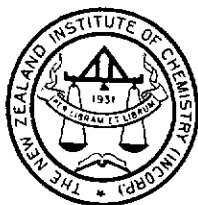


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June, 1938

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Copy for the September issue should be in the hands of the Publications Committee before 1st September, 1938.

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June, 1938.

EDITORIAL

A correspondent in the March number of this *Journal* has raised the question as to what the Institute of Chemistry may do as a fitting contribution to the Centenary Celebrations of 1939-40. The very pertinent question was asked: "Is there any way in which the Institute can proclaim at that time that chemical science in New Zealand has both a past and a future?" One suggestion made was that an authoritative historical record of the contribution of chemical science towards the development of the Dominion might be compiled with the co-operation of industries and research organisations. Branches have recently been asked by Council, at our President's request, to report on this suggestion, but they could go further and give full consideration to other plans also. It must be remembered that the celebrations themselves are to commence on a nation-wide scale in some eighteen months from now, and that the time has therefore arrived for some definite outline to be formulated.

Whatever forms the celebrations may take so far as chemists are concerned, we consider it of great importance that the whole profession should enter thus into the spirit of our growing awareness of nationhood. Vigorous and united action should be taken by each Branch, and each member might well ponder what contribution he can make as an individual.

The 1940 Conference may fittingly become the focal point of the whole scheme: this gathering of chemists could also, as part of its social programme, provide an opportunity for delegates to visit the Centennial Exhibition. We believe that the Institute should interest itself in ensuring that there is an adequate Chemical Exhibit at this function; should that be impossible, however, we could at least co-operate with organisations making exhibits, so that the chemical aspects of our national life are given sufficient emphasis.

There should be no delay if anything is to be accomplished on a worth-while scale. We suggest that a Committee be set up to consider and report upon ways and means of carrying some scheme into effect. An early start could then be made in collecting information, and definite proposals could be submitted for the consideration of Branches and for ratification by Council or at the next Conference.

Two New Zealand chemists have received the honour of a Knighthood within six months. We referred previously to Sir Theodore Rigg, and now desire to congratulate Sir Thomas Easterfield, who was created a K.B.E. in the King's Birthday Honours. An account of Sir Thomas Easterfield's work will appear in the September issue of this *Journal*.

The Presidential Address, delivered at the combined Annual Conference in Christchurch on 20th and 21st January, 1938, was published in the March issue of this *Journal*. The address of the Chairman of the New Zealand Section of the Institute of Chemistry of Great Britain and Ireland (Mr. F. H. V. Fielder) has now been published in the *Journal and Proceedings* of that Institute (April, 1938, pp. 168-180). This address, entitled "The Dissipation of Natural Resources," aroused much interest at the conference, and may now be read in full by those who were not privileged to be present.

We offer congratulations to Mr. W. Donovan, M.Sc., F.I.C., F.N.Z.I.C., F.R.S.N.Z., Dominion Analyst and Director of the Dominion Laboratory, on his election as a Fellow of the Royal Society of New Zealand.

The arrangement made by the Publications Committee with Messrs. Technical Publications, Ltd., for members to obtain technical books from overseas on advantageous terms has so far met with little response. It is to be hoped that our members will make use of these concessions as outlined on p. 5, Vol. 2 of this *Journal*.

General Notes:

The discussion by the Branches of the draft of a Bill to provide for the registration of Chemical Practitioners has been deferred until a more suitable time.

A proposal is afoot to introduce into the Institute a new class of members, provisionally called Laboratory Worker Members, who would not normally be eligible for election as a Fellow or Associate. The four Branches have received a request from the General Secretary to supply information under this heading.

A remit, dealing with suggested amendment to the Rules, has been sent out for the consideration of Branches, three of which have yet to report thereon.

The Centenary Celebrations were discussed at a Council meeting on May 19th, with the result that Branches have been asked to make suggestions as to the publication of a series of articles on the development of chemistry in New Zealand. This matter is referred to in the Editorial of this issue.

No further progress can be reported on the proposal to increase the annual subscription to the Institute, but it is increasingly felt that the present low subscription rate is greatly hampering our activities.

Obituary

It is with deep regret that we record the death at London in May, of one of New Zealand's most famous chemists, Dr. J. W. Mellor, at the age of 68 years. Trained at Otago University, the late Dr. Mellor proceeded to England on an 1851 Exhibition Scholarship, and spent most of his life in Staffordshire. He was an international authority on ceramic chemistry and a prolific author; only last year he completed, in the sixteenth volume, his monumental *Comprehensive Treatise on Inorganic and Theoretical Chemistry*, a work which we believe to be unique in chemical literature. The other side of his versatile mind is shown in his amateur cartoons and in his delightful *Uncle Joe's Nonsense*. As recently as in March of this year there appeared in the *Transactions of the Ceramic Society* a masterly review by Dr. Mellor of the later theories concerning the chemical constitution of the clay molecule—a fitting conclusion to innumerable contributions on various aspects of ceramic chemistry. We salute the memory of a great chemist.

CORRESPONDENCE.

SUB-ELEMENTS.

(To the Editor.)

Sir,—

For more than a hundred years chemists were so convinced that the inactive part of the atmosphere was nitrogen alone that the discovery of argon came as a distinct rebuke: there was no excuse for overlooking a component present to the extent of nearly one per cent. Similarly the discovery of deuterium was probably long delayed through our conviction that hydrogen atoms were all alike; we were not expecting a heavier isotope of hydrogen. May we not in like manner be closing our eyes to the existence of elements lighter than hydrogen? The hydrogen atom having a nucleus consisting of a single proton of unit positive charge is obviously, we convince ourselves, the simplest possible atom, the first member of the atomic series.

