EDITORIAL

EDUCATION FOR INDUSTRY

The recent Supplement published by *The Times* on "Careers in Industry" (12 March) is mainly concerned with the opportunities for grammar and public school boys entering industry at 16 to 18 years of age with the prospect of rising at least to important managerial positions. It is interesting to compare what the representatives of these schools and of industry have to say in the Supplement nearly a year after this subject was discussed in the *Fifth Annual Report* of the Advisory Council on Scientific Policy (Cmd. 8561, issued in May last year). In that report the Standing Committee on Scientific Man-Power criticised the public schools' attitude to science, technology and industry; it was also noticed that the proportion of pupils studying science subjects to higher school certificate level was much greater in the grammar schools than in the public schools and that science did not attract as many public school boys of outstanding ability as was desirable in the national interest. On the other hand, it was recognised that in the latter schools science is now being given much greater prominence than in the past (*see* p. 172), and that about half the boys in their sixth forms specialise in it.

It is therefore disturbing to find that one public school, which alone gives enough data to make a comparison, does not in fact reach anything like this balance between science and arts specialists. This school may be unrepresentative, but it is the only example we are given. The number of sixth formers specialising in science or mathematical subjects, when those already committed to medicine have been deducted, is only one-third as large again as the number of specialists in classics, and well under half the total number of arts specialists. This proportion, we learn, is unlikely to alter much in the near future; in general the boys tend to follow the same careers as their fathers, and the proportion now choosing industry and commerce is certainly no more than the proportion of parents so engaged. Clearly, the position is not changing sufficiently rapidly to meet national needs, and it seems that the Standing Committee may have understated its case.

In "Careers in Industry" we find industrialists admitting that they have not yet learned how to use arts men, though the will to learn is there, the attempt has been proceeding long enough, and last year no fewer than 258 arts graduates were absorbed from the University of Oxford alone (*see* p. 211). It may therefore be questioned whether the public schools have yet altered their attitude to the cultural value of science subjects in the school curriculum, and so whether they are in fact capable of making as great a contribution to the country's recovery as has perhaps too readily been assumed.

In justice it must be admitted that too great a pressure on the public schools would undoubtedly destroy some of their best qualities, for they must each try to find a balance consistent with their own character and traditions. Whatever the needs of commerce and various branches of industry, the public schools cannot properly forget the claims of medicine, law, education, the Church and the armed services. Moreover, most of the public schools have ties of long standing with the older universities,

and the endowments that enable them to send the best students there have come down from a time when science and industry had little claim on their products. Nevertheless, these schools do not all seem to have changed their views on these matters as readily as the older universities have already done.

Important changes are noted in the attitude of the Public Schools Appointment Bureau, which was reconstituted in 1950 after an appeal supported by the Federation of British Industries from the industrial side. We are informed that the Bureau has recently strengthened its relations with industry and that there are now strong ties between the two, both centrally and in many key localities. Relations between industry and the technical colleges have always been close, but this scarcely touches the public schools, since so many of their pupils go directly to the universities.

It is surprising and somewhat disconcerting to hear that, in spite of close ties being built up between industry and the public schools, understanding and relationship between industry and the grammar schools scarcely exist. No doubt there are exceptions. There is some reassurance in knowing that industry is becoming aware of its responsibility for making itself and its openings better known to both scholars and parents. The majority of recruits for industry must of necessity now be found in the grammar schools, and the apparent belief that leaders must be looked for mainly in the public schools is to-day untenable.

For industrialists, one of the beneficial results of the survey in "Careers in Industry" should be to direct attention to the grammar schools as a source of a larger proportion of recruits and to the need for developing closer relations with these schools. Their sixth forms contain the major proportion of the country's ablest youths and, as stated in the *Fifth Annual Report*, there is still a large potential reserve of young men of high ability, often as good as those who proceed to the universities, among the large numbers who leave the grammar schools before completing the full sixth form courses. Many of these, it seems, sometimes through ignorance of the opportunities available, are lost to industry and take up less responsible work than is consistent with their abilities, so giving a poor return for the country's investment in their education.

The *Universities and Industry* report of the Anglo-American Council on Productivity, published last year, pointed to the immediate need for preparing a large number of young men for industry on a full-time basis. This is one way in which the grammar schools' contribution to industry could be increased. The leader of the team that prepared this report has since stated his conviction that, in order to obtain suitable young men for senior positions in industry, it is essential to secure adequate prestige in the grammar schools for industrial careers.

Erratum.—Attention is drawn to an error in the last line of page 1 of the *Annual Report of the Council for* 1952; "Seventy-fifth" should be amended to read "Seventy-fourth."

THE RETIRING TREASURER

At the Annual General Meeting this month Dr D. W. Kent-Jones will relinquish the office of Honorary Treasurer of the Institute to which he was first appointed a little over seven years ago.

To this office he brought a wide experience of business affairs acquired in the hard school of building up and running a large consulting practice. The accounts of the Institute must have seemed very simple to him, but it was one of his first concerns to make them as comprehensible as possible to the ordinary member so that all might see exactly how their money was spent. To this end he introduced into the annual statement a number of special accounts relating to particular services, and had the building and its contents re-valued, so that these fixed assets might be included in the balance sheet.

Seeing that the accounts are in good order, however, is only one of the duties of the Treasurer, and one in which he is guided and watched over by the professional auditors; and, as Dr Kent-Jones would remark, "one doesn't keep a dog—and bark." The Treasurer of the Institute is *ex officio* the Chairman of the Finance and House Committee and of the Benevolent Fund Committee, and through these Committees advises the Council on all relevant matters of policy. It was in this broad field of action that the abounding energy and human understanding of Dr Kent-Jones found their full scope.

Everyone knew that he was inspired with a deep affection for the Institute. It soon became clear also that his exuberance betokened no element of irresponsibility, that his downrightness was wholly consistent with uprightness and that, if his manner was the direct opposite of the sanctimonious, what a rare and refreshing quality this was. Any doubt if one so generous in his personal dealings would take sufficient care of the funds of the Institute was likewise soon allayed, for while parsimony and niggardliness were foreign to his nature—and he knew they did not pay in the long run—he was equally averse to prodigality. Large-hearted in all things, he showed himself also a stern realist where the financial interests of the Institute were concerned.

In the economic blizzard that followed the war the maintenance and progressive development of the activities of the Institute called for skilful direction of financial policy. Steeply rising costs made it difficult to strike a balance between competing claims for more money, especially when the Treasurer himself was strongly sympathetic to those claims—and had, indeed, originated some of them. He gave strong support to increasing the grants to Local Sections, so that they might be able to extend their activities; he played a leading part in encouraging the development of the *Journal* so that it should look "less like a parish magazine" and become a publication that every member would want to read; he recognised the importance of looking after the interests of the staff, not only as regards salary rates, but also in modernising the pension scheme; and he was mainly responsible for making the Institute building more of a social centre for members by providing a members' room where they could gather and meet their friends.

There are many other developments that owe much to Dr Kent-Jones' vision, enthusiasm and drive: the construction of living quarters for resident housekeepers in the Institute building; the conversion of the laboratory into offices and provision of additional rooms for committee meetings and interviews; the refurnishing of the Council chamber, nd, as a finishing touch to a brighter and better Institute, the garnishing of the exterior of the building with window boxes!

We suspect, however, that an even more lasting memorial to K-J (here we must use his pet name) will be found in the hearts of innumerable men and women—colleagues, friends and people in all walks of life—who have benefited from his kindness and understanding when they have been in trouble. There can be little of the seamier side of life and few aspects of human suffering that have been hidden from one who while serving in the R.A.F. in the first world war went through the grim experience of being a prisoner in enemy hands—and who in the second war was a policeman. On K-J these experiences seem to have left no bitterness but rather an enhanced zest for life, even when—or perhaps especially when—there are difficulties to be faced and overcome.

What better prescription could there be for a Chairman of the Benevolent Fund Committee and, during its brief but not inglorious existence, the Residential Clubs Fund Committee? If we were asked to formulate the principles on which he has acted in the administration of these charities we should produce a series of aphorisms which he has (or might have) uttered, such as: "Let us have the full facts and decide accordingly"; "Don't raise false hopes—state bluntly the extent to which we are prepared to help"; "Never do anything that may injure a person's self-respect"; "The best way of helping anyone in difficulties is to provide the means whereby he can overcome them himself"; "If money is to be given, don't make it too much, for that discourages initiative—but don't make it too little, for that merely prolongs misery and may prevent help being obtained from other sources"; "We are a benevolent institution, not a court of morals"; and, finally, we feel sure he would add, "Don't try to formulate principles—we are concerned with human beings and should deal with each as an individual."

Dr Kent-Jones has recently been elected President of the Society of Public Analysts and Other Analytical Chemists, and in thanking him for all he has done for the Institute during his Treasurership we wish him well in his new office. We are assured that his interest in the Institute will not be diminished but realise that the Society, which has always been his other love, must now claim the greater share of his personal attention. In taking leave of K-J, in what we hope is but a limited sense, our sentiments are akin to those expressed in that well-known recitation "The Fully Licensed Man"; the regular customer in regretting the retirement of the revered landlord of "The Bullock's Head" recalls the latter's kindness in presenting a heart cake to his small boy who was sent to buy "a packet of fags for father" and concludes "And I don't mind telling you gents, we've got that 'art cake on our sideboard now!" We must get a sideboard for the Members' Room.

Dr D. W. Kent-Jones
Hon. Treasurer, 1946–1953

[*To face page 160*

Chemistry Department, East Front with (*left*) the new Parkinson Building, University of Leeds

SCHOOLS OF CHEMISTRY IN GREAT BRITAIN AND IRELAND—IV

THE CHEMISTRY DEPARTMENT OF THE UNIVERSITY OF LEEDS

By Professor FREDERICK CHALLENGER, Ph.D., D.Sc., F.R.I.C.

When the Yorkshire College of Science was opened in 1874 Thomas Edward Thorpe was appointed as the first Professor of Chemistry. He was a student of Roscoe's at Owens College, Manchester, and later his private assistant, and worked on photochemistry, perchlorates and vanadium compounds. He then spent about three years with Bunsen in Heidelberg and with Kekulé in Bonn. Before coming to Leeds he held the Chair of Chemistry at the Andersonian College, Glasgow, later the Royal Technical College.

Thorpe has described the conditions in the first Yorkshire College. "The premises . . . consisted of a disused Bankruptcy Court situated in Cookridge Street. After a somewhat chequered career the building had been partially used as a cookery school with the unfortunate result that it had been largely consumed by a fire just prior to being taken over by the College authorities." At the initial ceremony each of the three Professors (A. Rücker, experimental physics, and mathematics; A. H. Green, geology and mining, and Thorpe) gave an introductory lecture.

In 1877 the foundations of new buildings in College Road were laid. L. C. Miall had already been appointed to the Chair of Biology and later professorships in classical literature and history and modern literature and history were established. Consequently a significant change in the name of the College was made, and it became known as the Yorkshire College. Miall's son Stephen became a chemist and was for many years Editor of *Chemistry and Industry*. His editorials were characteristic of the man and reflected his wide reading and interests.

The new laboratories must have been excellent and sufficient for their purpose for many years. The large laboratory on the first floor was in use up to 1933 and was exceptionally lofty and spacious. It has now been divided into two good laboratories for botany and zoology.

Thorpe did not allow his wide interests and love of travel or administrative duties to interfere with his research. He remained at Leeds for 11 years and carried out much accurate work on the specific volumes of liquids and on the structure of phosphorus oxychloride. In 1881 the Chemical Society made the first award of the Longstaff Medal to Thorpe "for the best series of original investigations in chemistry published in Britain during the past three years." This work included the detection of heptane in the oil of *Pinus sabiniana* and a study of the relation between molecular weight and specific gravity in liquids. Other researches at Leeds dealt with the mineral waters of Yorkshire and dust explosions in collieries. He also determined the atomic weight of titanium. In later years Thorpe was Secretary of the International Committee on atomic weights and it is an interesting coincidence that Whytlaw-Gray, a later Professor of Chemistry in Leeds, was a prominent member of that Committee and the recognised British authority on the subject. Two remarkable

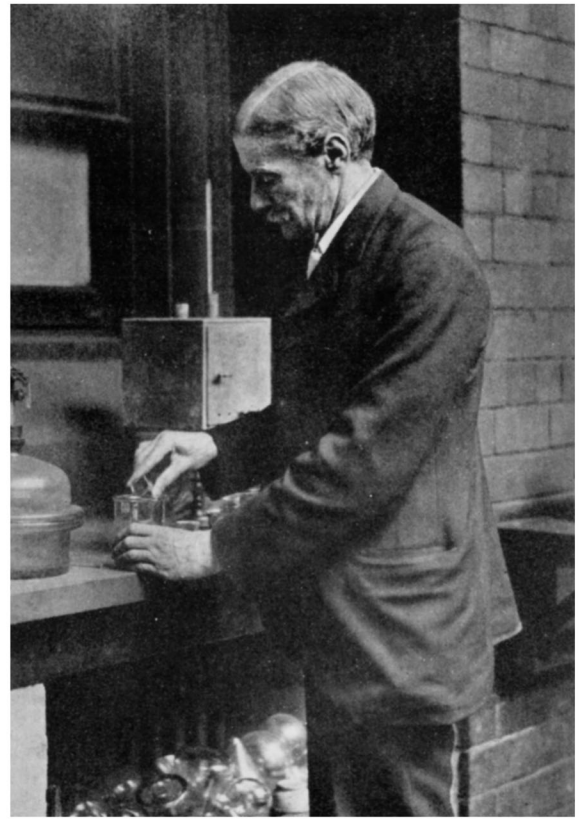
papers were published by Thorpe with James Young, from Glasgow. Young was the founder of the petroleum industry and the papers, entitled "The Action of Heat and Pressure on Paraffins" and "The Production of Olefines from Paraffins by Distillation under Pressure," clearly mark the first step towards the modern "cracking" processes.

In 1885 Thorpe succeeded Sir Edward Frankland in the Chair of Chemistry at the Royal College of Science, South Kensington. He received the honour of knighthood in 1909. He was an enthusiastic gardener and yachtsman with an intimate knowledge of the Dutch waterways and of the Seine. As an investigator he displayed "infinite resource and sagacity," consummate manipulative skill and scrupulous neatness and accuracy. His colleague, Dr A. E. H. Tutton, F.R.S., said of him: "he was a brilliant lecturer and experimenter and a faithful teacher, possessed of great clarity of expression. The spirit of research ever emanated from him and vivified all his teaching."

Thorpe's successor at Leeds was Arthur Smithells, who held the Chair of Chemistry from 1885 till 1923; he had been Assistant Lecturer in Owens College, Manchester, under Roscoe and with his friend J. B. Cohen had worked in Munich, afterwards moving to Bunsen's laboratory in Heidelberg. It is impossible to over-estimate the debt that the University owes to his wise foresight. His influence was felt far outside his own Department. He insisted on a sound training in fundamental science for those who would enter any branch of technology. This had a profound effect on the development of the departments of applied science—colour chemistry and dyeing, leather manufacture, textiles and fuel technology—which are now so important a feature of the University of Leeds. Degree courses in the Faculty of Technology were instituted in which a training in pure science provided the foundation for a later—sometimes even simultaneous—instruction in its industrial applications. That is to say, at Leeds an applied science is not usually studied as a postgraduate subject, but is incorporated in the course for a first degree. The scheme has on the whole worked well. Both the pure and applied science departments have benefited from the close association resulting from their membership of the Joint Board of the Faculties of Science and Technology, of which Smithells was Chairman for many years. Many problems arising in applied chemistry can only be attacked by the joint efforts of the academic chemist and his technical colleague. This co-operation has been, to a large extent, achieved in Leeds. To an increasing degree, the departments of applied science are appointing, as additional members of their staffs, experts in various branches of pure chemistry or physics or in new techniques.

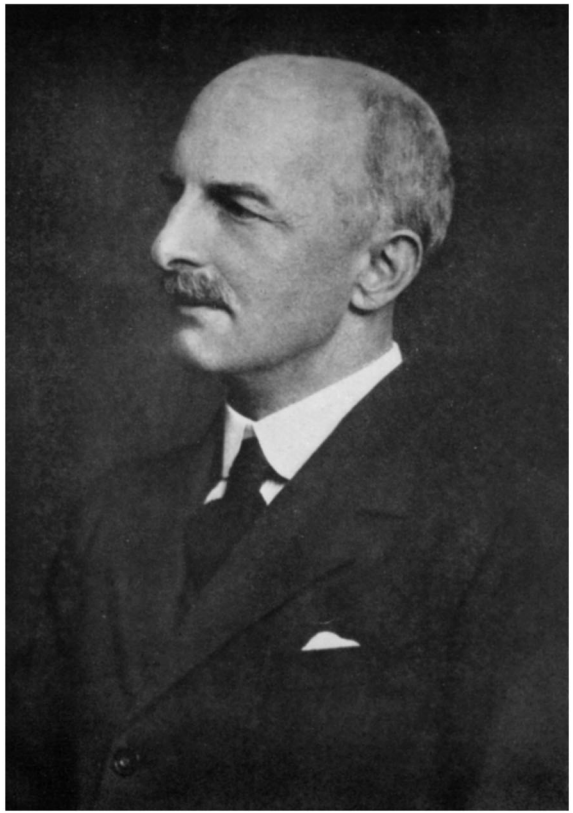
On Smithell's arrival in Leeds he found no department of organic chemistry. In 1890 he appointed J. B. Cohen as assistant lecturer. A year later he became lecturer and in 1904 Professor of Organic Chemistry. Smithells also secured the appointment of his former student H. M. Dawson as demonstrator in Physical Chemistry in 1899, lecturer in 1905 and Professor in 1920. The three chairs in chemistry have existed ever since and have ensured that all branches of the science receive due attention. A balanced curriculum has been maintained and researches of

Arthur Smithells, F.R.S.
(Professor of Chemistry, 1885–1923)

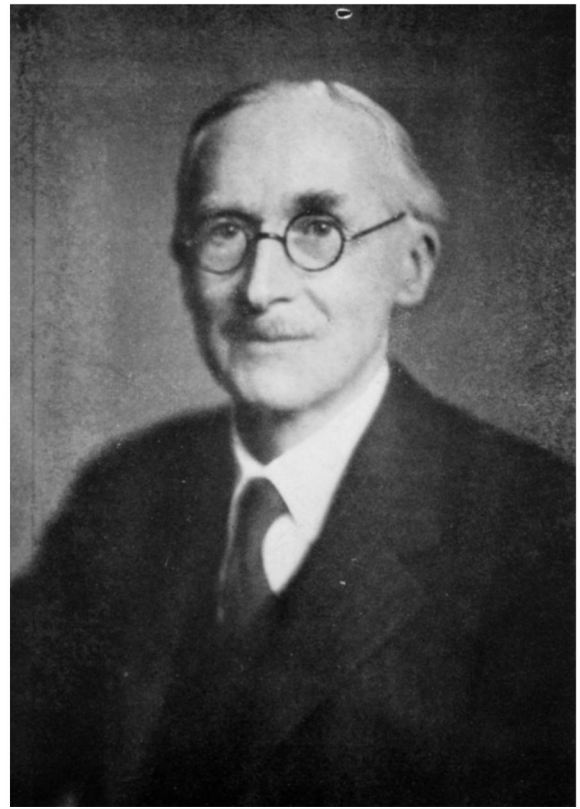


Julius Behrend Cohen, F.R.S.
(Professor of Organic Chemistry, 1904–1924)

[To face page 162



Harry Medforth Dawson, F.R.S.
(Professor of Physical Chemistry, 1920–1939)



Robert W. Whytlaw-Gray, F.R.S.
(Professor of Chemistry, 1923–1945)

the most varied types have centred round the three professors and their staffs. Leeds has always felt that three chairs of chemistry are a necessity and not a luxury. The chemical quadrilateral was completed in 1946 by the establishment of a Chair of Biochemistry in the University Medical School.

In 1908 His Majesty King Edward VII opened the extensions of the University buildings on Woodhouse Lane. These included new one-storey laboratories for inorganic and organic chemistry which continued in use until 1933.

Smithell's student and colleague, H. S. Raper, F.R.S., wrote: "As an investigator he was primarily interested in the processes of combustion. He discovered the 'flame separator,' a device by which the two cones of the flame of a Bunsen burner could be moved apart. Analysis of the interconal gases for flames of various hydrocarbons and for coal-gas showed that the inner cone contained hydrogen, oxides of carbon and steam without the separation of any carbon. Smithells then studied the luminosity of flames free from any solid particles and the flame spectra of salts of copper and gold." Much of this work can probably be traced back to the influence of his early days in Bunsen's laboratory.

Smithell's wide interests and sympathies caused him to devote much time to what would now be styled extramural work. He left the research of the Department largely in the hands of Cohen and Dawson and their assistants, but his services to the University were rated most highly and he ultimately became almost a tradition, to which his fine presence and courteous personality contributed in no small degree. Shortly before his resignation he became greatly interested in the Lewis-Langmuir developments of J. J. Thomson's theory of atomic structure and delivered lectures in several universities on the subject. He thus provided an interpretation of these new views which did much to promote a theoretical outlook among chemists.

Smithells was succeeded by R. W. Whytlaw-Gray, a colleague of Ramsay at University College, London. At the time of his appointment, he was the senior chemistry master at Eton, where he had engaged actively in research. His determination of the atomic weight of niton by the use of the delicate micro-balance, which he devised himself, attracted much attention. He held the Chair of Chemistry until 1946, a period in which momentous changes occurred in the Department and the University.

