PHYSICAL LABORATORY MANUAL FOR SECONDARY SCHOOLS

Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649181513

Physical laboratory manual for secondary schools by S. E. Coleman

Edited by Trieste Publishing Pty Ltd.
Cover @ 2017

www.triestepublishing.com

S. E. COLEMAN

PHYSICAL LABORATORY MANUAL FOR SECONDARY SCHOOLS

Trieste

PHYSICAL LABORATORY MANUAL

FOR SECONDARY SCHOOLS

BY

S. E. COLEMAN, S.B., A.M.

HEAD OF THE SCIENCE DEPARTMENT, AND TEACHER OF PHYSICS IN THE OAKLAND HIGH SCHOOL

NEW YORK ·:· CINCINNATI ·:· CHICAGO
AMERICAN BOOK COMPANY

COLEMAN, PHY. LAB. MAN.
W. P. 2

PREFACE

The number and variety of laboratory manuals in physics now on the market are so large that the merits of a new one are hardly to be sought in novelty of content, but rather in the utility of the material chosen from the abundant common store and in the method of presenting it. Believing that these are both matters of great importance and that the possibilities of improvement in them have not yet been exhausted, the author has written this manual in the hope that it will contribute toward this end.

Since both the choice of material and the method of treatment are in a large measure determined by the view entertained in regard to the place and function of the laboratory work in the course in physics, a brief statement on this point seems desirable. Rejecting the extreme view that little importance is to be attached to any part of the work except the laboratory course, as well as the opposite extreme which relegates this part of the work to the position of a supplementary adjunct to the old form of text-book instruction, the author has adopted in his teaching and has assumed as the controlling principle in the preparation of this manual the view that the laboratory course should stand in coördinate relationship to the work of the class room; which, in his opinion, should include as important elements qualitative experimental work by the teacher, the systematic study of a good text-book, as large a use of reference books as time and opportunity permit, a constant appeal to the everyday experience of the pupils, and, finally, the recitation or quiz, in which the information gleaned from the several sources is classified, organized into scientific knowledge, and assimilated.

This point of view presupposes that the laboratory work

will, in general, precede the recitation, but may itself be preceded by experimental work by the teacher, presenting fundamental phenomena as an introduction to either the qualitative or quantitative work of the laboratory. It is also assumed that the text-books and reference books are legitimate aids toward the interpretation of the experiment *while it is being performed*, and that the reading of the text on the subject of the experiment before the laboratory hour will economize time in the laboratory and lead to the best results.

The choice of experiments has been governed by the following considerations: —

(1) The content of the laboratory course should be rich and varied, and the manipulation the simplest that will serve the purpose. Skill in manipulation should not be sought for its own sake, but as a means to an end, the end being a satisfactory presentation of physical facts and principles. Measurements with vernier and micrometer calipers, the diagonal scale, the spherometer, etc., are omitted, since the knowledge of their use finds no important application in elementary physics.

(2) There are many qualitative experiments — such as the reflection or refraction of a beam of sunlight in a darkened room — that can be fully appreciated at a distance, and for which the recitation room affords better facilities than the laboratory. Such experiments are not included in the manual, which is limited to experiments best adapted to the laboratory. But the course includes many valuable qualitative experiments that can readily be provided for; and in a considerable number of cases they present phenomena to the student much more satisfactorily than the equivalent class-room experiments; although, for nearly all of them, the latter may be substituted if the teacher prefers.

(3) In order that there might be opportunity for choice, the number of experiments has been made considerably greater than most teachers will require of their classes. The alternative experiments serve the same purpose, and increase the

adaptability of the manual to the varying equipment of different laboratories.

The exercises marked with an asterisk in the Table of Contents, — exclusive of Part III of Exercise 10 and Part II of Exercises 27, 34, and 76, — are suggested as a minimum course. They cover all the essentials of a good laboratory course, yet, for the most part, require only inexpensive apparatus.

The method of treatment presents the following characteristic features: —

(1) The presentation is in the main inductive, but not exclusively so. The laboratory course is regarded as an important source of information at first hand, which is to serve as a *representative* (though generally incomplete) basis upon which to establish the theory, rather than as serving merely to illustrate or exemplify the theory dogmatically presented in the text-book and the recitation. No pains have been spared in the effort to cast the experiments in such form that the pupil will be led by correct reasoning from the observed facts to the *legitimate* inferences. Where the interpretation of results and the theory of experimental methods can best be arrived at deductively from established theory, this method is employed.

(2) A persistent effort is made throughout to stimulate thought and to minimize unreasoning, mechanical work. To this end the pupil is generally required to arrive at his results by simple analytical processes, which to be employed must be understood, and the understanding of which involves the *physics* of the experiment, instead of by means of formulæ, which the average pupil will use without verification.

(3) Economy of time and of effort is sought for both teacher and pupil in making the "exercise" the unit of work. With very few exceptions, each exercise can be performed in a single laboratory period of forty-five minutes. Short experiments on the same or related topics are grouped into an exercise for one laboratory period. This will overcome the tendency of pupils to dawdle over short and simple experiments.

The order of the chapters and, to some extent, of the individual exercises, may be varied to suit the text or the preference of the teacher; but generally a definite sequence of exercises within the chapters is necessary for the logical development of the subject, and, in writing the manual, it has been assumed that this sequence will be observed.

The books referred to throughout the course are the following: "A Brief Course in Physics," by George A. Hoadley (American Book Company); "High School Physics," by H. S. Carhart and H. N. Chute (Allyn and Bacon); "Physics," by Frederick Slate (Macmillan); "Elements of Physics," by Fernando Sanford (Holt); "Heat, Light and Sound," by D. E. Jones (Macmillan); "Heat," by H. G. Madan (Rivingtons, London).

The references are quite narrowly limited to the subject-matter of the experiments; the aim being to indicate the reading that may profitably precede and accompany the laboratory work, without entering upon the equally wide range of topics which fall within the scope of the recitation.

The author takes pleasure in acknowledging his great indebtedness to Mr. George L. Leslie, Head of the Science Department of the Los Angeles High School, under whose helpful direction he obtained his first experience in teaching physics, and whose laboratory course he has, during the years since 1899, developed into the present work. The author regrets to state that circumstances rendered impossible the contemplated coöperation of Mr. Leslie in the preparation of the manual for publication.

A further acknowledgment is due to Mr. A. G. Van Gorder, a former colleague at Los Angeles, to whom the author is indebted for a number of valuable suggestions.

S. E. COLEMAN.

OAKLAND, CALIFORNIA.

CONTENTS