

taking place in other parts of Hertfordshire, but no doubt the main impetus was the spirited interest shown by industry.

The County Council realized that the enlightened governance of the College would be achieved only by the inclusion of a large proportion of governors representing industry, commerce and the universities, while the representatives of the County Council themselves were men and women with wide experience of the sort of problems with which the new College was likely to be faced.

In addition to the guidance given over the years by the Governing Body itself, each department set up an advisory committee consisting of representatives of the industry concerned with particular technologies. The influence of these committees has been immeasurable. Busy executives have given up their leisure time without stint, and the confidence they have shown through this work has been an inspiration to the staff of the College.

Experience in an entirely new building, devoid of any tradition and in an area lacking anything in the way of precedent, has necessitated a few adjustments during the course of development. The initial plan of the head of a department, acting as academic registrar, proved to be impracticable and the commerce and social studies were merged into one, releasing the head of the former to take the post of academic registrar. The rapid growth of electrical engineering necessitated the formation of a separate department and some internal adaptations to provide more laboratory accommodation. The formation of a science department was delayed some twelve months from the start owing to delays in providing temporary accommodation.

A new building, especially if planned on unusual lines, excites comment, and this one was no exception. Visitors have come from all parts of the world, in some instances to make a very close study of the design and layout. Those who have been in the College during these past five years have appreciated the thought that went into its design and, now that the surroundings are mellowing, its charm and suitability for its function. In some respects, it was soon found to be too small to do all that was needed, but it has lent itself readily to minor adaptations to meet the changing demands of industry. The completion in the next two years of a new block which includes mainly laboratories, classrooms and more library accommodation will give that extra space which at present is lacking.

At the end of five years the College is now established on a firm basis with a full programme of Higher National Certificate and Diploma work in engineering, building, management and chemistry and final City and Guilds courses in various subjects. The College has a part-time degree course in aeronautical and electrical engineering and sandwich courses are being developed with a view to a future application for the Hives award. The recent visiting party from the Royal Institute of Chemistry is to recommend approval of courses for Parts I and II of the A.R.I.C. examination. The arrangements being made by the Governors and the Authority, for a number of neighbouring colleges of further education, will result in all work of intermediate standard being taken out of the College within a few years. By its character and setting, together with the tradition it has already attained, the College is well set for the responsibilities that this stage will involve.

MODERN ANALYTICAL CHEMISTRY IN INDUSTRY

WITH the increasing interest in scientific symposia and congresses one sometimes wonders wherein lies their attraction. Is it the attractiveness of the venue, the brilliance of the speakers, the interesting or topical nature of the subject-matter or is it a mere thirst for knowledge? Certainly the Congress on "Modern Analytical Chemistry in Industry", organized by the Scottish Section of the Society for Analytical Chemistry and held in the University of St. Andrews during June 24-28, had all these qualities and was an outstanding success. Three hundred delegates attended, and many more applications had to be refused. The Congress was remarkably well organized, and the organizing committee, consisting of Dr. Magnus Pyke (chairman), Mr. J. A. Eggleston (secretary), Mr. J. Brooks, Mr. H. C. Moir and Mr. A. F. Williams, had not only planned well but continued to give themselves unsparingly to ensuring the smooth running of the Congress and the comfort of the delegates.

The lectures were divided into three sections, dealing respectively with analyses in modern industry, the application of some newer analytical techniques in industry, and developments in analysis for new problems in industry. Each section was prefaced by a special lecture, the lecturers being Dr. J. Craik, chairman of the Nobel Division, Imperial Chemical Industries, Dr. E. B. Hughes, chief chemist of J. Lyons and Co., Ltd., and Prof. G. F. Smith, University of Illinois. Altogether, there were twenty-three lectures spread over eight sessions, each session being presided over by one of the following well-known personalities in chemistry: Prof. E. L. Hirst, Dr. H. W. Melville, Dr. D. Trail, Dr. R. Belcher, Prof. D. H. R. Barton, Dr. C. L. Wilson, Dr. D. W. Kent Jones and Dr. Magnus Pyke.

