Books

Take Care

ATOMIC MEDICINE. Edited by Charles F. Behrens, MD. 416 pp. Thomas Nelson and Sons, New York, 1949. $7.50.

The field of medicine has progressively been broken up into numerous specialities as a result of the large amount of new information obtained as a result of both clinical and biological experimentation. The book under review proposes another subdivision of medicine to be called "atomic medicine." As indicated in the first chapter, "it attempts to set forth authoritative information the physician and all those concerned with civilian defense should have at their disposal at this time".

From the contents of the book, however, the editor presumably believes that atomic medicine also includes such subjects as the use of radioactive isotopes as tracers in biology and medicine, as well as the design of laboratories using radioactive isotopes and the nature of high voltage equipment such as cyclotrons. There is no doubt that many of the topics covered in this volume, such as the nature of ionizing radiation and the biology, pathology, and hematology of ionizing radiation, are subjects which have been and should be included in the already well established medical specialty of radiology. The atom is no stranger to the field of medicine and a large body of knowledge was built up before the atomic bomb by those in the field of radiology. There is no question that with the advent of the atomic bomb and a larger supply of radioactive isotopes the subjects of protection from radiation and therapy of radiation damage deserve considerably more investigation and attention, not only by physicians but by all investigators concerned with radiation. A large part of this more intensive study involves instrumentation and physical measurements as well as design of equipment and facilities. These are portions of "atomic medicine" which do not fall naturally in the field of medicine but require such special training as may be found among electrical engineers, industrial hygiene engineers, physicists, chemists, and so on.

The book contains twenty-one chapters by twenty contributors. After the introductory chapter, four chapters are devoted to a description of basic physics of atomic energy including the "bomb in action." Interaction of ionizing radiation and living tissue is described in chapters on biology, pathologic anatomy, hematology, and radiation illness. Chapters on permissible dosage limits, detection and measurement of radiation, radiologic safety, atomic disaster planning, and the design of laboratories employing radioisotopes might be called the "protection" chapters. A chapter on acceleration of electrically charged particles is followed by four chapters on the use of isotopes, a chapter on radiation effects in dentistry, and a concluding chapter on research in atomic medicine. The appendix contains an excellent table of isotopes and definitions of terms, and the index appears to be quite complete.

Because this volume has been written by numerous authors, it probably was unavoidable that a fair amount of repetition and even in some places inconsistent statements would occur. For example, in judging blood changes, somewhat different criteria are given in Chapter 8 and in Chapter 9. The relative biological effectiveness of fast neutrons is indicated to be five times that of x-rays in Chapter 8, and ten times in Chapter 11. There is admittedly at the present time considerable confusion in the use of units for measuring different types of radiation and unfortunately the description of units in this book does little to clarify the subject for the reader. In fact, a gross error is made on page 140 (and repeated on page 142) where it is stated that the basic unit, the curie, "is the radioactivity equal to that from one gram of radon in equilibrium with radium and its disintegration products." Presumably, the amount of radon in equilibrium with *one gram* of radium was meant. The definition as given makes the curie about 100,000 times too large. Another definition of a curie is given on the next page (and also on page 170) which is more correct although it is not the original definition. The statement is also made that "dosage in curies for most purposes really might have been just as well put in terms of r units." The author of this chapter then goes on to describe the "rhm" as the amount of radiation per hour at one meter in r units. These statements also add to the confusion since there is a clear distinction between dosage in curies and amounts of radiation measured in roentgens. The "rhm," as proposed, does not refer to an amount of radiation but to an amount of radioactive material which produces one r per hour at one meter. On page 129 an attempt is made to describe units used in neutron dosimetry. The "n" unit is defined here and again later on page 170. These two definitions as given are contradictory since the first description refers to a boron lined ionization chamber and the second to a Victoreen 100 r chamber. Actually, as originally introduced, the second description is more correct but should refer to the specific thimble chamber which was used at the Radiation Laboratory in Berkeley.

One of the unfortunate tendencies in many of the discussions on calculation of biological effects of different types of ionizing radiation and in establishing criteria for protection levels is that statements originally made in the absence of specific information and in many cases for empirical reasons are perpetuated by later authors as well established facts. This applies, for example, to the factors for the relative biological effectiveness of neutrons, protons, and alpha particles as compared with gamma radiation. On page 129 the relative biological effectiveness of protons is given as four, a figure which is already outdated since the figure of ten is presently recommended. It should be emphasized that such numbers are still very arbitrary and far from gospel. The same statements must be made about tables of "permissible" levels such as the table given on page 205 for contamination criteria and Table I for permissible exposure. Such tables give misleading information if applied without understanding of the goals in mind and the actual hazards involved in handling specific materials. Table I gives an incorrect value for the permissible concentration of radon—instead of 10^{-8} curie per liter, it should be 10^{-11} curie. Permissible water concentrations given in this table do not specify the unit of volume measurement. "Blanket" levels, such as these, are better omitted since, even for specific radioactive materials, levels are still controversial.

