

**AN INTRODUCTION TO
PRACTICAL PHYSICS
FOR USE IN SCHOOLS**

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An Introduction to practical physics for use in schools by D. Rintoul

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D. RINTOUL

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Physics
Gen.

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TO
PRACTICAL PHYSICS

FOR USE IN SCHOOLS

BY

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PREFACE

THIS introduction to Practical Physics is published in the hope that it will be found of use by those who are engaged in teaching the subject to boys of about thirteen or fourteen years of age and upwards. It is based on the Laboratory notes which have been in use at Clifton for some years past, and the proof-sheets having been used in the Laboratory for some months, have thus received the criticism of those for whom the book has been primarily written. This fact enables the author to feel confident that the book will present no difficulty to the average boy of the age which has been mentioned, and that all the experiments described are capable of being performed with the most simple and inexpensive apparatus.

A word of explanation may be given as to the principles on which the book is based. A somewhat extended experience of teaching experimental Physics to large classes in a Public School has convinced the author that it is possible for a boy to "work through" a course of Practical Physics in such a way as to lose many of the advantages of this kind of study. If the explanations given in the text-book are too detailed, and if the conclusions to be drawn from each experiment are explicitly stated, a boy may perform the experiments, and write out a fairly clear account of them; yet this account may be nothing but a transcript or

a paraphrase of the text-book. All incentive to independent thought is here withdrawn, except in the case of boys who are greatly interested in the subject; and instead of a spirit of scientific curiosity being developed it is rather discouraged, since it is to the apparent interest of the pupil to hurry over the ground as fast as possible. The laboratory work becomes, like many other school lessons, a matter of learning certain facts, no doubt of considerable importance, without the mental training being different in kind from that conveyed in other branches of school work.

In the course here described, an attempt is made to induce the pupil to think for himself, and to treat each experiment as a problem which he himself has to solve; while the solution is rendered possible by suggestions given in the form of questions which he has to answer. Thus, after being told what he has to do, the pupil is asked what the result of his experiment has been—what consequences he has seen to result from certain operations. Instead of the conclusions to be drawn from the experiment, or the appropriate chain of reasoning, being explicitly stated, they are indicated by a series of questions which the pupil has to answer. If he cannot answer any of the questions he should go to the teacher, who can generally induce him to answer the question himself by one or two other questions judiciously put, or, what is casier but less instructive, can give the answer at once. So far as the author's own experience has gone, he is a very dull boy indeed who cannot work through nearly the whole course with the very minimum of help from the teacher. It may here be noted, that the pupil should be taught to write out his notes in such a way that reference to the book on the part of the teacher is unnecessary. Thus, instead of merely writing the answers to the questions in the text, the questions themselves should either be written down, each followed immediately by its

answer, or else the answers should be in such a form that there can be no doubt what the questions were. It is hardly necessary to say that the latter is much the better method.

There are many advantages which ought to be derived from some such method as this of treating the subject. The student is compelled at nearly every step to *think* for himself; his interest in his work is more easily sustained; he learns how to find out things for himself, that is, he is taught to learn from his own observations and not from books or teachers; and the knowledge which he has thus obtained is so much the more easily remembered for the effort with which it has been acquired.

If the teacher is wise, he will encourage all independence of thought. Above all things, the student must believe that what he honestly sees for himself is true and right, and that no statement of text-book or teacher should cause him to say that he has seen anything which he has not seen, or otherwise than he has seen it.

The course has been arranged in the order in which the subjects are usually taken by boys on the modern side at Clifton; but it is possible to take them in any order which the teacher may consider most suitable. For some reasons it may be desirable to take Part III. before Part II., but this must depend, to some extent, on the arrangements made for the teaching of Physics in each particular school. It will be noticed that certain experiments are marked with an asterisk. These are experiments which (mainly on account of their difficulty) may with advantage be omitted by younger boys on taking the subject for the first time.

The introductory chapter on "General Instructions" is intended primarily for the teacher. The matter contained in it is best given to the pupils in the form of lectures; and what is here written is designed to take the place of

notes of such lectures, so that the student may refer to it in the course of his work.

It has not been considered necessary to append a list of apparatus and prices, since price-lists of apparatus suitable for such a course as this are now issued by several well-known firms of instrument-makers. The author will be pleased to give any information on this subject to teachers who will communicate with him. He will also be very grateful for any suggestions which may tend to make the book more generally useful.

In conclusion, the author desires to express his thanks to the friends who have helped him in various ways to make this book less imperfect than it otherwise would have been. Especial thanks are due to Mr. H. Clissold, Mr. G. W. Palmer, and Mr. A. T. Simmons for reading the proofs and making valuable suggestions. In addition, he would desire to express his indebtedness to his predecessor at Clifton, Professor A. M. Worthington, F.R.S., whose *First Course of Physical Laboratory Practice* was the pioneer work in this field, and to whom, therefore, all teachers of the subject owe a debt of gratitude.

D. R.

CLIFTON COLLEGE,
September 1898.

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