The Congress was opened by Dr. Magnus Pyke, who referred to the changes taking place in analytical chemistry. There was a basic change, the uncovering of the knowledge of the physical world and particularly the unfolding of the nature of atomic structure, bringing a simplicity to the understanding of the diverse elements. A second change was the increasing use of physical instruments to measure the progress of chemical reactions. While these needed to be supervised by an analyst understanding the operating principles of the instruments and the chemistry of the reactions which they interpreted or measured, their manipulation could be entrusted to a young girl. A third change came from changes in the chemical industry with its trend towards continuous operations and automatic control.

Dr. J. Craik then opened the first group of lectures with his introductory lecture on "Analytical Chemistry in Industry". He stressed the help given to analysis by new techniques and by the development of instrumentation, help in overcoming limitations of man-power and in enabling problems to be solved which could not have been undertaken by the older classical methods. For example, the analysis of glycerol had been greatly simplified and speeded up by adopting the sodium metaperiodate method. Even simple volumetric procedures such as the determination of sulphuric acid, nitric acid and nitro compounds could be improved by the use of automatic titrimeters. The use of some of the newer techniques had also stimulated research into the behaviour of existing

instruments; for example, the use of gas chromatography had greatly increased our knowledge of the behaviour of katharometers. Dr. Craik considered that any large industrial organization needed an analytical research group, for problems were continually arising having no standard solutions and for which new techniques might be needed.

Following this lecture, Dr. G. R. Davies (Chemical Research Laboratory) dealt with some of the analytical research carried out by various stations of the Department of Scientific and Industrial Research. Particular attention was directed to the work of the Building Research Station in applying differential thermal analysis to the study of building materials, to the development of automatic methods of determining dissolved oxygen by the Water Pollution Research Laboratory and to the studies of the Chemical Research Laboratory on inorganic chromatography.

Analytical methods in the iron and steel industry formed the content of the next two papers. In the first of these, Mr. B. Bagshawe (Brown-Firth Research Laboratories) directed attention to some of the many changes which had taken place in recent years. Specifications were more exacting, more elements were being determined and a much larger use was being made of organic reagents and of absorptiometric methods. Co-operative research within the industry had led to the development of British Standard methods. Mr. Bagshawe then gave some examples of the methods employed.

Spectrographic methods of steel analysis were discussed by Mr. D. Manterfield (Steel, Peech and Tozer, Ltd.). The large tonnages of steel now being produced called for rapid methods of analyses, and by spectrographic methods steel of all types, slags and some refractories could be rapidly analysed. Mr. Manterfield then dealt with photographic and direct-reading instruments, illustrating the latter by means of the quantometer.

Mr. R. C. Chirnside (General Electric Co., Ltd.), in discussing the contribution of analysis as a research service to chemical problems in the electrical industry, directed attention to the wide variety of materials in which the electrical industry had an interest. Glass, ceramics, certain metals and alloys represented major interests, but fluorescent materials, thermionic coatings, semi-conductors, etc., had been developed and were manufactured. Much of the analysis carried out by industry was meaningless, Mr. Chirnside said, and still consisted in a catalogue of acidic and basic oxides. The analyst should have a greater interest in his answers and in interpreting his results to others. The failure of the conventional presentation of results to represent a composition was demonstrated by reference to an ore containing copper and zinc sulphides which could not be separated by flotation because they were present, not as a mixture of sulphides, but as a complex as shown by X-ray diffraction. Further examples of the uses of many techniques in dealing with analytical problems were given.

Physical methods of analysis used by the gas industry were described by Mr. A. B. Densham and Mr. G. Gough (North Thames Gas Board). Mr. Gough dealt with absorption, emission and fluorescent spectroscopy and gave examples of their use. Mr. Densham then discussed the use of chromatography, radioactive tracers, polarography, X-ray diffraction and differential thermal analysis.

Dr. G. M. Bennett (Government Chemist) gave an interesting review of the activities of his department.

In addition to the immense volume of revenue work, advice and service were provided for other Government departments. Dr. Bennett then dealt with some of the problems encountered in the revenue work, where the methods of assessing duty on alcohol, tobacco and sugar were all laid down by law. Topics dealt with by the non-revenue divisions were illustrated by the development of methods for determining toxic gases in factory atmospheres, the analysis of flours, nutritional surveys and the identification of the cause of the outbreak of food poisoning at Pontardawe in South Wales.