This conviction, however, should not be allowed to obscure the possibility of the existence of particles, or sub-elements, intermediate in mass between the electron and the proton. A whole new order of sub-atomic particles, or sub-elements, may be waiting to be discovered. Before being discovered such sub-elements must be imagined; they must be possible. Can we say that such sub-elements are logically impossible of existence?

In the atomic series the fundamental difference between one element and the next is the charge of the nucleus. It is difficult to see how the mass of the nucleus plays any direct part in atomic structure, this mass being due to the *accidental* mass of the proton and of the neutron.

Why should nuclei not possibly be built up of positrons instead of protons? Starting with a positron and an electron a neutral binary should be possible the two particles revolving about each other as do stellar binaries. Such neutral particles might serve in the building up of progressively more complex nuclei with larger and larger positive charge and surrounded by shells of electrons of compensating negative charge. In this manner it is possible to picture a whole periodic family of sub-elements, kinetically so active that they would pass through laboratory vessels without hindrance and would quickly escape from the gravitational attraction of the earth. Where then should evidence be sought for the existence of sub-elements? There appear to be three main fields, namely: (1) among the products of nuclear disintegration; (2) in cosmic rays; (3) in the relation between sun storms and electromagnetic conditions on the earth. It is noteworthy that already an effect of cosmic rays has been attributed to "heavy electrons." Sun storms may be connected with the disintegration of protons and accompanied by the emission of sub-elements. The relations between aurorae and sun spots suggests a connection not sufficiently close in time to be attributed solely to electromagnetic waves and electrons, but too closely related in time to be due to particles as massive as protons which would take a month or two to reach the earth. If a sudden explosion on the sun were accompanied by the ejection

of a shower of particles of different masses but of about the same temperature, the particles would become spread out along the line of flight into a mass spectrum; knowing the approximate initial temperature and the times taken to reach the earth the masses are immediately determined.* It is obviously important to record minutely all effects, whether auroral or in wireless transmission, attributable to observable solar phenomena.

F. P. WORLEY.

Auckland University College,
Auckland, N.Z.

*Williams and Pickup, *Nature*, 1938, *114*, 684 (16 Apr.).

New Associates elected during the current year:—

BIRD, Leslie Howard, M.Sc., *Wheat Research Institute, Christchurch.*

ELLYET, Clifton Darfield, M.Sc., *82 Murray Place, Christchurch.*

HARVEY, Hector Frederick, A.A.C.I., *c/o Qtol-Fluenzol Laboratories, Wellington.*

MORRISON, Gerald Oliphant, B.Sc., A.C.I.C., *c/o Morrison & Morrison, Ltd., Christchurch.*

PERYMAN, Roland Verney, M.Sc., *Wool Manufacturers' Research Association, Dunedin.*

THE STANDARDISATION OF VOLUMETRIC SOLUTIONS.

STUART H. WILSON.

In comparison with volumetric analysis, gravimetric analysis has an advantage, in that each piece of work stands by itself, dependent for accuracy on the reliability of the weighing and the care in the analysis. If volumetric analysis is to rank with gravimetric, as it may well do, it is evident that the standardisation of the solutions should be the subject of systematic planning.

The methods of standardisation adopted by large organisations will be found scarcely suitable for small laboratories, where the solutions are made up and standardised at infrequent intervals, and where time can hardly be spared for lengthy preparation of pure standard substances. Hence it may be of interest to describe the scheme of standardisation evolved to meet the needs of the Dominion Laboratory. The very abundance of methods in the text books makes choice a difficulty, so that there is a further reason for giving an account of methods found suitable in actual practice. Much of the material in this paper has been adapted from methods given in the book *Volumetric Analysis*, by Kolthoff and Furman¹, which is a mine of information on both the theoretical and practical aspects of volumetric work.

STANDARD SUBSTANCES.

The Primary Standards.—The solutions most important in volumetric work cannot be prepared by weighing out and dissolving an exact multiple of the equivalent weight. Instead the solutions must be standardised by means of pure chemical reference substances. At this point it is interesting to contrast the differing procedures in gravimetric and volumetric analysis. In gravimetric analysis, it is necessary in each analysis to isolate, purify and weigh a pure substance, and in this task varying degrees of success may be attained. The opposite procedure is adopted in volumetric analysis. One starts with a solution standardised with a pure substance. With this standardised solution, the substance sought is determined through some chemical property without isolation. Since many analyses are made with the standardised solution, there is justification for the expenditure of considerable time or money in the attainment of a pure substance for standardising the volumetric solution.

The choice of these primary reference substances is of fundamental importance. Methods of preparing very pure substances for use as primary standards are described at intervals in chemical literature: for example, silver or constant boiling-point hydrochloric acid. For a small laboratory, the time and work necessary to prepare a pure substance are not justified. Fortunately, among the Standard Samples procurable from the National Bureau of Standards of the United States are several that are very suitable for the standardisation of volumetric solutions. Those from this source that are used in the Dominion Laboratory are sodium oxalate, potassium hydrogen phthalate, and arsenic trioxide. Benzoic acid is also available as it is used as a calorimetric standard. It was formerly used as a volumetric standard, but its use for this purpose in this Laboratory has been given up in favour of potassium hydrogen phthalate. It is sometimes recommended to base the standardisation of as many solutions as possible on one primary standard. This may be ideal, but there are no real advantages in practice to justify the additional work. It is a convenience to have all three standards, and it is not considered necessary to base all solutions on one of these. However, where cost is a consideration, it may be desirable to limit the number used, and it is possible, as explained later, to use sodium oxalate alone as the primary standard.