There are throughout the book many general statements which should be qualified, or the fact that they have not been definitely established should be noted. For instance, on page 53 it is stated that the neutron has great power of penetration without specifically noting that the discussion refers to fast neutrons. On page 74 it is stated that reversibility or irreversibility of radiation effects depends on the radiation dose. This is not always true since it is fairly well agreed, for example, that point mutations are irreversible independent of the size of the dose. On page 123 it is stated that in an individual exposed to radiation, "nothing may be noted for long periods and then with great dismay one may find he is irretrievably damaged and perhaps doomed". It is generally believed, however, that such a phenomenon can occur only if no attempt is made to detect early changes and that, in the vast majority of cases, early radiation damage which does not doom the individual can be detected without excessive difficulty. On page 135 it is mentioned that "since it is probable that the human race already has quite a large burden of unfavorable recessive mutations, any addition is to be distinctly avoided". The opposite point of view, however, can be taken—that, since every individual does have a large number of unfavorable recessive mutations, a small increase in this number will probably not be of practical significance. Incidentally, the dose rate from cosmic radiations is said to be a few hundredths of a milliroentgen per day but in general at sea level it reaches 0.2 milliroentgen per day. On page 135 one finds the statement that "changes in the chromosomes tend to be permanent and reproduce themselves" without specifically mentioning that chromosome aberrations, and of course dominant lethals, may be rapidly lost in natural populations. On page 139 it is stated that lung carcinoma in the miners in Bohemia and Saxony has been attributed to exposure to uranium, whereas in fact it has rather been attributed primarily to radon and radium exposure. This distinction is of considerable practical importance because in the atomic energy industry there are exposures to uranium without necessarily any exposure to radon or radium.

While the above discussion indicates that the reviewer is highly critical of this book, nevertheless he feels that there is a large amount of useful information in it. There are excellent descriptions of the pathological and hematological changes resulting from radiation and a large portion of the fundamental physics and the description of instrumentation is excellent. The chapters on radioactive isotopes and tracer methods should be extremely helpful to those concerned with these aspects of atomic medicine. A valuable step forward has been taken by the editor and authors in attempting to gather together in one volume a large body of scattered information and to present it in interesting and understandable fashion.

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Two on Heat

HEAT TRANSFER, VOLUME I. **By Max Jakob. 758 pp. John Wiley and Sons, Inc., New York, 1949. $12.00.**

A TEXTBOOK ON HEAT. **By J. H. Awbery. 302 pp. Longmans, Green and Company, Inc., New York, 1949. $3.00.**

The first impression one has of Jakob's *Heat Transfer* is of the immense amount of work it represents—a thick volume with 240 figures, 91 tables, and two thousand-odd equations. The second is a feeling of satisfaction—to this reviewer at any rate—at the appearance of the third book in as many years largely concerned with the subject of heat conduction. This is more attention than this subject, which may seem a bit old-fashioned in comparison with its more up to date sisters, such as electronics, has had in the preceding decade. Heat conduction, however, takes up only half the present volume, the balance being devoted to convection and to the general basic equations, while Volume II, which is in preparation, will be concerned mostly with radiation and fields of application.

The author is more than just another authority on the subject of heat transfer. When it comes to fulfilling one of the principal aims set forth in the preface, which is to make more readily available the European work, mainly German, of the last quarter century, it would probably be impossible to find another as well fitted for this task. The half a hundred references under his name in the bibliography—a circumstance for which he quite unnecessarily apologizes—evidence the truth of this statement. The extent to which the above aim is carried out is indicated by the fact that some forty percent of the references are German.

The author develops the basic theory of heat conduction and makes many of the customary applications, but with surprisingly little overlapping with other recent books on this subject. The treatment of methods of measuring conductivity and the discussion of crystalline and amorphous bodies are among the many topics which will appeal to the physicist, while the thoroughgoing consideration of a large number of technical applications—one of the most extensively treated is that of cooling *fins*—will appeal to the engineer. The discussion of special mathematical methods and of numerical and graphical solutions is also very good. In the part on convection the reader will like particularly the description of optical methods, i.e., schlieren and interferometry, especially if he has been hunting for a good condensed description of these important techniques.

It seems to be expected of a reviewer that he point out some flaws, even if, as in the present case, they are of small importance. In deference to this tradition then it is suggested that the author has occasionally developed some feature to an extent which seems a bit out of proportion, that more use might profitably be made of the line source integral of page 707, and that the problems would be more