heavy elements so far as the general reader is concerned.

With the development of a large-scale nuclear power programme, a considerable chemical industry will also arise to fabricate and reprocess the fuel elements, and some knowledge of the chemistry of the heavy elements is necessary to an understanding of the basis of this industry which must gradually involve more and more chemists and chemical engineers from outside the official projects. To the student and teacher of chemistry, there is also much of interest, since many advances in inorganic chemistry have been made in this field. Moreover, research which has for a decade been largely conducted in the secrecy of government laboratories is once more being pursued in universities, now that the basic chemistry is being freely published in journals and books.

The chapters may be divided into categories. First there are those appealing mainly to a radiochemist, such as five dealing with the nuclear properties of all the isotopes of the elements from thorium to californium, and two on radiochemical techniques which give very full and authoritative accounts of separation methods and of alpha and fission counting respectively. There is then a group of chapters reviewing the basic chemistry, element by element, from actinium to the transplutonium elements taken together. Each chapter is sufficiently complete to be used as a general source without becoming a mere catalogue. The chemistry of plutonium, as befits an element of strategic and economic importance, is covered in three chapters. That on oxidation-reduction reactions and equilibria in solution contributes a great deal to clarify a very complex situation arising from the possibility of four valency-states co-existing in solution. Equally important is the chapter on ionic and molecular species in solution, where complex-ion formation has striking effects. Finally, there is an exhaustive dictionary of plutonium compounds, giving preparation and properties.

There are two rather specialized chapters reviewing the crystal structure and optical properties of compounds of the actinides, and one of the final chapters discusses the correlation of the chemical, spectroscopic, magnetic and crystallographic evidence, with respect to electronic structure and place in the periodic table; a very strong case for an actinide transition series is made out, although this is to-day a controversial point only for gaseous atoms.

The book is very well produced and remarkably free from misprints and errors, but rather expensive for the general reader. R. HURST

PROTEIN STRUCTURE AND METABOLISM

Serological Approaches to Studies of Protein Structure and Metabolism

Edited by William H. Cole. (Rutgers University: Bureau of Biological Research Annual Conferences on Protein Metabolism.) Pp. xi+97. (New Brunswick: Rutgers University Press, 1954.) 2 dollars.

POSSIBLY someone who is interested in protein structure and metabolism and is not soaked in serology would be better equipped than I to review this book. He might be better able to judge how far the book indicates the possible applications of serology and warns of the difficulties and limitations.

Heidelberger gives an outline of the quantitative methods that have been used in much of his work and have, together with Landsteiner's work with artificial antigens, formed the basis of most of our theories about antibodies and their reactions. Gitlin and Boyden describe techniques that may be very useful in quantitative work. I have only one small criticism of Munoz's excellent review of the gel diffusion method: he does not mention the great value of Ouchterlony's method of distinguishing cross-reactions between two preparations, due to two similar but not identical antigens (such as hen and duck ovalbumin), from cross-reactions, due to the presence of a common antigen.

Cohn describes an exciting application of serology. In the presence of a number of β-galactosides, *Bacillus coli* forms β-galactosidase (Gz), which is a good antigen. In the absence of a β-galactoside, another protein (Pz) which is not antigenic is formed. Pz forms a precipitate with antiserum against β-galactosidase, but when the two compete the latter is precipitated preferentially; both can be measured in mixtures of the two. All species of Enterobacteriacae that form the same β-galactosidase, or are capable of a mutant that does, contain Pz; those that are never known to form β-galactosidase do not. The formation of β-galactosidase in the presence of a β-galactoside leads to a decrease in the rate of formation of Pz; but the latter is not a precursor of β-galactosidase. There is no evidence of a dynamic equilibrium between β-galactosidase and other proteins.

Gitlin describes quantitative experiments that show that the serum albumin, in cases of nephrosis, and urinary albumin are serologically identical with normal serum albumin, and that in a-gammaglobulinæmia and a fibrinogenæmia the rates of synthesis of γ-globulin and fibrinogen are reduced. Boyden describes the application of a quantitative method to the correlation of the serological and the taxonomic relationships of animals.

Haurowitz finds that the labels of certain labelled proteins survive, apparently attached to protein, in cytoplasmic granules of reticuloendothelial cells of liver and spleen, and concludes that antibodies are made in these granules.

Now, I must turn to the difficulties and traps. There is no suggestion in the book that it may be difficult to get satisfactory antisera against some antigens—hæmoglobins, for example. There are indications in the articles on gel diffusion and on serological correspondence that considerable amounts of antibody may be formed against impurities of the antigen used for immunization. These antibodies have led to errors in attempts to identify and measure proteins by serological methods, and they probably account for the earlier claims that serum albumin in nephrosis differs from the normal serum albumin. I think the possibility of their presence in antisera is an objection to Boyden's method in which equal weights are given to antibody and antigen excess zones; the results may be unduly weighted by minor constituents. The conclusions may not be seriously affected when whole sera, which may contain the same constituents in roughly the same proportions, are compared; but when single proteins (such as hen and duck ovalbumin) which may contain variable amounts of impurity (for example, conalbumin) are compared, the results may be seriously affected; it becomes essential to avoid the antigen excess zone.

J. R. MARRACK