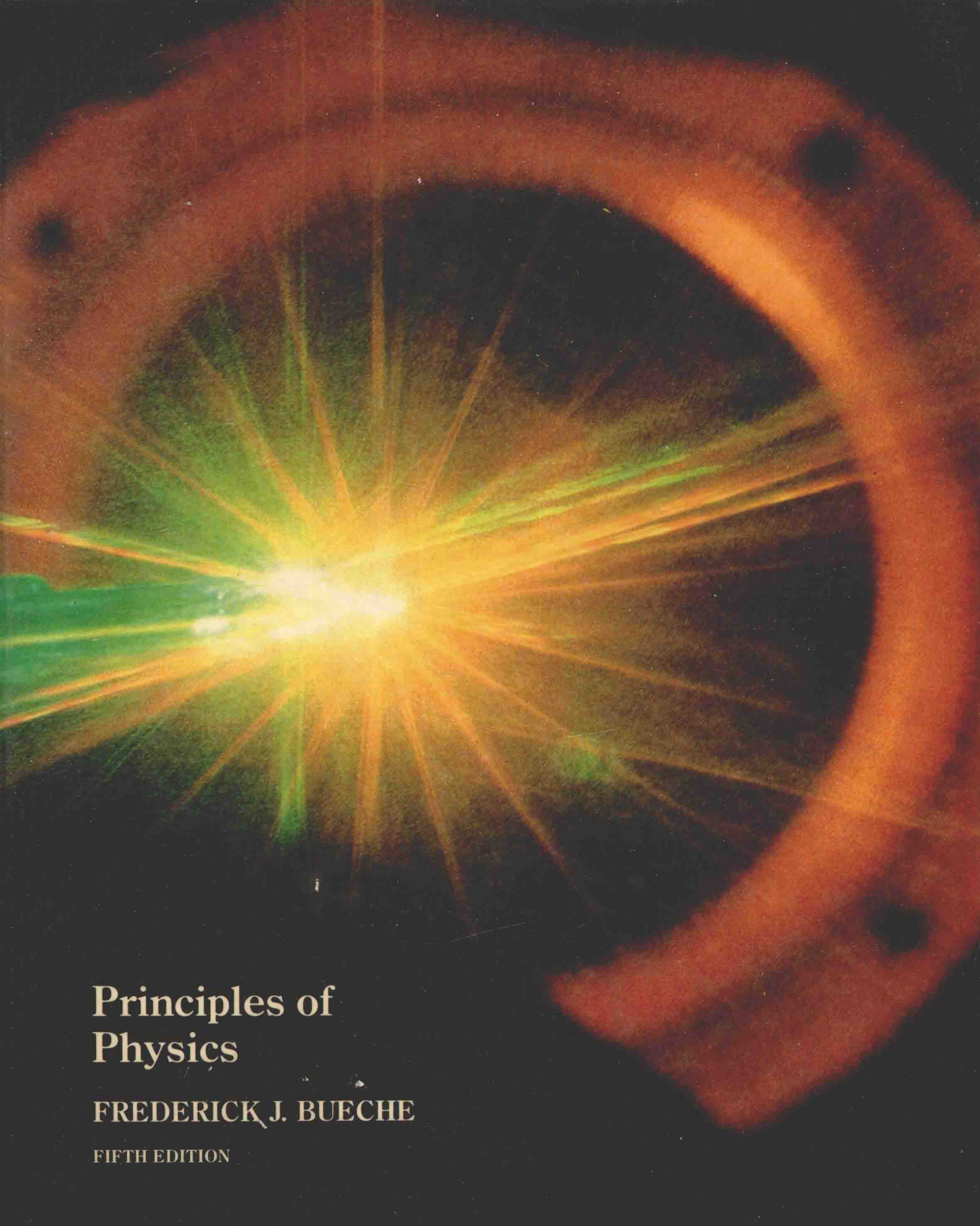

Principles of Physics

FREDERICK J. BUECHE

FIFTH EDITION

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Principles of Physics