In 1933 the new Chemistry building was ready, whereupon much of the old department was demolished to make way for the new Brotherton Library. The new building was to form a quadrilateral with a central quadrangle, but rather less than three sides have been completed. The accommodation proved ample at first, but since 1945 has been insufficient. The planning of the laboratories was carried out by Whytlaw-Gray, Dawson and Ingold. In 20 years little cause has been found for criticism of their scheme and, thanks to the vigilant care of the academic staff and the co-operation of the administrative authorities in providing efficient stores, laboratory and cleaning staff, the Department carries its years very lightly. Each of the three floors contains two very large teaching

laboratories and numerous smaller research rooms. There are two large lecture theatres and one small one. The new building with its wide corridors and spacious, well-lighted laboratories with very efficient ventilation was, and has remained, a great stimulus to both teaching and research. It was officially opened by Sir Frederick Gowland Hopkins, F.R.S., President of the Royal Society, on 12 January, 1934. Next day the Chaston Chapman Library was opened by Professor (later Sir) Jocelyn Thorpe, F.R.S. This collection of periodicals, books and pamphlets was presented by the late Alfred Chaston Chapman, F.R.S., a former President of the Institute of Chemistry and of the Society of Public Analysts, who had family connections with Yorkshire. The periodicals have been kept up to date and augmented by Professor Whytlaw-Gray and the late Dr Clifford Briggs.

Whytlaw-Gray continued his work on atomic weights in Leeds and with A. L. Roberts, now Professor of Coal Gas and Fuel Industries at Leeds, re-determined the atomic weight of silicon. His work for the War Office in 1915-18 gave him an enduring interest in smokes and aerosols and this work was continued with Patterson. In 1936 they published a book on this subject. He was appointed by the Chemical Society as the fifth Liversedge Lecturer in 1935, his discourse being entitled "The Process of Coagulation in Smokes." When war broke out in 1939 the Minister of Supply again enlisted his services.

Whytlaw-Gray was also interested in preparative inorganic chemistry, especially where the product was amenable to fractionation *in vacuo* by methods he had learned in Ramsay's laboratory. With Denbigh he described a new gaseous fluoride of sulphur (S_2F_{10}). He then studied the interaction of tellurium hexafluoride with tellurium in an alumina vessel at 200° C, when the tetrafluoride was formed. Like most workers with inorganic tellurium compounds, his students suffered from the characteristic garlic odour in the breath, owing to the methylation by the body of tellurium dioxide or telluric acid slowly absorbed in traces through the lungs or skin. The odour is due to dimethyl telluride.

Owing to the war Whytlaw-Gray continued as Professor of Chemistry till October, 1945. Until 1950 he worked with one or two senior assistants in a laboratory which was placed at his disposal by Professor M. G. Evans. In that year the University of Leeds conferred upon him the degree of Doctor of Science, *honoris causa*.

The qualities of the man and the chemist may be summed up, albeit imperfectly, in the words with which a resolution on his retirement was introduced in the Senate: "Of a quiet manner, careful of the feelings of others (especially when he differs from them) slow to speak, but holding fast to certain principles which guide his personal and scientific relations, he has never courted controversy—possibly because he sees beyond it. It may be that some aspects of his character may be related to the quiet detachment of the exact experimentalist—his unruffled calm to the poise and exactness which are characteristic of his own microbalances. . . . Throughout his career nothing but the over-riding need of his country for his specialised advice has ever deflected him from the experimental pursuit of exact knowledge for its own sake."

Cohen's tenure of the Chair of Organic Chemistry extended over 20 years. While still at Manchester he had introduced a short course of organic preparations into the laboratory instruction. This marked an important stage in the teaching of chemistry in this country. In 1887 Macmillan published the first edition of his *Practical Organic Chemistry*, which was the first English book of its kind and ever since then has occupied a foremost position. Professor H. S. Raper, F.R.S., a student and friend of Cohen's, wrote: "Cohen had his own bench in one corner of a small laboratory—he shunned the interruptions of a private room. There were research students at other benches and students just beginning their organic preparations or doing organic analysis at others. Those who were privileged to work in this laboratory will never forget its good fellowship, contact with research of various kinds and above all the kindly example of Cohen himself. His heart was in his laboratory and during normal university hours he was almost always to be found there. Committee work or meetings which took him away from his laboratory he hated. For many years he had no demonstrator to assist in the practical teaching, but he never allowed his research to flag." Much of his work was connected with the use of the aluminium-mercury couple, first as a reducing agent, then as a catalyst in the Friedel-Crafts reaction and later as a halogen carrier in aromatic substitution. Cohen and his student H. D. Dakin studied the influence of substituents in the nucleus on the orientation of halogens or nitro-groups subsequently introduced into toluene. About 1920 Lapworth advanced his theory of induced alternate polarities, which played a great part in the evolution of our views on this phenomenon. Cohen was keenly interested in these new developments and in one publication Lapworth quotes from one of his letters. Still later the Department of Organic Chemistry was to play an active part in the study of substitution reactions.

Early in 1915, H. D. Dakin and Carrel investigated the use of a solution of sodium hypochlorite and boric acid in the treatment of septic wounds. It appeared that the imino-groups of protein were converted to >N.Cl linkages and this suggested that compounds containing this group might be effective as antiseptics. A number of such compounds had been synthesised by Chattaway. Dakin asked Cohen to prepare these compounds and various analogues for testing. N-chloro-N-sodio-*p*-toluenesulphonamide $CH_3.C_6H_4.SO_2N.Cl.Na$ (Chloramine-T) was found to be the most effective.

Mann and Pope then found that it formed crystalline compounds (sulphilimines) with "mustard gas" and other organic sulphides. This led to Kenyon's resolution of a racemic compound of this type. Thirty-five years later Greenwood, a research student of the writer's, noticed the spontaneous liquefaction of the crystalline sulphilimine of diallyl sulphide and found that this was due to migration of the allyl group from sulphur to nitrogen.

After his retirement Cohen studied the mode of action of antiseptics and his results are briefly discussed by Raper in his obituary notice (*J. Chem. Soc.*, 1935, 1334). Many of Cohen's students showed a great interest in biochemistry. This arose from his work on the resolution of

racemic compounds by microbiological means and from the fact that he had grown cultures of atmospheric organisms on gelatin plates during his study of atmospheric pollution. Dakin was interested in these experiments and Cohen advised him to work at the Pasteur Institute. This could not be arranged, so the choice fell on the Lister Institute, Chelsea, where Dakin studied the resolution of racemates by enzymes. Thereafter "for many years his research students who were able to travel elsewhere for postgraduate work, were advised to enter the field of biochemistry." Among them may be mentioned (in addition to Dakin) Raper, Dudley, Raistrick, Platt and Clutterbuck. The first four of these men were elected to the Royal Society. Seven years after Cohen's retirement, work on the methylating action of moulds was begun in his old laboratory and has been in progress for over 20 years; many research students have thereby obtained their first introduction to problems on the border-line between organic chemistry and biology. Cohen also worked on the nature of soot, its effects and dispersal, the production of fog, and the effect of atmospheric pollution on vegetation, including the effect of the gaseous products of combustion. His researches were published in a book entitled *Smoke, a study of town air* (1896 and 1925). He also published other works. His *Advanced Organic Chemistry* appeared about 1907 and the fifth and last edition in 1928. It was one of the first textbooks that treated the subject along modern lines, each chapter being an essay on some special aspect of the subject. For long the book was regarded as an indispensable guide to undergraduates and to research students in chemistry.

Raper gives an attractive picture of Cohen. Social work among boys, music, painting, country activities (especially in the Lake District) all found a place in his life. "It was impossible to be associated with him without being affected by his austerity, his kindness of heart and his high-mindedness."

On Cohen's retirement in 1924 Christopher Kelk Ingold was appointed as his successor. At the Imperial College of Science and Technology, South Kensington, he had already acquired a reputation for brilliant experimental work on such themes as the glutaconic acids, the Michael reaction, the specific heats of gases (in which his interest in physical problems was foreshadowed) and various new aspects of tautomerism. Professor Ingold writes :—

> "We worked in the same one-storey temporary buildings which had been provided for Cohen. We re-arranged the benches available for research giving a total capacity of sixteen including staff. This accommodation was filled up, I think, in my second year and remained so until I left.
>
> I always think of Leeds as the place where I did my chief personal *pedagogic* research, finding out by trial and error how to present organic chemistry to students more rationally and less empirically than was formally the custom—as a science rather than an art. (We have done a lot more since on the integration of the branches of chemistry, but that is another story.)
>
> It was in Leeds that I began systematic work on the mechanism of organic reactions. Thorpe had given me a liking for that sort of thing. With a pretty good team, keen and young, and with a major and almost boundless subject opening up, we had a good time. Dawson taught me a lot of physical chemistry in a quiet way, and I became very interested in his attempts to sort out the kinetic effects of the constituents of electrolytic solutions."

Dr. J. W. Baker writes :—

"Three main topics were studied in the Department of Organic Chemistry under Ingold and almost the whole staff was engaged in this work :

(*a*) The nature and mechanism of the orienting effects of groups in aromatic substitution (mainly nitration) and correlation with the mechanism of aromatic side-chain reactions.

(*b*) A study of prototropic systems and the experimental verification of anionotropic change (with H. Burton), which was predicted as a necessary corollary of the ionic mechanism of tautomerism.

(*c*) The effect of polar substituents on the velocity and orientation of addition reactions to unsaturated systems. The work resulted in the correlation of the orienting effects of groups, arising from their polar characteristics, with their influence on tautomeric systems and additive reactions.

After Ingold's departure some aspects of this work were continued and extended by Baker and Rothstein. The study of the directing influence of pseudo-acidic and pseudo-basic groups in phenylnitromethane derivatives and in Schiff's bases respectively led Baker to the proof that, in strongly acid media, aromatic carbonyl and ester compounds Ar.CO.R and Ar.CO.OR are nitrated through the cation of the oxonium salt.

Several apparent anomalies in the effect of polar substituents in aromatic side-chain reactions suggested to Baker a detailed study of such reactions beginning with the Menschutkin reaction between pyridine and substituted benzyl halides. Here the electron-release effect of alkyl groups was almost exactly the reverse of that required by their inductive effects. The theory that the electrons of a C-H bond conjugated with an unsaturated system become 'delocalised' (the Baker-Nathan effect, later known as hyperconjugation) was then put forward. It is now widely accepted and plays a major role in the interpretation of the reactions of organic chemistry.

Kinetic studies of the cyanohydrin reaction with substituted benzaldehydes and the addition reactions of olefines, catalysed by electron acceptors such as stannic chloride, were then initiated. Additive reactions of both 'aldol' and 'Michael' type in the system $H-C=C=O$ have been paralleled by similar types of addition with the olefine system $H-C=C=C$. This led to a detailed kinetic study of the alcohol-aryl isocyanate reaction which unravelled the details of its complicated mechanism and of the effect of solvent and steric factors.

The cyanohydrin studies led to investigations of the polar effects of halogen substituents and the order of their mesomeric electron-release."

The teaching of organic chemistry in Leeds is now based from the outset on the electronic mechanism of reactions, thus continuing the approach initiated by Ingold.

In 1952, to the great satisfaction of his colleagues, the Oxford University Press published a work entitled *Hyperconjugation* by Dr Baker.

Work carried out jointly in Manchester and in Leeds showed that activation of the benzene nucleus by methyl affects the *meta*- as well as the *ortho*- and *para*-positions. Ingold and Rothstein also provided the first example of a formal negative charge, formed by the separation of a proton, being held within the three-carbon system itself $R_3N.CH : CH.CH.NR'_3$. This conception was later extended by Rothstein to include the polar effect of sulphonyl groups where $-\overset{+}{S}O_2\overset{-}{R}$ replaced $R_3\overset{+}{N}-$ in such compounds.

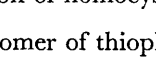
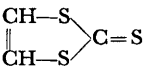
Rothstein has recently shown that *tert*-acid anhydrides and aluminium chloride give salt-like complexes which, in presence of benzene, lose carbon monoxide, giving hydrocarbons instead of ketones. The reaction has been studied kinetically by measurement of the carbon monoxide.

Ingold left a very strong staff, of whom H. Burton and C. W. Shoppee later obtained Chairs at King's College of Household and Social Science (now Queen Elizabeth College) and at University College, Swansea respectively. F. R. Goss became Head of the Chemistry Department at Battersea Polytechnic in succession to Kenyon, and J. W. Baker was appointed Reader in the Mechanism of Organic Reactions at Leeds.

When Ingold removed to University College, London in 1930, Frederick Challenger, a student of Jamieson Walker in Derby, Kipping in Nottingham and Wallach in Göttingen, succeeded him. He had already held appointments at Birmingham and Manchester under Frankland, Morgan, Dixon, Lapworth and Robinson.

Since then the research work of the department followed several main lines: (1) kinetics and other investigations on the mechanism of organic reactions, (2) studies on the methylating properties of certain moulds (an aspect of the much wider phenomenon of biological methylation), (3) synthesis and properties of heterocyclic compounds of sulphur, (4) work on the preparation of compounds having oestrogenic, anti-tubercular or anti-malarial action, (5) the determination of the end-groups in proteins and peptides.

The work with moulds established that trimethylarsine, dimethyl selenide and dimethyl telluride are evolved from cultures of *Scopulariopsis brevicaulis* containing inorganic compounds of arsenic, selenium and tellurium. Addition of $^{14}CH_3.S.CH_2.CH_2.CH(NH_2).COOH$, labelled methionine, to the cultures containing arsenious acid or sodium selenate (1952) showed that the transmethylation mechanism is similar to that established for animals and plants by du Vigneaud and others. Dr Margaret Simpson showed that the dimethyl sulphide evolved by the red marine alga *Polysiphonia fastigiata* arises from the thetin chloride $(CH_3)_2\overset{+}{S}.(\overset{-}{Cl}).CH_2.CH_2.COOH$. This sulphonium compound, the first to be found in plants, was then shown by du Vigneaud to act as a methyl donor in the conversion of homocysteine to methionine in rats.

The structure of the solid isomer of thiophthen  first obtained in Leeds in 1931, had rested solely on a preliminary X-ray examination by Bernal and the zero dipole moment (Goss). Recently its synthesis and the degradation of its methyl ketone have confirmed this structure. Work on derivatives of the thiophthens has established that electrophilic substitution occurs α to sulphur. Professor E. G. Cox studied the X-ray structure of solid thiophthen and of a by-product obtained during its preparation from acetylene and sulphur. The structure  has been assigned to this compound on chemical evidence and confirmed by Cox's work.

The writer is indebted to Dr G. F. Smith for the next paragraph.

"In 1899 H. M. Dawson was appointed demonstrator in physical chemistry. He had just returned from Germany, where he had worked with van't Hoff, Elbs and Abegg. From modest beginnings he built up the teaching of the

subject until in 1920 its importance was fully recognised by the institution of a Chair, to which Dawson was appointed. From then till his death in 1939 the department steadily expanded as ever-increasing demands were made for the teaching of physical chemistry, not least by the Medical School. His research work kept pace with this development. Although he freely gave up much time to teaching and other University activities, Dawson's dominant interest was always his research work. In his later work on the hydrolysis of the chloro- and bromo-acetates Dawson developed and perfected a notable technique for the analysis of the kinetics of very complex reactions. A long succession of his postgraduate students received a training that could scarcely be surpassed. All who worked with him were attracted by his genial and kindly personality and impressed by his high and exacting scientific standards."

Professor F. S. Dainton writes :—

"His early research in Leeds was concerned largely with phase equilibria and with the nature of complex ions in aqueous and other solutions; his major and most significant work, however, was in the field of reactions in solution where his great experimental skill and meticulous care enabled him to secure incontrovertible evidence for his Law of Multiple Catalysis and the catalytic catenary, formulated in 1927. During his occupation of the chair he recruited R. Spence and W. Wild, both of whom had experience in the United States and who together made substantial contributions to our knowledge of the photolysis of carbonyl compounds. They share the credit for the detection of diacetyl in the photodecomposition of acetone, and the recognition that very large quantities of methane may be formed at higher temperatures. The large schools of photochemistry under Steacie at Ottawa and Noyes at Rochester owe much to this early work.

Dawson's interest in thermodynamics and kinetics has its lineal descendant in Dr Caldin's studies of the kinetics of acid-base catalysed reactions and of the thermodynamics of the association of carboxylic acids in solution. Dr Ivin and Dainton have combined the thermodynamic and kinetic approaches, so that heats and entropies of polymerisation can now be determined from exclusively kinetic data. Dawson's first paper from Leeds was on the luminosity of flames; combustion and oxidation phenomena are now being investigated by Dr A. D. Walsh, who has also done most distinguished work on spectroscopy and molecular structure."

Dawson was succeeded in the Chair of Physical Chemistry in 1939 by Meredith Gwynne Evans, who studied at Manchester under Lapworth and Robinson. Later he became the collaborator and close friend of M. Polanyi. He had also spent a year as Rockefeller Fellow with Henry Eyring at Princeton.

Professor F. S. Dainton writes :—

"Both Polanyi and Eyring were well-versed in quantum and wave-mechanical theory and the acknowledged masters of the new transition state theory of reaction. Thus Evans came to Leeds better equipped than almost any of his contemporaries to carry this subject forward through the next phase of its development. His work at Leeds was concerned not only with general theory of simple reactions, e.g. atom and electron transfer processes, but with the elucidation of some of the complex reactions which are involved in addition polymerisation. In all this work, in which he was extremely well served by many collaborators, notably J. H. Baxendale, P. George and N. Uri, there was a simplicity and yet also an elegance which were the hall-mark of his quality. He was not, however, limited to reaction kinetics in his interest and enthusiasms, but made fruitful excursions into problems connected with equations of state, the thermodynamics of binary mixtures, and adsorption. As an exponent of his subject Evans was superb and it would be difficult to find any department in the country which he had not visited as a lecturer or as chairman of a

discussion, and where he had not illuminated some branch of the subject and thereby revivified interest in it. He had strong mathematical interests and drew collaborators of distinction (including those trained formally in mathematics) from all parts."

When Evans returned to Manchester as Professor of Physical Chemistry in 1949 he was succeeded by F. S. Dainton, who had been an undergraduate in Oxford and a postgraduate student, tutor, Fellow and Lecturer in Cambridge. He also worked in America and Canada during the last war. Professor Dainton continues :—

"Some of my own interests have certainly arisen through talks or correspondence with M. G. Evans, and we are continuing to develop the chemistry of atoms and free radicals in aqueous solution by using the polymerisation technique for their detection, and modern refined photochemical methods. The accumulated knowledge of these systems is sufficiently large and secure to be of value in elucidating the problem of the radiation chemistry of aqueous systems and a good deal of work is in progress with Dr G. Collinson on these lines, using soft and hard X-rays, β-particles and high energy electrons."

In 1945 Whytlaw-Gray retired and E. G. Cox succeeded him. Cox started academic life at the University of Bristol as a physicist and, after a valuable period of research spent under Sir W. H. Bragg at the Davy-Faraday laboratory, joined W. N. Haworth at the University of Birmingham, where he developed the X-ray study of carbohydrate derivatives and of inorganic and organic co-ordination compounds. Professor Cox writes :—

"The fusion of the departments of Inorganic and Physical Chemistry in 1945 did not destroy the continuity of their interests; in spite of the enormous changes which have taken place in physical chemistry it is possible to see more than a thread of development linking the work of Dawson, Evans and Dainton. My own work is not without roots in Leeds. Although it was not on a very large scale, important work on the solid state was done in Whytlaw-Gray's time by Hume, Colvin and Garrick and I am personally very happy to be extending the applications of Bragg's pioneer work in the same University. The connection with Smithells still remains in the work of A. D. Walsh on combustion, and Whytlaw-Gray's influence is seen in R. S. Bradley's very successful applications of the beautiful micro-balance techniques to the study of evaporation and the measurement of very low vapour pressures.

My own work has been concerned chiefly with the X-ray analysis of relatively simple molecules (mostly, but not exclusively, organic) with the object of making measurements of bond lengths and bond angles of sufficiently high accuracy to establish reliable values for various standard bonds (e.g. C−S, C=S, etc.) and in the case of hybrid bonds to discriminate critically between different values deduced from wave-mechanical calculations. In particular with G. A. Jeffrey, we have measured bond lengths in heterocyclic molecules, since the study of such systems by X-ray methods is much less developed than that of homocyclic molecules. It has been a pleasure to collaborate with Challenger in the study of various heterocyclic sulphur compounds. Complementary to the work on bond lengths is that of A. S. Carson on bond strength, for which the major tool is the bomb calorimeter.

The attainment of high accuracy in this work has depended on the development of suitable techniques, both experimental and interpretational, and work has been done both on the design of apparatus and on the methods of making accurate calculations of atomic positions. Our work on the latter subject with D. W. J. Cruickshank has enabled us to advise colleagues from a number of laboratories at home and abroad.

Several investigations on the stereochemistry of co-ordination compounds of

zinc, cadmium, ruthenium and other metals are in progress. At present the heaviest emphasis is on the use of X-rays in the study of the solid state, but we attach importance to other lines of approach. In addition to the application of Bradley's vapour pressure techniques to measurements of lattice energies, interesting work on the kinetics of phase transformation in solids is being done by N. H. Hartshorne. This department is probably the only one in the country where regular courses in chemical microscopy are given, the importance of which is attested by the success of Hartshorne's summer schools in the subject. These attract students from overseas as well as from this country. His work with Dr J. G. Kakabadse on the teaching of gravimetric analysis by means of a film deserves special mention. This was, so far as we know, the first film made specifically for the teaching of analytical chemistry to University undergraduates.

Dr Caldin has brought distinction to the department by his teaching and writing on the philosophy of science and the development of scientific thought. His book, *The Power and Limits of Science*, was reviewed about two years ago in this Journal by Professor A. Findlay.

Two special features of the department deserve mention. The importance of mathematical techniques has been recognised by the institution of a lectureship in mathematical chemistry, at present occupied by Dr Cruickshank. In recent years, through the generosity of the Brotherton family, we have been fortunate to have a research lectureship to which we could invite younger scientists of distinction for one or more years; the holders so far have been G. S. Rushbrooke, who was recently appointed to a chair at Newcastle, P. George now Assistant Director of the Colloid Science Laboratory, Cambridge, and E. W. Hughes, one of Professor Pauling's most distinguished lieutenants from the Californian Institute of Technology."