Secondary Standards.—Besides the primary standard substances of high purity, it is useful to have a number of other substances that may be termed secondary standards. For one thing, the primary standards are expensive, and it is desirable to have alternative substances to use in the preliminary adjustment of the solutions. After using them a few times in testing solutions, afterwards standardised by the primary standards, one has data for an accurate estimate of the purity of the secondary substances. These can then be used in checking the standard solutions occasionally if thought necessary. In addition these secondary standards can be chosen for their high equivalent weight, and hence are more suitable for standardising tenth normal or weaker solutions. Suitable secondary standards will be discussed when the various solutions are under consideration.

GENERAL CONSIDERATIONS IN STANDARDISING SOLUTIONS.

As a general principle it is undesirable to standardise by taking a measured volume of a stock solution. Even under the best circumstances, it is not possible to be quite certain of solutions that

have been kept any length of time. With the usual changes of men and methods, the largest portion of carefully prepared solutions of costly materials may end uselessly in the sink. Then, too, the measuring out of a solution with a pipette introduces a further source of error. The ideal, therefore, is to standardise every solution by weighing out a portion of standard substance, and titrating it with the solution. The standard substance should be of high equivalent weight, so that a portion giving a titration of 20 to 30 ml. can be accurately weighed. For a consideration of the accuracy of volumetric methods reference may be made to a paper by Ponndorf.³ Ordinary careful volumetric analysis has an accuracy of 2 to 5 parts per thousand. For standardisation, a higher accuracy should be aimed at—1 to 2 parts per thousand. This can be attained by careful work, and the use of certificated burettes, and with some attention to sources of error such as drainage error and temperature. Any further increase of accuracy can only be obtained by greatly increased effort.

Two burettes with "A" certificates of the N.P.L. should be set aside for standardisation purposes only. The time of outflow should be high, so that drainage error can be neglected. For a consideration of this the book by Stott² can be consulted. As normal alkali spoils a glass stopcock, one burette is kept for alkali, and is fitted with a rubber tube and glass olive. There is sure to be a burette with broken stopcock from which it can be made. The original tip should be used, or one will have to be made with the original time of outflow.

For weighing the standard substances, a set of weighing bottles should be prepared. As the checking of the secondary standards may have to be repeated when a new supply is bottled, it is best to have a large supply in the weighing bottle, as much as the balance will carry. Ordinary small bottles with wide ground glass stoppers are convenient. As the weighings should be more accurate for the weaker solutions, it is best to provide separate small weighing bottles of the usual type for these. All bottles should be labelled with a writing diamond.

After filling the bottles they are dried at the correct temperature, stoppered and kept in a desiccator. A desiccator cabinet is convenient. They are dried again before use if necessary. In weighing out the amount for titration, in order to avoid exposing the material to the air, no attempt should be made to weigh out an exact amount. A convenient technique is to learn to remove the

bottle from the balance with the thumb and third finger, and to remove the stopper with the middle and index finger of the same hand. Then with a bright spatula in the other hand, a suitable amount is removed and tapped into the flask or beaker.

There are a few points in regard to titrating that are worth mentioning. The burettes should, of course, have their main graduations carried right round, so that there is no trouble with parallax. Students generally learn to set the burette on the zero mark, and then read the burette after the titration to the nearest 0.1 or 0.05 ml. As every scientifically trained man should, as a matter of habit, estimate to the tenth part of the smallest division, it seems to the writer better not to adjust exactly to the zero mark, but to read the initial reading somewhat below the zero mark to 0.01 ml. and then the final reading in the same way. One advantage is that, as the initial reading must be noted, there is no danger of error through assuming the burette to have been adjusted to 0.00 ml., if this has been actually overlooked.

As most of the work of standardising is in weighing the standard substance and preparing the solution of it for standardising, it is worth while spending a little more time on determining the end-point of the titration. The method used by the writer is to have handy a burette filled with a solution of opposite character to that being standardised and of one-fifth or one-tenth the normality, which needs to be only approximately correct. On reaching the end-point, the burette reading is noted, then a few drops of the weak solution are added, and the end-point again determined; portions of a drop being added by touching the tip of the burette against the side of the flask and washing down with a jet from a wash-bottle. This can again be repeated. From the last two readings, one-fifth or one-tenth of the volumes of weak solution added is subtracted. Then the mean of the three can be taken, or the first one rejected as overshoot. Generally differences are not more than 0.01 ml. on a titration of 25 ml.

The temperature of the air should be noted at the time of standardising, and this can be taken as the temperature of the burette. For New Zealand conditions, where there is no central heating, 15° C. can be taken as the standard temperature. If the temperature does not differ from this by more than 2° C. for normal solutions, or 3° C. for tenth normal solutions, no correction need be applied. If a correction is necessary, a table can be found in the book by Kolthoff and Furman¹.

PREPARATION OF THE STANDARD SOLUTIONS.

It is the practice in the Dominion Laboratory to prepare normal solutions of acids (hydrochloric and sulphuric) and of sodium hydroxide in quantities of ten litres. These are made up and standardised initially at intervals of six to eighteen months. Tenth normal solutions (acid and alkali, iodine, sodium thiosulphate, and potassium permanganate) are made up in quantities of three litres. Semi-normal hydrochloric acid is made up in still smaller quantities for use in determining saponification values. Standard solutions of acids and alkalis are stored in large bottles with delivery siphons connected by a T-piece to a delivery jet, and also to a burette clamped to the bottle. The latter is used for rough titrations, and measuring out small quantities of the solutions. For general use in the various locations, one litre bottles are filled from the stock.

