses briefly the mechanism and causes of underground corrosion and describes laboratory tests used to estimate the corrosion to be expected in particular cases. A brief account of the generally accepted electrochemical theory of corrosion is given. The more important single factors involved, such as high acidity and low electrical resistivity of soils, differences in characteristic of adjacent soils, stray currents, physical and chemical non-uniformities in the metal, and anaerobic bacteria, are discussed.

Laboratory tests used in predicting the likely performance of a particular metal laid underground under specified conditions are described. These include the determination of such soil properties as total acidity, electrical resistivity and soluble salt content, texture and water holding capacity. A modificaton of the Denison cell test, which has been used for the study of corrosion phenomena by the U.S. National Bureau of Standards, is described.

Correlation between the results of laboratory tests and those obtained in the field is discussed. Measures used to prevent or minimise losses due to corrosion are outlined.

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PAPER No. 8

THE CITRIC SOLUBILITY OF SERPENTINE SUPERPHOSPHATES.

By W. E. Russell, N.Z. Farmers Fertiliser Co., Auckland.

The problem of devising a simple laboratory solubility test for evaluating insoluble phosphates has long been one which has troubled agricultural chemists. The subject took definite shape when Wagner showed by means of pot experiments that the value of Bessemer process basic slags bore a direct relationship to their solubility in a 2% citric acid solution.

The application of this method to all types of insoluble fertilizers, however, has led to inconsistent results, and it is probable that more controversy has raged around the point of citric solubility than most others coming within the direct purview of the agricultural chemist.

The citric solubility test was adopted for the analysis of serpentine superphosphate, a phosphatic fertilizer which was introduced in New Zealand in 1940, and which consists of three parts of superphosphate and one part of magnesium silicate or serpentine.

There is, however, still much difference of opinion on the use of citric acid as a solvent in determining the "availability" of phosphates. The test has been found to give inconsistent results for some types of basic slags and for native phosphates, and it was considered that a study of the analytical procedure used in estimating the citric acid soluble phosphates would yield evidence helpful in determining the limitations of this method in the case of serpentine superphosphate.

Experimental results showing the variation of physical factors and their effect on citric solubility are given. These factors including fineness of grinding, and time and method of extraction, must be rigidly fixed in comparative tests on serpentine superphosphate. The relationship between phosphate soluble in 2% citric acid solution and total phosphates has been investigated over a range of solubilities. Results show that the citric acid test gives inconsistent values for different weights of sample dissolved in the same quantity of solvent. Of the various solvents which have been investigated to overcome this difficulty, oxalic acid appears to be the most promising.

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PAPER No. 9

TRANSPORT NUMBER AND VAPOUR PRESSURE MEASUREMENTS IN RELATION TO THE CONSTITUTION OF SOME COMPLEX IONS.

By R. A. Robinson, University College, Auckland.

From vapour pressure measurements on solutions of uni-bivalent salts such as $CaCl_2$ and Na_2SO_4, it can be shown that nearly all salts fall in a regular sequence determined by ionic size and hydration. Although cadmium nitrate and zinc perchlorate and nitrate behave like other uni- bivalent salts, the halides of these two metals are anomalous and the anomaly is most pronounced in the case of zinc chloride and least with zinc iodide. Similar anomalies and a similar sequence is found for the transport numbers, which become negative in concentrated solutions, and also for the vapour pressures of solutions of K_2ZnX_4 where X is one of the three halides. A series of vapour pressure measurements will be described on solutions containing calcium and zinc chloride in different ratio which appear to establish not only the existence of complex chlorozincate ions but also their formula as $(ZnCl_4)^{=}$. From measurements on solutions of calcium chloride and zinc chloride in equimolecular amounts, the osmotic coefficient of $Ca(ZnCl_4)$ is found to be very large. This implies that in contrast to ions like $SO_4^{=}$ the $ZnCl_4^{=}$ ion must be very large and support for this can be obtained from crystallographic measurements. In brief, the formula of the complex zinc ion has been established as $ZnX_4^{=}$ and its stability increases in the order $ZnI_2 < ZnBr_2 < ZnCl_2$.

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PAPER No. 10

THE SOLUBILITY OF IONIC CRYSTALS.

By H. N. Parton and M. L. McGlashan.

The solubility of a salt is determined by a balance between the energy needed to break down the crystal and that obtained when the ions dissolve, and also by the corresponding entropy changes. These in turn depend on fundamental physical factors such as ion size charge and type, and similar factors for the solvent molecules. Some "anomalous" solubilities will be considered from this viewpoint.

Measurements have been made on the solubility of silver chloride in methanol-water mixtures. The heat evolved on solution of the ions from the gaseous state (obtained indirectly) is almost independent of the solvent, but the entropy changes are more negative in methanol than in water. As a negative entropy change represents increase in ordered motion, it appears that the replacement of a water molecule by an ion causes less ordering than the replacement of a methanol molecule. This is attributed to the hydrogen bonding in water, which has already produced some order in the structure.

Measurements on lead halides are difficult to interpret on account of ion-association. Lead iodide is much less soluble in water than the chloride or bromide. Study of the change in solubility of the latter salts with increasing methanol content in the solvent, led to the forecast that the plot of solubility of PbI_2 against per cent methanol should have a minimum. This has been confirmed.