The final paper in this first section was by Dr. D. C. Garratt (Boots Pure Drug Co., Ltd.), who dealt with analytical developments in a pharmaceutical laboratory. He instanced the analysis of metals by compleximetric titrations, by emission spectroscopy and by flame photometry. Paper chromatography was used for assessing the activity of freshly prepared samples of insulin, insulin solutions and insulin zinc suspensions. Alkaloids were separated quantitatively on columns of oxidized cellulose.

The second group of lectures, on the application of some newer analytical techniques in industry, was introduced by Dr. E. B. Hughes's lecture on "Analysis and Food". Before beginning the lecture he read a tribute to the late Dr. L. H. Lampitt, who had originally been asked to deliver this lecture. Dr. Hughes began by saying that analysis was the backbone of the food industry. There were chemical safeguards for the buying, processing, cooking and packaging of food products. The care required to prevent any variation in the products was illustrated by the close control exercised during the manufacture of the large volume of ice cream and the miles of Swiss roll produced daily. Dr. Hughes then referred to the importance of controlled humidity in microbiological work, to the separation of the constituents of tea extracts by paper chromatography and to the use of X-ray diffraction in routine analysis and research.

In the next lecture Dr. R. L. M. Synge (Rowett Research Institute) discussed the application of some of the physico-chemical methods, which had proved useful for the analytical separation of smaller molecules, to substances of high molecular weight. Counter-current distribution and chromatography based on liquid-liquid partition were considered as well as ion exchangers and solid adsorbents, including molecular sieve effects. A number of electrophoretic methods were described as well as procedures depending on differences in diffusion behaviour or on selective permeability in membranes.

"Emission Spectroscopy in Industrial Analysis" was the title of the paper by Mr. M. Milbourn (Metals Division, Imperial Chemical Industries). Various aspects of this technique were dealt with, including the scope of the method and the directions in which future progress is needed.

Dr. A. T. James (Medical Research Council), speaking on "Analyses in Medical Research", pointed out that there were few analysts in medical research. Each research worker carried out his own analytical work, for this varied with each problem. The general conduct of such a research was outlined and illustrated from the work on hypertensin, on the antagonist of dihydrostreptomycin and on the fatty acids derived from animal sources.

Infra-red spectroscopy was dealt with by Dr. A. E. Martin (Grubb, Parsons and Co., Ltd.), who described the modern equipment available, including the less

expensive instruments of restricted range which were very suitable for analytical use, and also instruments for process control. The various techniques available and a number of interesting analytical determinations were outlined.

An interesting account of the application of modern methods to the analytical problems of the plastics industry was given by Dr. J. Haslam (Plastics Division, Imperial Chemical Industries). Reference was made to chromatographic studies of hydrolysates from nylon and related products, to the examination of complex plasticizers in polyvinyl chloride and to the depolymerization of 'Perspex' and examination of the monomers by gas chromatography.

In his paper on "Modern Analytical Chemistry and the Rarer Metals", Mr. A. R. Powell (Johnson, Matthey and Co., Ltd.) showed how the increasing industrial use of these metals had called for rapid methods of analysis. Lithium, rubidium and caesium were conveniently determined by flame photometer, while spectrophotometry was useful in estimating the rare earths or the platinum metals. For that very important field of analysis, the determination of trace impurities in pure metals, the examples chosen were platinum in palladium and arsenic in germanium. The determination of non-metallic impurities in pure metals was also mentioned.

"Analytical Research in the Nobel Division of I.C.I." was the title of Mr. A. F. Williams's paper, and he showed that some of the problems encountered could only have been solved by modern methods. Chromatography had been used to separate glycerol from sugars, diphenylamine from its nitro derivatives and to separate 2:4- and 4:6-dinitroresorcinols from the mononitro compound, followed in the last case by polarographic determination. Analysis of mixtures of methyl chlorosilanes by vapour phase chromatography was also described.