Normal Solutions of Acids.—Normal solutions of acids are made up as usual by determining the density of a suitable strong solution. After ascertaining from tables the normality of the solution, the calculated volume is placed in a large measuring flask, and diluted with water. Flasks of four litre and two litre capacity are handy for making up ten litres. It is generally advised to make the required solution somewhat too strong, and, after ascertaining its normality, to add the required amount of water. A better practice is to make provision of two bottles containing $2N$ and $N/2$ solutions. The normality of these need not be very accurately known. The required solution is then made up as carefully as possible. Its normality is then determined by means of the secondary standard described later. Then the calculated amount of auxiliary solution is added to make the solution exactly normal. Finally the normality is accurately determined by means of the primary standard (for acids, sodium oxalate).

Normal Sodium Hydroxide.—The preparation of normal sodium hydroxide is somewhat more troublesome, and it may be useful to describe the method adopted. It is a modification of the method of Sørensen, given by Kolthoff and Furman. Sodium hydroxide is dissolved in water in proportion between 1:1, and 4:5. For ten litres, 480 gm. are dissolved in 480 ml. of water and the volume after cooling made up to 650 ml. Sticks are best dissolved by heating the water nearly to boiling in a beaker, and then dropping the sticks in judiciously as they dissolve. Pellets, as now generally available are more convenient. The cold solution is transferred to a

stoppered one litre measuring cylinder and allowed to stand overnight. A filter flask is fitted with the largest size of filtering funnel for Gooch crucibles. In the funnel is placed a perforated porcelain disc, on which a mat of asbestos is formed. To avoid disturbance of the mat, a second perforated disc is laid on the mat. The top of the funnel takes a rubber stopper of 5 cm. diameter. Through this passes a glass tube connected by two right-angle bends to a rubber stopper fitted to the neck of the measuring cylinder. This stopper also carries a short glass tube connected to a soda-lime tube. The side tube of the filter flask is connected through a soda-lime tube to the water pump. In this way a perfectly clear concentrated solution of sodium hydroxide free from carbonate is obtained in the filter flask. The rubber stopper of the filter flask is then quickly replaced by a rubber stopper carrying a glass tube reaching to the bottom of the flask. This tube is bent twice at right angles outside the flask and is closed by a rubber cap; the soda-lime tube on the side tube of the flask is also closed by a cap. With the aid of a blowing ball attached to the soda-lime tube, about twenty drops of solution are transferred to a small weighed Erlenmeyer flask with ground glass stopper. The flask is reweighed, and the solution washed into a flask and titrated with normal acid. The concentration of sodium hydroxide on a weight/weight basis is then calculated. The whole filter flask with soda-lime tube attached is then weighed on a large balance. With the blowing ball, about one-third of the solution is transferred to a three-litre flask and diluted to the mark with "equilibrium water." The solution is poured into a stock bottle coated with paraffin wax. This is repeated two more times, and then the filter flask again weighed. It is then possible to calculate the additional amount of water necessary to give a normal solution. This volume is added, and then the normality determined with the secondary standard. After adjusting the normality with some 2N or N/2 sodium hydroxide solution, the normality is finally accurately determined with the primary standard, potassium phthalate.

Equilibrium water is distilled water which has lost most of its content of carbon dioxide by standing exposed to the air. It is convenient to set aside a large bottle of distilled water to stand in a place free from fumes, so that it is ready when required.

The waxing of bottles for sodium hydroxide solutions presents some difficulty. The wax is very liable to flake off. To avoid this a hard wax is mixed with a proportion of very soft paraffin wax. The bottle is heated in a gas oven, enough melted wax poured in

to give as thick a layer as possible, and the bottle rolled till sides and bottom are coated with a thick layer.

Other Solutions.—Tenth normal solutions of acid and alkali are made by taking 300 ml. of normal solution, accurately measured in a measuring flask. This is washed into a three litre standard flask and diluted with equilibrium water.

The preparation of tenth-normal iodine and sodium thiosulphate calls for little comment. The latter should always contain 0.02 per cent. of sodium carbonate. Potassium permanganate solution should be allowed to stand at least a week after making up, and then filtered through asbestos on a Hirsch funnel with the aid of the water pump. A suitable funnel is easily made with an ordinary funnel and a perforated porcelain disc.

STANDARDISATION OF THE VOLUMETRIC SOLUTIONS.

Standard Solutions of Acids.—The most suitable primary standard is sodium oxalate (National Bureau of Standards, Standard Sample). This needs only occasional drying at 105° C. A portion is weighed out into a platinum crucible and ignited to incipient melting in an electric furnace. No error has been found if it melts completely, but it should not be heated too high. The crucible is leached in a beaker of water and the washings transferred to an Erlenmeyer flask. The solution is titrated with normal acid by the method described by Kolthoff and Furman. Acid is added till the colour of the methyl orange indicator begins to change. The solution is then boiled for two minutes, cooled and titrated to the end-point.

As secondary standard, guanidine carbonate has been found very suitable. It has been recommended as a volumetric standard by Dodd⁴. The commercial salt of A.R. quality should be dried over calcium chloride at reduced pressure. It has been found that a suitable indicator is a mixture of three parts of bromeresol green (0.4 per cent.) to two parts of methyl red (0.2 per cent.). However the end-point is not satisfactory unless carbon dioxide is removed. It is convenient to keep ready a rubber stopper of a size to fit the titration flask. This is fitted with two tubes, one of which is attached to a soda-lime tube. After adding acid till the end-point is reached, carbon dioxide is removed by drawing air (freed from CO₂) through the liquid with the aid of a water pump. The titration is then continued till the red colour just appears. As this substance has a higher equivalent weight and is less trouble to use than sodium oxalate, it is very suitable for standardising semi-normal and tenth

normal acid, and also for checking occasionally the titre of normal solutions. After a few standardisations of acids against both guanidine carbonate, and sodium oxalate, a reliable figure is obtained for the equivalent weight of the sample used.