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PAPER No. 11

THE PHARMACOLOGICAL ACTIVITY OF AMIDINE DERIVATIVES IN RELATION TO CERTAIN OF THEIR PHYSICO-CHEMICAL PROPERTIES.

By F. N. Fastier, Otago University, Dunedin.

Methyl iso-thiourea sulphate is a new pressor drug that has been employed locally for maintaining the blood pressure in spinal anaesthesia. It causes the contraction of different organs containing smooth muscle, its pressor action appearing to depend in part at least upon direct stimulation of the musculature of blood vessels.

Certain of its chemical relatives have been found to produce similar effects.

These 'active' chemical relatives of methyl iso-thiourea are all amidine derivatives of one sort or another; whether classified further as iso-thioureas, iso-ureas, guanidines or plain amidines, they all contain an amidine (—N=C—N=) group. So far as can be judged from sieving experiments, derivatives of methyl iso-thiourea belonging to such (relatively) non-basic groups as the thioureas, ureas, carbamates and imino-ethers do not display comparable activity, however closely they may resemble it chemically in other respects.

While compounds so diverse in structure as salts of methyl iso-thiourea, ethyl iso-urea, as.—dimethylguanidine, propion-amidine, S,N—ethylene iso-thiourea, 2—aminopyridine and iminazole are all strongly pressor, apparently because they possess the amidine skeleton —HN—C(:+NH—)—, such activity is less evident in their higher homologues. It seems, however, that pressor activity is inconspicuous in amidine derivatives of fairly high molecular weight, not because they lack entirely the capacity to constrict blood vessels (and so raise the blood pressure) but because this property is masked increasingly by an opposing (blood vessel dilating) tendency when a homologous series is ascended.

It is suggested (i) that all except the largest amidine cations can interact with anionic receptor elements in muscle: (ii) that the physical properties conferred by the longer side-chains cause the larger cations to be retained longer (statistically) by these receptor elements than the smaller cations; and (iii), that by 'sticking' longer, the larger cations are able to produce a more drastic derangement of muscle function, as evidenced for example by the vasodilation and diminished response to adrenaline that can be observed even when they are given in quite small doses.

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PAPER No. 12

LIQUID-LIQUID EXTRACTION.

By W. S. Metcalf, Victoria University College.

1. The distribution law. 2. Deviations. 3. Measurement of the distribution coefficient directly and 4. from the ratio of the concentrations of consecutive extracts.

Batch extraction. 5. For a given degree of extraction, extractant is saved by increasing the number of extractions, but beyond three or four extractions the saving in extractant is not commensurate with the increased labour. The appendix expresses this point quantitatively. 6. Extraction is most efficient when all the extracts are of equal volume.

Continuous Extraction (not countercurrent). This corresponds to an infinite number of small batches. 7. The minimum amount of extractant that must pass through the extractor is not much less than that required for a few batch extractions and is given in the Appendix.

Counter-current Extraction. 8. The amount of solvent required is given by $A=1$ (Appendix). 9. The ratio of the volumes of solution and extractant passing in opposite directions through the extractor in unit time must be kept equal to the distribution coefficient. If this ratio is too great extraction is incomplete, if too small, more than the minimum amount of extractant is needed.

Separation of two substances. 10. A scheme is presented for the separation of two substances each in a predetermined state of purity and with no losses.

Appendix 11. Total extraction required $= A \times \frac{V}{D}$

V is the volume to be extracted, D is the distribution coefficient given by

$$D = \frac{\text{conc. in extract}}{\text{conc. in solution.}}$$

A is given in the following table:—

Fraction left unextracted	Number of Extractions.												
	1	2	3	4	5	6	7	8	9	10	100	Contin.	Counterflow
1/10	9.0	4.3	3.5	3.1	2.9	2.8	2.8	2.7	2.6	2,6	2.3	2,3	.90
1/100	99	18	11	8.3	7,6	6.9	6.4	6.2	6.0	5.9	4.7	4,6	.99
1/1000	1000	61	27	19	15	13	12	11	10	9.9	7.1	6.9	.999

Proofs are available for each statement, but time will not permit a detailed presentation.

PAPER No. 13

THE NATURE OF THE C_{20} UNSATURATED ACIDS OF ANIMAL FATS.

By F. B. Shorland, Fats Research Laboratory, D.S.I.R., Wellington.

C_{20} Unsaturated Acids are found as major constituents of the fats of marine animals and in the phosphatides of animals and organs especially the liver.

In the case of marine animal fats the monoethenoid acid gadoleic (9:10 eicosenoic) acid has been isolated and its constitution clearly established.

Tetra and penta ethenoid acids of the C_{20} series have from marine sources also been described but their constitution apart from the straight chain structure is still regarded as uncertain.

From the liver lipids and other organs of land animals there has been isolated a C_{20} penta ethenoid (arachidonic) acid.

Arachidonic acid in common with other polyethenoid acids yields on bromination in cold ether a high melting point insoluble polybromide. Application of this reaction to the depot fats of land animals shows the presence of traces of arachidonic or similar acids and the tendency has been to assume that the C_{20} unsaturated acids are exclusively arachidonic or other similar polyethenoid acids.

