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# *The Fundamentals of X-ray and Radium Physics*

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**Dedicated to my wife**

## PREFACE

**I**t is obvious to anyone who has had experience in teaching radiologic physics to student x-ray technicians that the majority of students have had poor preparation for this course of study. Those students who may have been exposed to physics and mathematics in high school often retain so little knowledge of these subjects that they must learn anew even the simplest principles. The student x-ray technician with a background of college training in the sciences is indeed a rarity.

Many teachers devoted to the training of student x-ray technicians have long recognized the dearth of textbooks in physics designed for technicians. A desirable textbook of this type must lead the student, as painlessly as possible, from the most elementary considerations all the way to radiologic physics, a task which is by no means simple. The subject matter must be presented in great detail in order that the student may derive a more complete understanding of it. At the same time, the text must be as non-mathematical as possible and couched in language that is readily comprehensible.

On the basis of lecture notes and other data used in the instruction of student technicians over a period of years, the author has written the present book with the primary purpose of simplifying for the student x-ray technician the subject of radiologic physics in all its theoretical and practical aspects as it confronts the technician. With this aim in view, basic principles of physics and chemistry are emphasized and presented in greatest possible detail. At the same time, the simplest available terminology is employed in order to avoid a language barrier to the comprehension of these important principles. In accordance with the familiar pedagogic rule of repetition, the more significant physical principles are repeated, presented from various standpoints, and correlated wherever possible throughout the text.

Recognizing the value of visual aids to education, the author has made free use of numerous line drawings to facilitate the study of the text. Tables have been included only to emphasize certain points rather than as a source of reference for specific data. Throughout the book, fundamental principles are stressed, and if these are grasped by the student, he is then in a better position to understand the specific data furnished by the manufacturer for the equipment or supplies in use in his radiology department.

Mathematics of the simplest type is employed only where deemed essential to the understanding of fundamental principles. A summary of elementary mathematics introduces the book so that the student's memory can be more easily refreshed. It embodies all of the mathematical principles that are to appear in later chapters, so that if the first chapter is mastered the student should encounter no difficulty with the algebra and geometry employed in subsequent chapters.

There has been included a somewhat detailed consideration of the intimate structure of matter, and some space has been devoted to the quantum theory. This may be criticized by those teachers who feel that too much emphasis is already being placed on physics in the students' overburdened curriculum. However, it is felt, in view of the great strides that have been made in atomic physics in the last few years and the growing importance of radioactive isotopes, that the student should have at least a minimum concept of atomic structure and atomic energy.

The material has been so organized that certain sections may be omitted at the instructor's discretion without seriously interfering with the continuity of the text. On the other hand, these more advanced considerations will appeal to the student technician fortunate enough to have a better-than-average scientific background.

Although it has been pointed out repeatedly that this book has been conceived primarily for the student x-ray technician, it is felt that it will also be of distinct advantage to the resident in radiology who is just entering upon his period of training and needs an introductory textbook to prepare him for more advanced reading as his knowledge of the subject develops.

With some exceptions, the author makes no claim to originality,

but it is impossible to mention by name the thousands of radiologists, physicists, and technicians who have developed the science of radiology to its present high position. Grateful acknowledgement is hereby accorded to the following who so kindly took time from their busy curriculum to review certain sections of the text and offered invaluable suggestions and criticisms: T. W. Bonner, PhD., Professor of Physics at the Rice Institute; Otto Glasser, PhD., Professor of Biophysics at the Cleveland Clinic Foundation; and Mr. W. S. Cornwell and his associates at the Eastman Kodak Company. The illustrations were prepared from the author's sketches by Mr. Howard Marlin, Tyler, Texas. The manuscript typing was ably executed by Miss Betty Presley of Tyler, Texas.

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