Standardisation of Standard Alkali.—The primary standard for alkali solutions is potassium hydrogen phthalate (National Bureau Standards, Standard Sample). It requires only drying at 120° C. About 4 gms. are dissolved in water and titrated with phenolphthalein as indicator. Benzoic acid was originally used as primary standard and a sample of A.R. potassium hydrogen phthalate as secondary standard. This sample is still retained as secondary standard. The high equivalent weight of this salt makes it very suitable for titrating tenth normal solutions. It may be remarked that different indicators are used in standardising acid and alkali solutions. The titration errors of the indicator need only be considered when great accuracy is required with tenth normal solutions. The magnitude of the error may be ascertained from the table given by Kolthoff and Furman.

Iodine Solution.—A primary standard is available for iodine in arsenic trioxide (National Bureau of Standards, Standard Sample). It has the disadvantage that its equivalent weight is low. From 0.20 to 0.24 gm. should be weighed out, dissolved with warming in 15 ml. normal sodium hydroxide neutralised with a slight excess of normal sulphuric acid, and, after the addition of 2 gm. of sodium bicarbonate, titrated with the iodine solution. This is possibly the only case where, owing to low equivalent weight, the ideal of titrating directly a weighed amount need not be followed. About 0.6 gm. can be dissolved in normal alkali, neutralised with acid, and made up to 200 ml. in a standard flask. A certificated 50 ml. flask can be filled with the solution and washed into a flask for titration. The stock solution of starch described by Kolthoff and Furman has been found very suitable. About 2 gm. of soluble starch and 10 mg. of mercuric iodide are rubbed up with water and brought into one litre of boiling water. 10 ml. are used for every 100 ml. of solution.

As a secondary standard sodium thiosulphate may be used. A.R. reagent should be ground finely and kept some time in a desiccator over deliquescing calcium chloride. Its high equivalent weight makes it suitable for solutions weaker than tenth normal.

Sodium Thiosulphate.—No primary standard has been purchased for tenth normal thiosulphate. Iodine has been prepared pure by

sublimation by the writer and used for standardisation, but the weighing out and bringing into solution is troublesome. It is now preferred to use only potassium ferrieyanide as a secondary standard. This substance has the advantage of a very high equivalent weight which makes it suitable for solutions weaker than tenth normal. A sample was prepared by three recrystallisations from an A.R. supply. This was dried at 100° C.

Standardisation by potassium ferrieyanide is described by Kolt-hoff and Furman. One gram of the substance is dissolved in a glass stoppered bottle in 5 ml. of water; 17 ml. of 10 per cent. potassium iodide are added, and then 8 ml. of normal hydrochloric acid. It is allowed to stand stoppered for one minute, and then treated with 10 ml. of 30 per cent. zinc sulphate solution (free from iron). It is then titrated with the thiosulphate solution and starch till the colour disappears.

The equivalent weight of this secondary standard was determined by titration against thiosulphate solution which had been compared with iodine solution standardised by arsenic trioxide. Generally it is not necessary to check one volumetric solution against another, except to guard against an error. Even where two are used, as in methods involving back titration, the titre of only one solution is required, for a blank titration is always carried out, and the difference in millilitres of the one solution used in calculation of the result. However, when, as in this case, such a checking is necessary, it is best to measure both from burettes, as they are thus used in subsequent work. After running out a measured volume of one solution, it is titrated to the end-point with the other. Then a few drops of the first are added and the end-point again determined. The mean of the readings of the burettes for a few repetitions of the determination of the end-point gives an accurate result. In the case of iodine solution, to avoid volatilisation of iodine the tip should discharge into a large volume of water. The diluted solution is then titrated with thiosulphate.

Potassium Permanganate.—The primary standard is sodium oxalate (National Bureau of Standards, Standard Sample). It should be noted that there has recently appeared a modification of the method of standardising permanganate with sodium oxalate due to Fowler and Bright⁵.

The essential point of this is that to the substance dissolved in 250 ml. of 5:95 sulphuric acid, previously boiled, is added at 27° C. about 5 ml. less than the required amount of permanganate.

After standing a minute, the titration is completed at 60° C. In accurate standardising the correction for the permanganate to give a pink colour is best obtained by adding to the titrated solution at 25° C., 0.5 gm. potassium iodide and 2 ml. starch solution, and titrating with N/50 $\text{Na}_2\text{S}_2\text{O}_3$. It is not necessary to have a secondary standard for potassium permanganate.

Sodium Oxalate as Sole Primary Standard.—It is possible to base all the standardisation on sodium oxalate as primary standard. The equivalent weight of the secondary standard for alkali would have to be found by checking the normal alkali against normal acid standardised by sodium oxalate. The iodine solution can also be based on oxalate as standard. The equivalent weight of a sample of arsenic trioxide used as secondary standard for iodine solution can be found by titrating it with a potassium permanganate solution standardised by sodium oxalate. The method is given in a recent paper by Bright⁶. According to this method (due to Lange), 0.25 gm. of arsenic trioxide are dissolved in 10 ml. of 20 per cent. sodium hydroxide. After dissolving, there are added 100 ml. of water, 10 ml. of hydrochloric acid (S.G. 1.18) and one drop of 0.0025 M potassium iodate or iodide as catalyst. The solution is titrated with permanganate till faintly pink, a correction being applied for the amount of permanganate to give this colour.

The writer wishes to thank the Acting Dominion Analyst, Mr. R. L. Andrew, for permission to publish this paper.

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THE BRANCHES.

AUCKLAND.

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Committee: L. H. Briggs, R. T. D'Anvers, G. B. Jones, F. H. V. Fielder.
Branch Editor: R. T. D'Anvers.