In work recently carried out by the author in association with P.B.D. de la Mare it has been shown that the traces of C_{20} unsaturated acids which occur in pig depot fat can be only partially accounted for as arachidonic, the main C_{20} constituent being 11:12 eicosenoic acid which has not hitherto been found in animal fats.

Further work on other fats has suggested that this new acid may be a common constituent of animal fats.

Some consideration will be given to the origin and function of C_{20} unsaturated acids in animals.

PAPER No. 14

THE MUSTARD OIL GLUCOSIDES OF THE CRUCIFERAE IN RELATION TO TAINT IN MILK AND CREAM.

By F. H. McDowall, Dairy Research Institute, Palmerston North.

Many feeding materials and many weeds when consumed by milking cows cause taint in the milk and in the cream and butter produced from the milk. A large proportion of the taint producing weeds are Crucifers.

These plants generally contain a mustard oil glucoside, the nature of the mustard oil varying from the low boiling allyl isothiocyanate to the high boiling, only slightly steam volatile p—hydroxy benzyl isothiocyanate.

The actual tainting substance in milk and cream has never been definitely related to the isothiocyanate glucoside, and it is an inference, not founded on clear-cut evidence, that the glucoside is the source of the taint.

One author claimed to have shown that the glucoside passes direct into the milk, but taint appears only when the milk or cream become contaminated with bacteria that can split off the isothiocyanate; but the evidence is not cogent, although it has been accepted by many subsequent workers. At any rate it is only a partial truth, as the taints are often present in the milk when drawn.

In New Zealand, apart from the Crucifer feeds like Choumoellier and Turnips, much trouble is experienced through taint from a Crucifer weed. Coronopus didymus (generally known as land cress). The taint is much less marked in the cold cream than in heated cream, but persists after the heated cream is cooled. The critical temperature is about 180°F.

Steam distillation of the plant gave benzyl cyanide. Extraction of the glucoside with alcohol and decomposition of its silver salt with sodium thiosulphate gave benzyl isothiocyanate.

Addition of these substances to milk or cream did not give the characteristic land cress taint to the butter.

Garden cress, like the land cress, gives benzyl cyanide on steam distillation and benzyl isothiocyanate via the silver salt, but when fed to cows does not cause typical land cress taint in the cream.

The inference is that the glucoside is not responsible for the land cress taint which would then be due to an unknown substance present in land cress but not in garden cress; but in view of the general occurrence of the glucosides in the plants which cause taint, it is difficult to accept the view that the production of taint is independent of the isothiocyanate in the plant.

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PAPER No. 15

ADSORPTION AND DESORPTION OF WATER ON COLLAGEN.

By R. W. Green, R. Greenwell Ltd., Auckland.

The water content of collagen, the principal skin protein, varies with the aqueous vapour pressure, following the familiar sigmoid curve. This relationship has been studied by means of the isopiestic method used by Dr. Robinson for aqueous solutions. Equilibrium is attained in 1 day for adsorption and about 5 days for desorption, compared with the 3—6 weeks taken by previous investigators. At any given vapor pressure two different values of the water content are obtained according as the point is approached from above or below. That is, the adsorption and desorption curves are not coincident but exhibit a hysteresis loop. The previous history of the collagen affects the adsorption isotherm in another way. If the sample is dehydrated to a water content of less than about 4%, the subsequent adsorption curve is appreciably lower than the normal throughout most of its length. This effect increases with increasing degree of dehydration. Oven drying at 103°C. has an even stronger influence. An attempt will be made to interpret these experimental results in the light of the adsorption theory of Brunauer, Emmett and Teller, J. Amer. Chem. Soc., 60 309 (1938).

PAPER No. 16

RAPID METHODS FOR TISSUE TESTING.

By E. B. Kidson & J. Heath, Cawthron Institute, Nelson.

The paper contains a short account of preliminary work carried out in an attempt to determine the usefulness of rapid plant tissue tests for the study of deficiencies, toxicities and general nutrition of the tomato plant. The methods used were essentially those published by Carolus of the Virginia Truck Experiment Station, though several modifications have been introduced.

POTASSIUM.

More consistent results have been obtained by using a suspension of sodium cobaltinitrite in alcohol to precipitate the potassium than by adding the cobaltinitrite solution and alcohol separately.

MAGNESIUM.

The formation of a flocculent precipitate has been avoided by using smaller quantities of both titan yellow and plant extract, viz. $\frac{1}{4}$ of the former and about 1/100 of the latter.

RELATION BETWEEN RESULTS OBTAINED BY TISSUE TEST AND BY ORDINARY METHODS OF ANALYSES.

Data are given for potassium, calcium, magnesium and phosphorus. In the samples tested no consistent relationship is found between the figures obtained by the tissue tests on the fresh petiole and those given by standard laboratory methods in the dried petiole of corresponding leaf.

TISSUE TESTS ON PLANTS GROWN IN RIVER SAND WITH DIFFERENT FERTILIZER TREATMENTS.

Deficiencies of potassium, nitrogen and phosphorus and also excess of potash are reflected in the tissue tests. The results also give indications of the influence of a deficiency or excess of one element in the uptake of another. Analyses by ordinary laboratory methods are given of the corresponding leaves.

FIELD TEST.

