PHYSICAL LABORATORY EXPERIMENTS FOR ENGINEERING STUDENTS. PART I. MECHANICS, SOUND, HEAT, AND LIGHT

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40 ILLUSTRATIONS

PART I.

MECHANICS, SOUND, HEAT, AND LIGHT

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PREFACE

The material in this volume was prepared for the use of sophomore students in the Polytechnic Institute of Brooklyn. All of these students are candidates for engineering degrees and most of them, when they entered as freshmen, had pursued courses in laboratory physics in the high schools of Greater New York, which are generally supplied with superior laboratory equipments. The book comprises thirty exercises, and the performance of each is designed to occupy three hours of the student's time. The course, therefore, covers three hours per week for two semesters. Each experiment has been chosen because of its close connection with engineering work, and in many cases the theoretical result may be calculated from the constants of the apparatus with which that result obtained by experiment may readily be compared. As these two results approach to an equality the student gains confidence in the apparatus, confidence in the theory, and confidence in himself. Apparatus of engineering design has been chosen for each exercise so that the student may rely upon getting the same result under the same conditions, and the results obtained by different students are directly comparable with each other. Each exercise is self-contained and assumes a knowledge on the part of the student of the subject matter as treated in courses on college physics. *College Physics* by Reed and Guthe is the text used at the Polytechnic. The additional theory necessary for a thorough understanding of an exercise is suggestively given with a view to inspiring the student to think and to supply the gaps.

It is believed that many other teachers of laboratory physics to engineering students may be confronted with the same conditions as exist at the Polytechnic. It is hoped that this text may be of some service to them in the solution of their problems.

S. S.
E. H.

Polytechnic Institute of Brooklyn,
January, 1917.

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PHYSICAL LABORATORY EXPERIMENTS

EXPERIMENT 1

Radius of Curvature of Lenses by Spherometer

OBJECT. To determine the radius of curvature of a concave and of a convex lens with the use of a spherometer, a micrometer caliper, and a vernier caliper.

THEORY. The spherometer consists of a screw moving vertically in a nut mounted at the center of an equilateral tripod. The instrument is arranged to measure accurately the distance between the point of the screw and the plane of the three tripod legs. If the spherometer reading be a and the distance between the axes of the screw and tripod leg be r, it follows that the radius of a vertical circle which passes through the point of the screw and the end of one tripod leg, and whose center lies on the prolonged axis of the spherometer screw, is

$$R = \frac{r^2}{2a} + \frac{a}{2}.$$

The distance r can be expressed in terms of the mean length l between centers of the tripod legs, from the geometry of the equilateral triangle formed by these legs. Thus

$$r = \frac{l}{\sqrt{3}},$$

and substituting this value in the foregoing equation, then

$$R = \frac{l^2}{6a} + \frac{a}{2}.$$

APPARATUS. Spherometer, micrometer caliper, vernier caliper, plane surface, concave and convex lenses.

Spherometer. The spherometer, Fig. 1, carries a graduated circular disk at the top of the screw, and a fixed vertical scale graduated in divisions equal to the pitch of the spherometer screw. The whole number of revolutions of the screw can be read on the vertical scale and the fractions of a turn can be read on the disk. To take a zero reading, place the instrument on a true plane surface and turn the screw slowly by means of the knurled head until the entire spherometer just begins to revolve around the screw point as pivot. When this occurs without noticeable rocking of the instrument on the surface, the reading is taken by observing the indications on the vertical and circular scales and adding them. The settings of the circular scale should be estimated to tenths of divisions. Readings on other surfaces are made similarly.

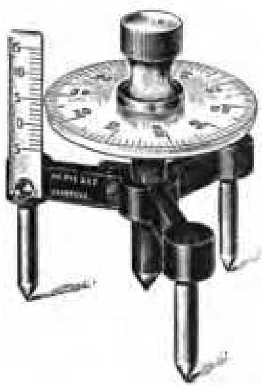

FIG. 1.

Micrometer caliper. The micrometer caliper, Fig. 2, is based upon the same operating principle as the spherometer. It consists of a screw moving in a U-shaped frame, the screw being provided with a hollow graduated head which can be turned back and forth over a fixed longitudinal scale. An object to be measured is placed between the screw and the anvil and the screw is turned until a slight pressure is felt. The whole turns of the