

**AN ELEMENTARY  
COURSE IN  
EXPERIMENTAL PHYSICS**

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An Elementary Course in Experimental Physics by Arthur Chambers Alexander

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**ARTHUR CHAMBERS ALEXANDER**

**AN ELEMENTARY  
COURSE IN  
EXPERIMENTAL PHYSICS**



UNIVERSITY OF  
AN

ELEMENTARY COURSE

IN

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*8-94*

# EXPERIMENTAL PHYSICS

BY

ARTHUR CHAMBERS ALEXANDER, Ph. D.

*Instructor in Physics in the University  
of California.*

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THIRD EDITION.

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BERKELEY, CAL.

1899.

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## PREFACE.

IN order to keep the work in Physics at the University of California properly related to that of the secondary schools of the state, it has been found necessary to eliminate many of the more elementary exercises that appeared in the first and second editions of this course. The remaining exercises have been revised and rearranged and, with some additional matter, will comprise the laboratory course in Elementary Physics to be given in 1899-1900.

The author wishes to acknowledge here his indebtedness to Prof. Slate and Mr. F. R. Watson for many valuable suggestions and changes in the text.

ARTHUR C. ALEXANDER.

*Berkeley, Cal., July 10, 1899.*





## PREFACE

TO THE FIRST EDITION.

THIS is not intended to be a complete laboratory manual, or textbook. It simply contains the directions for a series of laboratory exercises in Elementary Physics, representing substantially the first year's work in Experimental Physics at the University of California as given in 1896-97. These directions were originally typewritten and duplicated by means of the mimeograph, a method of preparation that, while allowing the instructor great freedom in modifying and adapting the course to his pupils and the exigencies of the laboratory, also entailed considerable time and labor. As the majority of the exercises will be given during the coming year in their present form, it was deemed best to print the entire course and to modify it, whenever necessary, by supplementary directions. It is not designed to be a course in Physical Measurement, the quantitative feature being retained from necessity and not choice. The primary object of the exercises is to illustrate and impress on the mind of the student the elementary principles of Physics. A course of lectures and recitations with assigned reading and problems is intended to accompany and supplement the work in the laboratory.

In arranging the sequence of exercises an attempt has been made to have those subjects taken up first that are more readily adapted to the laboratory facilities of the secondary schools, and can be easily comprehended by the immature student. In this way, and by giving an annual examination for advanced standing in the subject, it is hoped to induce many of the best equipped preparatory schools to carry their pupils somewhat farther in Physics than is required for admission to the University. The subject of Sound presents peculiar difficulties of presentation to a large class in the laboratory where only one room is available and all are not gifted

alike with the sense of musical pitch. As a result, many interesting and instructive laboratory exercises on this subject had to be omitted, and only two exercises on Sound have been retained in the course.

The author has made a free use of the work of his predecessors, most of these exercises having been adapted from Whiting's "Exercises in Elementary Physics," the text used in the University of California in 1894-95 and 1895-96. The general arrangement and method of presentation is also that of Whiting. This book represents only another step in the development of an elementary laboratory course in Physics. Many of the exercises described have barely passed the tentative stage, and there is still much to be done in the way of addition and elimination. It is the intention to further amplify and modify the course, and the author will be glad of suggestions from anyone interested.

As it is impracticable to furnish a complete set of apparatus for each exercise to every student, or pair of students, it has been found best to arrange the apparatus for the separate exercises on consecutive tables and to let the students pass from one table to another as the exercises are completed. A laboratory period of two hours and three-quarters is allowed for the performance of an exercise. A division of the subject matter of each exercise has been made, indicated in the text by an extra space and a dash between the lines. Every student is required to complete the first part in order to be credited with the exercise, and he is required to perform as much of the second part as the laboratory period will permit. The students are also required at the close of each laboratory period to leave duplicate copies of their notes with the instructor for correction.

The author has already mentioned the liberal use he has made of Whiting's "Exercises in Elementary Physics." He desires also to express his great indebtedness to the present members of the Department of Physics for the many ways in which they have helped and encouraged him, and for the hearty interest they have taken in the preparation of these exercises.

ARTHUR C. ALEXANDER.

*Berkeley, Cal., May 1, 1897.*

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