PROTEIN METABOLISM IN MAMMALS

A MEETING of the Nutrition Panel of the Food Group of the Society of Chemical Industry was held at the Royal Society of Medicine, Wimpole Street, on December 12, with Prof. John Yudkin in the chair. Prof. A. Neuberger gave a lecture on 'Some General Aspects of Protein Metabolism in Mammals'.

Until about twenty years ago the endogenous body protein was considered to be inert, or only slowly metabolized, while the exogenous dietary protein was metabolized rapidly. In 1939, however, Schoenheimer showed that amino-acids labelled with nitrogen-15, when fed to animals, rapidly appeared in all the tissue proteins even in adult animals. As most mammalian tissue shows few cells in division, it was assumed that protein turnover is independent of mitosis and that the body proteins are in a state of dynamic equilibrium. Cohn and Monod, in 1953, presented evidence that appeared to be in conflict with Schoenheimer's findings. β -Galactosidase, a bacterial adaptive enzyme, was found to show no evidence of turnover.

The interpretation of isotope experiments, particularly with the complex tissue proteins, presents difficulties that were not fully appreciated by the earlier workers. These problems have been clarified by consideration of the simpler plasma proteins. Radioactive proteins appear in the plasma about one hour after injecting labelled amino-acids. Maximum activity is reached after six to eight hours, and the subsequent sharp fall in radioactivity is due chiefly to mixing with non-circulating plasma protein. Mixing accompanied by protein katabolism goes on for two to four days.

Blood and liver amino-acid levels equilibrate about eighty times as fast as blood and muscle levels, at least with glycine. This effect, due partly to slower blood flow in the muscles and partly to the existence of a blood-muscle permeability barrier, explains in part the greater time taken for radioactivity to appear in the muscle than in plasma or liver proteins.

Incorporation of labelled amino-acids into collagen is found when new tissue is being laid down, as in the growing rat, but very little incorporation into the collagen of the adult rat occurs.

The present view is that structural proteins have a low turnover, or none at all, while metabolic proteins have a high rate of turnover. Protein synthesis undoubtedly occurs in the mammalian cell in the absence of mitosis, as is shown by the observed turnover of proteins in the muscle cell, where mitosis does not occur. Such synthesis probably took place in the experiments of Cohn and Monod, but was masked by the large amount of protein formed in cell multiplication. Protein turnover is not a simple reversible biochemical reaction but probably represents the formation and decay of mitochondria or other subcellular elements.

All the available evidence points to the synthesis of proteins from amino-acids with the participation of nucleoproteins or ribonucleic acid. In certain circumstances 'exchange' reactions may occur, and peptides arising from the breakdown of one protein may be utilized in the synthesis of other proteins. Such reactions appear to be important in *in vitro*

experiments, but from the present evidence it appears that they do not play a major part in protein synthesis occurring *in vivo*.

In the discussion, Mr. B. H. Doell said that an increase in the arginine content of plasma proteins had been reported on lysine-deficient diets. Prof. Neuberger commented that variation in the proportions of different proteins was a more likely explanation of such results than variation in amino-acid composition of the proteins. In answer to a question by Dr. S. Jacobs, Prof. Neuberger said that the various plasma proteins are not single substances but families of proteins, and replying to a question by Dr. A. E. Bender on the origin of endogenous urinary nitrogen, he said that endogenous and exogenous nitrogen are items on a nutritional balance sheet, but are biochemically indistinguishable.

B. H. DOELL

SALTS OF KARA-BOGHHAZ-GOL

IN an article on the salt of Kara-Boghaz-Gol, G. G. Urasov and V. D. Polyakov (*Priroda*, No. 9, 61; 1956) mention a curious paradox, namely, that the fresh river waters are salting the Caspian Sea, whereas the salty waters of Kara-Boghaz-Gol are desalting it. This is because the Volga and other rivers are bringing annually enormous quantities of salts into the enclosed Caspian Sea, while Kara-Boghaz-Gol, a large gulf situated at its eastern margin, receives annually 130 million tons of salt from the Caspian Sea. Kara-Boghaz-Gol is separated from the sea by a narrow sand bar pierced by a channel through which the sea water flows constantly in one direction only—from the sea into the gulf. Surrounded by an arid desert, the shallow waters of the gulf are subject to constant evaporation and, until recently, enormous masses of mirabilite were precipitated during the winter months and piled up by waves and wind all along the shore of the gulf. The waters of the Caspian Sea have a very low salinity of 1.3, while those of the Kara-Boghaz-Gol have a salinity near that of the saturation point, which is 28.5. The precipitation of mirabilite ($\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$) is conditioned by the following equilibrium:

The study of salt formation in Kara-Boghaz-Gol began some sixty years ago under the leadership of N. S. Kurnakov and has since been continued by teams of the Kurnakov's Institute of General and Inorganic Chemistry. Boring records of salt deposits in the region of the gulf have shown several cycles of sedimentation, which can be correlated with the present trend of salt deposition. Thus from 1929 the level of the sea and consequently the amount of flow into the gulf began to fall, and this markedly affected the nature of the salt precipitates. First, the salinity of the water showed a steady increase since 1897 when it was 16.4, to 1941 when it was 28.0. Secondly, the water area of the gulf considerably decreased; and thirdly, besides mirabilite, sodium chloride and other salts were also precipitated.

As the highly developed exploitation of mirabilite represents an important industrial enterprise, in 1941