Physical chemistry throughout the world has recently suffered a severe loss in the death of our colleague, M. G. Evans. The University of Leeds owes much to the tireless energy with which he addressed himself to problems of teaching, research and administration. In addition to the warm tribute paid by Professor Dainton in this article, appreciative and deeply understanding notices appeared in *The Times* and the *Manchester Guardian*.

THE CHEMIST IN THE HOSPITAL

Since the above article was printed (*J.*, 1953, 122) new rates of pay have been introduced for full-time hospital biochemists who are covered by P.T.A. Circular No. 9 and who are in the Basic and Senior Grades. The new rates (P.T.A. Circular No. 18), which are effective from 1 January, 1953, are as follows:

Basic Grade.—During the probationary period, those entering with a 1st or 2nd Class Honours degree or A.R.I.C. receive £460 rising by annual increments of £25 to £510. The starting-point is determined by adding one increment to the minimum for each year of postgraduate study (e.g. in preparation for a higher degree after taking the first science degree, or as a research student, including appropriate service of this kind with the Medical Research Council or a medical school department associated with a Teaching Hospital) provided £510 is not exceeded. The scale for all other entrants is £410 rising by annual increments of £25 to £510, the starting-point being decided as above.

After the probationary period, the scale becomes £585 rising by annual increments of £30 to £765.

Senior Grade.—The new scale is £835 to £1,080, rising by annual increments as follows:—£835 × £40—£1,035 × £25—£1,060 × £20—£1,080.

In addition to statutory and national holidays, leave amounts to 3 weeks per year during the probationary period, 4 weeks for those with salaries less than £1,035 a year, and 6 weeks a year for those receiving £1,035 or more.

THE CHEMIST AND HIS WORK—VI

THE CHEMIST IN THE GRAMMAR SCHOOL

By E. H. COULSON, M.Sc., A.R.C.S., D.I.C., A.R.I.C.

For the purpose of this article, the term "Grammar School" is taken to include all schools which present a substantial number of candidates annually for the General Certificate of Education Examination, at both Ordinary and Advanced Levels, i.e. it includes the Public Schools. The problems of all these schools, as far as the teaching of chemistry is concerned, are in most respects the same; where differences occur between them this will be indicated.

Chemistry, in common with the other sciences, is a comparative newcomer to the curriculum of the majority of schools in this country, when compared with subjects such as Latin, Greek, mathematics and English. Few schools can claim to have maintained a science department for one hundred years and, as Honours Schools in Natural Science were not founded in the Universities until the middle of the 19th century, this is not surprising, since schools desiring to give prominence to science instruction must have found difficulty in securing suitably qualified teachers. During the latter part of the last century the position slowly improved in the Public Schools, notable stimuli being the reports of the Royal Commission on Public Schools and Colleges (1864) and of the Royal Commission on Scientific Instruction (1871-1875), and the number of schools having laboratories where pupils could perform experiments in chemistry increased steadily. It is during the present century only, however, that the stage has been reached where almost all schools classed as "Secondary" by the Ministry of Education have such facilities for practical work.

The high standard of science teaching in the grammar schools which was built up between 1920 and the outbreak of war in 1939, and which made an important contribution to victory in 1945, owed much to the notable deficiencies in scientific manpower revealed early in the 1914-18 war. To the educationist the most important result of this revelation was the appointment, by the Prime Minister in 1916, of a strong committee, under the chairmanship of Sir J. J. Thomson, to inquire into the position occupied by Natural Science in the educational system of Great Britain, and to advise on the measures needed to promote its study. The report of this committee—"Natural Science in Education"—was published in 1918, and it is perhaps a melancholy reflection that many of its findings and recommendations apply with considerable force to the present time, when there has been some regression from the position established in 1939.

Complementary to the work of the various Government committees which have stimulated and encouraged the development of science in the schools has been that of two voluntary organisations—the Science Masters' Association and the Association of Women Science Teachers. Without permanent headquarters or salaried officials, these two associations include amongst their members most of the men and women teaching science in the grammar schools. Their influence on the development of syllabuses,

examinations and teaching methods has been marked, and the advice of their committees is in constant demand by other organisations concerned in the furtherance of science in education.

Although, as has been shown, the development of chemistry as a school subject has taken place largely during the past 50 years, there is now a wide measure of agreement on the content of elementary and advanced courses. An excellent survey of this topic, and of some of the methods used in teaching, has been given by E. W. Moore (*J.*, 1949, IV, 332-336; V, 417-422). It is not proposed to do more here than give a brief summary of these matters, indicating any changes which have occurred during the past five years.

In most grammar schools the elementary course in chemistry occupies pupils between the ages of 11 and 16 years; and usually takes one of three forms: (*a*) it is treated as a separate subject throughout and is then normally taught by a specialist teacher; (*b*) in the earlier stages, the first three years is commonest, it is taken as a part of the wider subject General Science (the treatment of the elements of physics, chemistry and biology, plus a little astronomy if possible, by one teacher is advisable here) followed by two years as a separate subject under a chemistry specialist; (*c*) it is treated throughout as a part of General Science, although more than one specialist may teach a given group of pupils in the later stages of the course. In the Public Schools, where pupils begin the study of chemistry at 13 years, the courses outlined above have to be compressed into two or three years, instead of five. Although the greater maturity of the pupils enables the elementary topics to be taken more quickly, the shorter total time available presents a not inconsiderable problem and an extension of science teaching in Preparatory Schools would be most welcome and helpful.

The introduction of General Science as an examination subject, largely as a result of the publication by the Science Masters' Association of a report on "The Teaching of General Science" in 1936, has given rise to much controversy. Many chemists expressed dismay at the relatively small amount of chemistry (as compared with physics and biology) contained in the basic syllabus of the 1936 report, but the publication of a completely revised version in 1950 has done much to remove this objection.

At the end of the elementary course suitable pupils are entered for the ordinary level papers of the General Certificate of Education Examination, either in chemistry as a separate subject, which may include a practical test, depending on the Examining Board, or as a part of a series of General Science papers, in which practical ability is not tested directly. The introduction of the General Certificate has been accompanied by a very considerable rise in the pass mark at this level, in chemistry it is now some 15 or 20 per cent above that for the old School Certificate.

Advanced courses in chemistry, taken by sixth form pupils, most of whom intend to specialise in science in later life, show a greater similarity than those dealing with earlier studies. A more mature approach now becomes possible and the teaching methods can be concerned more directly with stimulating individual work and encouraging originality in

thought. After two years the advanced and scholarship level papers of the General Certificate are taken, the latter by those desiring to proceed further with the study of chemistry after leaving school. In the larger schools it is not uncommon for pupils seeking scholarships and exhibitions to Universities to remain for a third year in the Sixth Form.

The foregoing paragraphs give a picture, admittedly over-simplified and, in some respects, fragmentary, of the general setting in which the chemist in the grammar school must work. The actual work of chemistry teaching is many-sided and provides more opportunities for varied treatment than almost any other school subject—therein lies much of its charm and challenge.

As an experimental science, chemistry must be taught by the method of practical investigation and, where time and circumstances permit, it is of the highest importance that the successive points of theory which unfold should do so as a result of experimental work, done either by the pupils themselves in the laboratory, or as lecture experiments by the teacher in laboratory or lecture room.

In the elementary course individual practical work is usually carried out by all pupils working at the same experiment in a given lesson; advanced classes commonly contain pupils working at different experiments. The chemistry teacher either gives instructions as the work proceeds, the more normal practice with junior forms, or supplies duplicated or printed directions. Under favourable conditions, such individual work is of great value in chemistry teaching, since many chemical reactions can be studied satisfactorily at close quarters only and are not suited to demonstration to large groups. Providing as it does training in accurate observations, reasoning power, resourcefulness and in the writing of clear English, this work has value to all grammar school pupils, whether future science specialists or not, and chemistry can provide a wealth of variety in it without the need for complex or expensive equipment. Practical lessons, however, are rarely longer than 90 minutes in the elementary course and, the rate of working being necessarily slow, a good deal of careful preparation by the teacher is required if they are to be effective. Also, since most chemical experiments are potentially dangerous, the safety aspect must be watched constantly. The overcrowded laboratories and large classes found in many schools make the teacher's work unduly difficult and nerve-wracking. No elementary practical class should contain more than 20 pupils if it is not to degenerate into a kind of drill lesson, retarding the progress of the better pupils and discouraging the slower ones (the present average is probably above 30). Advanced classes need to be even smaller, since the individual nature of the work and its greater difficulty make more demands on the teacher's time. Handicraft classes in schools are commonly much smaller than those in practical chemistry, but it is questionable whether the danger involved in dealing with glassware and corrosive substances is less than that of handling edged tools.

Even where conditions are good, a substantial proportion of the experimental work in a chemistry course must be performed by the teacher, either on account of the complexity of the apparatus used or

because progress is speeded up in this way. Such experiments need planning and rehearsal, and must be presented so as to stimulate the maximum co-operation by the class. They not only illustrate the methods by which science progresses but provide examples of technique which will enable pupils to improve their own laboratory work. Success in their performance demands qualities of resourcefulness and quick-thinking on the part of the teacher, together with the ability to deal promptly with the unexpected and to take advantage of a chance question or suggestion by the class. This work is in many ways the most difficult part of chemistry teaching and even experienced men and women strive constantly to improve their performance of it.

It is obvious that not all chemistry teaching can be done by experiment. As the pupils' minds mature the need to cover the syllabus more quickly entails a greater reliance on information obtained from textbooks and works of reference; here again training is necessary if the best results are to be obtained. The applications of chemical principles to everyday life and industry also assume a greater importance as the course proceeds. Judiciously used, visual aids such as wall charts, film-strips and films are valuable here and much useful material can also be obtained from industrial organisations. Constant repetition of important underlying principles, in as many different ways as can be devised, becomes necessary in order that pupils may master them, and abundant practice must be given in such things as the correct handling of formulae and equations, and in chemical arithmetic.

The satisfactory blending of the various methods by which chemistry may be taught into a well-balanced course calls for a good deal of experience and a capacity for planning ahead. The achievement of such a balance is a matter for each individual teacher, and many factors, such as accommodation and equipment available, size and intellectual capacity of the class concerned, and time allotted must be considered. A keen chemist never allows any of his courses to become static; they grow and evolve from one year to another as his own knowledge and experience expand. This constant and subtle state of change is another of the attractions of a teaching career in chemistry.

In schools where the syllabus up to the ordinary level of the General Certificate is devoted either partly or wholly to General Science, the chemistry specialist will almost certainly have to teach some biology and physics. This is, on the whole, an advantage both to himself and to his pupils, not only enabling him to maintain a broad outlook on science as a cultural subject, but also helping to preserve a measure of co-ordination between the more specialised studies of the older pupils in advanced courses. The cultural value of science as an element of a general education is being given more and more prominence at the present time, and this aspect of its study should be stressed in the grammar schools. An important contribution to this side of science teaching has been made recently by H. P. Ramage in an article "The Great Adventure" in *The School Science Review* of November, 1952.

Whilst the day-to-day activities of the chemistry teacher are under discussion, a word or two should be devoted to the correction of written

work. It cannot be claimed that this is the most exciting of educational tasks, but it is by no means the least important. Of necessity, pupils studying chemistry at all seriously must spend a considerable proportion of their time, either during lessons or as preparation, in note making and answering questions to test their knowledge of work already covered. Unless most of this is read and corrected by the teacher it loses much of its value in the estimation of the pupil, in addition to leaving the former ignorant of the effectiveness of his teaching. In a school with a large sixth form the number of pieces of written work clamouring for the attention of a chemistry teacher during a single week may number two or three hundred.

A matter of some concern to the chemist in the grammar school is that of maintaining his enthusiasm for his subject, without which much of his teaching becomes dull and sterile. University teachers find this stimulus largely in the pursuit of research—a method which has its counterpart in the schools, where many chemistry teachers contrive to find time to undertake some form of original work. Much of this would not be claimed as "research" by those doing it; it is mostly devoted to such matters as the investigation of reactions that can be used in teaching and devising apparatus for class use or lecture experiment. Such work, besides being of great value to the teacher, plays a notable part in the development of teaching methods.

The legend of the scientist as an individual who is relatively helpless outside his laboratory is, fortunately, now receding into the past, although it is still given credence in some quarters. Many chemistry teachers help to dispel this impression by taking an active part in the communal life of a school. Naturally, they will assist with the running of science societies, visits by pupils to local manufacturing firms and the organisation of exhibitions when parents and friends visit the school. But it is also common to find them taking leading parts in school house affairs; dramatic, musical and literary societies; scout and cadet units; games coaching and supervision; school journeys and many other similar "out of school" activities. Matters such as these are, inevitably, the concern, to a greater or less degree, of all the members of the teaching staff of a grammar school, and participation in them can be highly rewarding. They are mentioned here to stress the fact that the chemist in the school is no less enthusiastic in their pursuit than his colleagues, and because they form a by no means unimportant part of the life of a teacher.

One of the main functions of a grammar school in the service of the nation is to provide an adequate flow of young entrants to industry and the professions, either directly or through the Universities, and in view of the ever-increasing demand both for trained scientists and for recruits to other professions with a sufficient knowledge of science to utilise its opportunities to the fullest extent, it is vital that the number and quality of science teachers entering these schools should be maintained and extended. Since the war it has been increasingly obvious that this condition is not being fulfilled. In addition to the difficulty of filling posts as they become vacant, the number of chemistry graduates with first or second class honours entering the schools is falling rapidly, and

there is a growing tendency for well qualified men and women to leave the grammar schools for other posts. Already some schools, especially those for girls, have had to cease teaching chemistry, either completely or in the sixth form; others are carrying on with the aid of men and women long past retiring age. The small number of chemistry graduates entering the departments of education at universities, although often poor in quality, are sought out and offered engagements by headmasters almost before they have begun to attend lectures. Alongside this decline in the number and quality of teachers, the number of pupils requiring advanced courses in chemistry has increased, and the consequent overcrowding of sixth forms adds to the difficulty of those trying to cope with the situation. The dangers inherent in the present state of affairs have been apparent for some time to those dealing with the education and training of scientists; the evidence of the growing anxiety of a wider body of opinion is given by leading articles in the national press as well as in periodicals devoted to science.

Now the teaching of chemistry in grammar schools is a vocation which, under the right conditions, has many attractive features; it gives scope for initiative and organising ability, the stimulus of continually-changing problems and opportunities for serving the community in many different directions. In the past many men and women of high intellectual standing, with good academic qualifications, have been attracted to it and have spent their lives in its service. Why, then, has it lost its appeal in recent years?

There is no doubt that the major part of the answer to this question concerns finance. The present keen competition for scientific man-power is unprecedented, and the schools are unduly handicapped in such a market. The State-controlled grammar schools, tied to an inadequate salary scale, are especially badly off here; the larger Public Schools, where somewhat higher salaries can be offered, are in a stronger position, but in these the situation gives rise to some anxiety. Whilst it is possibly undesirable that there should be complete equality of remuneration and prospects between the grammar schools and industry or the Scientific Civil Service, the disparity must not be so great as to act as a deterrent to men and women who would otherwise be attracted to teaching. Even within the various branches of the science teaching profession the prospects are poorest in the grammar schools; for example, the Burnham Technical Scale now offers a considerable financial inducement for good graduates to transfer to the technical colleges, and not a few of them are doing so.

Improved salary scales, however, form only a part solution to this problem. It used to be claimed that the short working day, long holidays, relative security and independence of external control enjoyed by grammar school staffs provided compensation for the lower salary scales. When the practical equipment of a school could be housed in one cupboard there may have been some justification for the first two of these claims, as far as the chemist is concerned; to-day, with the increasing prominence given to experimental work, there is certainly little substance in them. The chemist in a grammar school, especially if he has charge of a department, must be prepared to spend a considerable portion of his leisure time, both

during term and in the holidays, attending to or supervising the maintenance of his laboratories in an efficient state. If he is to keep his department running smoothly, develop new ideas, keep abreast of his subject, attend to written work and, at the same time, take part in the corporate activities of the school, it is essential that he has the services of a trained laboratory steward at his disposal. To any school, whether for boys or girls, which makes a serious attempt at efficient science teaching, such an employee is as important as a caretaker or groundsman. In spite of repeated assertions to this effect, both by Ministry of Education Inspectors and the Science Masters' Association, far too many schools are without permanent assistance of this sort—a state of affairs for which Local Education Authorities are largely to blame, since here again the Public Schools have usually a much higher estimate of the worth of a graduate's time. How many responsible industrial concerns would engage a first-class chemist, possibly with some research experience, and then expect him to clean his laboratory and wash-up all his apparatus?

There is certainly security of employment for the chemist in the grammar school at the present, but the claim of independence of external control has lost some of its force in recent years. One of the effects of the 1944 Education Act has been a marked decline in the status of state controlled grammar schools. Numerous decisions affecting their welfare have passed from the control of headmasters and Boards of Governors to the more remote committees of the Local Education Authorities, causing many irritating and often petty restrictions to the freedom of the teachers serving in these schools.

As has been stated earlier, chemistry has approached full status as a school subject during the past 30 years only. The men and women responsible for this rapid advance are fast disappearing; their work was done when the prestige of grammar school teachers was higher than it is now and their salaries compared more favourably with those of other branches of the profession of chemistry. Unless suitably qualified successors are found in adequate numbers there will be a gradual and inevitable decline in the quality and quantity of undergraduates entering the chemistry departments of the universities and technical colleges; for the teaching of the arts subjects in the schools is likely to be maintained at its present high standard and the abler boys and girls will be attracted to these disciplines.

The present shortage of science teachers may be a temporary phase only and the position slowly improve in the next few years. There is at the moment, however, little evidence to suggest this and it would be folly to base future policy on mere pious hopes. A thorough investigation is called for and should be undertaken without delay. There are some marked similiarities between the present position and that which faced the "Thomson" Committee in 1916, and the investigating body should be of at least comparable standing. It will, however, have to work much more swiftly since the Burnham Scale is due for revision in March, 1954, and the decisions reached then will affect vitally the ultimate survival of the competent chemist in the grammar schools.

LECTURE SUMMARY

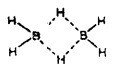
ELECTRON-DEFICIENT BONDS

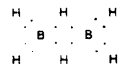
By Professor H. C. LONGUET-HIGGINS, M.A., D.Phil.

(London Section and the Brighton Technical College Chemical Society, 30 October, 1952)

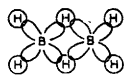
In the conventional classical theory there are three types of bond: covalent, ionic, and metallic. The principal distinctions between these are as follows:—*Covalent* compounds are, as a rule, comparatively volatile (with the notable exception of diamond, in which the crystal is really a giant molecule). The neighbours of any particular atom are small in number, e.g. 4, 6, or at the most, 8. There are always just two electrons per bond. In *ionic* compounds it is not so convenient to speak of bonds; the forces holding ions together are electrostatic, and any one ion is usually surrounded by a large number of other ions, e.g. 8 or 12. It is difficult to define a *metallic* bond. According to Pauling's theory, electrons in a metal are not localised as in diamond. The number of neighbours of any given atom is large, usually 12.

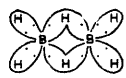
Even twenty-five years ago it had become apparent that this classification did not cover all compounds, the most notable exceptions being the boron hydrides. According to classical ideas, boron should form a simple hydride, BH_3, whereas in fact the simplest known hydride is B_2H_6. This compound cannot be classed as covalent, since it has 8 atoms and only 12 electrons (14 would be required for full two-electron bonds), and by its properties it is obviously neither metallic nor ionic. The original hypothesis, due to Pauling and Sidgwick, postulated the presence of one-electron bonds. Spectroscopic evidence, however, shows the actual structure to be:





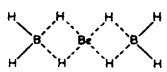
The molecular orbitals are represented in the following manner:



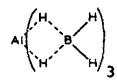


It is to be noted that in the B—H—B bonds *three* atomic orbitals overlap, forming a three-centred molecular orbital. This configuration does not occur in ammonia since the four sp^3 hybrid orbitals are already filled, each containing two electrons.

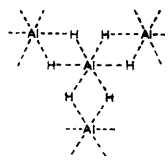
These ideas have been extended to other compounds, e.g.

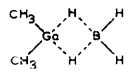


$[BeB_2H_8]$

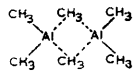


$[AlB_3H_{12}]$





$[(CH_3)_2GaBH_4]$



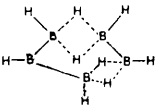
$[Al_2(CH_3)_6]$

$[(AlH_3)_n]$

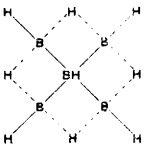
There are, however, several compounds whose structures have for many years presented considerable difficulty. These are :—

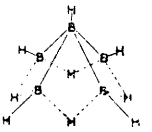
(1) *Pentaborane*, B_5H_9

Pitzer wrote the structure as

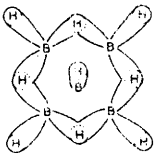


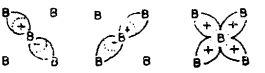
but this has been discarded. The structure as recently determined is shown in the following diagram which implies a co-ordination number for boron of five.





