times, that must be taken into account for valid mathematical modeling of rates of plasma-protein-ligand debinding and ligand transport from capillary blood to tissue. Conditions under which equilibrium measurements of concentrations in vitro can be assumed to be valid for the dynamic nonequilibrium conditions prevailing in vivo during transit within the capillary are analyzed. The analysis is then applied to a wide variety of protein-bound ligands, viz., tryptophan, thyroid hormones, steroid hormones, propranolol, free fatty acids and cholesterol, vitamins, electrolytes, and bilirubin. A similar discussion is presented for binding by cytoplasmic proteins. Chapter 11, "Transport of Radiolabeled Enzymes," explains that in comparison with the wide variety of radiolabeled proteins, such as hormones, fibrinogen, and gamma globulin used for in vivo studies in man, the use of radiolabeled enzymes is not yet very extensive. Given their high specificity and the sensitivity of radioanalytical techniques used in their examination, however, enzymes are strong candidates for radiolabeling applications in the near future. Fundamentals are described concerning structure and radiolabeling of enzymes, such as direct labeling and indirect labeling by using radiolabeled antibiotics and alkaloids that bind strongly to some of them. A discussion is presented of the results and problems encountered in enzyme radiolabeling, such as lack of specificity, radiolysis, and the risk of denaturing. A short review of the physiochemical and biological factors influencing transport of radiolabeled enzymes concludes the chapter. Chapter 12, "Transport of Radiolabeled Antibodies," discusses the administration of radiolabeled antibodies in cancer therapy. The purpose of this use is to achieve simultaneously tumor localization by external detection of the emitted radiation and a synergistic coupling of antibody and ionizing-radiation effects that together cause in situ destruction of tumor cells. Transport to the tumor site is by way of intravenous or lymphatic injection. A diagrammatic depiction of the transport of radiolabeled antibodies is shown. A history of the development of radiolabeled antibodies is given, followed by a discussion of their characteristics and of the advantages and disadvantages of their use. Suggestions are made for further developments. The authors emphasize that to date the use of radiolabeled antibodies in tumor therapy cannot be considered alone, but rather as an adjunctive modality to surgery, chemotherapy, and conventional radiotherapy.

Chapter 13, "Clinical Considerations in Radiotracer Biodistribution Studies," calls attention to the potential for altered distribution of radiotracers due to the presence of pharmacologic agents. Accordingly, the author points out that in a clinical situation it is important to be aware of drug effects on the transport of diagnostic tracers if any unusual behavior of the tracer is to be construed as due to disease-induced effects. It is emphasized that the increasing use of short-lived, cyclotron-produced radiopharmaceuticals, given their attendant high costs, makes imperative a heightened awareness of all variables that can influence or even invalidate test results. This, of course, echoes the call for better understanding of the transport mechanisms for radiotracers, which is the underlying theme sounded in other chapters of the book.

Chapter 14, "The Measurement of Transport In-Vivo Using Radiotracers," and Chapter 15, "In Vitro Techniques to Study the Transport of Radiotracers," the concluding two chapters of the book, describe two complementary modalities in the study of biological mass transport: in vivo and in vitro techniques. Comparisons and contrasts between the two approaches are not very sharply drawn in either chapter. (On page 100 of Chapter 10, there is a brief but clear discussion of the supposed dichotomy.) In Chapter 14, the author begins by stating "The primary challenge in attempting to measure transport across a particular cell membrane from the circulating fluid is in the design of a suitable radiotracer. This design problem has been largely circumvented by using naturally occurring substrates of known endogenous biomolecules." He then points out that to achieve labeling in such a way as to avoid altering biochemical properties, one has had to rely on the use of radioisotopes of the principal constituent atoms of biochemical compounds, i.e., carbon, oxygen, and nitrogen. (By implication, the author seems to have in mind external detection exclusively.) He continues by implying that the high cost of producing these radionuclides motivates the design of the new radiotracers that mimic endogenous biomolecules in their transport and localization properties but that use more widely available radionuclides. As examples of such tracers, he cites the use of selenium-75 diamines for the measurement of regional intracellular pH, krypton-81m for regional brain blood flow, and flourine-18 to label glucose and dopamine analogs. In Chapter 15, the authors remark that the in vivo study of transport is hindered by action of many uncontrolled variables, such as vascular inhomogeneity, and in pathological states, by necrosis and phagocytosis. In contrast, by using in vitro techniques, the factors that regulate transport can be tested individually. They illustrate in vitro radiotracer-transport studies by making special reference to their own research in which they use cultured chick embryo fibroblasts and thyroid carcinoma cells. Additionally, they review the results of other workers who have used these same preparations for in vitro studies of radiotracer uptake. The authors give plots of the time histories of the uptake of gallium-67 citrate and of thallium-201 chloride in these cultures. They conclude by reviewing briefly some in vitro studies of the cellular uptake of radiolabeled glucose and its analogs.