Tissue tests of tomato plants in the field indicated the usefulness of the method in the diagnosis of nitrogen deficiency. No obvious deficiencies of Ca, Mg or P have been identified in the field. Considerable variations have been found for potassium but no definite conclusions reached as to their significance.

It is pointed out that a number of factors must be taken into account in the interpretation of tissue tests, e.g. method and time of sampling, age of the plant, climatic conditions, and the relationship of one element to another.

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COUNCIL MEETING.

July 20th, 1946.

The President, Dr. J. C. Andrews presided over a Council Meeting at which the following decisions were taken.

The resignation of the Assistant Secretary, Mr. L. Wilkinson, was accepted with regret, and appreciation of his services recorded.

Mr. I. S. Hunt was appointed secretary of the Chemist's Employment Committee.

The President and Secretary are to prepare a full statement on the appointment of a Registrar, for consideration by Branches.

The Institute is to accept responsibility for the Chemistry Section of the Science Congress to be held in Wellington in May, 1947. Branches are to consider the possibility of combining the Annual Conference with the Congress.

The following sub-committee was appointed to supervise the Laboratory Assistant's Certificate: Messrs. W. A. Joiner, D. J. Fraser, T. A. Rafter, S. Lambourne, N. T. Clare and Dr. J. K. Dixon.

The annual grant to Branches was increased to £1, Branches to meet their own expenses as at present.

The following resignations were accepted with regret: Mrs. E. C. McLaughlin, Miss M. J. Taylor, Messrs. G. B. Jones, W. Ridland and R. C. M. Stewart.

Branches are to consider a recommendation that the teaching of General Science including Chemistry to School Certificate standard, be accepted as practical experience for a teacher applying for membership, if such teaching occupies most of his time.

Dr. L. H. Briggs was appointed to represent the Institute at the Adelaide Conference in August. The President conveyed greetings to the Institute from Mr. Bradley Dewey, President of the American Chemical Society.

ELECTION OF ASSOCIATES.

Council has much pleasure in announcing the election of the following Associates and in welcoming them into the Institute.

Miss R. P. Mauger, M.Sc., John Edmond Industrial Research Fellowship, now has a Wool Board Fellowship at Otago University.

J. Rogers, M.Sc., is a graduate from Canterbury College. For four years he was in Melbourne with the Physical Chemistry Section of the Division of Industrial Chemistry. He is now attached to the Soil Bureau, D.S.I.R., Wellington.

G. R. Muir, B.Sc., (Otago) was until recently sole Chemist to Bacon Factory subsidiaries operated by the N.Z. Pig Marketing Assn. He has now accepted an appointment to Messrs. Sutherland's Tannery, Onehunga.

J. Urlwin, B.Sc., completed his degree at Canterbury College and is now Chemist to H. C. Urlwin Ltd., Christchurch.

H. S. Ayling, M.Sc., took his degree at the Auckland University College and has been with Industrial Chemicals (N.Z.) Ltd. for over three years.

S. L. Dorofaeff, B.Sc., Canterbury College, is at the Animal Research Station, Ruakura, Hamilton.

I. E. Coop, M.Sc., (Canterbury College) D.Phil, (Oxford) has recently returned to New Zealand after four years in London as Scientific Liaison Officer. We wish Dr. Coop every success in his appointment to the Chair of Animal Husbandry at Canterbury Agricultural College, Lincoln.

After being awarded Senior Scholarships in Chemistry and Physics in 1935 and the 1851 Exhibition Science Research Scholarship in 1936, Dr. Coop did work on Molecular Structure by dipole moments and electron diffraction at Oxford, work on animal nutrition and biochemistry at Cambridge and a year on biochemistry at the Plant Chemistry Laboratory, D.S.I.R., N.Z.

Miss B. J. Levien, M.Sc, Auckland, after a year with the Westfield Freezing Co. took up her present position as Demonstrator in Physical Chemistry at Auckland University College.

I. Reifer, Dr. Ing., was awarded his degree from the University of Brunn, Czecho-Slovakia in 1932. Dr. Reifer has been with the Plant Chemistry Laboratory in Palmerston North for many years and is well known by his publications in the Journal of Science and Technology and elsewhere.

K. W. Kiddle, M.Sc., Victoria, after a period with the Municipal Milk Dept., Wellington, transferred to National Carbon Pty. Ltd. He has recently moved to Christchurch as Chemist to Fletcher Humphreys and Co. Ltd.

M. E. Pattinson has the distinction of being the first Associate of the New Zealand Institute of Chemistry to be elected as the result of the Institute's examination. Mr. Pattinson has been with Messrs. H. W. Lawrence and Son, Johnsonville, Consulting Chemists, since 1941 and is well known to Branch members in Wellington.

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BRANCH NOTES

AUCKLAND BRANCH.

The meeting on March 26th was devoted to "Optical Methods of Analysis." Mr. D. Whillans, of the Auckland Hospital, described the characteristics and uses of barrier layer and vacuum type photocells. He illustrated his lecture with numerous photographs and diagrams. The barrier layer photocell, said Mr. Whillans, was essentially a copper or iron anode coated with a semi-transparent collector cathode of gold, platinum, copper or lead. The whole was enclosed usually in a bakelite case with terminals and a transparent window through which the cell was illuminated. The vacuum type consisted of a coated cathode with an anode in an evacuated glass envelope. The latter type required an applied voltage while the barrier layer cell did not require any external source of voltage. Most of the commercial instruments used barrier layer cells for this reason. For exact measurements, however, vacuum tube instruments could be easily measured and amplified while the output of the barrier cell could be amplified only by means of a complicated potentometer.

