OBITUARIES

Prof. Paul Sabatier, For.Mem.R.S.

THE recent death of Paul Sabatier at Toulouse has removed from our midst one of the founders of modern catalytic chemistry. Sabatier commenced his lifelong research into problems of catalysis in 1897. The year 1900 may be regarded as the dawn of the epoch of catalytic hydrogenation, an investigation which culminated in the award of the Nobel Prize in 1912.

While Sabatier's general method of approach was from the point of view of a preparative organic chemist, nevertheless in the course of his work he showed a deep perception and thorough appreciation of the physical chemical implications. The range of reactions which he studied both by himself and with his co-workers, among whom the Abbé Senderens must be especially singled out, is truly remarkable, and a good account of them is presented in his monumental book "La Catalyse en Chimie Organique", first published in 1913 with a second edition in 1920.

Sabatier was greatly interested in the problem of hydrogenation, and showed *inter alia* that good hydrogenating catalysts were also effective in dehydrogenation; he succeeded in the difficult case of benzene in both hydrogenating it to cyclohexane and in dehydrogenating the product on the same catalyst. In his very early experiments he observed how sensitive catalysts were to heat treatment and how active catalysts could be prepared by gentle reduction of the oxides or nitrates. The use of alcohol instead of hydrogen as a reducing agent is due to Sabatier. He has put on record many interesting cases of selective hydrogenation which still await adequate explanation, such as the reduction of $\varphi CH_2\ CH_2\ CO\ CH_2\ CH_2\varphi$ to $\omega\ \omega'$ diphenyl pentane or to dicyclohexyl pentane, or amyl acetylene to amyl ethylene or to normal heptane, the former on a 'less active' copper catalyst, the latter on an 'active' nickel catalyst.

One of Sabatier's most illuminating contributions to the science lies in his discovery of directive or selective catalysis. He showed, for example, that formic acid could undergo two modes of decomposition, to carbon dioxide and hydrogen or to carbon monoxide and water; that alcohols could be converted into aldehydes and hydrogen or to ethylene and water. While metals 'favour' the first mode of catalytic decomposition and dehydrating oxides the second, there exists a whole series of catalysts on which both reactions occur, the relative extent of each reaction being dependent on the mode of preparation of the catalyst and on the temperature. This specific action of the catalyst led Sabatier to write: "La nature chimique du catalyseur exerce une action décisive dont on peut guère trouver l'explication que dans des combinaisons temporaires quoiqu'il puisse être dans certain cas, difficile d'en précisir la vraie nature." The modern hypothesis of the intermediate chemical compound or chemisorbed complex could not be expressed more clearly. That these "combinaisons temporaires" are not identical with isolatable chemical compounds could be gathered from further work of Sabatier, who was one of the first to evaluate the exact temperature coefficient and the apparent energies of activation of catalytic reactions. In many cases these were relatively small and less than those required to decompose the true chemical compounds.

Sabatier was likewise the first to pay detailed attention to what are now termed promoters; already in 1902 he investigated the effects of incorporating various oxides, for example, of beryllium, aluminium and magnesium in a nickel catalyst to obtain more active and robust systems. Among the many and varied catalytic reactions discovered by this indefatigable worker the following may be mentioned as ones which have been adapted to modern chemical industry or are potentially important: the reactions of alcohols with hydrogen sulphide and ammonia to yield thiols and amines respectively; esterification in the gaseous phase; the formation of ketones and ethers from acids and phenols. In hydrogenation reactions we may mention the reduction of the cyanides to amines and of the isocyanides to secondary amines and the stepwise reduction of the nitro group in cyclic nitrobodies.

Doubtless many of us wish that circumstances might have permitted us to solemnize in a more formal manner the departure of Paul Sabatier to a distant shore, but we can at least affirm that he has left his imperishable characteristic imprint on our science and on our industry. ERIC K. RIDEAL.

Dr. E. L. Ince

DR. EDWARD LINDSAY INCE, head of the Department of Technical Mathematics in the University of Edinburgh, died on March 16 at the comparatively early age of forty-nine. Dr. Ince, who was one of the first research students of Prof. E. T. Whittaker when the latter established a school of mathematical research in Edinburgh almost thirty years ago, had a varied life of mathematical activity. From Edinburgh he proceeded to Trinity College, Cambridge, becoming a Smith's Prizeman during the War of 1914–18. In 1918 he was a temporary lecturer at the University of Leeds; in 1919 he studied at Paris; from 1920 until 1926 he was a lecturer in mathematics at the University of Liverpool. In 1926 he was appointed to the professorship of mathematics in the then newly founded Egyptian University in Cairo, but in 1931 he returned to Britain for the sake of the health and education of his family. For a brief period he was lecturer in the University of Edinburgh, then at the Imperial College of Science and Technology, and finally, from 1935 until his death, lecturer in technical mathematics at Edinburgh.

