

in Tasmanian waters and making tests on methods of catching pelagic fish. A strong publicity policy was developed to reach the trade and fishermen and secure their confidence and co-operation.

The work of the National Standards Laboratory continued to have a purely defence aspect.

Referring to investigations in industrial chemistry, the report states that the Chemical Engineering Section is now well equipped to conduct pilot plant work on several processes developed in the laboratories of the Division. It is anticipated that more and more the Division will turn in future to two main types of projects: first, projects based on problems common to groups of companies or to numbers of industries, such as corrosion, problems connected with the transfer of gases, liquids and solids, with filtration, evaporation and distillation; and projects based upon raw materials with which Australia is well endowed and which are not now used or are not being used to the best advantage. For example, Australia's deposits of zirconia are the most extensive in the world and it is desirable to conduct research work on the chemistry of zirconium compounds and on the properties of zirconium metal and its alloys. The chief investigations in the Biochemical Section were concerned with fellmongery and industrial fermentation, but some work was also carried out on water-vapour permeability, rot-proofing, and the production of butylene glycol by fermentation. The Physical Section was concerned chiefly with the production of titanous powders, the silicizing of steel, corrosion of metals in ethylene glycol and in glycol-water engine-cooling mixtures and the corrosion of aluminium alloy sheet. In addition to the study of various flotation problems, the Physical Chemistry Section developed a method for determining the molecular weights of lightly condensed resins used in aircraft manufacture. The Organic Section tested numerous silver catalysts for their efficiency for catalysing the oxidation of ethylene to ethylene oxide, and pilot-plant investigations in collaboration with the Chemical Engineering Section were conducted on the manufacture of furfuraldehyde from agricultural waste material. In the Chemical Engineering Section the pilot-plant production of chromic anhydride was undertaken to test a new acid process developed by the Minerals Utilization Section for chromic acid from chrome iron ore. Extensive investigations were undertaken on lubricants and bearings. The Dairy Research Section dealt with problems such as hardened butter substitutes, the oxidation of butter fat, the deterioration of tinned cheese, the keeping quality of milk powder and the fermentation of whey to give lactic acid.

The demands for the services of the Information Section continued unabated, and among the surveys carried out by the Section may be mentioned those of the available data relating to the occurrence and chemical composition of natural gases reported at different times from various parts of the Commonwealth; the isolation of amyl alcohols from the fusel oil residues of the alcoholic fermentation industries and the preparation therefrom of amylene and *p-tert.*-amylphenol; and surveys of methods for the production of vinyl acetate from acetylene, and of the polysulphides of sodium and calcium to assist research projects in the manufacture of synthetic rubber of the thiokol type. Arrangements were completed during the year for the preparation of a revised edition of the "Catalogue of Scientific and Technical Periodicals in Australian Libraries".

SPECTROSCOPIC ANALYSIS

A JOINT meeting of the Physical Methods Group and the Scottish Section of the Society of Public Analysts and other Analytical Chemists was held at Edinburgh on May 23 at which five speakers dealt with various aspects of spectroscopic analysis¹. This was the third special meeting of this type arranged by the Physical Methods Group of the Society, previous symposia having dealt with polarography and chromatography².

Prof. R. A. Morton, in an introductory talk, emphasized the value to the analyst of the modern photo-electric spectrophotometer. One feature of the type of instrument now in use for ultra-violet absorption work is a specially designed electrical circuit for maintaining the light source (a high-intensity hydrogen lamp) at constant output. Measurements made with this apparatus are sufficiently reliable to form the basis of accurate analytical procedures.

As a precise method of analysis, absorption spectroscopy is, in general, limited to those instances where information is available concerning the absorption characteristics of all constituents of the material under examination. It may happen, however, that constituents other than those which it is required to estimate make an unknown and variable contribution to the measured absorption. Prof. Morton and Dr. A. L. Stubbs described a procedure by which a correction can be made to allow for this irrelevant absorption. Providing the absorption measurements can be made with the accuracy which is now attainable with modern equipment, the only assumption that has to be made is that the irrelevant absorption is linear over a selected short range of wave-lengths. The estimation of anthracene in petroleum oils was discussed as a typical instance where the correction procedure may be used. The application of the procedure to the spectrophotometric assay of vitamin A was also discussed at some length. The precise evaluation of the potency of an oil must involve an accurate determination of the absorption at 328 m μ which is unequivocally due to vitamin A. Such a determination must include, in most cases, a correction for irrelevant absorption, since saponification procedure does not always eliminate such absorbing substances. In order to convert the spectrophotometric measurement to international units per gram, a conversion factor is used. These spectrophotometric studies have suggested the most appropriate factors to use, for both corrected and uncorrected absorption measurements.