The formation of the molecular orbitals in pentaborane is shown in the following set of diagrams :—

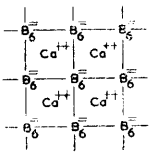


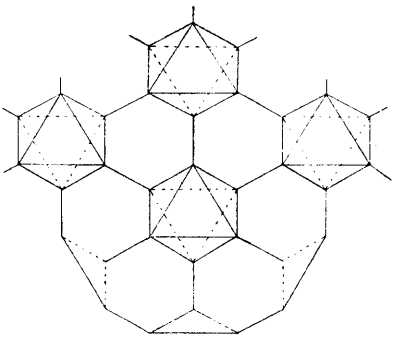


inward directed orbitals between the B atoms

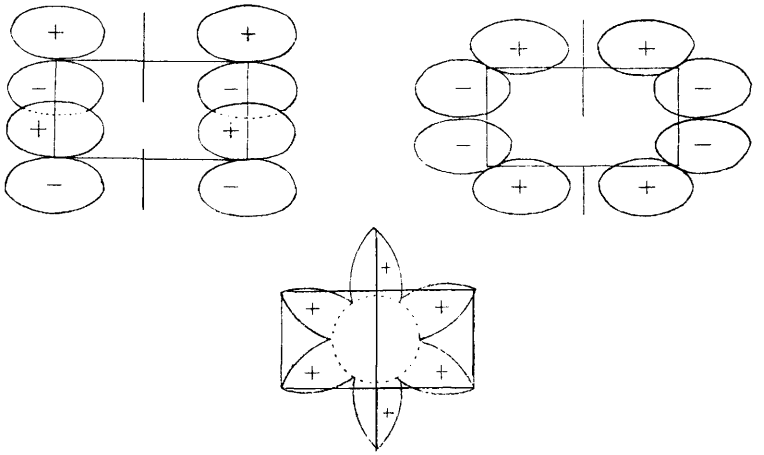
(2) *Calcium Boride*, CaB_6

This has a Na^+Cl^- type of structure. The boron atoms are arranged in groups of six in regular octahedral configurations. The B_6 groups are joined in a regular cubic network as shown, each group being joined to six others. Again, this formulation requires a co-ordination number of five for boron.





The bonding molecular orbitals of a B_6 group are of the following types :—

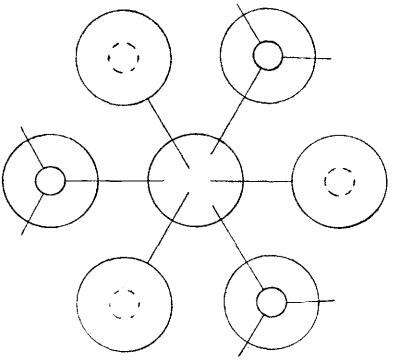


There are just enough valence electrons to fill all the bonding molecular orbitals, so the stability of the crystal can be understood.

(3) *Boron Carbide, B_4C*

This is a very surprising compound; by its crystal structure the formula is $B_{12}C_3$—with the boron atoms in groups of 12 and the carbon atoms in groups of 3. The group of 12 boron atoms forms a regular icosahedron, and the groups of 3 carbon atoms are linear rods. Each terminal carbon is linked to three icosahedra.

The crystal structure of B_4C is shown by the following diagram, in which the large circles represent B_{12} groups, and the small circles C_3 groups.



Analysis shows that the number of valence electrons is just sufficient to form a closed shell in a structure of this kind.

In conclusion, we have come to accept the idea that a chemical bond can embrace more than two atoms, i.e. that polycentred molecular orbitals exist embracing 3, 4, or even 12 centres.

ASSOCIATION OF CLINICAL BIOCHEMISTS

The inaugural general meeting of the Association of Clinical Biochemists was held at the Postgraduate Medical School of London on 28 March. The formation of the Association goes back to May, 1952, when, at a meeting held at the Sanatorium, Market Drayton, regional societies of clinical biochemists in Glasgow, the Midlands, North-Western and Southern England set up an interim committee under the chairmanship of Professor E. J. King. The Association now formed will be both scientific and professional in the scope of its activities. On the professional side it will concern itself with the status of scientifically qualified biochemists working in hospitals or allied laboratories, who have not hitherto been specifically provided for by professional associations. In its more important scientific sphere it will work in the rapidly expanding field of clinical biochemistry, where pathology, clinical medicine and biochemistry overlap, and which is not systematically covered by any of these branches of science.

The Association will hold regional and national meetings at which papers will be read and demonstrations given. Joint meetings with other societies will be arranged both locally and on the national scale. The Association hopes also to co-operate with the member societies of the International Association of Clinical Biochemists in a scheme for standardising and periodically checking analytical methods used in hospital laboratories. This subject has been in the forefront both here and in the United States recently.

The inaugural meeting accepted a set of Rules submitted by the interim committee who are to hold elections not later than 31 August. The Association will be directed by a President and a Council composed of a Chairman, Secretary, Treasurer and two nationally and five regionally elected members of Council. The interim committee is acting as a provisional council, with Dr A. L. Tárnoky (Royal Berkshire Hospital, Reading) as Secretary.

The following papers were read at the inaugural meeting: Mr E. B. Love (Preston) on the laboratory control of anticoagulant therapy; Dr I. D. P. Wootton (London) on the quartz spectrophotometer in clinical chemistry; Drs H. Bickel, J. Gerrard and E. M. Hickmans (Birmingham) on the influence of phenylalanine intake on phenylpyruvic oligophrenia; and Dr A. L. Latner (Newcastle upon Tyne) on quantitative paper-strip electrophoresis of serum proteins.

EXAMINATIONS: JANUARY, 1953

ABSTRACT OF THE REPORT OF THE BOARD OF EXAMINERS

Examinations were held as under—

	Entered	*Passed*
For the Associateship.		
Examiners: Professor D. H. Hey, Professor H. J. Emeléus and Dr D. J. G. Ives.		
The examination was held at the University of London, South Kensington (theoretical papers being taken also at various local centres), and at The Institute of Science, Bombay, India, in the periods 14 to 17 and 19 to 24 January, 1953.	126	45*
For the Fellowship.		
The examinations in Branch E and Branch H were held at the University of London, South Kensington, in the week beginning 12 January, and the Special Examination in Pharmaceutical Analysis in the Laboratories of Boots Pure Drug Company, Ltd., Nottingham, by courtesy of the Directors, in the week beginning 19 January, 1953.		
Branch E: The Chemistry, including Microscopy, of Food and Drugs and of Water. Examiners: Dr D. C. Garratt and Dr H. E. Archer.	12	3†
Branch H: General Analytical Chemistry. Examiners: Mr R. C. Chirnside and Dr J. Haslam.	1	0
Special Examination in Pharmaceutical Analysis. Examiner: Dr D. C. Garratt.	1	1
	140	49

* Some candidates completed their examinations by satisfying the Examiners in those parts in which they had previously failed and some failed in part only of the examination.

† Five candidates failed in part only of the examination.

EXAMINATION FOR THE ASSOCIATESHIP

MONDAY, 19 *JANUARY*, 1953: 10 *a.m. to* 1 *p.m.*

[*Answer* FIVE *questions* ONLY.]

1. Discuss and illustrate the correlation between the Periodic Table and the arrangement of electrons in the atoms of the chemical elements.

2. Review the chemistry of inorganic peroxy-compounds.

3. Describe briefly the preparation, properties and structure of FOUR of the following:—

(a)$Fe(CO)_5$, (b) IF_5, (c) $Co[(CO)_3NO]$, (d) H_2S_2, (e) B_2H_6, (f) HN_3.

4. Outline the chemistry of TWO of the following:—(a) bismuth, (b) cerium, (c) beryllium, (d) platinum.

5. Give a concise account of TWO of the following:—

(a) the abnormal valencies of the rare earths;
(b) interstitial hydrides;
(c) stereoisomerism in 6-co-ordinated metal complexes.

6. Give a comparative account of the chemistry of EITHER sulphur, selenium and tellurium, OR nitrogen, phosphorus and arsenic.

7. Discuss the chief sources of error in inorganic gravimetric analysis.

2 *to* 5 *p.m.*

[*Answer* FOUR *questions* ONLY.]

1. Answer BOTH of sections (*a*) and (*b*)—

(*a*) $NaBr.2H_2O$ has a dissociation pressure of water vapour of 5·47 mm at 20° C. Comment upon this statement in the light of the Phase Rule. Calculate the free energy of formation of the hydrate at 20° C from anhydrous salt and liquid water. The vapour pressure of water at this temperature is 17·54 mm and the value of R is 1·986 cal $mole^{-1}$ $deg.^{-1}$

(*b*) Derive expressions for K_p and K_c (equilibrium constants in terms of partial pressures and concentrations, respectively) for the thermal dissociation of nickel carbonyl,

$$Ni(CO)_{4(gas)} \rightleftharpoons Ni_{(solid)} + 4CO_{(gas)}$$

Show how the constants are related to the degree of dissociation and to each other.

2. Discuss briefly TWO of the following statements :—

(*a*) At very low compressions, films of insoluble substances on water behave like two-dimensional gases.

(*b*) The course of a catalysed heterogeneous reaction may depend upon the catalyst used.

(*c*) In some, but not in all, cases, reactions involving deuterium or deuterium compounds proceed more slowly than the corresponding reactions involving hydrogen or hydrogen compounds.

(*d*) The degree of dissociation of a weak acid increases with increasing ionic strength of the solution in which it is dissolved.

3. Write an essay on EITHER (*a*) solubility, OR (*b*) the dropping mercury electrode.

4. What factors cause gases to behave non-ideally? Show, by means of isothermal plots of PV against P how one factor or another may predominate according to (*a*) the nature of the gas, (*b*) temperature and (*c*) molar volume. Give a brief theoretical account of these effects, deriving an equation of state which expresses the behaviour of a non-ideal gas.

5. EITHER (*a*) Give a concise account of the determination of standard entropies of substances by the use of thermal measurements alone. Discuss the following standard entropy values :—diamond, 0·59 cal deg^{-1} g.-$atom^{-1}$; mercury, 18·5 cal deg^{-1} g.-$atom^{-1}$; argon, 36·99 cal deg^{-1} $mole^{-1}$; nitrogen, 45·79 cal deg^{-1} $mole^{-1}$.

OR (*b*) Explain the significance of H (enthalpy change) and $\triangle G$ (Gibbs free energy change) for a chemical reaction. Show how these quantities may be determined by measurements of electromotive force. Illustrate your answer by reference to the reaction $Hg_2Cl_2 + H_2 = 2Hg + 2HCl$ (aq) and derive any equations that you use.

6. Give a concise account of the principles of the Hittorf and moving boundary methods for the determination of transport numbers. For ONE of these methods, describe the apparatus and experimental procedure, indicating what precautions are necessary for accurate results. In what connections are transport number data of importance?

7. Give a summarising account of the use of (*a*) X-ray diffraction, (*b*) electron diffraction, and (*c*) dipole moment measurements in the elucidation of structural problems. Indicate the type of information that each method provides, without entering into unduly detailed discussion.

TUESDAY, 20 *JANUARY*, 1953: 10 *a.m. to* 1 *p.m.*

[*Answer* FOUR *questions* ONLY.]

1. Give an account of the preparation, properties and reactions of the di-, tri-, and polyhydric alcohols.

2. Cite examples of the methods of preparation of organo-metallic compounds containing (*a*) arsenic, (*b*) mercury and (*c*) zinc. Give a detailed account of the reactions which take place between a Grignard reagent RMgBr and (*a*) a ketone R′.CO.R″, (*b*) a nitrile R′.CN and (*c*) an ester R′.CO_2Et.

3. Give an account of the essential experimental conditions for the successful diazotisation of aromatic amines. Discuss briefly the reactions of diazonium salts whereby the amino-group of the original amine is replaced by (*a*) hydrogen, (*b*) chlorine, (*c*) phenyl and (*d*) -$NHNH_2$.

4. Write an essay on the chemistry of anthracene and phenanthrene and their derivatives.

5. Give THREE methods for the synthesis of pyridine or a derivative of pyridine. To what extent do the simple derivatives of pyridine resemble the corresponding derivatives of benzene? Give reasons for any similarities or dissimilarities upon which comment is made.

6. Discuss, *with the aid of specific examples*, the structural factors in the molecule which give rise to optical activity in organic compounds. Explain the significance of the terms "asymmetric synthesis" and "absolute configuration."

7. Give a concise account of any TWO of the following:—(*a*) anthocyanins; (*b*) non-steroid hormones; (*c*) alkaloids of the quinoline group; (*d*) glycosides; (*e*) antibiotics.

2 *to* 3.30 *p.m.*

[*The use of dictionaries is allowed.*]

FRENCH

Translate into English:—

Le mécanisme des échanges isotopiques dans les systèmes électrochimiques a déjà fait l'objet de quelques recherches qui montrent l'intérêt que présente ce phénomène au point de vue de la connaissance du mécanisme des équilibres électrode-solution.

Un travail récent sur les échanges entre une électrode métallique et des solutions de sels de ce métal montre l'importance de l'état de la surface sur la marche du phénomène.

Afin d'éliminer ce facteur, très difficile à préciser et à reproduire, nous avons étudié l'échange entre une électrode d'amalgame de cuivre monophasique et des solutions de sulfate cuivrique. De cette manière l'état de surface électrode-solution est toujours reproductible.

L'isotope radioactif utilisé est le $^{64}_{29}Cu$ préparé par irradiation d'une cible de cuivre électrolytique au faisceau de deutons produit par le cyclotron.

GERMAN

Translate into English :—

Die Untersuchungen an nichtwässrigen aber wasserähnlichen anorganischen Lösungsmitteln haben wichtige Ergebnisse für das Studium der Beziehung zwischen gelöstem Stoff und dem Solvens erbracht. Es sind daher bereits eine ganze Reihe von Stoffen unter dem Gesichtspunkt ihrer Eignung als Lösungsmittel betrachtet worden, u.a. auch der reine flüssige Cyanwasserstoff. Dieses Solvens besitzt ein gewisses Lösungsvermögen für organische und anorganische Stoffe, von denen ein grosser Teil ionogen gespalten in der Lösung vorliegt. Die Erscheinungen der Neutralisation, Solvolyse und Amphoterie sowie die Bildung von Solvaten sind, wie im Lösungsmittelsystem des Wassers, auch in dem wasserähnlichen Solvens Blausäure bekannt.

Die reine flüssige Cyanwasserstoff besitzt ein, wenn auch sehr geringes, Leitvermögen für den elektrischen Strom. Diese Leitfähigkeit, die bei $0° = 5 \times 10^{-7}$ rez.Ohm beträgt, muss auf eine schwache Eigendissoziation des Cyanwasserstoffs nach :

$$2HCN \rightleftharpoons (H_2CN)^+ + (CN)^-$$

zurückgeführt werden.

Practical: First Group

WEDNESDAY, 14 *JANUARY*, 1953 : 10 *a.m. to* 4.30 *p.m.*

[*Lengthy descriptions of practical work are not required. Make concise notes of your experiments as they are made and where possible in tabular form. State your final conclusions clearly.*]*

1. The solution (A) contains iron alum and ammonium alum together with sulphuric acid. Determine the iron volumetrically and the aluminium gravimetrically by the methods prescribed.† Express your results in terms of grams of Fe and Al per litre of solution.

[*The aluminium determination may be completed to-morrow.*]

2. Identify the single substance (B). [(B) = EITHER sodium dithionate OR sodium hydrosulphite (dithionite).]

THURSDAY, 15 *JANUARY*, 1953 : 10 *a.m. to* 4.30 *p.m.*

Complete yesterday's exercise 1.

3. The solution (C) contains zinc sulphate and sulphuric acid. Determine the zinc gravimetrically by the method prescribed.† Express your results in terms of grams of Zn per litre of solution.

4. Analyse qualitatively the mixture (D), which contains six radicals. [(D) = EITHER mercurous chloride, sodium fluoride, sodium ferrocyanide and zinc oxide, OR lead chloride, potassium fluoride, potassium ferricyanide and zinc oxide.]

FRIDAY, 16 *JANUARY*, 1953 : 10 *a.m. to* 4.30 *p.m.*

1. Identify the compounds (E) and (F). [(E) = EITHER urethane OR thiourea. (F) = EITHER ethyl orthoformate OR ethyl carbonate.]

* This note was repeated on each of the seven following papers.

† Not reproduced.

2. Reduce the aromatic nitro-compound (G) to the corresponding primary amine. Divide the latter into two portions and convert one portion into the *p*-toluenesulphonyl derivative and the other portion into the acetyl derivative. Record the melting points of the two derivatives thus obtained and submit your specimens for inspection. (G) = α-nitronaphthalene.]

[*Exercise* 2 *may be completed to-morrow.*]

SATURDAY, 17 *JANUARY*, 1953: 10 *a.m. to* 4.30 *p.m.*

Complete yesterday's exercise 2.

3. Report as fully as you can on the sample of commercial ethyl alcohol (H). [(H) contained ethyl alcohol, acetaldehyde and water.]

4. Report on, and if possible identify, the compound (J). [(J) = epichlorhydrin.]

Practical: Second Group

WEDNESDAY, 21 *JANUARY*, 1953: 10 *a.m. to* 4.30 *p.m.*

1. The solution (K) contains iron alum and ammonium alum together with sulphuric acid. Determine the aluminium gravimetrically and the iron volumetrically by the methods prescribed.† Express your results in terms of grams of Al and Fe per litre of solution.

[*The aluminium determination may be completed to-morrow.*]

2. Identify the single substance (L). [(L) = EITHER sodium cobaltinitrite OR ammonium stannichloride.]

THURSDAY, 22 *JANUARY*, 1953: 10 *a.m. to* 4.30 *p.m.*

Complete yesterday's exercise 1.

3. The solution (M) contains sodium molybdate. Determine the molybdenum gravimetrically by the method prescribed.† Express your results in terms of grams of Mo per litre of solution.

4. Analyse qualitatively the mixture (N), which contains six radicals. [(N) = EITHER antimony oxide (Sb_2O_3), arsenious oxide, calcium carbonate and sodium thiosulphate, OR stannous chloride, arsenious oxide, magnesium oxide and sodium thiosulphate.]

FRIDAY, 23 *JANUARY*, 1953: 10 *a.m. to* 4.30 *p.m.*

1. Identify the compounds (O) and (P). [(O) = EITHER lactose OR maltose. (P) = EITHER benzonitrile OR phenylacetonitrile (benzyl cyanide).]

2. Reduce the aromatic nitro-compound (Q) to the corresponding primary amine. Divide the latter into two portions and convert one portion into the *p*-toluenesulphonyl derivative and the other portion into the acetyl derivative. Record the melting points of the two derivatives thus obtained and submit your specimens for inspection. [(Q) = EITHER *o*-nitrotoluene OR *m*-nitrotoluene.].

[*Exercise* 2 *may be completed to-morrow.*]

† Not reproduced.

SATURDAY, 24 *JANUARY*, 1953: 10 *a.m.* *to* 4.30 *p.m.*

Complete yesterday's exercise 2.

3. Report as fully as you can on the sample of commercial methyl alcohol (R). [(R) contained methyl alcohol, acetone and water.]

4. Report on, and if possible identify, the compound (S). [(S) = morpholine.]

EXAMINATION FOR THE FELLOWSHIP

BRANCH E: THE CHEMISTRY, INCLUDING MICROSCOPY, OF FOOD AND DRUGS AND OF WATER

MONDAY, 12 *JANUARY*, 1953: 10 *to* 11.30 *a.m.*

1. Describe the manufacture of cheese and of processed cheese. Outline the analytical tests used in control and suggest suitable legal standards for the products.

2. Indicate the sources from which ingestion of traces of fluorine may arise and outline its determination in foodstuffs.

3. Describe the method for the determination of the 5-day B.O.D. of an effluent. Discuss the value of this test in assessing the quality of the effluent.

11.30 *a.m.* *to* 1 *p.m.*

[*Answer* THREE *questions* ONLY.]

1. What are the symptoms of chronic poisoning by arsenic? What material should be examined for the poison? Give a description of the method you would employ in one such examination.

2. Write an account of the pharmacology of strychnine.

3. Write short notes on:—(*a*) anti-thyroid drugs, (*b*) curare, (*c*) anti-cholinesterase drugs.

4. Give an account of the pharmacology and therapeutic uses of cocaine.

2 *to* 5 *p.m.*

1. Describe how you would determine if a milk having a normal freezing point but nevertheless suspected of being adulterated, is genuine.

2. Give the standards which you consider reasonable for the following articles: cocoa, dried parsley, iodised salt, ammoniated quinine and cinnamon, a glass of hot milk, rum and butter toffees, blancmange powder, mulligatawny soup.

3. Outline the scheme of tests you would employ in the bacteriological examination of a sample of meat roll suspected to be the origin of an outbreak of food poisoning.

4. Describe in detail the determination of ascorbic acid in (*a*) fresh vegetables, (*b*) blackcurrant juice, and of thiamine in (*a*) flour, (*b*) simple pharmaceutical tablets.

5. Outline the main provisions of the Labelling of Food Order.

6. Describe the construction of a photoelectric spectrophotometer and give examples of its applications in food analysis.

TUESDAY, 13 *JANUARY*, 1953: 10 *a.m. to* 5 *p.m.*

1. Report on the sample of ice-cream submitted under the Food Standards (Ice-Cream) (Amendment) Order.

[*The results will not be required before Wednesday evening but each day's work must be recorded.*]

2. Determine the hardness of the well water.

WEDNESDAY, 14 *JANUARY*, 1953: 10 *a.m. to* 5 *p.m.*

Complete yesterday's exercise 1.

3. Report on the quality of the sample of meat extract.

4. Report on the sample of iodised salt on the Food and Drugs Certificate provided.

THURSDAY, 15 *JANUARY*, 1953: 10 *a.m. to* 5 *p.m.*

5. Determine the composition of the sweetened coffee extract.

6. Report on the specimen of ground cloves.

FRIDAY, 16 *JANUARY*, 1953: 10 *a.m. to* 5 *p.m.*

7. Report on the culinary essence of lemon.

8. Report on the sample of cod-liver oil and malt of which complaint has been made that it tastes unpleasant.

SATURDAY, 17 *JANUARY*, 1953: 10 *a.m. to* 5 *p.m.*

1. Make a microscopical examination and identify the powdered drugs (A), (B) and (C). Sketch, describe and name the structures seen.

2. The specimen (D) is a portion of the gastric contents from a man who was presumed to have taken a corrosive poison. Identify the poison and also report on the presence or absence of blood.

