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DYNAMICS

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PREFACE.

IT has now come to be generally recognized that the most satisfactory method of teaching the Natural Sciences is by experiments which can be performed by the learners themselves. In consequence many teachers have arranged for their pupils courses of practical instruction designed to illustrate the fundamental principles of the subject they teach. The portions of the following book designated EXPERIMENTS have for the most part been in use for some time as a Practical Course for Medical Students at the Cavendish Laboratory.

The rest of the book contains the explanation of the theory of those experiments, and an account of the deductions from them. This part has grown out of my lectures to the same class. It has been my object in the lectures to avoid elaborate apparatus and to make the whole as simple as possible. Most of the lecture experiments are performed with the apparatus which is afterwards used by the class, and whenever it can be done the theoretical consequences are deduced from the results of these experiments.

In order to deal with classes of considerable size it is necessary to multiply the apparatus to a large extent. The students usually work in pairs and each pair has a separate table. On this table are placed all the apparatus for the experiments which are to be performed. Thus for a class

of 20 there would be 10 tables and 10 specimens of each of the pieces of apparatus. With some of the more elaborate experiments this plan is not possible. For them the class is taken in groups of five or six, the demonstrator in charge performs the necessary operations and makes the observations, the class work out the results for themselves.

It is with the hope of extending some such system as this in Colleges and Schools that I have undertaken the publication of the present book and others of the Series. My own experience has shewn the advantages of such a plan, and I know that that experience is shared by other teachers. The practical work interests the student. The apparatus required is simple; much of it might be made with a little assistance by the pupils themselves. Any good-sized room will serve as the Laboratory. Gas should be laid on to each table, and there should be a convenient water supply accessible; no other special preparation is necessary.

The plan of the book will, I hope, be sufficiently clear; the subject-matter of the various Sections is indicated by the headings in Clarendon type; the Experiments to be performed by the pupils are shewn thus:

EXPERIMENT (1). *To explain the use of a Vernier and to determine the number of centimetres in half a yard.*

These are numbered consecutively. Occasionally an account of additional experiments, to be performed with the same apparatus, is added in small type. Besides this the small-type articles contain some numerical examples worked out, and, in many cases, a notice of the principal sources of error in the experiments, with indications of the method of making the necessary corrections.

These latter portions may often with advantage be omitted on first reading. Articles or Chapters of a more advanced character, which may also at first be omitted, are marked with an asterisk.

I have found it convenient when arranging my own classes to begin with a few simple measurements of length, surface, volume and the like. These are given in Chapter I.

The two following chapters deal with Kinematics and treat the subject in the usual method.

When questions dealing with Momentum, Force, and Energy come to be considered two courses at least are open to the teacher. It is possible to make the whole subject purely deductive; we may start with some definitions and axioms—laws of motion, either as Newton gave them, or in some modern dress—and from these laws may deduce the behaviour of bodies under various circumstances.

Another and more instructive method, it seems to me, is to attempt to follow the track of the founders of Mechanics, to examine the circumstances of the motion of bodies in certain simple cases in the endeavour to discover the laws to which they are subject. This method has been followed in Chapters IV. and V. I have made free use of a piece of apparatus—the ballistic balance—devised by Professor Hicks of Sheffield and by its aid the student is led to realize the importance of momentum in dynamics and to study the transference of this quantity from one body to another. The rate at which momentum is transferred is then considered (Chapter V.) and a name—Force—is given to the rate of