A thought-provoking paper by Dr. B. W. Bradford (Billingham Division, Imperial Chemical Industries) on "Process Analytical Control" brought this second session to a close. Dr. Bradford dealt with the implications of the analytical service on the working process, the cost of analytical control, the difficulties of getting junior staff for routine analysis and the consequent development of instrumentation. The final objective was the linking of continuous analytical control on the plant to the actual process. Dr. Bradford then dealt with developments at Billingham in automatic analytical instruments; where possible, physical methods were used, while in other cases analytical procedures were mechanized. Examples were given of the use for control analysis of automatic titrimeters, optical, mass and X-ray spectrometers and gas chromatography.

The third group of lectures was opened by Prof. G. F. Smith (University of Illinois), whose topic was "New Analytical Reagents in Industrial Plant Control Operations". He pointed out that in spite of the emphasis on instrumental methods of analysis, wet chemical methods were still highly important. Recent years had seen an enormous development in organic analytical reagents, and reference was made to some of these and particularly to complexones and ion-exchange resins. Many organic reagents were of a non-specific character, but specificity could often be increased by structural modification. Progress on these lines was slow because the analyst depended on the organic chemist to do this for him instead of doing it himself. Prof. Smith then gave examples of the use

of periodates, ceric salts and perchloric acid in analysis and said that these reagents deserved a wider use.

In the absence of Mr. A. Smales through illness, the next paper, on the use of radioactive and stable isotopes in industrial and analytical problems, was given by Dr. D. J. Ferrett (Harwell). He first outlined those properties of the nucleus which could be used for analytical purposes, including spin and mass, and followed with a consideration of equipment and of health hazards in dealing with tracers. The interaction of a stable nucleus with radiation could lead to attenuation, radioactivity or secondary emission, and analytical procedures depending on these were discussed. Vacuum spark and isotope dilution methods of mass spectrometry were considered, while brief reference was made to nuclear magnetic resonance.

Mr. D. A. Patient (Baird and Tatlock (London), Ltd.) then described the 'B.T.L. Analmatic' range of automatic instruments. Three categories were dealt with: (1) semi-automatic equipment needing an operator to prepare samples and work out the results; (2) equipment to cater for techniques involving the handling of a large number of discrete samples; and (3) fully automatic laboratories.

Polarography was covered by three experts in this field from the U.K. Atomic Energy Authority (Dr. G. C. Barker, Mr. G. W. C. Milner and Mr. H. I. Shalgosky). Mr. Milner briefly compared the various types of polarograph and then described a wide range of analytical applications of the square-wave model. Mr. Shalgosky then dealt with the cathode-ray instrument, which was rapid and easy to operate and was well suited for routine analysis. Dr. Barker finally discussed the limitations of the square-wave polarograph and the methods being adopted to increase its sensitivity.

Gas chromatography was mentioned in many lectures, but it was left to Dr. A. I. M. Keulemans (Koninklijke Shell Laboratory, Amsterdam) to deal more fully with the subject, particularly in its application to the petroleum industry. Describing chromatography as the greatest single advance in analytical methods since the discovery of emission spectroscopy, he said that its techniques had soon been used by the petroleum industry. The value of gas chromatography was illustrated by its successful application to two problems: (a) the determination of impurities in *cyclopentadiene*; and (b) the explanation of the presence of acetone in doubly distilled methyl *isobutyl* ketone.

In the last paper of the Congress, Prof. C. F. Davidson (St. Andrews) dealt with the geochemical approach to prospecting. In prospecting for mineral deposits, the economic geologist had increasingly to direct his attention to sub-surface ore bodies hidden beneath tropical soils, forests, bogs and other covering. In this search he was becoming more dependent on geochemical aids. Sometimes a metal might be found by the company it kept or by mass spectrographic studies of absolute age. In other cases, analyses of soils, groundwaters, streams or vegetation might point to geochemical anomalies reflecting the presence of a nearby ore-body.

Looking back on the Congress, one could not help being impressed by the keenness and enthusiasm of those who attended. Session after session, the lecture hall was crowded with eager listeners; discussions inside and outside the hall were on a high level and few who attended could have failed to gain much knowledge which should prove valuable in later days.

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