3. Make a qualitative analysis of the sample of human urine (E) and report on the presence of any constituents that might be caused by disease.

4. Identify the principal constituent of the tablet (G) and determine the amount present.

BRANCH H: GENERAL ANALYTICAL CHEMISTRY

MONDAY, 12 *JANUARY*, 1953: 10 *a.m. to* 1 *p.m.*

[*Answer* FIVE *questions* ONLY.]

1. Discuss applications of solvent extraction in inorganic analysis.

2. Describe the use of statistical methods in the examination of analytical results.

State briefly what you understand by the following terms:—

(*a*) standard deviation, (*b*) analysis of variance, (*c*) factorial design.

3. Give a critical account of the analytical chemistry of barium, strontium and calcium.

4. Discuss critically the methods available for the determination of sulphur in organic substances.

How would you determine the sulphur in:—

(*a*) lubricating oil, (*b*) coal gas, (*c*) thionaphthen?

5. Outline a scheme for the complete analysis of a sample of raw magnesite.

6. How would you determine :—(*a*) the available chlorine in a sample of bleaching powder; (*b*) the residual chlorine in a potable water supply?

7. Discuss critically microtechniques available for the determination of (*a*) carbon and hydrogen and (*b*) oxygen in organic substances.

2 *to* 5 *p.m.*

(*Answer* FIVE *questions* ONLY.]

1. Discuss critically the volumetric methods available for the determination of chloride, bromide and iodide, singly and together.

2. Discuss briefly the principles involved in FOUR of the following techniques :—

(i) liquid-gas partition chromatography;
(ii) solubilisation titration;
(iii) neutron activation analysis;
(iv) the use of fungi in the determination of trace metals;
(v) the use of metal chelates in analysis;
(vi) X-ray diffraction analysis;
(vii) dithizone reversion methods.

3. Describe the methods available for the determination of manganese. How would you determine :—(*a*) manganese in steel, (*b*) MnO_2 in pyrolusite, (*c*) manganese in a paint "drier"?

4. Coal is delivered to your works in 20-ton open wagons. Outline the steps you would take to determine its "quality."

5. What tests would you carry out on a sample of well water to determine its suitability for use in low pressure boilers?

6. Outline methods for the determination of :—

(*a*) sodium in aluminium;
(*b*) arsenic in copper;
(*c*) nitrogen in steel;
(*d*) selenium and tellurium in a mixture of the two.

7. Discuss the uses in analysis of :—

(i) potassium iodate;
(ii) potassium periodate;
(iii) iodine pentoxide;
(iv) ammonium persulphate;
(v) sodium bismuthate.

Give examples, with equations.

TUESDAY, 13 *JANUARY*, 1953 : 10 *a.m. to* 5 *p.m.*

1. Report qualitatively on the samples (A) and (B). [(A) = mixture of graphite and manganese dioxide. (B) = triethanolamine.]

[*To be completed by noon.*]

2. Determine the copper and the sulphur in the sample of pyrites (C).

[*This exercise may be completed to-morrow.*]

WEDNESDAY, 14 *JANUARY*, 1953: 10 *a.m.* *to* 5 *p.m.*

Complete yesterday's exercise 2.

3. Examine and report on the sample of glue (D). [(D) = caesin, sodium fluoride, paraffin and calcium hydroxide.]

[*This exercise may be completed to-morrow.*]

THURSDAY, 15 *JANUARY*, 1953: 10 *a.m.* *to* 5 *p.m.*

Complete yesterday's exercise 3.

4. Examine and report on the solvent (E). [(E) = benzene containing small proportions of toluene and thiophen.]

FRIDAY, 16 *JANUARY*, 1953: 10 *a.m.* *to* 5 *p.m.*

5. Sample (F) is a surface water which has been drawn from a sump adjacent to a chemical works. Examine and report on this water. Your report should be in a form suitable for presentation to the Works Engineer. [(F) contained small amounts of *m*-cresol and formaldehyde.]

SPECIAL EXAMINATION IN PHARMACEUTICAL ANALYSIS

MONDAY, 19 *JANUARY*, 1953: 10 *a.m.* *to* 1 *p.m.*

1. Discuss the application of statistical methods to either (*a*) sampling or (*b*) variation in tablet weight.

2. Outline the provisions of the Pharmacy and Medicines Act. Indicate how this Act can supplement the enforcement of the Food and Drugs Act.

3. Describe the construction of a photoelectric spectrophotometer and indicate its advantages over other instruments with photographic recording.

4. Describe and critically discuss the methods available for sterility testing of oily preparations.

5. Describe the technique of quantitative microscopy and illustrate its applications from recently published work.

6. Indicate the nature of pyrogens and methods for their elimination from injectable products. Describe the tests used to show their absence from such products.

2 *to* 5 *p.m.*

1. Describe in detail the B.P. method for the determination of morphine in opium, indicate the reasons for each step in the assay and give your criticisms of the method. Give an outline of methods for the determination of other alkaloids in opium.

2. Give applications of the use of the following reagents in pharmaceutical analysis: (*a*) 8-hydroxyquinoline, (*b*) ammonium reineckate, (*c*) potassium iodate, (*d*) silicotungstic acid, (*e*) periodic acid, (*f*) mercuric nitrate, (*g*) 2 : 4-dinitrophenylhydrazine.

3. Write an essay on ONE of the following subjects:—

(*a*) The assay of pharmaceutical clays;
(*b*) Titration in non-aqueous solvents;
(*c*) Potentiometric titrations.

4. Write an essay on the determination of small amounts of surface active agents in solution.

5. Discuss the standardisation of vegetable purgative drugs.

6. Discuss the theoretical aspects and practical details of the methods employed for the determination of iodine and iodides in pharmaceutical preparations.

TUESDAY, 20 *JANUARY*, 1953: 10 *a.m. to* 5 *p.m.*

1. (A) is a sample of powdered ipecacuanha. (B) is a liquid extract prepared from (A). Determine the adjustment of (B) necessary to produce a pharmacopoeial liquid extract of ipecacuanha and report on the efficiency of the extraction.

2. Determine the potency of the given antibiotic preparation (C) in relation to the sample of pure sodium benzyl penicillin provided, using the plate method and *B. subtilis* as growth organism.

[*These exercises may be completed to-morrow.*]

WEDNESDAY, 21 *JANUARY*, 1953: 10 *a.m. to* 5 *p.m.*

Complete yesterday's exercises 1 and 2.

3. Identify the official tablets (D) and determine whether they have been made correctly to formula.

[*This exercise may be completed to-morrow.*]

THURSDAY, 22 *JANUARY*, 1953: 10 *a.m. to* 5 *p.m.*

Complete yesterday's exercise 3.

4. (E) is a water-soluble solid. Determine spectrophotometrically the proportion of (E) in the aqueous solution (F).

5. Report on the sample of fennel fruits (G).

[*Exercise* 5 *may be completed to-morrow.*]

FRIDAY, 23 *JANUARY*, 1953: 10 *a.m. to* 5 *p.m.*

Complete yesterday's exercise 5.

6. Medicine (H) is a sample taken formally under the Food and Drugs Act. Determine whether it has been satisfactorily dispensed to the prescription provided.

REPORT OF THE EXAMINERS

Examination for the Associateship

Inorganic Chemistry

In Q. 1 of the written paper there was a tendency to frame the answers too generally and not to state clearly the reason why, in some instances, inner orbits are filled preferentially. In Q. 2 the main weakness was in describing peroxy compounds of the transition metals. Candidates were, in general, familiar with peroxides of the alkalis and alkaline earths and with the common peracids. Iodine pentafluoride and cobalt nitrosyl carbonyl were unfamiliar to many. It should be noted that iodine trifluoride does not exist and that no diborane is obtained in the reaction of an acid with magnesium boride. The reaction of lithium aluminium hydride with a boron halide in ether solution is now the standard method for preparing this compound. Answers to Q. 4 and 6 were, on the whole, very satisfactory. In Q. 5, however, the standard was low. Many candidates failed to realise that the *normal* valency of the rare earths is three and that the abnormal valencies are those which are either below or above this value. The subject of interstitial hydrides was not well understood, and, in discussing the stereochemistry of 6-co-ordinated metal complexes, few mentioned the significance of d_2sp^3 hybridisation. Answers to the last question produced as a rule an exhaustive list of sources of error in analysis but very little discussion.

In the practical examination the determination of iron produced some good but many poor results. That of aluminium proved difficult under the conditions of the examination and this circumstance was taken into account. The determinations of zinc and molybdenum were well done. Sodium dithionate and hydrosulphite presented unexpected difficulties. The former, for example, was variously reported as a tartrate, a persulphate and the sodium salt of a chlorine-containing acid. Few candidates identified the latter, although most noted its strong reducing properties. The identifications of sodium cobaltinitrite and ammonium hexachlorostannate were often marred by failure to suggest a formula for the anion. The general weakness in qualitative analysis was further emphasised by results for the mixtures. Most candidates missed at least one radical and reported at least one which was absent.

Physical Chemistry

The recent general improvement was not fully maintained and the number of very weak candidates remains excessive. Most sections of the paper, however, received answers which set a good standard. Rather surprising exceptions were Q. 4, which elicited a great deal of irrelevant information, and Q. 6. Few clear accounts of the principles of the Hittorf method were given and none at all of the moving boundary. One quarter of the attempts on Q. 1 showed a degree of competence. High marks were obtained in all sections of Q. 2 for brief and knowledgeable answers, but these were not numerous. Q. 3 produced some good answers, those to section (*b*), however, being confined entirely to the polarograph, the principles of which were, as often as not, either ignored or completely misunderstood.

In Q. 5 the first section was unpopular, and few candidates showed any appreciation of the significance of the data given. The second section was better done, but, as so often, there was much misunderstanding, clearly exhibited by indecipherable or inconsistent symbols. Q. 7 was moderately done by some candidates; others made some incredible inventions.

The general standard of clarity and relevance is still far short of what it should be; candidates should realise that strict relevance to the questions, the avoidance of careless blunders (such as the inversion of axes of plots) and equal attention to each of the four questions would greatly improve their prospects of success.

Organic Chemistry

The general level attained in the theoretical paper showed a small but definite improvement on that of recent examinations, and some of the answers were of good quality. In the question on glycols few candidates were able to give a satisfactory account of their oxidation and dehydration. Many candidates had no knowledge of the action of a Grignard reagent on a nitrile, the replacement of a diazo group by phenyl, or the methods of preparing organic compounds of arsenic and mercury. Experimental details of the process of diazotisation were rarely complete and most candidates seemed to hold the view that a low temperature was all that was necessary. A surprising number of candidates thought that benzene-diazonium chloride could be converted into benzene by boiling with water! Many candidates confused asymmetric synthesis with optical resolution and, in spite of the descriptive terminology, which could hardly be more helpful, there was again the usual confusion between "electrophilic" and "nucleophilic," for which there can be no excuse. Not many candidates attempted the question on anthracene and phenanthrene, but those who did produced some creditable answers. It might be helpful to add that the sugars are not normally regarded as polyhydric alcohols and therefore do not qualify for inclusion in answers to the first question: and secondly, the answers to the question on glycosides were expected to include more than α- and β-methylglucoside.

In the practical exercises the identification of urethane, thiourea and ethyl carbonate did not appear to present much difficulty to most candidates, but ethyl orthoformate, benzonitrile and phenylacetonitrile proved to be more troublesome. The reduction of α-nitronaphthalene caused unexpected difficulties, whereas the

reduction of the nitrotoluenes appeared to be straightforward. The reports on epichlorhydrin and morpholine were very unsatisfactory, and seem to show that once candidates leave the well-worn paths, so carefully prepared for them in certain textbooks, they are completely lost and are quite unable to rely on their own observations and inferences.

Examination for the Fellowship

Branch E: The Chemistry, including Microscopy, of Food and Drugs and of Water

Candidates must be reminded that once they have obtained the Fellowship they are eligible to assume the responsibilities of a Public Analyst. Hence to have examined only one or two samples of a commodity as practice for the examination is not good enough: a reputable firm should not be required to defend its good name against such inexperience. Candidates should realise that the examination is intended for those whose experience in all parts of the work is sound and sufficient for a well-considered judgment.

The answers to the theory papers in Food and Drugs were rather disappointing; the memorising of textbooks enables a good answer to be given when description of an analytical method is called for, but such limitation becomes obvious when practical application is to be discussed. If the knowledge came from experience no difficulty would arise in answering either theoretical or practical questions. For example, no one with reasonable analytical experience of the tests would propose the oxidation of aneurin to thiochrome with ferrocyanide or incubate the B.O.D. test at 37° C, although otherwise giving admirable descriptions of the methods.

Candidates relied mainly on protein, lactose and ash figures to calculate milk solids in ice cream; since most ice-cream formulations include hydrolysed flour and stabilisers, it was not surprising that the results were poor. Only one candidate attempted a fermentation method. The determination of the hardness of an alkaline water again proved difficult; standard soap solution should not be used for this purpose.

The analysis of the meat extract was approached satisfactorily, but few candidates looked for metallic contamination (100 parts per million of copper were present) and the presence of fat was ignored. The determination of the iodine in iodised salt was well done, but the certificates ruined the work. Inability of candidates to write a satisfactory certificate is very common, but it is not realised how vital the matter may be; experience in this important part of the work of a Public Analyst must be obtained.

The analytical determinations on the sweetened coffee extract were satisfactory, but some candidates found difficulty in applying the results to calculate coffee and chicory extractives. The ground cloves contained a proportion of clove stem; this was detected by most candidates. The conclusion that the culinary essence of lemon was pure lemon oil was easily reached, but the opinions given as to why it was unsuitable for domestic purposes often showed lack of thought.

The therapeutics and pharmacology theory papers were fairly well done and the microscopy was generally very satisfactory. The practical work showed a general improvement, although too few details of findings are still given and the data were sometimes insufficient for assessing whether the answer was fortuitous or a reasoned conclusion based on analytical results.

PASS LIST

Examination for the Associateship

Arber, Scott Gordon, Royal Technical College, Salford.
Attfield, Donald James, College of Technology, Birmingham.
Beech, John Alan, South-East Essex Technical College, Dagenham, and Battersea Polytechnic, London.
Beech, Sidney, B.Sc. (Lond.), Royal Technical College, Salford.
Berry, Ernest, College of Technology, Liverpool.
Bickley, William Peter, B.Sc. (Lond.), Municipal Technical College, Hull.

Bishop, Michael, Rutherford College of Technology, Newcastle upon Tyne.
Clarke, Alan, Technical College, Doncaster, and Technical College, Huddersfield.
Crompton, Thomas Roy, College of Technology, Liverpool.
Curnow, Richard Dennis, Technical College, Newport, Mon.
Daley, Peter Derek Wane, South-West Essex Technical College, Walthamstow.
Daly, Norman Stanley, Royal Technical College, Salford.
Dixon, Jean Elizabeth, College of Technology, Liverpool, and Northern Polytechnic, London.
Dixon, John Roy, College of Technology, Birmingham.
Doyle, Denis, College of Further Education, Widnes.
Dunbar, James, Rutherford College of Technology, Newcastle upon Tyne.
Early, Geoffrey Ingham, Technical College, Bradford, Harris Institute, Preston, and Plymouth and Devonport Technical College, Plymouth.
Ellis, Peter Manfried, B.Sc. (Lond.), University College of the South-West of England, Exeter.
Fielden, Thomas Brian, College of Technology, Liverpool.
Fletcher, Henry, College of Technology, Manchester, and Royal Technical College. Salford.
Hand, Kenneth, Denbighshire Technical College, Wrexham.
Hayward, Edward James, Denbighshire Technical College, Wrexham.
Higson, Harold George, B.Sc. (Lond.), Royal Technical College, Salford.
Hunt, Eric Charles, B.Sc. (Lond.), Acton Technical College, London.
Johnston, Ian, College of Technology, Liverpool, Municipal Technical College, Bolton, and Municipal College, Burnley.
McAdam, Ian Alexander, College of Technology, Liverpool.
McGill, Arthur William, College of Technology, Leeds.
Marsh, Alan Spencer, B.Sc. (Lond.), Northern Polytechnic and Sir John Cass College, London.
Miéville, Rodney Louis, Northern Polytechnic, London.
Milner, William Derek, Wigan and District Mining and Technical College, Wigan.
Moth, Donald Frederick, Technical College, Brighton.
Murray, Dudley Charles, Technical College, Brighton.
Newey, Arthur Ernest, B.Sc. (Lond.), M.P.S., Nottingham and District Technical College, Nottingham.
Overend, Norman Howarth, B.Sc. (Lond.), Technical College, Bradford.
Sherliker, Francis Raymond, College of Further Education, Widnes, and Municipal College, Burnley.
Smith, Edward Thomas, Rutherford College of Technology, Newcastle upon Tyne.
Stokoe, John Neville, Royal Technical College, Salford.
Tee, Peter Arthur Handbury, Technical College, Brighton.
Timm, Eric Ralph, Municipal Technical College, Hull.
Trewick, Ronald Frederick George, South-West Essex Technical College, Walthamstow.
Whalley, George Raymond, Nottingham and District Technical College, Nottingham.
Whitehead, Geoffrey, Royal Technical College, Salford.
Williams, William Leonard, College of Technology, Bristol.
Woods, John, B.Sc. (Lond.), Municipal Technical College, Bolton.
Young, Trevor Owen, College of Technology, Birmingham.

EXAMINATION FOR THE FELLOWSHIP

Branch E: The Chemistry, including Microscopy, of Food and Drugs and of Water.

Kirby, Norman, B.Sc. (Lond.).
McGinn, Colin James Patrick, B.Sc. (Lond.).
Ramasamy, Murugesu, B.Sc. (Ceylon).

Special Examination in Pharmaceutical Analysis.

Ashley, Michael George, M.P.S., Ph.C.

BOOK REVIEWS

Organic Chemistry. E. E. Turner and M. M. Harris. Pp. xi + 904. (London: Longmans, Green and Co., Ltd., 1952.) 50s. net.

Our indigenous professors of organic chemistry have never been over conspicuous in the making of many books, and systematic textbooks of professorial authority may comfortably be counted on one hand. The appearance of the present work is therefore an unusual event of some importance, welcome as such and also as offering a rare opportunity of avoiding the far too frequent breath-taking dollar-exchange prices.

With a subject like organic chemistry, which has expanded and still expands so rapidly, it becomes increasingly difficult to write an advanced textbook that covers the field and yet remains within reasonable limits of size. Nevertheless, the present authors have shown that this can still be achieved, without sacrificing an even balance between formal systematic instruction and specialised topics, and between the theoretical, practical and historical approaches.

It is admitted in the preface that it is apparent that the authors are more interested in some parts of the subject than in others, and in view of the identity of the senior author, some spread in the realm of stereochemistry could well have been predicted. No apology is needed, however, for the clear, comprehensive and up-to-date survey of this subject has brought together a wealth of scattered material not readily available to the average student.

The arrangement of the book is on traditional lines, comprising 20 chapters on standard aliphatic and aromatic types, and special chapters on stereochemistry, carbohydrates, alicyclic compounds, terpenes, aromatic substitution, *cyclo*octatetraene and tropolones, steroids, free radicals, organometallic compounds, vitamins, plant alkaloids and purines. The latter are admirable in choice of topics and in the selection and arrangement of material, and a surprisingly uniform standard of excellence is maintained.

The chapter on Aromatic Substitution reviews all the major developments, from the empirical rule of Crum Brown and Gibson, to the nitronium theory of Bennett and Williams and Ingold and Hughes. That on alicyclics deals with the main preparative methods, including those for large rings, and discusses the Sachse-Mohr theory. The chapter on terpenes deals mainly with acyclic, monocyclic and dicyclic types; this is particularly welcome, since most writers appear to regard this subject as a somewhat outmoded necessary evil, and, apart from a well-known monograph, there is no really satisfactory modern account at this level. A monumental, yet most readable chapter is the one on heterocyclics, which whilst dealing fully with the formal five and six membered heterocyclics and derivatives, gives good accounts *inter alia* of haemin, bilirubin, chlorophyl, tryptophane, indigo, histamine, penicillin, anthocyanins and cyanine dyes.

Sufficient has now been said to give an impression of the scope of the work: it is most interestingly written and modern in outlook, and more than adequately covers the requirements of a good honours course. It should be in the hands of all honours students, with whom it is likely to win favour very rapidly, and to whom it can be recommended unhesitatingly.

Considering the mass of formulae in the book, errors are surprisingly few; at the top of p. 268, CO_2 should be CO; on p. 856, the amino group of aminouracil is written NH; on p. 801—possibly rather a fine point—the two ribose structures, as written in co-enzyme I, are mirror images, whereas both should be D(−).

A final word to the publishers. Unless the reviewer has been unlucky in his copy, the sewing and backing do not seem to be robust enough for the frequent handling this book is bound to have.

T. MALKIN

An Introduction to the Chemistry of the Hydrides. Dallas T. Hurd. Pp. x + 231. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1952.) 44s. net.

It is remarkable that no monograph published hitherto has dealt exclusively with the hydrides. This important group, embracing as it does the familiar

covalent compounds, salt-like hydrides formed by the alkali and alkaline earth metals and the interstitial derivatives of the transition metals and rare earths, is of obvious interest to the academic worker. Indeed, this is one of the most active fields of research in inorganic chemistry. Less well known are the actual and potential technical applications of certain hydrides which, until recently, were chemical curiosities. The author, himself a member of the General Electric Research Laboratory at Schenectady, has made a number of important contributions to the field.

The book is divided into 17 chapters, the first three of which serve as a general introduction to the valency problems encountered. Subsequent chapters deal in turn with hydrides in each of the main groups, starting with the salt-like compounds and continuing through the covalent hydrides to those of the transitional elements. More complex hydrides, of which lithium aluminium hydride is typical, are dealt with separately, as is a group of hydrides formed by elements such as copper, silver and mercury, the precise classification of which is at present impossible. Familiar compounds, such as the halogen hydrides, are discussed very briefly and there is a corresponding expansion in the treatment of less familiar compounds, such as the boron hydrides. A number of interesting new technical applications are given and, to quote one instance, titanium hydride is referred to as an article of commerce.