THE PURIFICATION OF WATER—*G. B. Jones*. The purification of water can be conveniently dealt with under three headings: (1) the removal of suspended and colloidal matter; (2) the removal of undesirable matter from solution; (3) the removal of bacteria and plankton.

To remove suspended matter, water was for many years filtered through beds of sand, but this process has latterly been accelerated by the additional use of a coagulant such as aluminium or ferrous sulphate. The added advantages are that bacteria are largely removed, and the sand may be regenerated by back-washing with purified water and compressed air.

Two processes are in use for removing the undesirable dissolved solids from solution: the lime-soda process and the Permutit or base exchange method. The relative merits and applicability of the two processes were discussed.

The earliest attempt to sterilise water was by means of chlorine, but this method often had the one disadvantage of leaving an objectionable flavour in the water. A more recent modification is the chloramine process whereby ammonia and chlorine gas are used in conjunction, the chloramines formed (NHCl_2 and NH_2Cl) being equally as effective as chlorine and practically odourless. Use is sometimes made of the germicidal action of ultra violet light to sterilise water, and a similar effect has been produced by bubbling ozonised air through the water. A further method involves the use of a very low concentration of certain heavy metallic ions, notably copper and silver, as little as one hundredth part per million of this latter being sufficient.

One of the most interesting recent developments in the purification of water is a method of removing the dissolved solids by passing the water through beds of a raw material allied to the synthetic resins. This material has the remarkable property of removing the salts from solution and results in a neutral water free of dissolved solids.

WELLINGTON.

OFFICERS, 1938: *Chairman*: W. A. Joiner; *Secretary*: J. A. D. Nash,
c/o Dominion Laboratory, Sydney Street, Wellington, N.1.
Committee: W. G. Hughson, K. J. McNaught, O. H. Keys.
Branch Editor: F. G. Caughley.

THE MODERN CONCEPTION OF DIET AND PUBLIC HEALTH—
H. Jephcott. The speaker, who was a visitor from the Glaxo Laboratories, England, conveyed to the meeting greetings from the parent Institute, and introduced his remarks by saying that his treatment of the subject referred to British conditions only. The following was an illustration of the competition which the necessaries of diet had to face in commanding an adequate proportion of a family's resources. A slum area in England was cleared and replaced by dwellings designed to provide what are to-day regarded as the essentials of healthy living conditions. One half of the district was completed a year before the other half was started. Thus for a year the two sets of conditions, the old and the new, existed side by side and health authorities took the opportunity of observing the effect on health produced by improved housing. At the end of the year the comparison showed the surprising result that the incidence of ill-health had increased for the group in the new dwellings as compared with the group remaining in the old slum conditions. The cause was traced to the fact that a higher rent than previously was being paid by the newly-housed group, resulting in a smaller amount of domestic income being available for food. In consequence, as already had been recorded from large scale enquiries, articles of diet having a protective function had been replaced by cheaper articles whose functions were more of a "filling" nature. The illustration pointed to the conclusions, first, that the calorific value of a diet was not an index to health, and, secondly, that the maintenance of a suitable diet must not be lost sight of in acquiring other amenities of civilisation which are sometimes more prominently associated with a high standard of living.

A large amount of post-war laboratory work had built up a modern conception of diet superseding that based on mere calorific values, and the centre of interest was now passing from the laboratory findings to their application in the life of the community. The findings were that about eighteen particular proteins, eleven particular minerals, five vitamins, glucose and linoleic acid were essential in a complete diet. Clear-cut differences in the standards of health of social and tribal groups had been traced directly to

marked deficiencies of one or more of these items. There also existed marginal deficiencies whose effects were ill-defined and led rather to a general susceptibility to ill-health than to the incidence of some specific disease. It was now also widely believed that deficiencies in early life could produce a general tendency to ill-health which could not be eradicated by a subsequent correction of diet. Deficiency of vitamin A in early years was strongly suspected of causing permanent tissue damage affecting the course of health throughout life. The provision of foods containing the above essential constituents was a concern for many different authorities and sections of the community. The problem of the provision of milk which contains so many of the essentials had even reached the arena of politics.

What help could the chemist give in the general attack? First Harris had drawn attention to the need for more and better standards for substances whose deficiencies in small quantities indicated faulty diet. It was beginning to be felt, for instance, that the optical test for vitamin B did not carry complete conviction, and it would be well to reconsider the basis for a standard. Again, there was clinical evidence, although somewhat limited, that patients who were off colour without definite symptoms, showed on blood analysis, a lack of vitamin C. This suggested an opportunity for a thorough investigation. Secondly, the chemist could investigate and assist in developing the sources and production of such substances as the vitamins. As a result of such effort, attention was being turned toward the viscera of land animals as being a source of vitamin A preferable even to cod-liver oil. Further, there were three processes being worked to produce vitamin B, on a commercial scale, although unfortunately none of these were in British hands. Howard's famous synthesis of vitamin C was an advance that had not yet been translated into a successful works process. Vitamin D was being prepared readily and plentifully. The lecturer believed that greater importance would be placed on vitamin E in the future. It had not yet been prepared in the pure state, and the progress of experimental work was restricted by the necessity of reference to slow biological tests on animals.

Preparation of the vitamins on a commercial scale meant availability to health authorities who could see that they were distributed in order to correct deficiencies in a defective diet. Along these lines the Medical Research Council had experimented, in conjunction with laboratory work, for several years in the depressed area of South Wales, and results were expected in the near future.

The lecture concluded with the observation that one advantage of a State health insurance scheme was that it automatically provided data for estimating the incidence of disease in a community. The prospect of such a scheme in New Zealand was of interest since after a few years of operation a comparison with England could be made and related to the diets of the two countries.

CANTERBURY.

