of whether the point at which the sperm fertilizes the egg determines the first cleavage furrow. The answer was no, and recently he remarked, with a twinkle in his eye, that this finding still seemed valid. In the next year he published a paper on the histology of milk secretion, which was awarded a prize from the medical faculty. His gift for exposition and for a grasp of the particular field of his study was made evident in the writing at this time of a text-book on embryology for medical students, which in rapid succession went into some nine editions.

In Berlin his work came to the attention of Paul Ehrlich, who offered him a position as assistant. Here he studied the histological staining properties of the various new dyes then under elaboration by the German chemical dye industry; and while so doing he discovered the specific vital-staining effect of Janus Green on certain cytoplasmic bodies which were later to become known as mitochondria. In this new field of his endeavour he wrote a text-book on the chemistry of dyestuffs for histologists, a book which revealed a mature understanding of the basic chemical processes underlying the staining techniques.

For a few years after he worked on the transplantation of mouse cancer, and was among those who first found that the success of transplantation depends on the strain of the species used. He also observed a marked change in the immunological specificity of serum albumin when digested for an exceedingly short time with pepsin.

In 1905, Michaelis became bacteriologist in the municipal hospital in Berlin, and in close co-operation with Peter Rona undertook problems which were primarily in the newly developing field of physical chemistry. His main life's work was to be in this field, and in it he could use to the fullest his abilities to ask questions about living things and set up basic experiments involving few variables. His laboratory was on a most primitive and restricted scale. The City administration strongly discouraged any kind of research in municipal hospitals. Such work was frowned upon also by the director, who could not see how studies of such problems as hydrogen-ion concentration in relation to enzymic activity, fundamental studies on electrophoresis of proteins, a theory of enzyme affinity for substrate (Michaelis–Menten), studies on enzyme inhibitors, the problems of exchange adsorption of dyestuffs—how all these could be related to the cause and cure of disease. Only later were his studies realized to have provided integral parts of the framework of our knowledge of enzyme action and protein behaviour. In 1914 his book on hydrogen-ion concentration appeared, which was to become a classic in the field of physical chemistry. At this time also he wrote his stimulating book on "Dynamics of Surfaces", and his manual of physical chemistry. For the purpose of his investigations he found it necessary to learn more mathematics, and he summarized his studies on this theme in another fine book, "Mathematics for Biologists and Chemists", published in 1921.

In 1922 he was invited as visiting professor in biochemistry to the Medical School of Nagoya, Japan. This was an unusual event, since no foreigner had been engaged as full professor in Japan for a long time. He remained there for three years, was greatly honoured, had many graduate students, and was provided with excellent facilities for research. Here he began studies on permeability with artificial membranes specifically permeable to positive ions. Of the permeability of the living membranes he once remarked, "We know what it can be, what it might be, and still it is different".

In 1926 he went to Johns Hopkins University as a resident lecturer, and three years later was appointed a member of the Rockefeller Institute for Medical Research. The field of his main achievements in the United States centred around problems of oxidation and reduction. He was not only interested in investigating these problems, using the customary formal thermodynamic approach, but also at the same time inquired into the specific mechanisms by which these oxidations could take place. Early in this work he developed an ingenious theory of heavy metal ion catalysis, based on the formation of Werner complexes, to explain the effect of iron in catalysing cysteine oxidation with oxygen. This study was soon followed by the fundamental discovery of organic radicals stable in aqueous solutions, the 'semiquinones', a discovery arising from inquiries into the anomalous behaviour of certain compounds during potentiometric titration. The idea of the existence of organic radicals in aqueous solution met with considerable opposition, so much so that his first papers on the subject had to be published in European journals. A firm and independent proof of the existence of these semiquinones, or radicals containing unpaired electrons, was provided by magneto-chemical experiments. Different organic compounds provided further examples of these radicals, the stability of which is most readily accounted for on the principle of resonance. Some of these observations are summarized in his book on oxidation-reduction potentials, which has been translated into a number of languages. The beautifully developed thermodynamic equations of semiquinone formation were used in one paper to obtain values of acidity in strongly acid solution. The dimerization of the organic radicals led him to investigate the dimerization of dyes and other molecules, and to renewed studies of the metachromatic effect of dyes in histological staining, a problem which had intrigued him in his early years with Ehrlich. Further magneto-chemical investigations included the studies on ferritin iron, on ferric phenanthrolene, on the reversible oxygenated complexes of cobaltiac and of cobalt histidine.

Among other subjects he investigated was the conversion, using thioglycollate, of keratin into soluble material. The principle of this study is to-day the basis of the 'cold permanent wave' industry of cosmeticians. His most recent feat was the discovery of the radical of vitamin E, a discovery which may prove to be basic to an understanding of the action of this vitamin.

Dr. Michaelis is survived by his wife, Hedwig Philipsthal, and his two daughters, Ilse Wolman and Eva M. Jacoby.

By those who knew him closely and worked with him, Dr. Michaelis was respected and honoured. By his contemporaries his abilities were envied and admired. His influence on the world of science will be lasting.

S. GRANICK

WE regret to announce the following deaths:

Mr. A. J. Wilmott, deputy keeper in the Department of Botany, British Museum (Natural History), on January 27, aged sixty-one.

Prof. W. P. Wynne, F.R.S., emeritus professor of chemistry in the University of Sheffield, on February 16, aged eighty-nine.