About one-fifth of the book is devoted to general topics and this is the least satisfactory part. The sections on chemical bonding and on acids and bases, for example, should be familiar to most readers and could well have been amplified considerably or replaced by more detail in some of the descriptive chapters. The latter are by no means complete and the bibliography is poor. The appendix on vacuum manipulation is also rather trifling. These shortcomings must, however, be classed as sins of omission and they do not detract greatly from the merit of the book as a whole. It should prove most valuable for reference purposes. It also brings out very clearly the limitations of our present knowledge and the directions in which progress may be made.

H. J. EMELÉUS

Inorganic Chemistry. Introductory Lecture Notes. Joseph Reilly. Pp. v + 81. (Cork: The University Press; Oxford: B. H. Blackwell, Ltd., 1952.) 8s. 6d. net.

Professor Reilly has been giving an introductory course in inorganic chemistry at University College, Cork, for over a quarter of a century and the present abstracts have been prepared for the convenience of students there—not as a substitute for textbooks, but to reduce the need for note-taking and for use in revision. The book takes the form of pages of compact notes and simple sketch diagrams alternating with blank pages.

The emphasis falls strongly on descriptive factual inorganic chemistry with an absolute minimum of theory. Even so, it is to be hoped that the statements "solutions, in water, of most electrovalent compounds conduct electricity due to the dissociation of the molecule by water into ions . . . NaCl + water $\rightarrow Na^+ + Cl^-$" (page 71) and that the number of ions so formed is "reciprocally dependent on the concentration" (page 54) do not represent a faithful transcription of the actual lectures. At the level aimed at it seems odd to devote space to ill-defined compounds such as C_4O_3 and C_8O_3, Ca_2P_2 and CaP_3, or $Al(CO)_2$. Indeed the whole page devoted to carbonyls seems curiously out of proportion, while the comments on the bivalency of iron in $Fe(CO)_5$ and the ring structure for $Ni(CO)_4$, even if introduced parenthetically in the lectures, ought not to survive in a book intended for use in revision. The appeal of such notes as these to a wider circle is difficult to assess; they certainly challenge the strongly held view that taking adequate and accurate lecture notes forms a vitally important part of a student's training.

H. IRVING

Industrial Waste Treatment. Edmund B. Besselievre. Pp. ix + 391. (New York: McGraw-Hill Book Company, Inc.; London: McGraw-Hill Publishing Co., Ltd., 1952.) 59s. 6d.

The disposal of the liquid wastes of a community has, in recent times, increasingly become an urgent scientific problem. Moreover, of the "pollution load" (which has to be purified either by preliminary special treatment or finally by natural purification of the effluent by the dissolved oxygen in the water of the receiving stream), the proportion due to industrial wastes as compared with that occasioned by true domestic sewage has increased rapidly as the range of industries has widened and developed. Though a multitude of papers has been published on the subject of trade wastes, there is a paucity of recent books bringing the position up to date.

The present volume contains 17 chapters, the contents of which can roughly be divided into three parts, dealing with (*a*) general considerations; (*b*) the treatment of individual types of waste; and (*c*) plant, engineering considerations and cost. Part (*b*) is that which will have most appeal to the chemist, unless he is a specialist concerned in detail with sewage and waste treatment. In it there is much useful information, but it must constantly be borne in mind that this book is written from the aspect of conditions and practice in the United States of America and that there are essential differences so far as this country is concerned. There is, indeed, very little reference to British work on this subject. Moreover, the author is an engineer and the book is intended primarily for members of the profession of Public Health Engineers. From the point of view of the chemist specialist it must be compared with the standard British work by B. A. Southgate, *Treatment and Disposal of Industrial Waste Waters*, issued by H.M. Stationery Office in 1948 at the low price of 12s. 6d., which is, in many ways, to be preferred. Nevertheless, the new book contains much useful information and material of a supplementary nature and, on this basis, can be recommended as a useful addition to the specialist's library.

C. J. REGAN

Textbook of Pharmacognosy. G. E. Trease. Sixth Edition. Pp. viii + 821. (London: Baillière, Tindall and Cox, 1952.) 37s. 6d. net.

It is scarcely four years since the appearance of the fifth edition of this book and a review, with a brief account of the subject of Pharmacognosy, was published (*J.*, 1949, V, 442). The short interval between the editions is some indication of the popularity of this book, and Mr Trease has taken the opportunity of deleting or condensing some of the matter, which now seems obsolete or of minor importance, in order to include more recent work. The revival of interest in such old drugs as veratrum, podophyllum, curare and cocculus, however, makes it no easy matter to decide which drugs to exclude as being obsolete. As most recent work on the animal and vegetable materia medica has been on the chemical composition and pharmacology of crude drugs, the opportunity has been taken to bring this information up to date. A notable improvement is the insertion of short bibliographies at the end of each chapter or sub-section. There is also an interesting chapter on the application of absorption and partition chromatography to pharmacognostical problems.

J. W. FAIRBAIRN

BOOKS AND PAMPHLETS RECEIVED BUT NOT REVIEWED

Radiation Chemistry. The Faraday Society. Pp. vi + 319. (Aberdeen: The University Press, 1952.) 35s. net.

[A General Discussion on Radiation Chemistry was held in the Department of Chemistry, the University of Leeds, on 8-10 April, 1952, with the President of the Society, Sir Charles Goodeve, in the Chair. Principal Contents:—General Introduction by Professor F. S. Dainton, followed by groups of papers and discussion under the following headings:—I. The Primary Act; II, Actinometry and Radiolysis of Pure Liquids; III, Indirect Action—Aqueous Systems with Single Solute; IV, Protection and Sensitization.]

LOCAL SECTION AFFAIRS

Bristol and District.—Meetings during the latter part of the Session were all held as originally published, four in Bristol and three in Gloucester.

On 22 January at a Joint Meeting with the S.C.I. Oils and Fats Group in the University of Bristol, Dr T. W. Goodwin spoke on the "Biogenesis of the Carotenoids."

On 29 January a paper on "Progress in Hydrogen Bond Chemistry" was read by Professor L. Hunter of Leicester, who gave an exceptionally clear and at times humorous account of recent work in this branch of chemistry. The speaker expressed his great appreciation of the reception given him in the relatively remote town of Gloucester, and of the very lively discussion that had followed his lecture.

On 5 February at Bristol, Dr F. Rose (I.C.I. Pharmaceuticals) in his lecture on "Practical Approach to Chemotherapy" gave an account of methods whereby various pharmaceutical chemicals had been developed and how their physiological activity had been determined. Details of structure and the method of preparation of some important antibiotics were also given.

On 25 February at Gloucester a joint meeting with the Plastics Institute was held at which Mr T. W. M. Pond spoke on "The Construction of the British Resin Factory at Barry."

At Bristol on 5 March, Dr A. T. Green read a paper on "Refractory Materials : Trends in Research and Development." This meeting was held jointly with the Institute of Fuel.

It is usual to hold one meeting of a social character at both Bristol and Gloucester during each session. The Gloucester meeting this year was held at Urch's Cafe, Gloucester, on 12 March, when Dr A. Marsden gave an account of his recent American visit. Dr Marsden confined his talk to the less technical aspects of his tour, as befitted the occasion, and his vivid descriptions of some of his experiences were very well received. Later, a film by Messrs Fisons entitled "Britain Can Grow It" was shown, and afterwards members met socially over refreshments.

On 19 March following the Annual General Meeting of the Section, Dr H. W. Thompson, of the University of Oxford, spoke on "Some New Applications of Infra-Red Spectroscopy." Dr Thompson mentioned the more recent developments of this method of analysis and showed spectrograms of several substances to illustrate the exceptional sensitivity now achieved by the infra-red spectrograph.

At the Annual General Meeting, over which Mr G. H. Moore presided, three new members of committee were elected—Mr R. Goulden, Mr E. Harding and Dr C. G. Silcocks. Dr D. Woodcock was elected Hon. Secretary and Treasurer in succession to Mr B. W. Minifie, who had previously announced his retirement after six years in office. The meeting carried the proposal that the new committee should appoint another member to fill the vacancy arising from Dr Woodcock's election as Hon. Secretary.

Mr Moore and Dr Malkin proposed a vote of thanks to the retiring Hon. Secretary, to retiring members of committee and to the Hon. Auditors.

The Chairman at the conclusion of the meeting said that the Section was greatly indebted to the University of Bristol and the Technical College, Gloucester, for the use of lecture rooms during the Session.

Cumberland and District.—On 21 January, 1953, a meeting was held at Seascale at which Mr K. Saddington presented a film depicting "Radiochemical Techniques." The film showed actual laboratory demonstrations of analytical methods used in handling alpha-active materials, and certain devices used in beta and gamma work. The film has a wide appeal in addition to its obvious interest to our local membership. A vote of thanks was given by Dr A. R. Lowe.

On 27 February, 1953, Mr G. S. Towler took the chair at a meeting addressed by Dr W. M. Cumming on the subject of "Natural Products in Industry." The estimated life of supplies of some of out commoner metals gave much food for thought. A vote of thanks to the lecturer was proposed by Mr K. Saddington.

Dublin and District.—The Annual General Meeting of the Dublin Section was held in the Chemistry Department, University College, Dublin, on 11 March, 1953; in the unavoidable absence through illness of the Chairman of the Section, Mr W. J. Stringer, the chair was taken by Mr J. Andrews.

The Hon. Auditors, Messrs B. G. Fagan and G. A. F. Harrison, were thanked for their services and unanimously re-elected on the proposal of Dr V. C. Barry, seconded by Mr R. A. D'Arcy. Two nominations were received for the two vacancies on the Committee—Messrs D. Crowley and J. T. O'Herlihy—and the Chairman accordingly declared them elected. The outgoing members, Mr J. Andrews and Dr A. G. G. Leonard, were heartily thanked for their many past services to the Section.

A recommendation from the Committee, that the office of Recorder to the Section should be created, was approved in principle, subject to the necessary alteration in the Section rules being made. In this connection, the Hon. Secretary reported that a sub-committee had been set up to revise the Section rules; when this had been done, a revised draft would be circulated to the members for their consideration.

The thanks of the members were accorded to the authorities of Trinity College and University College, Dublin, for providing meeting facilities; and to the Hon. Treasurer and the Hon. Secretary for their services to the Section.

The Hon. Secretary was requested to convey to Mr Stringer the good wishes of the members for his speedy recovery.

A discussion was initiated by Mr T. G. Webb on the subject of the most suitable time for holding meetings. After a number of members had spoken, a show of hands resulted in a substantial majority of those present being in favour of no change from the existing practice.

Dundee and District.—On 20 February, Dr Eric Clar spoke to a large audience in the Chemistry Lecture Theatre, University College, Dundee, on "The Significance of Kekulé Structures on the Stability of Aromatic Hydrocarbons." Mr Andrew Dargie was in the Chair. The lecture was well illustrated by lantern slides. After the discussion Dr John Iball, F.R.S.E., proposed a vote of thanks to Dr Clar for his interesting lecture.

On 20 March, in the Chemistry Lecture Theatre, University College, Dundee, Dr George H. Smith, M.C., of Scottish Oils, Ltd., delivered a lecture entitled "The Production and Refining of Shale Oil." Mr Henry A. Watson was in the Chair.

Dr Smith gave an account of the development of the industry from the pioneer work of Dr James Young in 1850 to the present time and told a fascinating story of the mining of shale, the retorting plants, shale oil and its refinement, diesel oil, petrol, wax, coke and by-products, ammonium sulphate, detergent and bricks.

The lecture was extensively illustrated by lantern slides and sample products were placed on view. A lively discussion of many of the practical points raised by the lecture followed. The vote of thanks was porposed by Mr John Wylie and warmly accorded.

East Midlands.—A meeting was held on 12 February at Loughborough College. Dr J. E. Johnston of the Isotope School at the Atomic Energy Research Establishment, Harwell, gave a talk on "The Production of Radioactive Isotopes in the Pile and some of their Applications." Mr L. P. Priestley, Chairman of the Section, presided. Dr Johnston, whose talk was illustrated with a number of extremely interesting slides, described the pile and the method of producing the isotopes, and went on to instance a variety of applications in different fields such as medicine, chemical research and mining engineering. After a useful discussion, Dr R. F. Phillips proposed a vote of thanks on behalf of the students of Loughborough College, which was seconded on behalf of the Institute by Mr R. Betteridge.

On 12 March, a meeting was held at the Midland Hotel, Derby. Mr L. P. Priestley took the Chair, and a talk on "The History of Clothing" was given by Mr C. F. Ward, a member of the Section Committee and Chairman-designate for the coming year. Mr Ward traced the history of clothing back to early times when the bark of trees was a principal item, and illustrated his lecture with slides showing the development of clothes and fabrics. Methods of spinning in early times were also described. A very interesting discussion followed in which some of the methods of treating fabrics described by Mr Ward were linked with certain districts of Derby in days gone by. A vote of thanks was proposed by Mr R. Betteridge and seconded by Dr A. G. Catchpole.

Huddersfield.—The Annual General Meeting of the Section was held on 10 March and Mr H. Boothroyd and Mr N. Fones were elected Committee members to replace Mr D. Hanson and Dr J. R. Atkinson, who retired by rule. Mr T. Ritchie presided, and the retiring Committee members were thanked by Dr W. McMeeking for their very willing services. Immediately after the Annual General Meeting the following three short papers were given by members of the Section :—"Synthetic Detergents in Sewage Disposal," by Dr H. H. Goldthorpe; "Scientific Theory," by Mr T. Ritchie; and "Tetrahydropteridines and related Natural Compounds," by Mr J. Lister. This programme of short papers, an innovation in the Section, proved most interesting and attractive, and it is anticipated that similar programmes will be arranged in the future. Dr W. B. Waddington presided at this meeting and the lecturers were thanked by Mr C. V. Hockey on behalf of the audience.

Leeds Area.—Members of the three chartered bodies joined forces in the Annual Dinner which was held at the Hotel Metropole, Leeds, on 21 February, 1953. Dr W. Cule Davies presided and Dr and Mrs F. G. Mann were the guests of the evening.

The Chairman welcomed the gathering, which included an encouraging proportion of younger members and in which academic and industrial interests were equally represented. Special good wishes were extended to Professor Challenger on his approaching retirement and cordial reference was made to the notable services which he had rendered to the Royal Institute of Chemistry, both nationally and locally, during his tenure of the Chair of Organic Chemistry at Leeds. Dr Cule Davies then introduced Dr Mann as a "bridge" uniting two eras at Cambridge—the age of stereochemistry under Pope and that of the chemistry of natural products under Todd.

Dr Mann recalled the happy association between the Chairman and himself at Cambridge, which had resulted in the first optical resolution of a tertiary phosphine sulphide, and referred to the record of fruitful partnerships in Professor Challenger's masterly and deeply moving memoir of the late Professor Kipping. Partnerships revealed the human aspects of the chemist, and the earlier history of chemistry in this country contained some remarkable characters. There was, for instance, Richard Watson of Cambridge who, having graduated in Classics and become a Wrangler in Mathematics, was appointed Professor of Chemistry, and not only proceeded to "get up" his subject but also established an important precedent at that time by actually lecturing in it: moreover, he induced the Crown to provide a stipend for the Chair (which no previous occupant had received) and in this respect he can be considered to have anticipated in some measure the work of the University Grants Committee. Later, however, he qualified for the Chair of Divinity by securing a "Lambeth D.D." Degree almost the day before the election, and managed to work up the initial emoluments of £330 to something like £1,000 per annum, before crowning his career by becoming Bishop of Llandaff, and having secured this appointment he lived happily thereafter at Windermere. Reference was made to Smithson Tennant, Wollaston and Roscoe, and the audience were only sorry that Dr Mann did not bring his catalogue of unusual men more up-to-date.

A vote of thanks was moved by Professor Dainton and concluded a most enjoyable evening.

Liverpool and North-Western.—On 25 February, an exhibition of laboratory apparatus, sponsored by the British Association of Chemists, was held at the College of Technology, Liverpool. In contrast with the recent R.I.C. exhibitions in Manchester and Preston (the latter is reported below) this was predominantly a trade exhibition. Its main contrasting feature was that, after inspecting the exhibits, members of the audience took their seats, whilst each of a dozen demonstrators addressed them in turn. Later, time was available for further inspection of the apparatus, of which there was a wide range on show.

On 5 March, a joint meeting was held with the North Wales Section, at the Grosvenor Hotel, Chester. Dr F. J. Smith presided and introduced the speaker, Mr C. A. McDowell, of the University of Liverpool, where he holds the post of Lecturer in Physical and Inorganic Chemistry. "Some Chemical Applications of Mass Spectrometry" was the title of his lecture, which had also been delivered on several occasions during his recent lecture tour in the United States. Mr McDowell first described the mass spectrometer with its ionisation chamber in which charged atoms in a beam of positive rays are subjected to a magnetic field. He proceeded to give examples of the dissociation of organic molecules, such as ethyl bromide, into combinations of ions, and drew a number of ionisation efficiency curves. He explained that ionisation potential could be calculated from the ultra-violet absorption spectra according to the molecular orbital theory. It was interesting to note that although kinetic energies could not yet be determined very accurately, work was now proceeding at the University of Liverpool, which gave hope of this being achieved in the near future. Drs Smith and J. B. Matthews, Messrs G. C. Eltinton and W. E. Cowley all contributed to the discussion. A vote of thanks to the speaker was proposed by Mr Eltinton on behalf of the Liverpool Section, and seconded by Mr Vernon H. Williams on behalf of the North Wales Section.

On 10 March, there was a Section meeting at the Mining and Technical College, Wigan. Dr Smith introduced Dr A. K. Holliday, whose lecture was entitled "Some New Inorganic Compounds." Dr Holliday is well known not only as a lecturer at the University of Liverpool but also as the local representative of the Chemical Society. He dealt with some compounds of beryllium boron, aluminium and gallium, mainly their hydrides and halides. He likened the very reactive compounds, lithium borohydride and lithium aluminium hydride, to the Grignard reagent, and described how they could be used to produce many new metallic hydrides, such as BeH_2, previously unknown. He drew attention to the remarkable resemblance of the boron-nitrogen compounds to both aliphatic and aromatic carbon compounds. Among examples of the aliphatic was aminoborine $H_2N.BH_2$ which might be considered as a homologue of ethylene. For the aromatic, the ring structure of borazole $B_3N_3H_6$ was surprisingly similar to that of benzene. Following the lecture, Drs Smith and H. K. Dean, with Messrs A. Ledwithy, C. Ashurst and D. J. C. Bailey contributed to a discussion. Dr M. Woodhead proposed a vote of thanks to the speaker, which was seconded by Mr Ledwithy.

The annual meeting of the Preston Sub-Section was held on 11 March at the Harris Institute, Preston. Dr Smith, our ubiquitous Chairman, congratulated the Sub-Section on its activities: the number of meetings held had exceeded those of the parent body. Mr Crowther, the local hon. secretary, delivered his report, which was followed by the election of the sub-committee. Those elected were Messrs E. Taylor, A. B. Crowther, B. C. James, A. N. Edmonson, C. D. Lafferty, and E. Rogers. The meeting was followed by an exhibition of analytical instruments on loan from a number of local organisations. Probably the most spectacular exhibit was an apparatus, shown by the Ministry of Supply, for using radioactive tracers for the determination of ion exchange properties. Amongst the many interesting instruments were a couple of "eye-catchers" loaned by Siemens Electric Lamp Co., firstly a stroboscopic "rev" counter, and secondly a U.V. lamp cabinet showing fluorescent effects of various activated metallic salts. Other exhibitors were The Harris Institute, The English Electric Co., The British Tyre and Rubber Co., Williamson & Co. and The Leyland Paint Co. At the conclusion of the meeting a vote of thanks to the exhibitors was proposed by Mr Rogers.

London.—The last month has been a busy one for the London Section. Dr A. G. Maddock has been especially obliging, delivering three different lectures at three different places. On 25 February he spoke to a large audience at Norwood Technical College on "The Role of the Chemist in the Realisation of Atomic Energy." On 9 March at Woolwich Polytechnic and on 12 March at Acton Technical College his lecture was entitled "Developments in Experimental Techniques of Radio-Chemistry," but it differed appreciably in content at each place. Another popular talk is Dr Pankhurst's "The Physics and Chemistry of Detergent Solutions," which he first gave at Walthamstow and repeated at the South-East Essex Technical College, Dagenham, on 26 February at a joint meeting with the London Section of the Society of Chemical Industry and the Technical College Chemical Society.

On 4 March four films, "An Introduction to Radio-Chemical Techniques, part 1, alpha," "The Nature of Plastics," "The Extraction of Penicillin" and "Crown Derby" were shown at a meeting at West Ham Municipal College, and Mr Jones, of Messrs Bakelite, answered questions in the interval on the second film. At Welwyn Garden City on 17 March, Dr J. Haslam delivered a characteristic, provocative and very interesting lecture on "The Importance of Analytical Chemistry in Industry with some Observations on the Training of Analytical Chemists," which gave rise to considerable discussion. He also showed a large exhibition of apparatus used in the analysis of plastics.

The central London meeting this month was held jointly with the London Section of the Society of Chemical Industry at University College on 18 March. Dr F. Sanger came from Cambridge to give a lecture under the title of "The Chemistry of Insulin" on the fascinating and very important work he has done in recent years in elucidating the arrangement of the amino-acids in the insulin molecule.

Mention must also be made of the dance held at Caxton Hall on 28 February. This, like last year's, was run jointly with the Local Section of the Society of Chemical Industry, and was again a most happy occasion. Last year the R.I.C.'s share in the profits enabled nearly £37 to be paid to the Benevolent Fund. Final figures for this year's dance are not yet to hand, but it is confidently hoped that the Fund will receive about the same amount.

