Elementary practical mechanics

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ELEMENTARY PRACTICAL MECHANICS
PREFACE

The accompanying text is an attempt to express practical mechanics as the science of the processes and structures of every-day life rather than as a series of more or less abstract mathematical demonstrations. It aims to convey not only a knowledge of facts and of fundamental theory, but also some training in ability to apply such knowledge; to equip the student who is to receive no further formal instruction in mechanics with practical information required for business or industrial life, and to establish a foundation and right point of view for the student who is to continue his study along applied lines, which shall enable him to advance without confusion or loss of time in acquiring new methods and a new vocabulary.

It is designed primarily as a text for elementary technical and manual training schools which find the usual texts in elementary mechanics too theoretical or too mathematical for their needs, and which require a more complete and practical course than that furnished by a text in general physics; also as an introductory text for engineering schools to be followed by the more applied courses in mechanism, and in the electrical and mechanical laboratories. The subjects of work, friction, and power transmission, and of power brake and dynamometer tests are discussed with considerable detail, and a chapter is
devoted to elasticity and to stress in materials. If properly supplemented by laboratory exercises, therefore, it is believed that satisfactory material will be found for a short course in applied mechanics.

It should, perhaps, be stated that the present text has grown out of a series of notes issued for several years in mimeograph form to the students in the School of Science and Technology, Pratt Institute. Nothing is included, therefore, which has not stood the test of several years' use with students in elementary technical courses. The time given to the subject at Pratt Institute is represented by one-half year with five lectures or recitations and six hours laboratory per week. The requirements in mathematics are limited to simultaneous and simple quadratic equations and the simplest trigonometric functions.

The order of presentation is that which has been found to give best results. General principles and definitions to form a ground work for laboratory exercises are introduced early, and the complete statement of theory, together with its applications, is then reached through laboratory and lecture work combined. The importance of carefully adapted laboratory exercises in teaching mechanics cannot be over emphasized. Numerous suggestions of models, etc., used in the laboratories at Pratt Institute are given in the figures illustrating this text.

In statics, as a rule, both the graphical and the analytical solutions are indicated. If desired, therefore, the use of trigonometric functions may be avoided without greatly modifying the ground covered in the text. Special effort has been made to present in a clear and usable form those portions of the text which deal with the mechanics of moving bodies, and to make the students' work in this subject something more than blind substitution of values in an uncomprehended formula. Repeated drill is pro
vided in the application of the fundamental principle $f = ma$ to familiar instances, such as the starting and stopping of trains, the tension in hoisting ropes, etc., and of the corresponding expression for torque in rotary motion, to shafting, fly-wheels, etc. The conception of moment of inertia and radius of gyration is approached through the familiar ideas of action and reaction and of moment of force rather than through more abstract mathematical reasoning.

No apology is offered for the large amount of space devoted to problems. Too many problems in mechanics are scarcely possible. It is believed that the problems in this text will be found carefully selected and well distributed.

It is our practice to require the student to construct a simple, preliminary diagram of force conditions as a help to clear thinking, and as a basis for the final mathematical statement of his solution. Diagrams of this character have been inserted freely in the text, and an attempt has also been made to supply a number of cuts from photographs of actual commercial structures which, upon the specification of the necessary angles and dimensions by the instructor, shall supply material for valuable problems. In this connection, grateful acknowledgment is returned to Messrs. John Wiley & Sons, publishers, and to the respective authors, for permission to reproduce the following cuts: Fig. 91 taken from Sanborn’s “Problems in Mechanics;” Fig. 103 from Merriman and Jacoby’s “Roofs and Bridges;” Fig. 104 from Johnson, Bryan, and Turneaure’s “Theory and Practice in the Designing of Modern Framed Structures;” and Fig. 155 from Carpenter’s “Experimental Engineering;” also to the publishers of the Railroad Gazette for Fig. 102, and to the Brown Hoisting Machinery Company for numerous illustrations of various types of hoisting machinery.
In conclusion, the author wishes to express his very great indebtedness to Mr. Dana Pierce, Electrical Engineer for the Underwriters' Laboratories, jointly with whom, when associates at Pratt Institute, the original notes were written. Much of the plan and present form of the text is due to his valuable suggestions and assistance.

Grateful thanks are also extended to Mr. Arthur L. Williston, Director of the School of Science and Technology, Pratt Institute, for his encouragement and many suggestions in developing the course in mechanics; to my associates, Dr. Harrison H. Brown, Mr. William H. Timbie, and Mr. John A. Randall for helpful criticisms of the manuscript, and to Mr. Randall also for superintending the preparation of the illustrations and supplying the index.

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J. M. Jameson.