Ince's published work falls into three parts: some two score or more papers, mostly on Mathieu functions

and on linear differential equations with periodic coefficients; a tract on descriptive geometry and two text-books on ordinary differential equations; and a volume of tables ("Cycles of Reduced Ideals") computed for the British Association, on the Tables Committee of which he served for many years.

Ince firmly believed that theoretical solutions of problems, however abstractly elegant, were incomplete unless the mathematician either tabulated the solving functions himself or rendered them tabulable. Perusal of his papers will show that in his chosen field of research he achieved both of these objects. He regarded his research, however, as entirely subsidiary to the work of teaching and of examination. To these duties he brought a rigour of self-imposed obligation which in the end was worn as a natural discipline, until ill-health supervened.

Unversed in Ince's special domain, I will not presume to appraise his papers. That has been fitly done by his master and colleague, Prof. E. T. Whittaker, in the recent posthumous conferment of the Makdougall-Brisbane Prize, awarded to Dr. Ince by the Royal Society of Edinburgh. Perhaps a more personal reminiscence may be permitted. When the "University Series" of small text-books, published by Messrs. Oliver and Boyd, was projected some three years ago, the editors invited Dr. Ince to submit a manuscript on ordinary differential equations. Soon afterwards Dr. Ince was seized by a very debilitating illness, which laid the seeds of the later and mortal one. I at once begged him to relinquish or defer the undertaking; but I was met by a quiet yet firm refusal. The book had been sketched; its outlines were clear; during convalescence chapters would be pencilled; examples would later be added. And indeed in due course the book was completed; nor does it bear any trace of the physical weakness that attended its composition.

The quiet resolution that nerved Ince to this task, as later to the completion of his last paper on Lamé functions, gives the measure of the man. He drew this courage from sources which evoke the respect and reverence of his friends.

A. C. AITKEN.

Prof. N. S. Kurnakov

BY the death of Prof. N. S. Kurnakov on March 19, at the age of eighty, Russia has lost a pioneer physical chemist whose work and influence, great in his own country, extended far beyond its borders. His early training some sixty years ago in the St. Petersburg Mining Institute must have largely influenced the trend of his subsequent work, which was mainly concerned with the applications of the principles of the phase rule to the study of binary systems, more especially alloys and salt mixtures, and with the development of the mineral resources of Russia. Kurnakov was one of the first to devise and use recording pyrometers for the thermal study of alloys and binary mixtures generally, and he was particularly interested in the variations of viscosity and of hardness which accompany changes of composition in such systems. He founded one of the chief schools of inorganic chemistry in the U.S.S.R., and right to the end of his life was director of the Institute of General and Inorganic Chemistry of the Academy of Sciences of the U.S.S.R.

Kurnakov's work, carried through with the assistance of numerous younger collaborators, many of whom are now contributing materially both to the defence and the development of Russia, is an admirable example of the fact that the development of scientific knowledge and the growth of industrial practice are closely related and largely mutually dependent. The work and ideas embodied in his treatise "An Introduction to Physico-Chemical Analysis" enabled him to play a great part in discovering and developing the resources of the salt lakes in the Crimea and on the Caspian, the deposits of potassium and magnesium in the region between the Volga and the Emba Rivers, and the deposits of bauxite at Tikhvin, upon which the Russian production of aluminium largely depends. His concern with the exploitation of Russia's resources in platinum and other noble metals led to researches on their compounds, which in turn yielded important developments in the extraction and purification of these metals.

Though little known personally to his British colleagues, Kurnakov was greatly esteemed and honoured in the U.S.S.R.: he held the Order of the Red Banner of Labour and was very recently awarded a Stalin Prize.

H. V. A. BRISCOE.

WE regret to announce the following deaths:

Prof. E. Abelaus, formerly professor of physiology in the University of Toulouse.

Dr. R. D. Archibald, formerly senior lecturer in electrical engineering in the Royal Naval Engineering College, Keyham, on August 17.

Prof. Otfrid Foerster, formerly professor of neurology in the University of Breslau, honorary fellow of the Royal Society of Medicine, aged sixty-eight.

Dr. W. Gardiner, F.R.S., honorary fellow and formerly fellow and bursar of Clare College, lately University lecturer in botany in the University of Cambridge, on August 31, aged eighty-one.

Prof. Thomas Gibson, formerly professor of pharmacology in Queen's University, Kingston, aged seventy-six.

Mr. S. H. Horgan, a pioneer in the half-tone process for the reproduction of pictures, on August 31, aged eighty-six.

Prof. R. F. Irvine, the well-known Australian economist.

Mr. W. Macnab, C.B.E., the well-known chemical engineer, technical adviser to the Explosives Supply Department of the Ministry of Munitions during the War of 1914–18, on September 3.

Prof. A. K. M. Noyons, professor of physiology in the University of Utrecht, aged sixty-three.

Dr. Vinnie A. Pease, since 1920 micro-analyst in the U.S. Bureau of Chemistry (now the Bureau of Agricultural Chemistry and Engineering), on April 30 aged fifty-nine.