

**A SHORT ELEMENTARY TREATISE
ON EXPERIMENTAL AND
MATHEMATICAL OPTICS:
DESIGNED FOR THE USE OF
STUDENTS IN THE UNIVERSITY**

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A Short Elementary Treatise on Experimental and Mathematical Optics: Designed for the Use of Students in the University by Baden Powell

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BADEN POWELL

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THE REV. BADEN POWELL, M. A. F. R. S.

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DESIGNED FOR THE USE OF STUDENTS
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P R E F A C E.

IN offering a new treatise on any science, it may be considered incumbent on the author to point out wherein it differs from those already extant, and to explain the particular object in view in its publication.

In the present instance, the author's object is to facilitate the study of Elementary Optics, with immediate reference to the wants of the student, circumstanced as he at present is in the University of Oxford. To this particular case none of the existing treatises appear completely adapted; and though such is the discouragement under which physical studies labour in this place, that the mere character of the treatises produced on these branches, can, perhaps, very little affect their actual progress; yet that no obstacle may remain which is capable of being removed, he considers it worth while to try to remedy the complaints against existing works, whether as too large and too difficult on the one hand, or as incomplete and obscure on the other.

Of those works it is not his intention to speak in a tone of criticism, but merely to point out in what particulars he has been led to deviate from the methods adopted in them.

The treatise of Dr. Wood has long maintained its ground from the admirable soundness of its geometrical reasoning; but the character thus given to it has necessarily produced two results, that of excessive length in the establishment of the theorems of ordinary reflexion and

refraction, and of limiting the range of subject to those few points which are susceptible of this mode of demonstration: and in the most important of these, in point of fact, the author is obliged to deviate from the geometrical method, and though still in the disguise of a geometrical dress, to introduce, what are in reality, analytical processes.

In the later treatises of Mr. Coddington, especially in his first and smaller work, these evils have been in some degree remedied. In his new and larger work, the complete development of the theory of reflexion, refraction, and optical instruments is highly valuable, but too elaborate for the limited range of academical reading; whilst at present it is confined to these branches of the science.

The valuable "Treatise on Light and Vision," by the Rev. H. Lloyd, F. T. C. D. Dublin, 1831, is perhaps better suited to the purposes of general study, but appears, in several parts unnecessarily lengthy: and does not extend to the higher properties of light.

On the other hand, the masterly work of Sir J. Herschel, even were it to be had in a separate form, is hardly of a description to suit the purposes of the academical student, at least until academical study shall have acquired a much higher character than it can at present boast: whilst the popular treatises by Sir D. Brewster, in the Cabinet Cyclopaedia and Library of Useful Knowledge, from the professed avoidance of mathematics, are of course deprived of all that comprehensive brevity and perspicuity which results from the adoption of that valuable instrument of investigation; and in regard to the

more recondite experimental results, the student would feel rather overwhelmed with the multitude of details, than enlightened by a view of general truths.

In the present work it has been the author's endeavour to preserve the utmost degree of brevity consistent with perspicuity, and to unite this with the greatest simplicity in the method of pursuing the investigation. To effect these objects he has adopted throughout the analytical method, as that which conducts the student most easily and rapidly to the comprehensive principles of the science, at the same time taking care to point out those propositions which admit of elegant geometrical constructions. The immense advantage gained in this way, in point of conciseness, and avoiding those repetitions which occur in the separate establishment of the individual cases, will clearly appear upon comparison: and it is presumed whatever tends thus to abridge the labour of acquiring elementary knowledge, must be regarded as no inconsiderable aid to the advancement of the study. The analytical methods made use of, never extend beyond the very first elements of the differential and integral calculus. And it is always an easier process for the student first to acquire such knowledge before he enters upon the study of the mixed branches, than to proceed with those parts which may be treated (though in a very disadvantageous form) by the application of geometry; when, after all, he must at a certain stage have recourse to analysis, with all the evils of a change of system, and an unnecessary loss of time and trouble in the first instance. One source of abridgement has been found in the omission of the steps of algebraical processes; but these are generally of such

a kind as will be quite obvious, and are properly passed over in a work whose specific business is not to *teach* mathematical processes, but supposing them already familiar, to employ them as instruments of physical investigation.

The range of subject which it has been attempted to include in this treatise, is considerably wider than that to which elementary works of the same description have hitherto been usually confined. This appears to be demanded by the existing state of knowledge; and the introduction of the more attractive subjects of recent discovery will not fail to act as an additional stimulus to the learner, to master the difficulties of the preliminary parts. It has hitherto been customary to draw a broad line of distinction between what were called *mathematical, or common* optics, and *physical* optics: a distinction *wholly arbitrary*, and not a little repressive of the student's advance into the latter portion of the subject. Reflexion and refraction are as much *physical* properties of light, as polarization and double refraction. It so happens that from the simplicity of the laws which regulate the two former, a multitude of important consequences are deduced by mere mathematical reasoning, on the assumption of straight lines representing the directions of the rays; but this constitutes no essential distinction: and the only real division of the subject is that which would be occasioned by the necessity of introducing a physical theory of the nature of light; and a reference to such a theory has perhaps been regarded as inseparable from the discussion of polarization, coloured rings, &c. That these subjects, however, are