Newcastle upon Tyne and North-East Coast.—A meeting was held at Sunderland in the Technical College on 26 February, 1953, when Dr E. Lester Smith lectured on "Vitamin B12 and Related Factors" before a large and appreciative audience.

Dr Lester Smith outlined the isolation of vitamin B12 from liver extract and its manufacture from *Streptomyces*. An up-to-date review of the chemistry and structure of vitamin B12 and its related factors was also given. The Lecture was well illustrated with lantern slides, specimens of various extracts and vitamin B12 and chromatograms. There was an interesting and varied discussion after the lecture, and Dr J. O. Harris proposed a vote of thanks to the speaker, which was carried with acclamation.

The 34th Annual General Meeting of the Section was held on 11 March, in the Chemistry Lecture Theatre, King's College, Newcastle. Before the business the President, Mr H. W. Cremer, C.B.E., addressed the meeting, expressing his thanks for the invitation to be present and wishing the Section success in all its activities.

The following were elected for the session 1953-54:—Chairman, Mr H. E. Blayden; Hon. Secretary, Dr J. Gibson; Hon. Treasurer, Mr W. Marsden; Hon. Auditors, Dr H. R. Thirsk and Dr H. Marsh; Members of Committee, Dr E. E. Aynsley, Dr R. W. Bolland, Mr R. J. H. Dyson, Mr H. R. Galleymore, Dr J. O. Harris, Dr E. W. Mills and Mr W. F. Stones.

A suggestion to shorten the name of the Section resulted in the motion "That the name of this Section remain as it is," which was carried unanimously. Light refreshments were served in the Johnson Laboratory.

Following the Annual General Meeting, the Chairman's Address was delivered by Mr H. E. Blayden on "A Semi-Micro Method for the Determination of

Molecular Weights." The apparatus, an adaptation of the Hill-Baldes osmometer, was described and a working demonstration given.

Results of molecular weight determinations carried out on coal solvent-extracts and pure substances for standardisation purposes were outlined and discussed. The meeting heartily endorsed a vote of thanks proposed by Dr Gibson.

South Wales.—On 13 March a meeting was held at University College, Swansea, jointly with the Chemical Society and the College Chemical Society, with Professor C. W. Shoppee presiding. Professor M. Stacey, F.R.S., delivered a lecture on "Acids containing Fluorine," in which he first described derivatives of acids such as fluorophosphonic and monofluoroacetic acids and then dealt in more detail with trifluoroacetic acid and compounds obtainable from it, e.g. trifluoroacetic anhydride and trifluoroacetone.

Northern India.—At the Third Annual General Meeting of the Section, held on 7 March, 1953, in the lecture theatre of the Chemistry Department, University of Delhi, the following Officers and Committee members were unanimously elected for 1953-54:—Chairman, Professor T. R. Seshadri (Head of the Department of Chemistry, Delhi); Hon. Secretary and Treasurer, Dr G. S. Saharia (Reader in Chemistry, Delhi); Hon. Auditor, Mr B. N. Sastri (Chief Editor, Dictionary of Economic Products and Industrial Research of India); Members of Committee, Dr R. B. B. Vishwanath (Planning Commission, New Delhi), Dr G. E. Gale (Principal Scientific Adviser (Navy), Government of India), M. K. Maitra (Chief Inspector of Explosives, Government of India), B. N. Sastri, P. T. Ramacharlu (Defence Science Organisation) and D. Das Gupta (Technical Officer, Indian Standards Institute).

Following the Annual General Meeting, Professor T. R. Seshadri, Chairman of the Section, gave a very interesting talk on "The Quinonoid grouping as the Active Centre in Antibiotics." The lecture was followed by a lively discussion. A social function was also arranged.

INSTITUTE AFFAIRS

EXAMINATIONS

Examinations will be held in September, 1953, as follows :—

For the Associateship :

Theoretical papers in London, Birmingham and Glasgow and, if required, in other centres, on Monday and Tuesday, 14 and 15 September.

Practical exercises in London on Tuesday to Friday, 8 to 11 September inclusive, and in London, Birmingham and Glasgow on Wednesday to Saturday, 16 to 19 September inclusive.

If the number of entries is large, some candidates in the London area may be required to do their practical exercises on Tuesday to Friday, 1 to 4 September inclusive.

Candidates will be asked to state their preference as to the centre for their theoretical papers and for their practical exercises, but it must be clearly understood that no guarantee is given that their wishes can be met.

Candidates who have not yet been accepted for examination should obtain from the Assistant Registrar without delay the prescribed Application Form, so as to allow ample time to secure thereon the necessary signatures certifying that they have complied with the Regulations concerning their courses of training. **The completed Application Form must reach the Institute not later than Monday, 8 June, 1953.** No application in respect of the September Examination will be considered if received later than that date.

Entry Forms will be sent as soon as they are ready to all candidates who have been accepted already and to those whose applications are received as above and accepted. **The last date for the receipt of Entry Forms will be Monday, 6 July, 1953.** No entry will be accepted if received after that date.

For the Fellowship :

In the week beginning Monday, 14 September, in London, or elsewhere at the discretion of the Council. Last dates for application and for entry will be as for the Associateship, except that candidates who desire to present themselves for examination in Branch G : Industrial Chemistry, with special reference to a particular field of work, or in a Special Branch, must submit their Entry Forms not later than Monday, 8 June.

REMUNERATION STATISTICS

With the February issue of the *Journal* cards were enclosed on which Fellows and Associates were asked to indicate their remuneration and the nature of their employment.

The explanatory leaflet which accompanied the cards pointed out that previous surveys had proved valuable to all concerned with the economic status of chemists.

Although several thousands of cards have been returned, the response has not been nearly as good as in 1942 and 1947. The accuracy of the survey obviously depends on its completeness. **Members who have not yet returned their cards are therefore urged to do so forthwith, and in any event not later than Monday, 27 April.**

Anyone who wishes to do so may of course return the card in an envelope : if the envelope is not sealed, the postage will be 1½d.

INTERNAL AFFAIRS

Presidential Address.—The Presidential Address by Mr H. W. Cremer, C.B.E., entitled "Whither Chemistry ?" will be delivered in the Lecture Theatre of the Institution of Electrical Engineers, Savoy Place, W.C.2, at 11.30 a.m. on Friday, 24 April. It will be open to members, registered students and visitors.

Appointment of Scrutineers.—In accordance with the provisions of By-law 29, the Council has appointed Mr W. H. Bennett and Dr H. G. Smith as scrutineers of the Ballot for the Election of Officers, General Members of Council and Censors.

Business of Committees.—The Council has resolved that in the period between the date of the Annual General Meeting (24 April) and that of the appointment of committees by the new Council at its first meeting on 15 May, urgent business may be dealt with by the existing committees or, in the case of committees of the Council, by their members who remain Members of Council.

Examinations of the Institute.—For some time the Council and the Nominations, Examinations and Institutions Committee have been concerned about the large proportion of failures in the Associateship examination. Questions have also been raised about the standard of the papers in this examination and about the conditions of admission to the Fellowship by examination and otherwise. The Council has referred these matters in the first instance to the Education Committee on the understanding that the Chairman of the Board of Examiners, the Examiners for the Associateship and several Members of Council who had expressed views on certain aspects of the subject would be invited to meetings of the Committee at which these problems were discussed.

Status of the Fellowship.—At their meeting on 13 March the Council received a letter from the Secretary of the Edinburgh and East of Scotland Section referring to the concern that had been expressed at the Annual General Meeting of the Section at the possible implication of the statement (*J.*, 1953, 99) that "a considerable proportion of the older Associates are in any event eligible for admission to the Fellowship . . ." and asking for an assurance that no lowering of the standard of the Fellowship is contemplated. The Council had not anticipated that any doubt on this matter would arise from the statement, for it had always been recognised that many Associates were suitably qualified to proceed to the Fellowship, but for one reason or another they did not do so. There is certainly no intention of lowering the standard for admission to this senior grade.

Hon. Representatives in Universities and Colleges.—Mr R. E. Parker has accepted an invitation to become the Hon. Representative of the Institute in the University of Southampton. He succeeds Dr A. R. Burkin, who left the University last September in order to take up an appointment in the Department of Mineral Dressing at the Royal School of Mines, Imperial College, London.

AWARDS

Meldola Medals, 1952.—The Council of the Institute, with the concurrence of the Society of Maccabaeans, has decided to award two Meldola Medals for 1952, one to Mr Tom Leadbetter Cottrell and the other to Dr Basil Charles Leicester Weedon. Short statements on the careers and work of these medallists will be published in the next issue of the *Journal*.

Sir George Beilby Memorial Fund: Award for 1952.—The Administrators of the Fund, consisting of representatives of the Royal Institute of Chemistry, the Institute of Metals and the Society of Chemical Industry, have decided to make an award from the fund of 150 guineas to Mr Thomas Victor Arden. A note on Mr Arden's career and work will be published in the next issue.

MEMORIAL LECTURES

With the concurrence of the Local Sections concerned and of the donors of the Gluckstein Memorial Fund, it has been agreed that Gluckstein, Henderson and Frankland Memorial Lectures shall in future be spaced so that one Memorial Lecture will be delivered each year. The sequence will be:—Gluckstein Memorial Lecture, 1953; Henderson Memorial Lecture, 1954; Frankland Memorial Lecture, 1955. The annual Dalton Lecture, arranged by the Manchester and District Section, does not come in the category of Memorial Lectures.

Gluckstein Memorial Lecture.—Dr John Rogers, O.B.E., the Chairman of Imperial Chemical Industries, Ltd., has accepted an invitation to deliver the 13th Gluckstein Memorial Lecture in the Autumn of 1953.

BRITISH STANDARDS INSTITUTION

The Council has nominated Mr H. W. Cremer, C.B.E., to be the representative of the Institute on the Chemical Divisional Council for 1953-54, in succession to Dr G. M. Bennett, C.B., F.R.S., who will have completed the maximum period of continuous service this year.

The British Standards Institution has set up a Technical Committee LBC/18—Laboratory Furniture and Fittings. At one of the earlier meetings of this Committee the Institute was represented by Dr F. H. Milner, who recommended that it should have a permanent representative on the Committee in view of the general importance of the subject to chemists. The Council has accordingly nominated Dr A. H. Cook, F.R.S., as its representative on the Committee.

Mr George Taylor, O.B.E., attended a Conference on Chemical Products called by the B.S.I. to consider the constitution of a technical committee to deal with methods of test. The primary need for such a committee arose from the desire to provide adequate support to United Kingdom representatives at meetings of the Committee on Chemistry established under the International Organisation for Standardisation (ISO/TC.47), which was at present considering methods of test for hydrochloric, nitric and sulphuric acids, potassium and sodium hydroxides, sodium carbonate and ammonia. On the recommendation of Mr Taylor it was agreed to appoint a representative to the new Technical Committee HCC/6—Methods of Test for Chemical Products, and the Council of the Institute has nominated Mr H. E. Evans in this capacity.

PERSONAL NOTES

Honours and Awards

The Royal Society.—Mr A. R. Powell, *Fellow*, and Professor T. Wallace, C.B.E., *Fellow*, have been elected Fellows of the Royal Society.

The Royal Society of Edinburgh.—Four Fellows of the Institute have been elected Fellows of the Royal Society of Edinburgh. They are Professor F. Bell, Dr E. A. C. Chamberlain, Dr A. Clow and Mr B. G. McLellan.

South African Chemical Institute.—To mark its fortieth anniversary, the S.A.C.I. has elected the following to be honorary members:—

Mr J. E. Worsdale, *Fellow*, who has recently been elected President of the Associated Scientific and Technical Societies of South Africa.

Dr H. H. Dodds, *Fellow*, who retired in 1951 as Director of the South African Sugar Association's experiment station at Mount Edgecombe, Natal.

Society of Dyers and Colourists.—Mr F. L. Goodall, *Fellow*, has been nominated by the Council of the Society for election as President for the session 1953-54.

Degrees.—The degree of Doctor of Science has been conferred upon the following members:—

Dr D. V. N. Hardy, *Fellow*, by the University of Southampton, for his contribution to the knowledge of derivatives of triaryl carbinols and tetra-arylmethanes, and of organo-silicon compounds; the synthesis of organic compounds by high pressure techniques; and the development of polyethylene terephthalate.

Dr R. A. Raphael, *Associate*, by the University of London; his recent work includes a study of the new quasi-aromatic tropolone system and the synthetic applications of acetylenic compounds in various fields of organic chemistry.

Dr S. L. Neppe, *Fellow*, has been awarded the D.Sc. (Eng.) of the University of Witwatersrand for a thesis on "Classification of Bitumens in Asphalt Technology by certain Rheological Properties."

Appointments

Dr G. H. Beeby, *Associate*, has been appointed I.C.I. Salt Division director, and chairman of the divisional Board at Winsford.

Mr A. R. Bone, *Fellow*, has been appointed chief chemist of Damancy & Co., Ltd.

Mr A. E. G. Brown, *Associate*, has been appointed general manager of Duresco Products, Ltd., where he was formerly works manager and chief chemist.

Dr J. A. V. Butler, *Fellow*, has been appointed to the recently established Chair of Physical Chemistry in the University of London, tenable at the Chester Beatty Research Institute (Institute of Cancer Research, Royal Cancer Hospital).

Dr N. B. Dyson, *Fellow*, has been appointed works manager of Monsanto Chemicals, Ltd., Newport, Mon., where he was formerly assistant works manager.

Dr F. A. Freeth, O.B.E., *Fellow*, has been elected United Kingdom representative to the Standing Committee of the Annual European Congress for Chemical Engineering.

Mr G. G. Grant, *Fellow*, has been appointed manager of the Pumpherston refinery of Scottish Oils, Ltd., where he has for many years been chemist.

Mr R. F. Hayman, *Fellow*, has been appointed Gas Development Officer to the Gas Council, and will leave the North Thames Gas Board at the end of this month.

Dr G. I. Higson, *Fellow*, has been appointed a director of British Titan Products Co., Ltd.

Mr H. Trefor Jones, *Fellow*, deputy provincial director, Yorks and Lancs province, has been appointed provincial director, Yorks and Lancs province, in the National Agricultural Advisory Service.

Dr S. Krishna, C.I.E., *Fellow*, has been re-appointed Scientific Adviser to the High Commissioner for India in the United Kingdom and Indian Scientific Liaison Officer, London.

Mr D. C. Lee, *Associate*, has been admitted into partnership by Dr G. Lewi, Industrial Consultant. The practice will in future be known as George Lewi and Partners.

Dr A. H. Nissan, *Fellow*, technical executive director on the Board of Bowaters Development and Research, Ltd., is to occupy the Research Chair of Wool Textile Engineering in the University of Leeds.

Mr G. H. Osborn, *Fellow*, chief analyst of the British Drug Houses, Poole, Dorset, will be giving up his present appointment shortly to take a partnership with Mr A. S. Carlos, Public Analyst to the boroughs of Bournemouth and Poole. He was a member of Council of the Society of Public Analysts from 1951 to 1953 and Hon. Secretary of the Mid-Southern Counties Section of the Institute from 1947 to 1952.

Sir Arthur Smout, J.P., *Fellow*, has retired from the Board of Imperial Chemical Industries, Ltd.

Dr J. D. H. Strickland, *Fellow*, formerly with the Ministry of Supply, has joined the Chemistry Division of the British Columbia Research Council at the University of British Columbia, Vancouver.

Dr R. S. Young, *Fellow*, has resigned from the post of director of the Diamond Research Laboratory, Johannesburg and is taking up an appointment with the International Nickel Company of Canada. He will be attached to the New York Office and will initially spend some time with the Mond Nickel Company, Clydach, Swansea.

Mr J. Russell, *Associate*, has been awarded a two-year research associateship of Cornell University, Ithaca, New York. He hopes to leave for America in November.

Dr G. M. Badger, *Fellow*, Reader in Organic Chemistry at the University of Adelaide, is expected to arrive in this country in May next. He is interested in research in aromatic compounds, drugs and medicinals, and he will stay in Britain until August.

PROFESSIONAL NEWS AND NOTES

SCIENTIFIC COURSES

Bradford Technical College.—A course of 10 lectures on **Chemical Thermodynamics** will be held on Thursdays at 7 p.m., commencing 21 May. It will be a postgraduate refresher course, designed to present a survey of chemical thermodynamics and its applications to problems of interest to both the industrial and research chemist. Fee for the course, 30s.

A course of 9 lectures and demonstrations on **The Chemistry of High Polymers** will be held on Wednesdays at 7 p.m., commencing 20 May. This is also a postgraduate course, designed to present a survey of the modern chemistry of high polymers, including industrial and textile aspects. A knowledge of elementary classical thermodynamics will be required in later lectures and the course in thermodynamics will provide revision lectures for students requiring them. Fee for the course, 30s.

Chelsea Polytechnic.—A course of two postgraduate lectures on **Moving Fronts in Porphyrin Chemistry and Biochemistry** will be given by Dr J. E. Falk, of University College Hospital Medical School, on 11 and 18 May at 7.30 p.m. Fee 5s.

A pamphlet giving further particulars can be obtained from the Secretary of the Polytechnic, Manresa Road, London, S.W.3.

Imperial College, London.—A course of 15 lectures will be held from 20 to 24 April inclusive on **Ignition and Flame Propagation in Gases.**

The fee for the course is £3 13s. 6d. but students of the College and intercollegiate students will be admitted free. Enquiries should be addressed to the Deputy Registrar, City and Guilds College, Exhibition Road, S.W.7.

The Combustion Laboratories will be open to visitors in the afternoons of 22 and 23 April from 3.30 p.m.

The University of Leeds.—A Postgraduate Summer School on **Optical Crystallographic Methods** will be held from 31 August to 11 September. The course will deal with the theory and use of the polarising microscope in chemistry and other branches of science and technology and will consist largely of practical work. The study of opaque materials by reflected polarised light will be included. Tuition fee 15 guineas. Application Forms may be obtained from The Secretary, Department of Adult Education and Extra-Mural Studies, The University, Leeds, 2, and must be returned not later than 11 May, 1953.

Loughborough College of Technology.—The Department of Chemical Engineering is arranging a further one-year post-graduate course in **Chemical Engineering,** commencing in September, 1953. This full-time course is designed to prepare students for examinations leading to the Honours Diploma of the College and the A.M.I.Chem.E. Students will be accommodated in College hostels or approved lodgings. Applications from graduates in chemistry or engineering, or from other suitably qualified persons, should be made to The Registrar, Loughborough College of Technology, Loughborough, Leics.

CONFERENCES AND EXHIBITIONS

British Plastics Convention.—The Second British Plastics Exhibition and Convention will be held at Olympia from 8 to 18 June, 1953. The exhibition will provide the most comprehensive and practical picture yet presented of the versatility and technical efficiency of the plastics industry. The subject-matter of the Convention includes unplasticised p.v.c., development in materials, reinforced plastics, durability and performance, injection moulding, economic factors of large moulding machines, and new uses in industry. Exhibition admission tickets and Convention tickets can be obtained from the Exhibition Manager, British Plastics, Dorset House, Stamford Street, London, S.E.1.

Institute of Metal Finishing.—The Spring Conference will be held at the Hotel Majestic, Harrogate, from 22 to 25 April, 1953. Technical, social and ladies' programmes have been arranged. Accommodation is being allocated in the order in which applications and remittances are received. Further details can be obtained from the Conference Secretary, Institute of Metal Finishing, 32, Great Ormond Street, London, W.C.1.

The Iron and Steel Institute.—A special meeting on **Boron in Steel** will be held on 29 April at the offices of the Institute, 4, Grosvenor Gardens, S.W.1. This meeting has been arranged by the Institute at the suggestion of the Ministry of Supply, acting in conjunction with the Organization for European Economic Co-operation, to discuss recent manufacturing developments in the U.S.A. It will precede the Annual General Meeting, arranged for 30 April and 1 May. Further details can be obtained from the Secretary at the above address.

Nutrition Society.—A two-day conference in honour of the bicentenary of the publication of James Lind's *Treatise of the Scurvy* will take place at Edinburgh on 22 and 23 May. After an opening ceremony in the University Upper Library, Surg. Vice Admiral Sir Sheldon Dudley will give an address on Lind, and Sir Edward Mellanby will then take the Chair at the first session of the conference. Further particulars may be obtained from Dr C. P. Stewart, Clinical Laboratory, the Royal Infirmary, Edinburgh.

Society of Chemical Industry.—The Oils and Fats Group will hold a **Symposium on Oxidation** at the Low Temperature Research Station, Cambridge on 24 April, 1953. Visitors will be welcome. Full particulars may be obtained from the General Secretary, Society of Chemical Industry, 56, Victoria Street, London, S.W.1.

The Textile Institute.—The 38th Annual Conference of the Textile Institute will be held from 25 to 29 May at Llandudno. In view of the fact that this Conference immediately precedes the Coronation, it is expected that a large contingent of oversea visitors will attend.

Some 14 papers will be given by prominent British and American scientists and technologists, on the general theme **Structure and Purpose**, covering a wide range of subjects: man-made fibres, felt for paper-making, jute, furnishing and other fabrics used for industrial purposes; functional properties, design, serviceability and tensile strength testing are discussed.

A civic reception will be given by the Chairman of the Llandudno Council. The ladies' programme will include special tours through the Welsh mountains and theatre visits. Other visits to textile plants in the vicinity and a golf tournament have been arranged.

Booking forms may be obtained from the General Secretary, 10, Blackfriars Street, Manchester, 3.