Chemical analysis by emission spectroscopy is also now attaining its full status as a reliable quantitative procedure. Both branches of spectroscopic analysis have recently shown some notable developments. These were discussed by Mr. B. S. Cooper who, in his paper, described the new apparatus and techniques which have made possible these recent advances. In the field of emission spectroscopy, probably the most important single factor is the development of electrical circuits which enable spectra to be excited with the greatest reproducibility consistent with high sensitivity. In metallurgical applications, an important feature is the study of the optimum conditions for casting and preparing sample electrodes. Another technique now employed is the preparation of a small flat surface on some fabricated part; this forms one electrode while the other is a pointed graphite rod. Photographic aspects discussed included sensitization of plates to the far ultra-violet by coating the emul-

sion with a fluorescent material and the new Kodak plates which have a uniform contrast factor between 2,600 A. and 4,000 A. In some very recent applications, the ultra-violet sensitive multiplier photocell has replaced the photographic plate as the energy receiver; this development is of great significance in connexion with routine quantitative analysis by emission spectroscopy. Some specialized light sources suitable for absorption spectroscopy were also described. These included a high-intensity hydrogen lamp, a multi-component discharge lamp giving many strong lines throughout the ultra-violet, and a tungsten filament source in a special design of glass envelope transparent to 2,700 A. Of interest for general spectroscopic measurements, very high sensitivity thermopiles are now available which may be used in conjunction with a galvanometer deflexion amplifier. Optical materials were also briefly reviewed.

In the discussion following this paper, Mr. G. E. Wilson described a method of converting the anode carbon into a filter stick. Use of this device *in situ* eliminates the necessity of transferring micro-chemical amounts of solid material to the anode crater. The usual micro-chemical filtration technique is used, preferably from a centrifuge tube.

Dr. R. L. Mitchell dealt with the spectrographic methods employed in soil investigations. For the determination of trace constituents in soils, rocks, plant and animal tissues, arc emission, using the cathode-layer technique, is employed, generally in conjunction with a prior chemical concentration of the trace constituents by precipitation with organic reagents such as 8-hydroxyquinoline, tannic acid and thionalide. The photometric technique for quantitative work employs a step sector, blackening curves being drawn for each line measured. The relative intensities of the internal standard and trace element lines are found from measurements made at a constant density, with or without background correction. Errors of this analytical procedure seldom exceed ± 10 per cent for known samples. Practical applications have been to the study of cobalt in soils and plants and its relation to the occurrence of cobalt deficiency in sheep. For the determination of alkalis, alkaline earths, magnesium and manganese in soil extracts and plant materials, the Lundegårdh flame emission method is used. Errors do not exceed about ± 5 per cent for solutions containing 0.1–10 mgm. per 50 ml.

Mr. D. M. Smith contributed a paper on the spectrographic analysis of rare and high-purity materials with particular reference to the control of "Spectroscopically Standardized Substances"³. Examples discussed were: (1) the manufacture and control of highest-purity copper electrodes, (2) the use of high-purity carbon and graphite electrodes, and (3) the analysis of rare earths. With these very high-purity materials it is only by a combination of spectrographic and chemical determinations that a reliable estimate of purity can be obtained. Difficulties encountered include the

masking of sensitive impurity lines by lines of the basis or other elements, the presence of faint lines of doubtful origin, the enhancement of impurity lines in carbon and graphite electrode materials and the occurrence of spark lines (when using an intermittent A.C. arc) having the appearance of impurity lines. To obtain optimum conditions for the excitation of the spectrum of any given substance, it is necessary to provide a variety of excitation circuits. Various types of sources suitable for analytical purposes were mentioned, including the D.C. arc, the constant-current D.C. arc, the intermittent A.C. arc and the new general purpose source unit which has recently been developed in the laboratories of the British Non-Ferrous Metals Research Association.

In the discussion following this paper, reference was made to the desirability of having a conditioned atmosphere in the spectrographic laboratory used for analysis of the highest-purity materials. Examples were quoted of the intrusion of airborne impurities from neighbouring premises.

The general impression given by the papers and discussions was that the methods of emission and absorption spectroscopy, as applied to chemical analysis, have now attained their full status as reliable quantitative procedures.

¹ These papers will be published in the *Analyst*.

² See *Nature*, 157, 487 (1946).

³ See *Nature*, 155, 784 (1945).

CO-OPERATIVE RESEARCH

ONE of the most outstanding industrial developments in Great Britain during the last generation has been the establishment and rapid expansion of the research association. Some idea of the growth of co-operative research in Great Britain will be gathered from the fact that the expenditure of all the research associations has shown an increase during the last ten years from £300,000 to more than a million pounds a year. On April 27, Sir Charles