Mr. J. B. Brown then gave a talk on the uses and capabilities of colorimeters and spectrophotomers and the theory underlying their use. He confined his remarks to absorption colorimetry, where light of known wavelength and the degree to which that light was absorbed by a medium was being considered. In fluorimetry, on the other hand, light on passage through a medium was changed to light of different wavelength. He showed examples of typical absorption curves, obtained by plotting the amount of light absorbed against the wavelength for a constant concentration and thickness of the medium being studied. Such a curve was useful not only in identifying the pigment present, but also in identifying the chromophoric groups in the molecule. The effect of concentration on the shape of the curve was also demonstrated, and the Lambert-Beer law of absorption explained. The speaker referred to the different types of colorimeters and tintometers and their uses, and concluded by outlining some miscellaneous applications of the spectrophotometer, such as the measurement of pH, the indication of end-points in titration, and the estimation of two or more coloured compounds in a solution.

The last speaker for the evening, Mr. R. M. Allison, M.Sc., of the Dominion Laboratory, spoke on fluorimetric methods of analysis. These methods, he said, had been widely used in the estimation of vitamins, alkaloids, and many other physiologically important compounds such as the carcinogenic hydrocarbons, The general process underlying the phenomenon of fluorescence was one of energy transfer to absorbing molecules, which became activated and re-emitted some of the absorbed energy as radiation. The intensity of the emitted light was in the ideal case proportional to the number of molecules capable of absorbing the exciting wavelength, and according to the law of the conservation of energy the emitted light must have the same or smaller energy than the incident radiation, i.e., it must have a longer wavelength. The activating source of radiation was usually a high pressure mercury vapour lamp, or other light source rich in ultraviolet radiation. The straight line relationship between fluorescence and concentration was affected in practice by a number of factors which were then dealt with in detail by the speaker. These included: absorption of u.v. radiation that is not re-emitted as fluorescence by the substance being estimated; absorption of incident u.v. light by other materials present in the solution under test; the presence of other fluorescing materials in the solution; chemical interaction of impurities in the solution with the fluorescing substance; and quenching of the fluorescence by the presence of inorganic salts, pH variation, and temperature variation.

On April 10th, Mr. W. G. Hughson, M.Sc., chemist in charge of the Coal Survey Laboratory of the Department of Scientific and Industrial Research, Wellington, and general Secretary of the Institute, gave an address on, The Utilisation of Low-grade Coals, with particular reference to the methods adopted and under trial in Australia at present. Having recently returned from an official trip to that country he was able to describe at first hand both recent experimental work and commercial practice. Of especial interest were his remarks on the operations of the New South Wales State Electricity Commission at Yallourn, where the vast deposits of lignite of 65% moisture content were used at the rate of 17,000 tons a day for the generation of electricity and also for briquetting. He also described briefly his visit to the shale oil refinery at Glen Davis.

Much experimental work had been done in Australia on the complete gasification of coal. Two processes had been developed in Germany—the Lurgi and Bubiag-Didier processes—in which coal was completely converted into good quality town gas of about 500 B. Th. U. per cubic foot by treatment with oxygen and steam at 800°C. and 300 pounds to the square inch pressure. The commercial operation of such processes was, however, dependent on an adequate supply of cheap oxygen. In Australia the Broadhead process had been developed. In this method the coal was treated in a series of three generators, 7½ to 27 minutes being required for a complete cycle. The gas produced was of only 390 B. Th. U. per cubic foot, but could be carburetted by spraying oil into the retorts, or enriched by the addition of methane (produced by passing a mixture of water gas and complete gas over a nickel-aluminium catalyst at 280°) and subsequent removal of carbon dioxide.

So far this year two very successful excursions have been held by the branch. About the middle of May several parties were shown over the works of the Colonial Sugar Refining Co. at Chelsea, and in the evening of July 2nd, about 20 members took advantage of the opportunity to inspect the works and laboratories of New Zealand Forest Products Ltd., the manufacturers of Pinex, at Penrose.

PERSONAL.

Mr. R. A. Green has transferred from Sutherland's Tanneries to R. Greenwell Ltd.

Vital Statistics: Drs. Andrews and Briggs have taken up the challenge of the Branch Chairman, Mr. R. Stansfield, and both reported additions to their families recently. This still does not put either equal with Mr. Stansfield, however. Dr. Andrews is said to have been heard muttering: "If only it had been twins; perhaps next time . . . . " (See June number of the Journal).

Professor Worley and Dr. Andrews were able to arrange for several members of the branch to have lunch with Mr. Bradley Dewey, President of the American Chemical Society, during his recent visit to Auckland.

Following the decision made at the last Annual Meeting to spend £25 of the branch funds on books, a subscription has been taken out to the Journal of Chemical Education (not previously available in Auckland), and the first copies are now circulating among members.

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WELLINGTON BRANCH.