NEW PUBLICATIONS

The Colour Index: Second Edition.—The Society of Dyers and Colourists and the American Association of Textile Chemists and Colorists have announced that a second edition of the *Colour Index* will be published in 1955. The work has been re-designed and brought up to date with the co-operation of all the dye manufacturers in Great Britain, America, Western Europe, India and Japan. The new edition will be much more costly than the first, as it has increased in size from one to five volumes. The *Index* will cost £30 if payment is made before 30 June, 1953; £33 in three annual payments, 1953 to 1955; or not less than £35 on publication (1955). Order forms can be obtained from the Society of Dyers and Colourists, 19, Piccadilly, Bradford, Yorks.

Acta Metallurgica.—This is the title of a new international journal for the Science of Metals. The first issue appeared in January, 1953 and it is being published initially in alternate months. The purpose of the new journal is to provide a medium for the publication of papers describing theoretical and

experimental investigations contributing to the understanding of the properties of metals in terms of fundamental particles, forces and energies. *Acta Metallurgica* was initiated and is being sponsored by the American Society for Metals. The Iron and Steel Institute, the Institute of Metals and the Chemical Society are among the societies co-operating in this publication. Members of these three societies can subscribe at the privileged rate of £3 6s. per annum. Orders will only be accepted on the printed form of subscription. Non-members of these societies should send their orders direct or through an agent to Acta Metallurgica, 57, East 55th Street, New York, 22.

MISCELLANEOUS

Laboratory Technicians' Work: Courses.—The Department of Technology of the City and Guilds of London Institute have announced that courses in Laboratory Technicians' Work have now been scheduled with that Institute at Gateshead, Liverpool, Leicester, Paddington, S.E. London Technical College, Nottingham, Weybridge, Handsworth (Birmingham), Salisbury, Sheffield, Bristol and Dagenham.

National Institute of Adult Education.—The Institute met with representatives of the A.T.I. and A.P.T.I. last year to set up a committee of inquiry into the relationship of vocational and non-vocational studies in further education and training in England and Wales (*J.*, 1952, VI, 341).

The Committee has now been constituted and has held a preliminary meeting. Among those who have accepted invitations to serve on it are Mr. H. W. Cremer, C.B.E., and Dr P. F. R. Venables.

Observations or information on the subject of the inquiry from bodies or individuals interested will be welcomed by the Committee. Communications should be addressed to the Joint Honorary Secretaries, Further Education Inquiry, 35, Queen Anne Street, London, W.1.

Oxford University Appointments Committee.—In the Committee's annual report it is stated that last year only 71 out of 482 honours science graduates enquired for a first permanent educational post, and half of these hoped for university lectureships or research posts. Only 17 took teaching posts in schools, *and these were in public schools*. On the other hand 105 scientists entered the technical branches of industry.

Last year also 258 arts graduates obtained commercial or industrial positions. The total number of non-technical business vacancies rose by only 1 per cent., which suggests that the demand for non-technical graduates in industry is levelling out, though it remains at a high figure.

Parliamentary and Scientific Committee.—The following officers have been elected for 1953 :—President, Viscount Waverley; Vice-Presidents, Viscount Falmouth, Lord Haden-Guest, the Earl of Halsbury, F. J. Erroll, M. Philips Price, Sir Charles Goodeve and Dr W. R. Woolridge (one vacancy); Chairman, Sir Wavell Wakefield; Vice-Chairman, Sir Henry Tizard; Deputy-Chairman, Sir Ralph Glyn and W. T. Wells; Hon. Treasurer, Dr H. J. T. Ellingham; Hon. Secretaries, Hugh Linstead, Austen Albu and Dr S. Whitehead; Administrative Secretary, Lt. Commander Christopher Powell, R.N. On a proposal from Viscount Calverley a vote of thanks to Viscount Samuel for his work as president was recently placed on record and the title of President Emeritus was conferred on him on the proposal of Professor A. V. Hill.

The Society of Public Analysts and other Analytical Chemists.—The following officers have been elected for the coming year :—President, Dr D. W. Kent-Jones; Past-Presidents serving on the Council, Lewis Eynon, G. W. Monier-Williams, J. R. Nicholls and George Taylor. Vice-Presidents, A. J. Amos, T. McLachlan and Eric Voelcker; Hon. Treasurer, J. H. Hamence; Hon. Secretary, K. A. Williams.

OBITUARY NOTES

Lawrence Hay Watt Adan. *B.* 4.7.1885. *Ed.* Robert Gordon's College and University of Aberdeen 1903-07. M.A., B.Sc. Chemistry master, Methlick H.G. Public School 1907-08, and Central H.G. Public School, Aberdeen, 1909-25 *ca.* Assisted in the University Chemistry Laboratory 1915, working under Professor Soddy. Afterwards Headmaster, Frederick St Jr. Secondary School. (*A.* 1920.) *D.* 29.6.52.

John Samuel Strafford Brame. *B.* 28.11.1871. *Ed.* Sir Thomas Rich's School, Gloucester. Articled to G. Embrey, Public Analyst, Gloucester, 5 years. Remained a further 2 years as assistant to Embrey at the Gloucester School of Science and in the Public Analyst's laboratory. Studied at the Royal College of Science 1893-94, completing the A.I.C. course. Research studentship 1895-96. Senior teaching scholar, R.C.S., 1896-97. Demonstrator (1897), Instructor (1902) and Professor of Chemistry (1914), Royal Naval College, Greenwich. C.B.E. Published several papers on applied chemistry topics; author of *Fuels—Solids, Liquid and Gaseous*; joint author with Professor V. B. Lewes of some later editions of *Service Chemistry*. Served on the Councils of the Chemical Society and the Institution of Petroleum Technologists (sometime President), on Committee "C" of the National Whitley Council, etc. (*F.* 1918.) *D.* 10.12.52.

Joseph Michael Connolly. *B.* 3.6.12. *Ed.* Loughborough Grammar School and Loughborough College 1930-33. B.Sc. Studied reactions of thiocarbonyl tetrachloride. Ph.D. 1936. Demonstrator, Loughborough College 1934-36; lecturer 1936-45; senior assistant 1945-51; senior lecturer 1951-52. Dr Connolly devoted his entire life to the study of organic chemistry and was a lucid and well-informed lecturer. Recently he had become especially interested in the application of semi-micro methods to organic analysis and was the joint author of a number of papers on the subject. (*A.* 1933, *F.* 1946.) *D.* 28.6.52.

Alfred James Dunk. *B.* 4.8.1892. *Ed.* Parmiter's School and Finsbury Technical College 1908-11. With Messrs Morgan Crucible Co. 4 years. Works chemist, H.M. Factory, Langwith, Notts, 1915-18. Afterwards works chemist, Cape Asbestos Co. (*A.* 1920.) *D.* 30.12.52.

Otto Heinz Gellner. *B.* 28.3.26. *Ed.* in Prague, and East Sheen and Richmond County School for Boys; University of Manchester 1943-47. Research work on dissociation energies and bond strengths 1947-48. M.Sc. Naturalised 1948. Scientific officer, British Iron and Steel Research Association from January, 1949. (*A.* 1950.) *D.* 17.1.52.

Frank Matthews. *B.* 28.6.1886. *Ed.* Regent Street Polytechnic Technical Secondary School 1898-1905; University College London 1905-08 and South-Western Polytechnic 1907-18. Chemistry master, Polytechnic Secondary School 1909 onwards. Research on picramino-benzoic acids and their derivatives, and preparation of local anaesthetics for Trench Warfare Committee. Also worked on the constitution of the chloraceto-pyrogallols. Continued with government work after the war, and served on a chemical Sub-Committee of the Research Board. Ph.D. 1925, thesis on analogues of adrenaline. (*A.* 1918, *F.* 1925.) *D.* 21.11.52.

James Miller. *B.* 21.2.1872. Trained at the Glasgow and West of Scotland Technical College. Chemist and assayer, Mexican Gold and Silver Recovery Co., Ltd., 1893-96, representing John Taylor and Sons, London, Mining Engineers. Was admitted to the Fellowship on his return to this country and then spent 8 years in South America for the same firm, as manager of the Sao Bento Mines, Minas Geraes, Brazil. On the closing of the mine he was able to retire and afterwards lived at Helensburgh, Dumbartonshire. (*F.* 1897.) *D.* 16.10.52.

Harry Gordon Reeves. *B.* 13.11.1896. *Ed.* St Michael's School, Handsworth and Municipal Technical Day School, Birmingham; University of Birmingham 1914-19 (research on chemical war projects). Demonstrator 1921-23. M.Sc. 1921. Demonstrator, King's College, London 1923-26. Ph.D. 1924. Senior Demonstrator in biochemistry, St Bartholomew's Hospital Medical School, 1926. D.Sc. Numerous publications in *J.C.S.*, *J.Physiol.*, *Lancet*, etc. Evacuated to department of chemistry, University of Cambridge, during the war, returning afterwards to Charterhouse Square, where he remained until the time of his death as Senior Lecturer in biochemistry. "Daddy" Reeves was beloved by his students; he was a first-class musician and an authority on the theatre. See *St. Bartholomew's Hospital J.*, 1953, 70. (*A.* 1920, *F.* 1928.) *D.* 23.11.52.

Gordon Evans Rose. *B.* 17.11.02 at Durban. *Ed.* Rondebosch Boys' High School and University of Cape Town 1920-23. M.A. At first became chemist to a cement works and afterwards to the P.O. Dynamite Factory, Cape Province, eventually becoming senior chemist, Cape Explosive Works, Ltd. (*A.* 1924.) *D.* 21.4.52.

Robert Henry Slater. *B.* 8.11.1900. *Ed.* Daniel Stewart's College and University of Edinburgh 1919-25. B.Sc. 1922, Ph.D. 1924. Carnegie Research Scholarship 1924-25; D.S.I.R. grant 1925-27; Carnegie Research Fellowship 1927-29; Grocers' Company Scholarship 1929-32; Freeland Barbour Fellowship, Royal College of Physicians, Edinburgh 1931. Worked at the Royal College of Physicians' laboratory, Edinburgh, from 1925-32. Joint paper with Dr Roche Lynch on the determination of lead in biological material. F.R.S.E. 1930. D.Sc. 1932. Numerous papers on organic chemistry and biochemistry. Assistant chemical pathologist, St Mary's Hospital, London 1932, remaining there until 1945. Chemical pathologist, Royal South Hants and Southampton Hospital 1947, and subsequently principal biochemist, Southampton Group Hospitals. In later years interested mainly in toxicology. (*A.* 1923, *F.* 1935.) *D.* 11.12.52.

John Leslie Taylor. *B.* 16.12.05. *Ed.* Royal Masonic School and University College, Cardiff 1923-27. B.Sc. Research chemist, Anglo-American Oil Co., Ltd. Afterwards technical adviser, Cory Bros and Co., Ltd. (*A.* 1927.) *D.* 19.11.52.

Frederic Eric Tomkinson. *B.* 28.2.04. *Ed.* Boys' Secondary School, Barrow in Furness and University of Liverpool 1922-25, B.Sc. Research Scholar, Dip.Ed., and M.A. 1929. Chemistry master, St Asaph County School 1927 onwards, and lecturer, Flint Evening Institute from 1937. Afterwards senior science master, St Asaph Grammar School. (*A.* 1943.) *D.* 8.7.52.

CORRESPONDENCE

SIR,—Comment is asked for on the letter of Mr C. J. Riley, in the March issue of the *Journal*, with regard to facilities for higher degrees. One of the difficulties is, I think, the fact that most if not all Universities other than London do not permit such degrees to be taken, except internally. There are now numerous Research Organisations under the direction of first-class men, the research staff of which, although publishing good work, have no hope of obtaining a higher degree, except by collecting, in the course of time, enough papers to submit for a D.Sc. If the Universities could be persuaded to alter their regulations so as to allow their own graduates to submit theses on work done while they are on the staff of an approved Research Organisation, a lot would be gained.

It is true that in many cases such work would be "applied" rather than "pure" science, but nowadays, surely, the distinction lacks reality and should not prove an insuperable barrier. If the Universities could be persuaded to

move in this direction, I do not anticipate lack of response on the part of Directors of Research.

I support Mr Riley's suggestion that Council consider an approach, not only to London, but to all other Universities, and to Directors of Research Organisations and Principals of certain Technical Colleges, to see what can be done.

Redhill, R. E. ESSERY
Surrey.

SIR,—Attention is drawn in the foreword to the report of Dr Saunders' lecture on "The Chemistry and Toxicology of Organic Fluorine and Phosphorus Compounds" to the introduction of a new system of nomenclature for compounds containing one phosphorus atom per molecule. Items of this type, which occur from time to time, raise serious issues in connection with the recording and use of chemical literature.

Systems of nomenclature which have served for the development of chemistry to its present status, with its hundreds of thousands of known compounds, cannot be so radically faulty that they must be discarded. Modifications of such systems should be evolutionary—not revolutionary—otherwise, just as the older chemists of the present day will have difficulty in following the newly-adopted terminology, so will those of future generations find early twentieth-century literature almost unintelligible. As a consequence, much of the best work of past generations may become lost to most contemporary chemists. Even in the case of chemists with postgraduate research to their credit, only comparatively few remain in close touch with the academic field for most of their lives and radical alterations in nomenclature are highly detrimental to any efforts which they may make to keep abreast with the latest published works not directly related to their specific branch of chemistry.

Expansion, not alteration beyond recognition, should be the watchword for the development of methods of nomenclature and classification.

Mitcham, B. H. INGHAM
Surrey.

SIR,—I welcome the opportunity of replying to Dr B. H. Ingham and would state at the outset that I am in sympathy with many of the points that he has raised with regard to nomenclature. Nevertheless we must face up to the situation as it is. Several years ago British chemists working in the phosphorus field agreed to call substances of the type $(RO)_2POX$, esters of phosphonic acid, where X represented a very wide range of substituents. For example, $(EtO)_2POF$ was diethyl fluorophosphonate and $(EtO)_2PONH_2$, diethyl aminophosphonate. The system was simple to operate and easy to remember. Certain workers abroad, for reasons which cannot be given here, could not agree to this scheme except where X was a hydrocarbon radical, e.g. $MePO(OEt)_2$, and we found it difficult to accept certain of their proposals. As extensive work is being carried out on phosphorus compounds here and abroad it is essential that we should understand one another and so an entirely new "agreed system" was arrived at as indicated in my monograph.

It is obviously a tremendous advantage for all those working in a new and expanding field to speak the same language, cacophanous though it be, always hoping that (rough) usage will result in something both practicable and euphonious.

In conclusion I would draw attention to the recently published Nomenclature Report of the Chemical Society—a praiseworthy compilation by its Editor.

University Chemical Laboratory, B. C. SAUNDERS
Cambridge.

THE REGISTER

Bracketed letters indicate Local Sections. For key *see* page xii.

NEW FELLOWS

(P) STANLEY, Herbert Muggleton, M.Sc., Ph.D. (Birm.)

ASSOCIATES ELECTED TO THE FELLOWSHIP

(P) BEACH, Martin David, B.Sc. (Lond.)
(W) BRAITHWAITE, Eric Reeves, M.Sc. (Manc.)
(P) CHAMBERS, Fred William, Dip.Chem. (Cologne), M.I.Chem.E., A.R.P.S.
DODD, Richard Arthur, M.Sc. (Lond.), Ph.D. (Birm.), A.I.M.
(C) GALLAHER, Patrick Edmund, M.Inst. Gas E., M.Inst.F.
(P) GROSSMITH, Frederick, B.Sc., Dip.Ed. (Liv.)
(P) MCLEAN, Robert Foster, A.H.-W.C.
NEYTZELL-de-WILDE, Frank Gerard, B.Sc., Ph.D. (Witwatersrand)
(N) NICHOLSON, Donald Elliott, B.Sc., Ph.D. (Lond.)
(P) TONG, Samuel Travis
van GARDEREN, Jacob, M.Sc. (Stellenbosch), D.Sc.Agric. (Pretoria)
(OE) VENKATESWARLU, Varanasi, D.Sc. (Andhra), Ph.D. (Liv.)

NEW ASSOCIATES

(S) ADAMSON, Alan Featonby, B.Sc. (Dunelm.)
(C) ATTFIELD, Donald James
(K) BEATTIE, John Gray, B.Sc. (Glas.), A.R.T.C.
(P) BEECH, John Alan
(Q) BEECH, Sidney, B.Sc. (Lond.)
(O) BENOLIEL, Judith Valerie, B.A. (Cantab.)
(O) BERRY, Ernest
(C) BICKLEY, William Peter, B.Sc. (Lond.)
(C) BIRD, Roger, B.Sc., Ph.D. (Birm.)
(S) BISHOP, Michael
(P) BOND, John, B.Sc., Dip.Chem.Eng. (Lond.)
(O) BROOK, David Whiteley, B.Sc., Ph.D. (Lond.)
(P) BRYCE, Douglas Maxwell, B.Pharm., Ph.C., B.Sc. (Lond.)
(Q) BURTON, James Dennis, B.Sc. (Lond.)
(N) CARR, Kenneth, B.Sc., Ph.D. (Leeds)
(L) CLARKE, Alan
(E) CODD, Gareth Morgan, B.Sc. (Wales)
(P) COOPER, Graham Baptie, B.Sc., Ph.D. (Lond.)
(O) CROMPTON, Thomas Roy
(P) CUMPER, Charles William Neville, M.A., Ph.D. (Cantab.)
(E) CURNOW, Richard Dennis
(P) DALEY, Peter Derek Wane
(Q) DALY, Norman Stanley
(P) DAVIDSON, George Rose, B.Sc. (Lond.)
(P) DIXON, Jean Elizabeth
(C) DIXON, John Roy
(O) DOYLE, Denis
(S) DUNBAR, James
(W) EARLY, Geoffrey Ingham
(H) EBERLIN, Christine Russell, B.Sc. (Notts.)
(W) ELLIS, Peter Manfrid, B.Sc. (Lond.)
(N) EPSTEIN, Joseph Alexander, B.Sc. (Lond.)
EVANS, John Walter, B.Sc., Ph.D. (Lond.), D.I.C.
(O) FIELDEN, Thomas Brian
(X) FITZGERALD, Desmond Michael, M.Sc. (N.U.I.)
(Q) FLETCHER, Henry
(X) GOODRIDGE, Francis, B.Sc. (Lond.)
(O) HAND, Kenneth
(P) HARNDEN, Maurice Harold, B.Sc. (Lond.)
(O) HARRISON, Arthur, B.Sc. (Manc.)
(O) HAYWARD, Edward James
(Q) HIGSON, Harold George, B.Sc. (Lond.)
(P) HODGKINSON, Roy William
HUBBARD, Patricia, B.Sc. (Lond.)
(P) HUNT, Eric Charles, B.Sc. (Lond.)
(L) INGHAM, Donald Victor
(N) JEFFREY, Stanley, B.Sc. (Leeds)
(EE) JOHNSTON, Ian
(P) KEAR, Robert William
(P) LAMBERT, Gordon Maurice, B.Sc. (Lond.)
(O) MCADAM, Ian Alexander
(M) MCGILL, Arthur William
(J) MCHATTIE, Gordon Victor, B.Sc. (Edin.)
MAJUMDAR, Anil Kumar, B.Sc. (Calcutta)
MANN, Denis Robert, M.Sc., Dip.Ed. (S.A.)
(P) MARSH, Alan Spencer, B.Sc. (Lond.)
(P) MIEVILLE, Rodney Louis
(O) MILNER, William Derek
(P) MOTH, Donald Frederick
(Q) MULLARKEY, Joseph Raymond, B.Sc. (Lond.)
(P) MURRAY, Dudley Charles
(H) NEWEY, Arthur Ernest, B.Sc. (Lond.), M.P.S.
(N) OVEREND, Norman Howarth, B.Sc. (Lond.)
(D) PEXTON, Frank William, B.Sc. (Leeds)
(P) PELLETT, Peter Lewis, B.Sc. (Lond.)

(P) RENTON, Eric William, B.Sc. (Lond.)
(Q) ROBINSON, Ronald Harry, B.Sc. (Lond.)
(C) SAMBROOK, Cynthia Margaret, B.Sc. (Birm.)
(P) SANYAL, Bhabatosh, M.Sc. (Benares)
(OF) SARIN, Badri Nath, M.Sc. (Punjab)
(O) SHERLIKER, Francis Raymond
(S) SMITH, Edward Thomas
(W) STOKOE, John Neville
(EE) TAYLOR, Colin George, M.Sc. (Lond.)
(O) TEE, Peter Arthur Handbury
(H) TELESZ, Ludwik Alojzy, B.Sc. (Lond.)
(X) THOMPSON, Dennis, B.Sc., Ph.D. (Lond.)
(M) TIMM, Eric Ralph
(P) TREWICK, Ronald Frederick George
(U) WALLER, Jeffrey, B.Sc. (Leeds)
(H) WHALLEY, George Raymond
(Q) WHITEHEAD, Geoffrey
(D) WHITEHOUSE, Donald Brian, B.Sc. (Bris.)
(P) WILLIAMS, Reginald Latham, B.Sc. (Lond.)
(D) WILLIAMS, William Leonard
(Q) WOODS, John, B.Sc. (Lond.)
(C) YOUNG, Trevor Owen

DEATHS

Fellows

(Q) HODGSON, Thomas Reginald, M.A. (Cantab. and Dublin). Died 18 December, 1952, aged 69. *A.* 1907, *F.* 1910.

(H) ORANGE, Lionel, M.B.E., B.Sc. (Lond.), M.I.Chem.E. Died 19 February, 1953, aged 63. *A.* 1914, *F.* 1917.

Associates

(E) ALDRED, Harold, M.Sc. (Vict.). Died 19 January, 1953, aged 78. *A.* 1918.

(P) BARROW, Gathorne Dixon, A.T.I. Died 14 February, 1952, aged 52. *A.* 1944.

(O) COUCH, Norman. Died 26 February, 1953, aged 33. *A.* 1944.

(P) MILLIGAN, Arthur George, M.Sc. (Q.U.B.). Died 7 February, 1953, aged 57. *A.* 1919.

(T) ROSE, Maurice James, B.Sc., Ph.D. (Lond.). Died 7 December, 1952, aged 37. *A.* 1937.