OBITUARIES

Prof. A. Lapworth, F.R.S.

AS a professor of chemistry, Arthur Lapworth will be remembered for his distinguished pioneer work on the mechanism of organic reactions and the reactivity of organic compounds, which was recognized in the award of the Davy Medal of the Royal Society. His colleagues in the University of Manchester and his many other friends will also remember, with gratitude and affection, such characteristics as his devotion to the maintenance of high intellectual standards in the University, his encouragement of co-operation between workers in different branches of science, his lively and expert interest in half a dozen fields outside his scientific work, and his sensitive sincerity and modesty.

After graduating at Mason College, later the University of Birmingham, where his father had become the first professor of geology, Lapworth began his research career in H. E. Armstrong's department at the City and Guilds Institute, South Kensington. The careful study of the sulphonation of the ethers of β-naphthol, for which he obtained his London D.Sc. in 1895 at the age of twenty-three, laid a foundation for his interest in aromatic substitution and isomeric change. With F. S. Kipping as senior collaborator he entered the terpene field with studies of bromocamphors and camphorsulphonic acids. Later, as lecturer in chemistry at the School of Pharmacy, Bloomsbury, he extended this work independently to the extent of some twenty papers, making particularly important contributions to the clearing up of the tangle of the monocarboxylic acids derived from camphoric acid. His report on the constitution of camphor, published by the British Association in 1900, is regarded as a classic.

Parallel with this work and later, when Lapworth had become head of the Chemistry Department at the Goldsmiths' Institute, he developed his characteristic contribution to the study of organic reactions. His attack on this problem shows two interacting aspects. On one hand he carried out fundamental investigations of the kinetics of a variety of organic reactions, which provided him with chosen foundations for theoretical discussion and many workers with a basis for extensive studies of further detail. On the other hand, he was always seeking generalizations concerning reactants and reactions which would be more comprehensive than the very limited analogies which were the stock in trade of organic chemists. He saw that very ambitious speculations would get lost in the bewildering mass of data concerning the behaviour of carbon compounds, but that progress could best be made in stages by accounting for well-chosen groups of related phenomena. Generalizations such as he put forward are necessarily open to a variety of criticisms, and it was only when, in the fullness of time, they were seen to build into wider theoretical conceptions, that the extraordinary soundness of Lapworth's insight gained full recognition. He combined what sometimes seemed almost artistic convictions about the significance of particular analogies and conceptions, with precision of thought in stating and applying them. Unfortunately, some of his critics skimmed over the outlines of his ideas, and on applying their impressions met with inevitable disappointments.

Lapworth's recognition in 1898 of the generality of isomeric changes of the form

$$M-R_\alpha-R_\beta=R_\gamma \rightleftarrows R_\alpha=R_\beta-R_\gamma-M$$

led to his discovery that the γ-position in crotonic ester shows reactivity similar of that characteristic of the α-position in saturated esters. He first established essential features of cyanohydrin formation by a typically simple colorimetric method using yellow camphor-quinone, and from this beginning he developed comparisons of the properties of the carbonyl group and of the ethylene bond in αβ-unsaturated carbonyl compounds. He also formulated the accepted mechanism of the benzoin condensation. His interest in the relation between tautomeric change and aromatic and aliphatic substitution led to fundamental experiments on the halogenation of acetone and of carboxylic acids. The study of the effect of acids on enolization, and hence on halogenation, was followed by physico-chemical investigations on the catalytic activity of hydrogen ions, including consideration of the effect of adding water to acids in organic solvents. In 1909, at an early stage of this work, Lapworth was appointed senior lecturer in inorganic and physical chemistry and assistant director of the Inorganic Chemical Laboratories in the University of Manchester. His continuation of the work on ionization, together with lecturing requirements, gave him a grasp of thermodynamics which was an important element in his later thought.

Turning again to organic chemistry, Lapworth established a number of properties of sulphonic esters, contrasting their tendency to detachment of the alkyl group with that of carboxylic esters to reactions involving detachment of alkoxyl. In 1913 he was elected to the Royal Society and appointed to succeed W. H. Perkin, junior, as professor of organic chemistry in Manchester. The war of 1914–18 soon interrupted publications, except for a small group on the constituents of brain tissue and the pungent principles of ginger.

