AN ELEMENTARY COURSE IN PRACTICAL PHYSICS

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IN

PRACTICAL PHYSICS

BY

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PREFACE.

THE older method of giving statistical information on science subjects was very unsatisfactory, alike to teacher and to student, and is now being replaced by a better system, in which the student, instead of seeing an experiment performed by the practised hand of a teacher, is furnished with the necessary apparatus, and with information sufficient to enable him to carry it out with some approach to accuracy.

In this manner, instead of attempting the hopeless task of remembering a law, often expressed in language which he cannot understand, he finds from careful experiments, and by the liberal use of squared paper, that such a law exists—he can even trace it in a rough experiment (and the apparatus which is sometimes given to students is as rough as it is possible to make it); but with care and proper precautions he is able to obtain either an accurate result, or at least a good approximation to it. Having proceeded so far, there is, at any rate, some incentive to induce him to try to understand more clearly what the law implies, and it thus becomes of vital interest and importance, instead of a mere jargon of words to be carefully remembered for examination purposes.

As will be seen on reference to the following pages, the attempt is made to include only those experiments which are well within the capabilities of first and second year students in science schools and classes.

The grouping together of one or more sections of each subject into chapters affords an opportunity of giving at the end of each a short recapitulatory summary, and, in addition, numerical exercises on the subject-matter. These are chiefly selected from the examination papers of the Science and Art Department. Solutions to these are given where necessary, and the answers to the remainder.

It is an easy matter to assume that by means of a simple experiment an important law is understood; but if the knowledge so gained is not sufficient to solve a fairly easy numerical question, it indicates that the matter is not so clear as it ought to be. Hence these questions will be found useful, not as an end, but as a means to an end.

During an experience of over twenty years' teaching in science classes, the writer has found that the majority of students fail to realize the great importance of Physics, especially of Elementary Mensuration.

As will be seen on reference to the following pages, considerable space is devoted to this subject. The experiments, although numerous, are so arranged that they may be taken in any desired order, and, if necessary, at the discretion of the teacher the more difficult ones may be omitted altogether.

The same remarks apply to the sections dealing with Mechanics, Sound, Light, Heat, Magnetism, and Electricity.

In the few simple and practical experiments in Mechanics, the excellent method introduced by Professor Perry, D.Sc., F.R.S., which is now being generally adopted, is indicated, and consists in setting apart suitable apparatus for each experiment. This is easily made and fitted up, is always ready for use, and enables a student to obtain fairly accurate quantitative results.

In a book of this kind it would be impossible to acknowledge all the help received from various sources, but the writer is especially indebted to his brother, Mr. F. G. Castle, A.I.M.E., and to Mr. G. W. Fearnley, A.R.C.S., for many valuable suggestions and corrections in the sections dealing with Mensuration, Mechanics, and Heat; also to Mr. C. A. West, A.R.C.S., A.I.C., and Mr. J. Schofield, A.R.C.S., whose valuable aid in the sections dealing with Sound, Light, Magnetism, and Electricity has in no small measure contributed to any good feature which this part of the work presents.

LABORATORY WORK.

It should be carefully noted by the student that the educational value of the work done by him will depend entirely *on the way it is done*. The results will be valueless unless in each case an effort is made to ensure that the most accurate results have been obtained. When this is done, it will be possible to illustrate the general principles of science, to reason in a clear manner on the facts observed, and to obtain clear ideas as to the cause of any discrepancy between the observed values and those obtained from calculation. The following rules should be observed:—

1. Before commencing an experiment, see that all the materials required are in readiness and in good working order; read all about the experiment, so that before you begin you have a clear conception of what you are about to do.

2. Use the apparatus as directed in the instructions, and note briefly any inferences you can make as the work proceeds.

3. A methodical record of all work done should be made, and a notebook should be kept exclusively for laboratory work. This should be about six inches wide by eight inches long, with stiff covers. A smaller book may be used if desirable, but the larger one will be found to be much more convenient.

4. The number or description of the experiment must be entered also. Suitable columns, with the headings as shown in the following experiments, should be prepared, and all results obtained entered in their proper places.

5. The numbers recorded in any column must not be the result of calculations, but those obtained from the experiments.

6. The right-hand page may be kept for the record of work done, and the left-hand page for sketches of the apparatus used. These sketches should always be made, *not sketched from the book but from the apparatus actually used.*

7. When the experiment is completed, remove all apparatus not required for the next experiment; and before leaving the laboratory, see that all things are put away in their proper places.

8. After the experimental work is finished, proceed to make the necessary computations. All equations and results should be entered on the right-hand page, the arithmetical work as neatly as possible on the left-hand page, in such a position as not to interfere with the sketch previously made of the apparatus.

9. Wherever possible, the values obtained should be plotted on squared paper. This enables slight errors of observation to be readily corrected. The paper may be cut to a suitable size and inserted in the notebook (pasting a narrow strip along one edge for that purpose). In this manner all the results may be kept together.

10. The notebook must be handed in to the instructor for examination, and the corrections, if any, indicated should be made by the student before proceeding to the next experiment.

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