The sequence of topics is logical, beginning at the relatively basic level of biological organization represented by the cell and its membrane, continuing through a development of multicapillary and organ models, and proceeding to clinical considerations. As would be expected in such a compilation of individual contributions, there is considerable uneveness of quality and breadth, together with some inevitable redundancies. The latter may after all be felicitous, for there is perhaps advantage in having discussions of the same topic from different perspectives. The quality of production is excellent, but no more than would be expected given the price of the book. There are some typographical errors, most of which are mathematical, and the context usually suggests the missing symbols. An annoying recurrence is the use of different fonts for the same symbol in the equations and in the text. Each chapter, except for three, has its individual table of contents, and the index is adequate. One of the most appealing features of this book is that it is exceedingly well referenced.

The scope of the book is reflected in the wide range of specialties of the various authors, and probably no single scientist (and certainly not this reviewer) could feel equally at home with the lot. For this reason, the book could most profitably serve as a reference text in a university interdepartmental library. There is much to recommend the book in this capacity.

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**GENERAL PROCESSES OF RADIOTRACER LOCALIZATION, VOLUME I.** L. J. Anghileri, Ed. Boca Raton, Florida, CRC Press, 1982, 257 pp, $78.00, US; $88.00, outside US

The use of radiotracers in biology and medicine is expanding at a tremendous rate. Radioisotopes are used to probe the metabolic pathways of organs and cells, and, with increasing specificity, are being used to differentiate diseased tissues from normal. *General Processes of Radiotracer Localization* is in two volumes, the most recent in a series of books concerning radiotracers in biology and medicine. Leopold J. Anghileri has endeavored to produce an in-depth reference on the science of tracer localization. Volume I is primarily concerned with the numerous factors related to the mechanism of localization of radiotracers by biological substrate. Each chapter has a general discussion on the basic cel-

lular anatomy and physiology that is prerequisite to the ensuing extensive discussion of the specific pathways of radiotracer incorporation. Detailed descriptions of the numerous radiotracers that have been used in the past and that may be useful in the future are included.

Chapter One reviews the general topics of localization of radiotracers. Subsequent chapters present excellent discussions on the localization of radiotracers in inflammatory lesions and tumors and the role of radiotracers in the study of endocytosis and phagocytosis. The application of radiotracers to bacterial phagocytosis is of interest to fewer readers than are the other chapters.

Particularly excellent are the chapters, "Radiotracer Localization in Inflammatory Lesions" and "Mechanism of Localization of Radiotracers in Tumors." These exceptionally complete reviews of the pertinent literature will be most welcome by all of those who have endeavored to ascertain the mechanism of accumulation of gallium-67 citrate and related agents. The bibliography with each chapter is current and complete with two chapters having greater than 300 references.

Volume I of *General Processes of Radiotracer Localization* will be of primary interest to radiochemists and radiopharmacists who are concerned with the development of new radiotracers and techniques. The general nuclear medicine physician will find this text a valuable reference. It is a resource with extensive information concerning the wide and varied mechanisms of the localization of radiopharmaceuticals by healthy and diseased tissues.

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**GENERAL PROCESSES OF RADIOTRACER LOCALIZATION, VOLUME II.** L. J. Anghileri, Ed. Boca Raton, Florida, CRC Press, 1982, 255 pp, $78.00, US; $88.00, outside US

*General Processes of Radiotracer Localization, Volume II* is concerned with the mechanism and use of various in vivo techniques using radiotracers. Eight diverse areas are extensively reviewed. These topics include the use of radiotracers for the estimation of blood flow, the clearance of microspheres, the localization of thromboembolic disease, the study of essential element metabolism, nuclear cardiology, nuclear cisternography, respiratory function studies, and ophthalmological studies.

