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EXPERIMENTAL OPTICS

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A MANUAL FOR THE LABORATORY

BY

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PREFACE

THIS Manual describes the optical experiments done in my practical class at the Cavendish Laboratory. The students attending the class vary greatly as regards previous experience of optical work, and a wide range of experiments is required to satisfy their needs. One term in each year is now devoted entirely to Optics instead of to a combination of Electricity and Optics, and this change has led to some extension of the course in Optics, for we have now to be prepared to provide experiments for perhaps 70 students working simultaneously.

Much of Optics depends on purely geometrical principles and is independent of any particular theory of light. Where the actual nature of the vibrations is involved, I employ Maxwell's electromagnetic theory and use the simple methods due to Oliver Heaviside. Maxwell's kindness in showing me some experiments at the Cavendish Laboratory, when I visited it with my father as a birthday treat nearly 50 years ago, drew me to the Laboratory, where I have now taught for 37 years. It is therefore natural that I should use Maxwell's theory.

Optical measurements depend so closely upon the mathematical treatment of the subject that a good deal of mathematical work was inevitable. In order to shorten the accounts of the experiments, the theoretical discussions have, for the most part, been placed in chapters or in sections by themselves.

The experiments have been tested by use in the practical class; most of the "Practical examples" are the records of students' work. If I have used some of my own measurements, it is merely because they were at hand and not because any special accuracy is claimed for them.

The apparatus required for most of the experiments is of a simple nature and can be modified without loss of efficiency, provided that the optical parts be of good quality and that the measuring scales be accurate. The greater part of the apparatus used in my class has been made by Mr Lincoln and Mr Roff,

instrument makers at the Laboratory, by my laboratory assistants, or by myself.

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

I owe the method of Experiment 46 to the late Prof. R. B. Clifton, of the Clarendon Laboratory, Oxford.

Towards the preparation of the manuscript, much help has been given by my wife and also by Messrs G. M. B. Dobson, W. L. Carter, D. A. Keys, C. F. Sharman and C. Underwood. I am indebted to my colleague Mr G. Stead for his account of Experiment 8. The Cambridge Philosophical Society, Messrs W. G. Pye & Co., and Mr W. Wilson have lent blocks for several figures. Mr C. G. Tilley, my laboratory assistant, has kindly made a large number of the drawings. Many others have helped in other ways; my thanks are due to them all.

Miss J. M. W. Slater, Lecturer in Chemistry and Physics, Newnham College, assistant demonstrator in my practical class since 1919, has revised the proofs. Her intimate knowledge of the experiments, and of the difficulties encountered by students, has made her generous help of much value. The proofs have also been read by Mr O. A. Saunders, of Trinity College, and by Mr C. Underwood, of Peterhouse.

In the preface to the Manual on *Experimental Elasticity* published in 1908, I expressed the hope that an *Experimental Optics* would follow in a few months. But months have grown to years. A decline in strength culminated in 1910 in a severe breakdown which stopped all work for more than a year, and the preparation of the *Optics* for several years. When I recovered in 1915, the War was raging. On my return from the Royal Aircraft Establishment to Cambridge in 1919, the demands of the abnormal number of students prevented me from making a fresh start. Prof. Sir E. Rutherford came to the rescue and released me from the duty of teaching in the Long Vacation of 1920 and of subsequent years; his kindness has given me the opportunity to prepare the manuscript and to see the book through the press.

Restoration to health was essential to the completion of the work. I should be more than ungrateful if I did not confess that a little book, *The Living Touch*, in which Miss Dorothy

Kerin has recorded her own miraculous healing, was used to teach me that God does mighty works of healing to-day. From that time I have been given full health and strength. I could tell of others who have come to know, by happy experience, that "with His stripes we are healed."

May this book be for the glory of the great Creator, Who in the beginning said, "Let there be light."

G. F. C. SEARLE.

CAVENDISH LABORATORY,
CAMBRIDGE.
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