without whose great zeal, able management, unwearied perseverance, scientific attainments and disinterested generosity the Principia might never have been published."

When Halley died he had held the office of Astronomer Royal for some twenty years, having succeeded Flamsteed in 1720. His death took place on January 14, 1742, a few months before that of Abraham Sharp, who had furnished Flamsteed with instruments, and of whom Smeaton, in a report in the *Philosophical Transactions* in 1786, said that "I look upon Mr. Sharp as having been the first person that cut accurate and delicate divisions upon astronomical instruments".

Another interesting figure of those times, and one well known in Great Britain, was the Dutch mathematician Wilhelm Jacob 's Gravesande (1688–1742), the first professor of the University of Leyden to teach the Newtonian philosophy, and the author of a work on natural philosophy, Desagulier's translation of which was studied eagerly by James Watt as a boy of fifteen.

The men of science born in 1742 include the famous Swedish chemist Scheele, the German natural philosopher Lichtenberg and the unfortunate French chemist and inventor Nicolas Leblanc. When surgeon to the Duke of Orleans, Leblanc, to gain a prize offered by the Paris Academy of Sciences, set himself the problem of making soda from common salt. After several years he was rewarded with success, and with the aid of the Duke a factory was erected at St. Denis. Then came the French Revolution. The Duke was guillotined, the factory was confiscated and Leblanc forced to reveal his process. After much misery Leblanc, in 1806, died by his own hand. At one time his name was almost forgotten, but to-day his statue stands in the forecourt of the Conservatoire des Arts et Métiers in Paris.

Coming down to 1842 the list lengthens, but it is proposed to refer to only a few of the more important men. In April of that year the British surgeon, Sir Charles Bell, died suddenly at the age of sixty-eight; on September 6 the Belgian chemist Jean Baptiste van Mons passed away at Louvain, having done much to spread a knowledge of the discoveries of Lavoisier and his successors, and on September 21 the British mathematician Sir James Ivory, Copley medallist in 1814, died in Hampstead. The month of February 1842 saw the birth of the French astronomer Camille Flammarion (died, 1925), the month of April the birth of the German astronomer Hermann Carl Vogel (died, 1907). Carl von Linde, the German pioneer of refrigeration, was born in June 1842; the German chemist Albert Ladenburg, in July. Sir William Tilden, Sir James Dewar and Lord Rayleigh were all born in the latter part of 1842, as were also the Norwegian mathematician Marius Sophia Lie, For. Mem. R.S., and the Russian chemist, Nicolai Alexandrovich Menschutkin, one of the outstanding contemporaries of Mendeléeff. Lie died in 1899, Menschutkin in 1907. A memoir of the latter by Tilden appeared in the *Journal of the Chemical Society* in 1911.

OBITUARIES

Prof. Rudolf Schoenheimer

THE death of Rudolf Schoenheimer at the early age of forty-three has removed from our midst a biochemist of outstanding ability. His work, characterized always by originality of conception, has opened up a new, and most fertile, field in biochemistry.

Schoenheimer was born in Berlin in 1898 and he received his M.D. there in 1922. He was associated with the University of Freiburg and became head of its Department of Pathological Chemistry in 1931. He left Germany in 1933 to take up a position as assistant, and later as associate, professor of biochemistry in the College of Physicians and Surgeons, Columbia University. He held this position at the time of his death in September 1941.

Schoenheimer's work, until he went finally to the United States, was concerned primarily with the metabolism of cholesterol. He continued his studies on cholesterol for a few years and in 1934 he commenced his work on the application of stable isotopes to the study of intermediary metabolism. During the following seven years Schoenheimer, usually in co-operation with his colleague D. Rittenberg, developed this new experimental approach to problems of biochemistry.

Much of our knowledge of intermediary metabolism depends on an analysis of the products formed after the administration to an animal of substances which may or may not be normal metabolites. The method has been extended to the use of intact isolated organs (by perfusion techniques) or of surviving tissue slices. Much valuable information has been and is still being obtained by work carried out in this manner. It is recognized, however, that this method of investigation has definite limitations. Administration to the body of relatively large quantities of even normal metabolites may upset the normal balance of events and call forth changes which do not reflect the normal quantitative relationships. Administration of substances, labelled with halogen, phenyl or other groups to facilitate the chemical examination of intermediates in the process of breakdown of the parent substances, involves the use of compounds having different chemical and physical properties from those of normal substrates and metabolites. Such substances, foreign to the body, may be treated, in certain respects, differently from normal substances. Yet the elucidation of the intermediate steps in the course of breakdown of

normal substrates in the body or in the living cell represents one of the most important and formidable problems in biochemistry.