The final meeting of the 1945 season took the form of a symposium on "Paint," and the subject received comprehensive treatment by four speakers. As an introduction, Mr. R. L. Dunn discussed the chemistry of paints, following which Mr. L. Wilkinson spoke on paints and painting problems in New Zealand. Mr. R. Gibbons read Mr. D. Fraser's paper on old and new raw materials, and Mr. M. Tingey closed the symposium by dealing with present day painting practice. The meeting was particularly well attended, and at question time several visitors showed their interest by contributing materially to the discussion.

The opening meeting for 1946 was addressed by Mr. G. S. Lambert, whose subject was, "Aggressive Waters." Mr. Lambert has had wide experience in corrosion problems involving the examination of water supplies, and in opening his address he said that the term "aggressive" is generally applied to natural waters which are corrosive to metals. Corrosion of metals is an electrochemical process resulting from the establishment of corrosion cells on the surface of the metal. The formation of these cells can be due to a number of causes, e.g. variations in composition of the metal, due to segregation, impurities, inclusions or the presence of two or more metallic phases in the microstructure of the metal; variations in the natural oxide films on the metal, usually caused by varying degrees of aeration of the surface; variations in grain size of the microstructure; variations in internal stress. However these cells are caused, the mechanism of corrosion is the same-metal ions passing into solution at the anodic areas and hydrogen atoms being released at the cathodic. The severity of corrosion depends on the freedom with which these cell reactions can proceed.

In natural waters the constituents most effective in promoting corrosion are dissolved oxygen and carbon dioxide. The former prevents cathodic polarisation by oxidising the hydrogen and the latter, by lowering the pH, prevents the precipitation of insoluble protective coatings. Waters saturated with calcium carbonate are relatively non-corrosive as local raising of the pH at the cathodes of the corrosion cells causes the precipitation of a film of carbonate which gradually seals off the metal from attack. Waterworks practice has shown that trouble from corrosion is to be expected with most soft waters, the severity increasing as the pH of the water falls below that at which it would be in equilibrium with calcium carbonate. From the viewpoint of waterworks engineering the amount of corrosion measured by loss of weight of metal may be less important than the form assumed by the corrosion products, e.g. with only moderately corrosive waters considerable reduction of carrying capacity of mains may result from the growth of tubercules of rust. With a more corrosive water tuberculation may be lower but staining and "red water" troubles may be experienced, while with still more corrosive waters extensive pitting of mains may result without much evidence of tuberculation or "red water".

Methods of mitigating corrosiveness in water systems were referred to by the speaker. These included, aeration for removal of carbon dioxide, passage over limestone or treatment with lime or soda for raising the pH to that at which the water would be in equilibrium with calcium carbonate. Special treatments for small systems involving deaeration or chemical removal of dissolved oxygen and treatments with alkalis and salts such as phosphates, silicates and chromates were also described.

The speaker illustrated his talk by reference to a number of graphs and tables and showed exhibits of both ferrous and non-ferrous metals showing the effects produced by waters of varying corrosive characteristics in different parts of New Zealand.

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Mr. N. T. Clare, M.Sc., of the Wallaceville Laboratories, addressed the May meeting on "The Chemistry and Metabolism of Phenothiazine in Domestic Animals." Phenothiazine (thiodiphenylamine) has come into prominence within the last few years as an anthelmintic for farm animals. In 1943 the occurence of some cases of keratitis, or opacity of the cornea, was observed in New Zealand in calves dosed with this drug, and following more widespread reports of this condition from field officers in 1945 an investigation was started at Wallaceville in conjunction with the Parasitologist, Mr. L. K. Whitten. An association of the ocular symptoms with exposure to sunlight soon after dosing was taken as evidence that the condition was due to photosensitization, and this was soon confirmed by controlled exposure experiments. Use of various light filters showed that the active radiation lies between 320 and 380 mu. However, certain unusual features distinguish this photosensitivity from others such as facial eczema. Thus, the effects are generally not spread over all exposed unpigmented areas, but are confined to the cornea; the condition occurs only in cattle and pigs; and except for reference to occurrence in pigs in America the condition has not been reported outside New Zealand.

The chemical side of investigations at Wallaceville has been concerned with the identification of the photosensitizing agent and the metabolism of phenothiazine in calves. Other workers have studied the absorption and excretion of phenothiazine and its derivatives in man, sheep, horses and small animals, but not in bovines. The chief derivatives found in urine from most species appear to be phenothiazone (3 oxythiodiphenylamine) and its leuco form, occuring partly uncombined, but largely as a conjugate. From sheep urine a potassium ethereal sulphate of leuco phenothiazone has been isolated. Thionol (3:6 dioxythiodiphenylamine) has also been found and the main excretion product in rabbits is a glucuronate of leucothionol. Phenothiazine sulphoxide has been noticed in several species, especially in pig urine, but scant attention has been paid to it by most workers. Little information is available on derivatives in the blood, other than spectroscopic identification of phenothiazone in sheep serum.

The work at Wallaceville so far has shown that, while phenothiazone is present in the blood of calves at the age at which dosing is generally carried out it is always accompanied by some phenothiazine sulphoxide. In younger animals (bobby calves) the pigment is almost entirely the sulphoxide. The detection of sulphoxide in the presence of the other pigments was made possible by the discovery that the former could be extracted directly from plasma by ethyl acetate. When this procedure was applied to sheep plasma sulphoxide was not detected in animals receiving the normal dose; it did appear in some to which several times the normal dose had been given.

