

Book Reviews

REPROCESSING PROBLEMS

Engineering for Nuclear Fuel Reprocessing

By Justin T. Long. Pp. ix + 1023. (Gordon and Breach: New York and London, August 1968.) 515s.

FIRST drafts of the various sections of this book, which is sponsored by the US Atomic Energy Commission, were prepared by a group of engineers in the Chemical Technology Division at Oak Ridge National Laboratory, and the final writing and editing were done by Dr Long. This arrangement ensured that each section would be authoritative and that there would be continuity as well as a degree of uniformity throughout. So many projects in other countries, including Britain, drew on this great and freely available reservoir of information that it would be ungenerous not to acknowledge the debt. Those readers, however, who are interested in future developments will regret that the date of the most recently quoted literature is 1963 (except two dated 1964). As a result, relatively little space is devoted to current and future reprocessing problems whereas obsolete or abortive processes are described in detail. It also becomes evident from the introduction that the author is really only concerned with the American scene. Here (and also on page 539) it is claimed that "the first successful solvent extraction process for the recovery of both plutonium and uranium in decontaminated form was . . . the Redox process". Research on this process may well have started first, but the Butex plant at Windscale actually began active operations early in 1952, whereas the Redox plant at Hanford did not start until the following October. The Butex plant, moreover, used a salt free nitric acid feed, an advance which the author claims for the subsequent American Purex process.

Following on the general introduction there is a very useful chapter on "Special Considerations in Radiochemical Processing" in which the principles of radioactive growth and decay, of shielding, criticality, plant maintenance, waste treatment and disposal are set out. Chapter three deals with the chemistry of separations processes, including solvent extraction, absorption, precipitation and non-aqueous methods, and chapter four covers "Spent Fuel Dissolution". Here again, the balance of treatment seems outdated. While several pages are devoted to excellent, detailed accounts of the dissolution of metal fuels, uranium dioxide is dismissed in two paragraphs, plutonium dioxide fuels in one, and coated particle fuels are scarcely mentioned. Agitation, centrifugation, filtration, fluidization and mechanical separations including decanning are dealt with in chapter five.

Fluidization is introduced chiefly in connexion with the production of feed materials although this subject does not properly fall within the theme of reprocessing. Chapter six on "Fluid Flow" and chapter seven on "Heat Transfer Operations" contain valuable descriptions of pipe welding and remote connecting techniques and of plant for heating, cooling, calcining and various other types of operation. Perhaps the most interesting and important chapter is that on "Solvent Extraction" (chapter eight). Packed and pulsed columns and mixer settlers are fully described, though most space is devoted to pulsed columns. As some references are made here to air operated systems and to British work on them, it seems a pity that the first air lift mixer settler developed by ICI Widnes Laboratory in 1949 is not mentioned. The account of the Savannah River centrifuge plant is especially valuable in view of the potentiality of the centrifuge for fast reactor reprocessing, though the lack of more recent information on this subject is particularly regrettable. Chapter nine, on "Other Mass Transfer Operations", deals with nitric acid recovery, distillation, absorption of gaseous fission products and of radio-iodine, ion exchange methods and the foam separation process.

Comprehensive accounts of American plant instrumentation and auxiliary equipment are given in chapters ten and eleven, and the various considerations affecting plant location and design are presented in chapter twelve. Neither here nor elsewhere in the book, however, is there any attempt to deal specifically with plutonium finishing processes and plant. Another deficiency, which would seem important to European readers, is the omission of any reference to coastal locations and to the technology of low level waste disposal through seaward pipelines. The final chapters are entitled "Plant Management and Operation" and "Radiochemical Processing Costs", and the book is rounded off by seven useful appendices listing fission product and heavy nuclide data, shielding information, plant start up procedures, and the like. Illustrations and diagrams are good and textual errors are rare. As an exposition of principles and as a record of American work before 1963, this is an excellent book. Principal libraries providing a reference service in the field clearly must have it, but it seems doubtful whether many individuals will feel justified in buying it at the price of 515s.

R. SPENCE

NUCLEAR THEORY

Introduction to Nuclear Theory

By I. E. McCarthy. Pp. xv + 555. (Wiley: New York and London, January 1969.) 125s.

IN this book, Professor McCarthy presents an introduction to nuclear theory from the point of view of a nuclear physicist primarily interested in the use of nuclear reactions in the study of nuclear structure. This approach gives a unified theme to the book although it leads in places to a slightly unexpected selection of topics.

Approximately one-third of the book is concerned with what is usually called nuclear structure theory and deals with the nucleon-nucleon interaction, nuclear matter, the shell model, collective models, and Hartree-Fock theory. These topics are discussed in considerable mathematical detail, but there is frequent reference to experimental results for guidance, particularly from those nuclear reactions which reveal single-particle aspects of nuclei. The remaining two-thirds of the book is concerned with nuclear reactions and scattering with an emphasis on direct reactions at medium energies. In addition to familiar topics such as elastic scattering in the framework of the optical model, distorted wave theory for inelastic scattering and rearrangement and break-up reactions, and compound nucleus theory, this section also includes a