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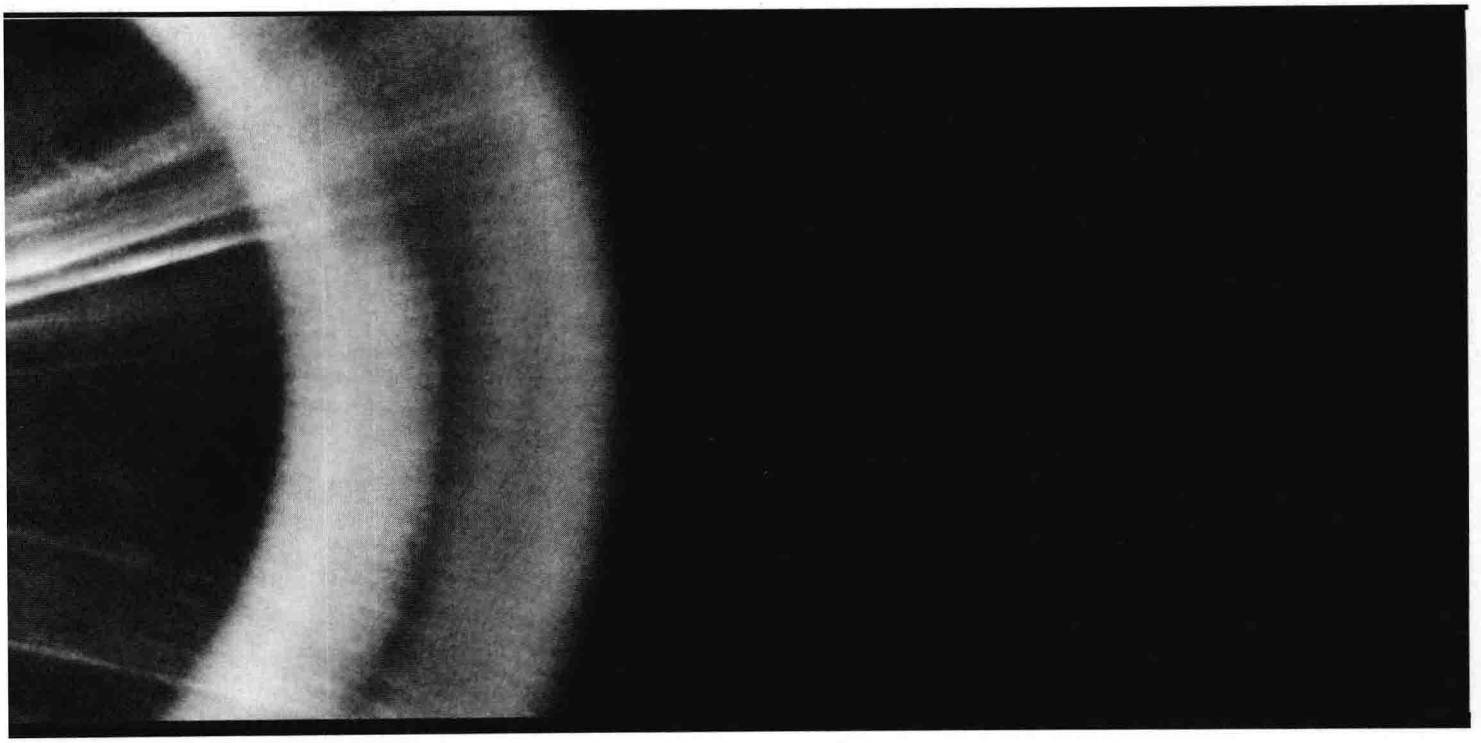
Professor of Physics
University of Dayton