Such a difference between derivatives in the blood of calves and sheep suggested that the sulphoxide might be the photosensitizing agent in the former. Examination of aqueous humour—the medium through which the cornea largely obtains its nutrients—in both species revealed sulphoxide in calves but no phenothiazine derivatives in sheep, except in those cases in which sulphoxide was found in the blood after administration of large doses of phenohtiazine. When sulphoxide was injected into the anterior chamber in both species and the animals exposed to sunlight typical corneal lesions were obtained and lesions were also produced in sheep which carried sulphoxide in blood and aqueous humour after receiving a high dose of phenothiazine. The effective radiation was again in the 320—380 mu region of the spectrum, and this is consistent with the absorption spectrum of phenothiazine sulphoxide.

In seeking an explanation for the differences in the nature of the pigments in the blood of the two species the contents of the alimentary tract of sheep and calves dosed with phenothiazine were examined. Contrary to the results of some overseas workers it was found that the predominating pigment was not phenothiazone but the sulphoxide. Furthermore, sulphoxide was present in the portal blood in both species even when, as in sheep, only phenothiazone could be found in the systemic circulation. It appears possible,therefore, that the difference between the two species lies in the greater ability of the sheep to convert the sulphoxide to phenothiazone and to conjugate it to an excretable form. Studies along these lines are being continued in the hope that a knowledge of the metabolism of phenothiazine will assist in the devising of measures to control the photosensitivity condition.

Two further points of biochemical interest have arisen in the course of this work. Firstly, phenothiazine in the urine of bobby calves has been found to be conjugated with an unknown substance with protein-like properties. Secondly, the identification of the sulphoxide as an important metabolic product of phenothiazine suggests that the sulphoxide may be the actual anthelmintic. Some results of parasitological studies by Mr. Whitten support this hypothesis.

A warm welcome was extended at the June meeting to Miss A. E. Lorimer, M.B.E., M.Sc., who has been in the Middle East, India and China in activities connected with the Y.W.C.A. and who is at present home on short furlough.

Mr. and Mrs. D. H. Freeman have returned to Australia after several years spent in New Zealand. Mr. Freeman was Branch Chairman in 1945 and has been a most active member of the Branch.

Mr. L. Wilkinson, who has been Assistant Secretary of the Institute and Officer-in-Charge of the Employment Register and Business Manager of the Journal, has been transferred to the Auckland Branch of the Dominion Laboratories and has consequently resigned his Institute duties.

The Wellington Branch prize for the best first-year student at Victoria University College, was gained this year by Messrs. D. A. Evans and L. I. Hart, who were placed first equal.

Before the delivery of the Mellor Memorial Lecture, the meeting passed the following resolution:—

"The Wellington Branch of the N.Z.I.C. wishes to place on record its support of the efforts of the Royal Society of N.Z. to have the Dominion Museum and Art Gallery vacated by the R.N.Z.A.F. at an early date, and restored to its rightful use as a most important centre of learning and culture in the life of this city and of the Dominion."

CANTERBURY BRANCH.

Dr. I. E. Coop gave an account of his experiences in Britain as Scientific Liaison Officer to the April Meeting. Dr. Coop began his address by outlining the functions of the Scientific Liaison Office in London. This office is a part of the Department of Scientific and Industrial Research and whilst it acts on behalf of all scientific interests it is primarily engaged in serving this Department. The London office is a centre for the collection of scientific information from the United Kingdom for use in N.Z. Much of this information is collected and despatched to N.Z. in the form of reports from research organisations. Other information of more immediate or direct interest to N.Z. is obtained by personal contact of the scientific liaison officer with the research workers themselves. In this way many problems and enquiries from N.Z. are answered. Conversely the office acts as a channel for the transmission of scientific information from N.Z. to the U.K. In peacetime most of the work has been of an agricultural nature but during the war there was a wide expansion of defence and industrial activities.

The organisation of chemical research in the U.K. was then described. Very little war research in applied chemistry was done in specific research establishments as was the case in physics. Instead the majority of research was carried out by industrial firms both large and small. To this can be added extra-mural research done at the universities, and a continuation of the applied research in the peacetime laboratories of the D.S.I.R., Industrial Research Associations, Medical Research Council, etc. Finally certain chemical applications, such as chemical warfare, were studied in the laboratories of the Ministry of Supply. All the chemical research work whether in industry, universities or government departments was co-ordinated by the Ministry of Supply.

After a brief allusion to a comparison of the state of development of radar, antisubmarine warfare, jet propulsion and rockets in the United Kingdom and Germany, Dr. Coop concluded with a reference to the German development on hydrogen peroxide. The Germans had succeeded in preparing concentrating and stabilising it to a degree that it could be used as a liquid fuel. Hydrogen peroxide can be decomposed catalytically with evolution of heat and oxygen, the latter being available for combustion so that powerful liquid fuel systems could be developed which were independent of intake of air. Such systems could be used either to drive a turbine or to give a jet. Brief reference was made to the application of this development in the flying bomb, long range rocket, aircraft and torpedoes.

OTAGO BRANCH.