In 1920 Lapworth published his principle of alternate polarities. In this he focused attention on the polar properties induced in aliphatic and aromatic compounds by substitution, as shown by the study of the characteristic activity of the various atoms in molecules of both types. He also emphasized how unsatisfactory were the terms 'electronegative' and 'electropositive' as applied to groupings in organic molecules, and stressed the significance of the classification of groups according to their general influence on acidic or basic properties of compounds. He

developed these views later, based successful experiments on them and, partly by his publications such as those in 1922 but also by personal discussions, he helped in laying the foundations on which Robinson based a more general and clearer interpretation of these phenomena in electronic terms. Most valuable was his classification of reactants in organic reactions as anionoid and cationoid (1925), which fused conceptions of organic reactivity with those by which acids and oxidizing agents are recognized as electron acceptors, and bases and reducing agents as electron donors. The condensed nature of this publication and the renaming of these classes by Ingold eight years later should not obscure the fundamental nature of Lapworth's contribution.

Among his work on the subsequent developments of electronic conceptions one may notice particularly the recognition, in 1928, that the effect which was afterwards given a physical interpretation as resonance must be regarded as affecting the average molecules of the reactants, and that the polarizability of molecules was not an adequate explanation. These theoretical extensions were made in discussing further experimental studies of the cyanohydrin and other reactions.

In all this original work Lapworth's theoretical insight and his skill with simple experimental methods were combined with an extraordinary grasp of general chemistry. It was therefore natural that as a teacher, lecturing on physical, organic and general inorganic chemistry in succession, he should concern himself to an unusual degree with the exposition of ideas, methods and general principles, so that his lectures were most stimulating and valuable to his better students, though they might be the despair of some who wanted only the easy catalogue of information.

By taste and temperament Lapworth was a scholar and investigator rather than an administrator, but he was called to be director of the Chemistry Laboratories at Manchester for a dozen years. Throughout this period he had invaluable help from his wife in handling departmental details, and his own qualities brought to him the affection and full support of his colleagues. The first half of his period as director saw the fruitful collaboration between himself and Prof. (now Sir Robert) Robinson, whom the University was able to invite to become professor of organic chemistry in 1922 through Lapworth's ability to transfer from that chair to the inorganic and physical side. When Robinson went to London in 1928, Lapworth made his objective the development of the school of physical chemistry in Manchester to full stature, through the appointment of a professor of established reputation to a new chair in that branch of chemistry, while maintaining the traditional strength of the organic side of the department. During the five years which, as it transpired, were necessary to achieve this, he was responsible for the whole department and, with characteristic sacrifice of personal and temporary interests, he considered it necessary to maintain it on the most economical basis to provide for the maximum expansion of equipment and opportunity when he would be handing over. It will generally be agreed that with the appointments of Prof. I. M. Heilbron and Prof. M. Polanyi the object which he set himself, and which the University adopted, was fully achieved. But for the present war it would have been rounded off by a new building for physical chemistry, in addition to the re-equipping of the existing laboratories which his successors carried out.

After the severe strain of these years of responsibility, Lapworth's health, which was never robust, broke down, but a period of rest and care enabled him to enjoy again the visits of his friends and some of the many hobbies and recreations which he had cultivated with remarkable skill and thoroughness. Music had run through his whole life. He had represented the University on the council of the Royal Manchester College of Music for more than twenty years. His taste was thoroughly sound, and he played the violin well and with great enjoyment. At his house one might have chamber music, or talk of fishing or of the arrival of migrant birds on an Easter holiday, or perhaps an exposition of microscopy or a wireless speciality, or reminiscences of mountaineering, or news of the latest from the theatre or the films—indeed the most diverse interests and lively comment. Many of his friends will retain pleasant memories of these occasions.

G. N. BURKHARDT.

Dr. R. T. Beatty

DR. RICHARD THOMAS BEATTY, whose death was announced recently, was a member of the Admiralty Scientific Staff and was born at Dungannon on April 26, 1882. He was educated at the Royal School, Dungannon, and Queen's University, Belfast, where he afterwards became lecturer in experimental physics.

Beatty worked for some years at the Cavendish Laboratory where he became interested in what were then known as homogeneous or characteristic X-rays. He was exciting this radiation and the associated secondary electrons and making a number of pioneer observations in this field. These observations were among those which helped to lay the experimental foundations of the quantum idea which was only then beginning to take shape. Between 1907 and 1920 he published a number of papers, mainly in the *Philosophical Magazine* and the *Proceedings of the Royal Society*, on this and related subjects.

Beatty served at the Admiralty in a temporary capacity in the War of 1914–18, and was engaged in research work at Portsmouth. In 1920 he joined the permanent scientific staff of the Admiralty.

WE regret to announce the following deaths :

Squadron-Leader J. O. Hinks, formerly Armourers and Brasiers' research fellow in aeronautics at Cambridge, on active service, aged twenty-nine.

Prof. W. Vogt, professor of anatomy in the University of Munich, noted for his work on the embryology of the Amphibia, on March 17.