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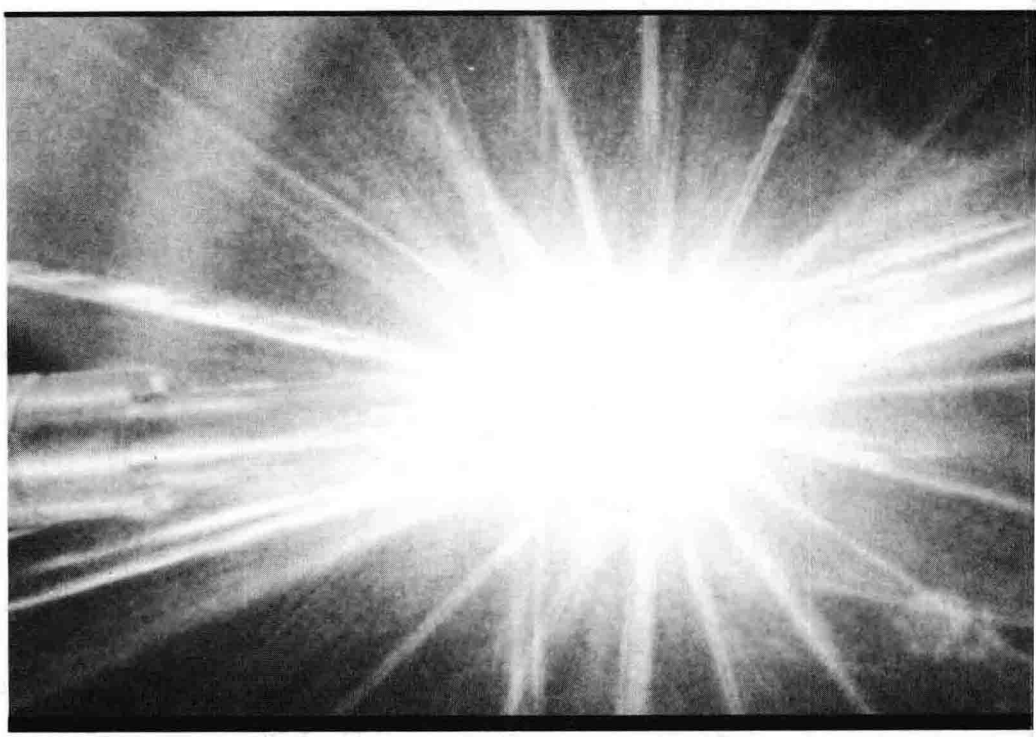

Preface

THIS text is designed for the noncalculus physics course taken by those who intend to pursue careers in science and its application. It can also be used profitably by intelligent nonscientists who desire a better understanding of the world in which we live. Although mathematics through simple algebra and trigonometry is used, the trigonometry required is taught in the text and the algebra as presented is not difficult. I believe firmly — and experience confirms — that the average college student is capable of mastering the material in this book without undue difficulty.

One of the major guidelines I have followed in preparing this text is that, because time is so limited, the principles of physics must receive overriding emphasis. Although relatively few in number, these principles form the framework on which we base our understanding of nature. It is important that students understand how each facet of their study is related to these principles. In that way, they see that many seemingly unrelated facts are simply different glimpses of the same fundamental concept. Physics thus becomes an understandable, related whole rather than a collection of individual facts and formulas to be memorized.

Because the principles of physics permeate the world around us, we can elicit many of them from careful observation of familiar phenomena. I try to present each fundamental principle by drawing upon the wealth of observational data each student already possesses. When students are led in this way, it is easy for them to achieve first a qualitative and then a quantitative appreciation of the principle. Although many physical concepts are quite complex until they are well understood, the skillful teacher — and that is what this textbook tries to be — can lead the student to understanding while bypassing the pitfalls that seem to obscure the concept.

No concept is completely understood until one can use it to solve problems that require both qualitative and quantitative reasoning. This text provides a multitude of **worked examples** to illustrate quantitative applications. In addition, the **questions and guesstimates** at the end of each chapter test the students' ability to reason out the meaning of challenging situations, and the end-of-chapter **problems** provide ample opportunity for quantitative practice.

You will notice that the difficulty level of each problem is indicated, with the more difficult problems being preceded by a single or a double solid square. However, the particular section to which the problem applies is not listed, although this is done in the instructor's manual. I do this for two reasons: (1) many problems require ideas from several sections, and (2) a major part of problem solving is to determine which concept to apply. I wish my students to be able to furnish this aspect of problem analysis, and I assume you wish the same for your students.

The solution methods for all problems are given in a solutions manual prepared by Joseph J. Kepes. In addition, he has prepared a workbook that gives the student additional practice.

One of the major difficulties students have in learning physics is the result of our trying to cover too much in too little time. By emphasizing principles, I have been able to divide the text into only 28 chapters, including four on modern physics. This amounts to about one chapter a week for the traditional two-semester course. If even this proves to be too formidable a menu, further abbreviations that can be instituted are pointed out in the instructor's manual.