On 17th April, Dr. R. Gardner spoke on, "Heat Transmission in Works Plant." By way of introduction it was pointed out that this is a subject that the laboratory worker seldom has to consider seriously, but in designing works plant is of the greatest importance. Heat is transmitted by the well-known three mechanisms—conduction, convection and radiation. Principles usually met with in a first year course in heat are used for dealing quantitatively with conduction and radiation but convection which is very important in practice is not so readily amenable to calculation. The relationship between the coefficient of conductivity and the coefficient of heat transmission usually used in design work, which has the dimensions of conductivity divided by length, was pointed out, but in practice one practically never comes across cases of conductivity alone and as an illustration of this a method of dealing with heat loss from an insulated surface was explained.

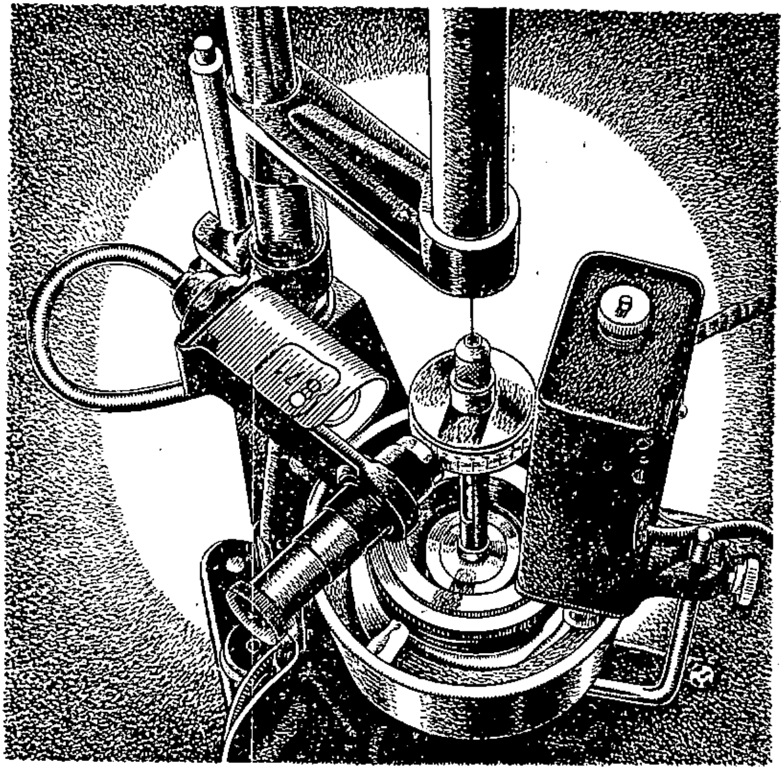
The speaker then dealt with the important case in which heat is transmitted from a hot fluid across a metal wall, such as the wall of a pipe, to a cold fluid. It was shown that in nearly all cases the most important resistance to heat flow arises in the sluggish layers of fluid next to the wall, the thickness and conductivity of the metal wall being of surprisingly little importance in this respect. In a typical case which was used to illustrate the method of working out the overall coefficient of heat transmission when the film coefficients are known it was found that the substitution for copper of lead, which has about a tenth the conductivity of copper, reduced the heat transmitted by only about five per cent. The available methods of evaluation of film coefficients of heat transfer were considered, particularly the Dittus-Boelter (1930) and similar equations for the case of fluid flowing in pipes. The method of deriving the Dittus-Boelter equation by means of dimensional analysis was shown, the significance of dimensionless group and the use of the Reynolds number as a criterion of turbulence being pointed out.

A short table of typical values of film coefficients showed over a thousandfold variation from condensing steam to gases at low velocities, the latter giving as low as one British Thermal Unit per hour per square foot per degree Fahrenheit. As the overall coefficient of heat transfer is approximately equal to the lower film coefficient, it is difficult to arrange high rates of transfer to or from gases.

Finally as an example of the unexpected results sometimes found it was shown that in certain cases when the inside film coefficient is controlling, substitution of a smaller for a larger diameter of pipe can result in a shorter length of pipe giving the same amount of heat transfer, though at the expense of a rise in the power required to move a given flow of liquid through the pipe.

An interesting general discussion followed.

See how they run—



Some liquids 'run' easily. Others are sticky or viscous. Some substances are so viscous that their movement can be detected only by periodical observation over months or even years. Pitch, for example, when examined under laboratory conditions, flows so slowly that at ordinary temperatures it would take tens of years to move only a few inches. The chemist frequently needs to find exactly how 'thick' or how 'thin' a given liquid is: in other words, to determine its viscosity with accuracy. Viscosity can be measured by noting the time taken for a sample to pass through a hole of standard size. The newer type of viscometer is more elaborate and enables a detailed analysis of viscosity to be made. In one form of instrument the liquid to be tested is placed in a metal cup which rotates about a closely-fitting plunger suspended from a fine steel wire. As the liquid is carried round it exerts a drag on the plunger causing it to turn and thus to twist its supporting wire—the greater the viscosity of the liquid, the greater the drag. The degree of twist is shown on a finely graduated scale from which readings can be taken. These provide figures from which viscosity can be calculated with great accuracy. It is this new accuracy that, to give one example, enables the oil-refiner to achieve complete uniformity in every grade of oil he produces, for the British chemical industry uses the viscometer in a hundred ways to further its ability to serve the public.

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