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

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

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

SOME FUNCTIONS OF AN INSTITUTE OF CHEMISTRY—H. N. Parton (Chairman's Address). "I think it will be agreed that the years which have passed since the foundation of the New Zealand Institute of Chemistry have seen the building up of an organisation which is now sufficiently strong, in that it embraces most of the chemists in the country qualified to join, to begin to exercise whatever functions the members may consider it should have. I say 'begin to exercise' advisedly, because apart from providing opportunity for chemists to meet and hear each other's views on technical and general topics, admittedly a useful function, and admittedly also one which the Institute performs excellently, I have been unable to persuade myself that the Institute is exercising any function at all. This is not intended as a criticism of those who were sufficiently far-sighted to see that the well-being of the profession of chemistry in New Zealand required the formation of such a body as that to which we belong. Nor is it directed at those who have held, or are holding, office on the Council or the local committees. They represent us, the members. They provide the machinery to carry out our wishes. The driving force must come from the members, in a democratically organised body. And I do not believe that any body otherwise organised could serve the interests of all.

"An institution which is functionless should die. Some have a lingering death, living on to plague the vigorous in the community. How should an institution be judged? Life, you might say, is activity, and an active institution is alive. Not necessarily, I think. The activity to be human must have purpose. On the whole it seems to stand as true, that 'By their fruits, ye shall know them.' I want to try to picture for you a few fruits which I should like

to see growing on the tree which is our Institute, and also to suggest why it has not grown those fruits already. I am a little sceptical of the mineral deficiency theories of soil chemistry. Perhaps we shall find that a human deficiency theory will explain our failure to function, as an Institute, for I think we have failed. On the other hand, circumstance may be as yet too much for us.

“First of all, why an Institute? Not, I hope, because England has one. New Zealand surely has grown up. What else could we have? Probably a trade union. Well, why not? Mainly I suppose because we call ourselves a profession, and first of all I want to explain what that word conveys to me.

“The expression ‘professional man’ is usually restricted to members of the learned artistic and administrative professions which aim at ensuring that their members conform to high standards of efficiency and integrity of conduct, and combine to uphold the status of their calling with due regard to public interest. ‘The essence of professional status,’ said a past president of the American Institute of Electrical Engineers, ‘lies in the moral obligation involved in the act of professing. This act is always personal and it is in a professional man’s personal relations to his fellows and to society and the obligations involved therein, wholly over and beyond obligations for which he is compensated, that his professional status resides. That is why violations of professional ethics rather than failures in professional competence have been practically the only grounds on which expulsion from the great professional societies have been based.’ In all professions we find that questions of personal obligation to fellows and to society constitute the very foundation of the professional conception. The medical profession pledges its novitiates to the service of suffering mankind, irrespective of compensation. The legal profession, in defending the penniless, and in the amount of unrewarded service it renders to the courts and the public as an arm of the law, illustrates the concept of professional service. With the clergy, the objective is social and their devotion to it cannot be measured by the monetary compensation.

“It is right that the science of chemistry, the science of the transformation of matter, should, in an age which devotes much of its energy to transforming matter, be served by people whose avowed aim it is to maintain standards of professional conduct. It has, however, to be realised that in forming an organisation whose main object is and must remain the maintenance of those standards, members of the chemical profession have virtually given up the

right of organising for the purpose of collective bargaining for the betterment of their conditions of salary and status. Now I think it is likely that members of the Institute are generally satisfied with this position. Equally, however, they are not satisfied with the financial rewards at present obtainable, particularly among the younger members who are faced with the task of paying off the cost of an expensive education in a period of a rising cost of living, and at the same time are desirous of taking on those wider responsibilities of marriage and family life, which I think it is in the interests of the community they should be able to support. The task before the Institute is either to resolve this difficulty, or to support those concerned in forming an organisation which can resolve it, such as a union of chemical laboratory workers.

“In discussions of the problem of the status of the chemist, I have frequently been confronted with the statement that a chemist of such and such training is not worth more than so much, to an industry. I think it will contribute to both the clarity and the honesty of such discussions if we agree not to use the word ‘worth.’ I am unable to see that it has any meaning. The blunt truth of the situation may be summed thus: the returns of any industry, after costs of materials, interest on loan capital, sinking fund, and all such items have been paid, are divided up among employees and owners. The various groups of employees are necessarily in competition with each other for their share of the total allotted to employees. If one group have organised themselves and through the power of their organisation obtained betterment of their conditions, it is more than possible that other groups, not so organised, may suffer. As an example, the factory workers of a particular industry may obtain higher wages. If the returns of the industry do not increase, it may be impossible for, say, unorganised clerical workers to obtain increases. If this occurs at a time when the cost of living is rising, the result is a decrease in the real wages, of, in my example, the clerical workers. I submit that this is occurring to chemical employees at the present time. During the slump, which I understand is no longer with us, the supply of chemists exceeded the demand, the output of this department, for instance, was abnormally high. As a result chemical laboratory assistants were obtainable at low salaries. As I remarked above, the question of their ‘worth’ did not arise. I do not believe it ever does, and should be grateful to anyone who could demonstrate to my simple intelligence how it could be estimated. An industry might be turning out a product of, say, minimum purity fixed by law. If the purity

could only be obtained by chemical analysis, it might be that the industry could not carry on at all without a chemist. In such a hypothetical and, of course, extreme case, the 'worth' of the chemist cannot be estimated in money. What he is actually paid is governed entirely by what minimum sum a satisfactory chemist can be obtained for.