Despite my emphasis on principles, you will find many **applications** and interesting **sidelights** scattered throughout the text. The applications are carefully screened for relevance to the principles being taught; care is taken that the principles stand out clearly and do not become lost among the extraneous material. The **special notes** interjected throughout the text are intended to extend the students' horizons, provide interesting sidelights to the material being studied, and encourage an appreciation of the historical and cultural aspects of physics. I have noticed that students often flip through the text to read these notes, which are conveniently set apart from the text proper. Students seem to relish these interesting, often self-contained excursions into optional material.

New to the Fifth Edition

In response to extensive surveys and reviews, numerous changes in organization, coverage, and presentation have been made in this new edition of *Principles of Physics*. If you used the fourth edition and wanted some changes, look for them here; they probably have been made. A cursory examination will show that the figures and the use of color have been improved greatly. Notice how the most important statements and equations are enhanced by color and by their positioning on the page. Further emphasis is achieved by the judicious use of boldface and italic type. Many of the end-of-chapter problems are new, and most of the others use new numbers. **Minimum learning goals** serve as a summary for each chapter. They have the advantage of requiring the active participation of the student for their use, thus serving as a self-test.

One change deserves special comment: statics now precedes linear motion. Many experienced teachers have long recognized the great difficulty students experience with the topic of motion. Recent educational research confirms their observations. We have therefore returned to the "old-fashioned" format so dear to the hearts of many experienced teachers: simple statics is studied first and then linear motion is introduced, with particular care being taken to avoid misunderstandings and to remove mistaken concepts. On a more practical level, motion problems tend to

encourage memorization, something we wish to deemphasize. By starting with statics, we can easily show the students that success in physics is *not* achieved through memorization.

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I thank them, as well as others whose names I have inadvertently omitted, for their thoughtful suggestions. Joseph J. Kepes, who prepared the workbook and instructor's manual, has as usual been extremely helpful. I also extend my gratitude to the McGraw-Hill editorial staff, particularly to Irene Nunes, whose influence is seen throughout the text, and to James W. Bradley, who shepherded the text through the production process.

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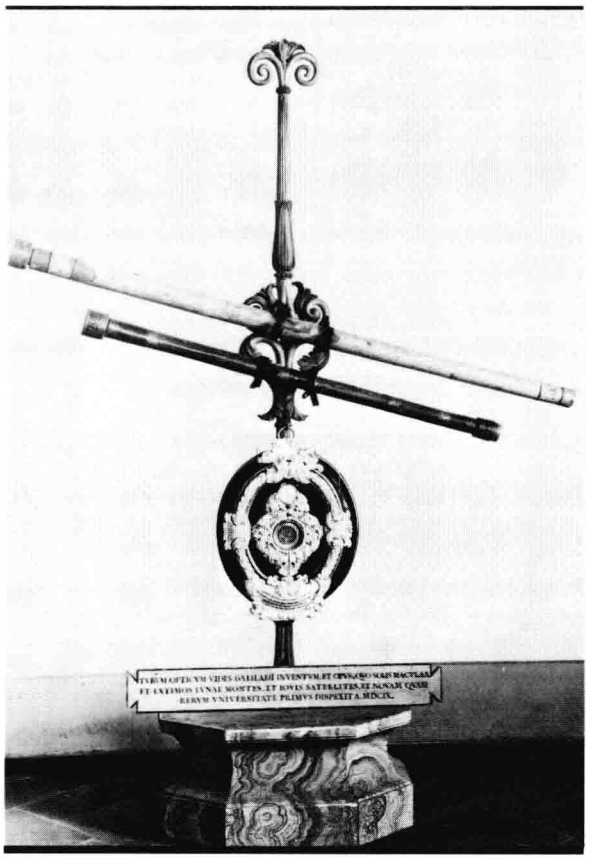

As you begin your study of physics, there are probably several questions in your mind concerning the nature of this course and the field of physics in general. Let us therefore take time at the outset to make a few general comments you may find valuable.

What is physics?

We cannot give a one-sentence answer that does justice to this question. Some typical short answers are:

1 Physics is the study of the laws of nature and their application to nonliving things.

2 Physics is the science of matter and energy and of the relations between them.

3 Physics is the most basic of all sciences. It deals with the structure and behavior of matter.

4 Physics is the body of knowledge gained from the study of natural phenomena.

5 Physics is what physicists do.

All of these describe the field of physics, but the last answer is perhaps more informative than the others. So let us examine what physicists do.