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.