"With these facts clearly in mind, and I am aware that it is not quite respectable to put them so crudely, let us see what a professional body such as this Institute can do for its underpaid members. Reliance may be placed, as an editorial in the *Christchurch Star-Sun* during our annual meeting suggested, on the common sense of employers to pay their chemists adequately. It would be unfair to say that the common sense of employers will always operate to obtain the best service for the minimum wage. But I think we must consider it on that basis. However, cases will arise when it will be possible to help a chemist by placing before his employers a reasoned case for better treatment. I am sure that it is entirely in accordance with those obligations of professional status to which I referred that the help of senior members of the profession will always be available to younger members. In fact we know that it is so. Beyond that I must frankly confess that I cannot conceive of any action likely to be successful, which a professional Institute can take, in the case of a chemist employed by a private firm.

"With public bodies, the position is different. The final employer of the public servant is the community at large. It should be possible for the Institute to appeal to that employer, the public, in the most open manner possible, if the salary offered for a position is too low. This will, of course, react upon the private employer. The most hopeful feature of the present situation in New Zealand is the setting up of improved standards for chemists in the Government service. The attraction to that service of the best graduates, that is, of course, of those who remain here after the very best have gone abroad, must in the long run react upon industry.

"Moreover an industry operating under tariff protection, that is, receiving a subsidy from the common purse, cannot be said to be entirely a private enterprise. It is right that the community through its elected representatives should ensure that protected industries should be as efficient as possible. If the efficiency can be improved by the help of chemical control, and there are, of course, many industries to which this does not apply, the Government might

insist that such control be used, and the chemists employed paid at similar rates to those in its own service.

“But we must finally realise that so long as industry is privately owned the final say will rest either with the owner or with an arbitration court. I am persuaded that the improvement in workers' conditions which has been obtained in the last hundred years in democratic countries has been so obtained by the system of collective bargaining through the unions, and that it would have not been won by any less thorough-going means.”

Dr. Parton proceeded to advocate increased association of the Institute with other professional bodies and proposed a series of wider contacts with men of all types. He considered that the Institute had not as yet given a lead in chemical education. He advocated a concentration on processes rather than the details of the properties of the elements, and continued, “I see no reason why a boy leaving school even from the sixth form, requires any knowledge of, say, the properties of bromine, or the oxyacids of chlorine. It was always a source of annoyance to me that I had to learn the properties of those sort of things, which I never met in my ordinary way of life, and was taught nothing about sugar, say. The reason given was that sugar is an organic compound and is too difficult for the secondary school. That reason illustrates perfectly the criticism I have to make, the angle of approach is wrong. I grant entirely that the properties of grape sugar as an organic hydroxy compound, aldehyde, etc., and its structure as revealed by the beautiful researches of organic chemists, are no fit subjects for even the sixth form. But what is the function of sugars in daily life. They are energy producers and are burned in the body. They have their place in the chapter on combination, which should be one of the largest and most important chapters in elementary chemistry books.

“A teaching of chemical processes, with illustrations drawn from industrial practice would I think provoke and maintain the interest of the best students in the schools, and we as chemists should be alive to the necessity of attracting a good proportion of the best to our science.”

Dealing with the University, Dr. Parton noted how much of its work was conditioned by the double task of justifying its existence to a world almost entirely dominated by a financial outlook, and at the same time educating the world to realise the value of the University tradition. The main function of the chemical department was not the training of specialists, but the advance-

ment of the science in New Zealand. Even America, which had attempted to produce from its colleges specialists, was reverting to the training of chemists with breadth of education rather than intensity. For it was found that very seldom did a graduate spend his life in the particular branch of industry for which he had been trained. "Until it is widely understood that processes such as smelting iron, making fertilizers, leather, artificial silk and plastics, controlling water purity and hundreds of other necessary activities of men are chemical processes, the chemist will not take his rightful place in the community."

OTAGO.

OFFICERS, 1938: *Chairman*: G. Bagley; *Secretary*: C. L. Carter, University of Otago, Dunedin.

Committee: Prof. F. G. Soper, L. H. James, R. M. Bruce.

Branch Editor: C. L. Carter.

SOME OBSERVATIONS ON SOAP MANUFACTURE—*G. Bagley* (Chairman's Address). After reviewing and exhibiting specimens of the various raw materials used in the soap industry, the lecturer described the methods used in the purification of fats. For the best toilet soaps, only pure edible fats were employed.

The glycerine lyes extracted containing 5-7 per cent. (glycerine) were concentrated up to 97 per cent. This was not further purified in New Zealand but was exported.

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Soap-making was an art controlled mainly by rule-of-thumb. Only when the process failed to give the desired product was the chemist invited to put matters right.

In conclusion the lecturer described the methods of chemical control and analysis as applied to soap and stearine manufacture.

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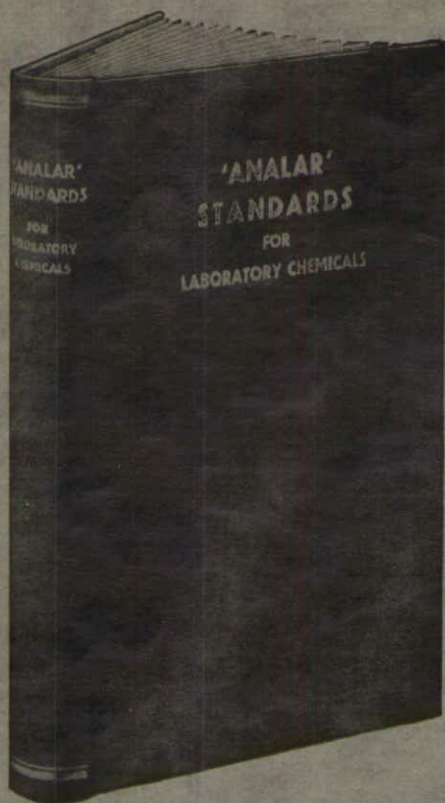
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