A MANUAL OF ELEMENTARY PRACTICAL PHYSICS FOR HIGH SCHOOLS

Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649044856

A Manual of Elementary Practical Physics for High Schools by Julius Hortvet

Edited by Trieste Publishing Pty Ltd.
Cover @ 2017

www.triestepublishing.com

JULIUS HORTVET

A MANUAL OF ELEMENTARY PRACTICAL PHYSICS FOR HIGH SCHOOLS

Trieste

A MANUAL

OF

ELEMENTARY PRACTICAL PHYSICS

FOR HIGH SCHOOLS

BY

JULIUS HORTVET, B. S.
TEACHER OF PHYSICS IN THE EAST HIGH SCHOOL, MINNEAPOLIS

FIRST EDITION

MINNEAPOLIS
H. W. WILSON, PUBLISHER
UNIVERSITY BOOK STORE
1900

The University Press
MINNEAPOLIS, MINN.

cP

PREFACE.

This book has been written in the hope that it will be found helpful in promoting a greater thoroughness in the study of elementary physics. It is an outgrowth of several years experience in teaching experimental physics to large classes in the East High School in Minneapolis. The greater part of the experiments have been performed each year by nearly a hundred pupils, and have been altered until experience has shown that the explanations and directions given were sufficient, and that good results could be obtained. The author, therefore, feels confident that the course described in the following pages will present no unconquerable difficulties to the average high school pupil in the junior year.

It is the plan throughout this book to supply ample necessary explanations as to the theory and purpose of each experiment, so that the significance of each experiment and its results may be more fully perceived. It is not expected that the pupil shall go through the necessarily slow process of acquiring *all* his knowledge by his own investigations; *some* information must be given him, in fact, in many cases it is almost inevitable that in giving such directions as will enable a pupil to discover a fact, the fact shall be stated beforehand. While in theory much is conceded in favor of inductive methods in science teaching, it is found in practice that the *purely* inductive method fails at points where it is expected to do the greatest amount of good. Life is

not long enough to admit of a *rediscovery* of the fundamental laws of physics. Besides, an important fact that seems to be generally overlooked is that some of the great laws were not discovered through experiment at all, but, on the contrary, were obtained by pure reasoning, and afterwards *verified* by experiment.

The comparatively small value of mere book knowledge in any of the experimental sciences is conceded by all who realize the purpose of scientific study. The knowledge of facts is not the be-all and end-all of study in any subject. To reap the full benefit of the mental discipline that the study of physical science offers, reading must go hand in hand with individual experiment. The pupil must learn by his own experience and observation what experimental evidence means, in order to appreciate rightly the evidences and the processes of reasoning by which the fundamental laws of physical science are established.

The purpose of this course is to teach pupils to measure accurately, to manipulate carefully, to work methodically, to see fully, to reason intelligently, and to express their observations and results clearly. Each pupil is expected to think for himself and to treat each experiment as a problem which he himself has to solve, while the chain of reasoning to be followed and the conclusions to be drawn are indicated by questions which the pupil has to answer. If the pupil cannot answer certain questions, the teacher can induce him to answer them by other questions judiciously put. In brief, after a pupil is fairly prepared to undertake a given experiment, he is compelled thereafter at every step to *think* in order that he may realize the richest returns.

The keeping of a note-book is regarded as an important part of a course in practical physics. The work of preparing a proper record of each experiment, both in temporary and permanent form, is in itself a valuable mental discipline. In fact, a course in experimental physics that does not encourage the keeping of a good note-book is far from fulfilling its purpose. In this course the pupil is expected to keep systematic notes, and receives careful instructions as to how all notes should be recorded.

The course includes about forty experiments, and can be completed in a school year of nine months, allowing an average of two hours a week for the laboratory work. In the selection of the experiments and methods of procedure, attention has been given mainly to those fundamental principles which are considered well calculated to give the pupil a good preparation for the further study of physics. While in none of the experiments is there anything too advanced for the average pupil of the age that has been mentioned, it can be said that no effort has been made to make anything *easy* to the extent of depriving the pupil of knowledge and discipline that will be all the more valuable for the extra effort that may be demanded.

The matter of apparatus cannot longer be considered a serious obstacle to the beginning of good laboratory work. Apparatus suitable for the experiments in this book can now be obtained at reasonable prices. A list of the apparatus required for the laboratory work is given in the Appendix, under Apparatus and Materials. The author will be pleased to give any information on this subject to teachers who will write to him.

The author desires to express his indebtedness to

other teachers of physics who have given many valuable suggestions. Especial thanks are due to Mr. A. Zeleny of the University of Minnesota for reading portions of the manuscript and making helpful criticisms.

Nearly the entire course of experiments has been given during the past two years in the University of Minnesota Summer School.

J. H.

MINNEAPOLIS, MINNESOTA,
JANUARY, 1900.

CONTENTS

PAGE

General Instructions 1

GENERAL MEASUREMENTS.

The Fundamental Units 15
Measurement of Length 17
Measurement of Mass 30
Measurement of Time 41
Volume of Fluids 45

MECHANICS.

Hooke's Law 52
Acceleration due to Gravity 58
Measurement of Force 66
The Parallelogram Law 69
The Law of Moments 74
Density of a Liquid 81
Density and Specific Gravity 85
The Barometer 90
Boyle's Law 95

SOUND.

Length and Velocity of a Sound Wave in Air . . . 101
Velocity of Sound in a Solid: Kundt's Method . . . 107

HEAT.

Measurement of Temperature: The Thermometer . . 112
Expansion of a Solid: Coefficient of Linear Expansion . 119
Measurement of Quantity of Heat: Water Equivalent . 124
Specific Heat 129
Latent Heat of Fusion 134
Latent Heat of Vaporization 137