In general, each chapter presents a good overview of the subject, particularly the chapters on thromboembolic disease and cisternography. The chapter concerning the estimation of blood flow and volume using the intravascular dispersion of radiotracers presents theoretical and clinical applications of the tracer technique for determining flow and volumes. Many of the problems of the technique, especially as related to the dispersion process, are discussed. The chapter on ventricular function is quite basic and covers material well known to clinicians in nuclear medicine, and it is a good review for persons not clinically involved with radiotracer studies in cardiology. The chapter on respiratory function reviews the evaluation of pulmonary function using multidetector instrumentation and Xe-133. Most of the data is from the early to mid-1970s and is not applicable to radiopharmaceuticals and instrumentation available today. Also, the nuclear physician will find some of the chapters lacking in clinical correlation since the desire of the authors was to address the wide audience of all those who work with radiotracers. The extensive bibliography with most of the chapters will be of considerable benefit to persons interested in the topics discussed.

Volume II reviews several important topics in which radiotracers are used. Since the topics are very specific (e.g., ophthalmologic studies and essential element metabolism), Volume II is of less general interest than Volume I to the scientist using radiotracer techniques. Furthermore, some of the chapters discuss largely outdated technology or are too superficial. Thus, this volume is of limited utility to scientists and physicians using radiotracers.

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**BIOLOGIE DE L'ACTION DES RAYONNEMENTS IONISANTS.** C. Ferradini, J. Pucheault. Paris, Masson, 1983, 224 pp, 150 F

This book emphasizes the close relationship that exists between the biological and physiocochemical effects of ionizing radiation. The authors begin with a detailed review of the interactions of ionizing radiation with matter and the radiolysis of water and aqueous solutions. The properties of free radicals are also thoroughly discussed. Clear distinction is made between indirect effects resulting from the chemical reactions of the products of radiolysis with the surrounding milieu and the direct effects due to deposition of primary energy in homogeneous and heterogeneous milieus. A full chapter is devoted to the discussion of radiolysis of various biological compounds, such as carbohydrates, lipids, sulfuric compounds, amino acids, and nucleic acids. As radiobiology is specific to the living matter and its development, it cannot be based solely upon the knowledge of the physical chemistry of the free radicals. Thus, in another chapter, additional specific points are considered: First, that the living matter is exquisitely sensitive to radiation due to the presence of DNA, (structural cause), processes such as enzymes inactivation, and the phases of mitosis (dynamic causes); second, that there is a logarithmic relationship between cell survival and dose. Various models for cell death and factors modifying radiosensitivity are discussed. The important concept of high toxicity of the radiolysis radicals as compared with that of the radicals of biochemical origin is also introduced, with hypotheses explaining the reason for this discrepancy. Finally, pertinent information is provided regarding the biotechnological applications of ionizing radiation such as sterilization of medical equipment, food preservation, and preparation of polymers. Interesting concepts about the origins of life are discussed as related to the role of ionizing radiation.

In conclusion, this material is presented in a logical manner, with appropriate explanations, definitions, and with continuity of thought throughout the chapters. The book contains a good list of references and has a well-designed index. In view of the degree of difficulty of the content, however, a more schematic organization of ideas in the form of tables, charts, and more illustrations would have made certain concepts clearer and easier to understand. Despite this minor limitation, the book should be of benefit to all radiation workers, and in particular to fellows and physicians in nuclear medicine.

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**NUCLEAR POWER: HEALTH IMPLICATIONS OF TRANSURANIUM ELEMENTS.** Copenhagen, WHO Regional Publications, European Series II, 1982, 88 pp

This is a conveniently organized, short report based on a meeting of the World Health Organization (WHO) working group on transuranium elements in Brussels, November, 1979. It is not a proceedings, but rather an interim report (one of a series) by the group. At the beginning there is a summary of the current state of knowledge, along with recommendations for further studies. This is followed by more detailed chapters on physical and chemical properties, metabolism, dosimetry and safety, sources