The introduction into a metabolite of isotopes of one or more of its elements brings about little or no change in its physical or chemical properties, and hence it is not to be expected that the animal will be able to differentiate between a normal metabolite and one containing isotopes of its elements. Experimental evidence exists which supports this conclusion. Since it is now possible to distinguish isotopes and to estimate them in relatively small quantities and in high dilutions, it is obvious that the use of molecules containing isotopes places a new and most powerful weapon in the hands of the biochemist.

The first to realize the importance of isotopes for biological investigations was von Hevesy, who studied phosphorus metabolism, using radioactive phosphorus. Radioactive isotopes of hydrogen and nitrogen, however, the migrations of which in the body form so important an aspect of intermediary metabolism, were not known, at the time of Schoenheimer's work, with a half-life long enough to permit their use in metabolism experiments. It was necessary to use stable isotopes concentrated from the natural mixtures. Urey, by devising methods of isotope fractionation, made it possible to use such isotopes in metabolism work.

The first series of experiments of Schoenheimer and his colleagues (*J. Biol. Chem.*, 1935–38) was concerned with the use of deuterium. They employed two methods of attack. They administered heavy water to animals over a certain period and then estimated the stable deuterium in the different organic constituents of the body. This gave information on the nature of the substances utilizing hydrogen of the body fluids themselves. They synthesized and administered organic compounds containing deuterium and followed up the fate of the isotope. This gave information on the mode of breakdown of the labelled organic compound.

They were able to show, on feeding fats containing deuterium, that the major part (even if administered in relatively small amounts) is deposited in fat depots prior to utilization. They showed that desaturation of fats, as, for example, the transformation of stearic acid into oleic acid, and that the conversion of stearic acid into palmitic acid, are processes definitely occurring in the animal body. They showed that reversible saturation and desaturation of fats are normal metabolic changes. Schoenheimer and his colleagues further demonstrated, by feeding experiments with deuterobutyric and caproic acids, that these short-chain fatty acids are completely burned in the body and not used for fat formation. They followed fatty acid development in the embryo and in the adult animal and investigated sterol metabolism and synthesis. In all these investigations they were faced with serious difficulties, having to devise methods of synthesis of isotope-containing compounds and to cope with the problem of the stability of the carbon-bound hydrogen *in vivo*.

Schoenheimer and his colleagues turned their attention to the study of protein metabolism using ^{15}N as the isotopic label (*J. Biol. Chem.*, 1939–41). This isotope was estimated by means of the mass-spectrograph. They showed that isotopes ^{14}N and ^{15}N are treated by the body indiscriminately in anabolic and catabolic processes. They found that administered glycine (marked with ^{15}N) may be used partly for hippuric acid synthesis, that animals fed with isotopic ammonium citrate form proteins, the constituent amino acids of which, with the exception of lysine, contain ^{15}N. This made it evident that amino acids can be built up in the body from dietary ammonia. The fate of amino acids such as tyrosine containing ^{15}N, after ingestion by an animal, was investigated and it was shown that part of the ^{15}N is transferred to various other amino acids in the proteins of the animal. The experiments indicated that in a normal full-grown and healthy animal, kept on a normal diet, the nitrogen of the dietary amino acid may only partly be excreted in the urine, the rest being retained in the protein of the animal with a corresponding excretion of tissue nitrogen. The exceptional property of lysine, among the amino acids, in resisting the introduction into its molecule of ^{15}N, after the ingestion by an animal of isotopic nitrogen, was demonstrated. Apparently lysine is not involved in the reversible shift of amino groups, which seems to be a prominent feature of nitrogen metabolism of the body.

It is clear that metabolism work involving the use of isotopes has just begun, and the significant results already obtained justify a great extension of the work. It is indeed a tragedy, and a most serious loss to biological science, that Schoenheimer should have been cut off at so early an age from those pioneer investigations the future of which is so full of promise.

J. H. QUASTEL.

Dr. W. Steiner

DR. WERNER STEINER, born 1896 at Cologne, died after a brief illness on September 10 at Durham. From 1926 onwards he was Prof. M. Bodenstein's assistant in the Institute of Physical Chemistry at Berlin and in charge there of the teaching and research work in spectroscopy. He published some thirty valuable papers on this and related subjects, several of them in English journals. After leaving Germany in 1933 he worked for a while on similar lines at Cambridge in the laboratories of the late Prof. T. M. Lowry. In 1936 he accepted the position of a science master at the Gordonstoun School in Morayshire, and in January 1941 at the Durham School. Here, as well as in his University career, he gave of his best. Besides science his main interest was divinity, and his last contribution was to a theological journal.

F. A. PANETH.

WE regret to announce the following deaths:

Mr. F. A. Leete, C.I.E., lately chief conservator of forests, Burma, on December 11.

Prof. J. Wilson, formerly professor of agriculture in the Royal College of Science, Dublin, on December 9, aged seventy-nine.