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**CAMBRIDGE PHYSICAL SERIES**

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# EXPERIMENTAL HARMONIC MOTION

A MANUAL FOR THE LABORATORY

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## PREFACE

THE subject of Harmonic Motion presents difficulties to many students. For some reason they fail to get any real grasp of the principles and in consequence dare not trust themselves to apply them to the simple examples they meet with in practical physics, even in those cases where the mathematical analysis is quite elementary. The present little volume is an attempt to meet the difficulty. The simplest parts of the theory of Harmonic Motion are considered in Chapter I. In Chapter II descriptions are given of a number of experiments which illustrate the principles of the subject. Where necessary, the theory of Chapter I is extended to meet the problem in hand. In each case the method has been found by experience to be such that a serious student can rely upon obtaining a result which he will feel is a satisfactory reward of not more than about two hours' work. In some cases it would be possible to devise arrangements which would secure greater accuracy, but in my class at the Cavendish Laboratory we have to be content with what may be described as Rapid Physics. We teach Mechanics, Heat, Light, Electricity and Magnetism in the same rooms so that nearly all the apparatus has to be such that it can be readily moved from place to place. The apparatus described is of a simple description, but this, I hope, will not be found to be a disadvantage. The simpler the apparatus, the less likely it is to go wrong—a consideration which will appeal to every demonstrator. I have tried to design the apparatus so that the physical realities may conform as closely as I could make them, under the existing laboratory limitations, to the ideal conditions contemplated in the mathematical theory.

The volume concludes with a few Notes dealing with some points in the mathematical theory of the subject.

In the preface to the Manual on "Experimental Elasticity," published in 1908, I expressed the hope that an "Experimental Optics" would be published in a few months and that, if life and health were given me, this might be followed by some volumes on other parts of physics. But in 1910 I experienced a severe

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nervous breakdown and I was absent from Cambridge till October 1911. Since then I have carried on the class, a work making great demands upon a demonstrator, since there have been sometimes over 50 students working in the class at the same time. Those who have “broken down” will perhaps understand that this work of teaching is a sufficient excuse for some delay in the appearance of the *Experimental Optics* and the other volumes. But the breakdown was much more than merely a rather trying experience for it has had results for which I have much cause to be thankful.

As the effort required to take up again all the threads of the partially written *Experimental Optics* and to complete the book would have been considerable, I decided, in making a fresh start, to take the rather easier course of publishing the work done in my class in *Experimental Harmonic Motion*. I still hope that the *Optics* is merely delayed; I have done something in the way of collecting materials for it, and part of the book is in type.

To make the work done in my class available to some extent to other teachers and students, I have in recent years communicated to the *Proceedings of the Cambridge Philosophical Society* accounts of several experiments in Optics and other parts of physics. Some other optical experiments are described in Vol. II. of the *Proceedings of the Optical Convention, 1912*.

I have authorised Messrs W. G. Pye and Co., of Cambridge, to supply apparatus made to my designs.

I have to thank Mr G. Stead, of Clare College, for very efficient help in the preparation of this volume from the manuscripts used in my practical class. Mr J. R. Airey, of St John's College, assisted in 1905 in some of the preliminary work, and my wife has also helped.

I cannot end this preface without expressing my thankfulness for the kindness and consideration of those who have assisted me in the teaching in my class and for the enthusiasm and friendship of the students. Above all, I must give thanks to God for giving me the restoration of health that has enabled me to write this book.

G. F. C. SEARLE.

1 *May* 1915.

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