REFRACTION and MOT

REFRACTION

Correlated with Optics and Physiological Optics

and

MOTILITY

Limited to Heterophoria

By

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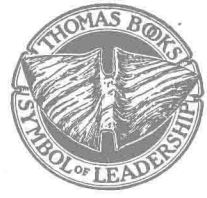

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REFRACTION *and* MOTILITY

TO

JAMES JOSEPH REGAN, M.D.

who has done more than anyone to
spread knowledge of what we like to call
"The best method of measuring errors of refraction"

PREFACE

THERE are many excellent texts covering refraction and motility—why write another? The writer has had 35 years service on the American Board of Ophthalmology and has had other unusual opportunities to form an opinion. It is his considered judgment that since the founding of the Board enormous progress has been made in teaching ophthalmology in all subjects except **refraction and motility.**

The writer has asked himself the question: Why is the average eye specialist so deficient in what is the major job of his practice? Is it possible that the system is deficient in some respects that could be remedied? Study of this problem has led the writer to the conclusion that in three ways the current text-books fail to produce the desired results.

(1) These text-books all devote considerable space to the fundamental principles of optics and of physiological optics.

Nevertheless 35 years experience on the American Board of Ophthalmology has shown that the average ophthalmologist of good training has not learned and digested this part of the subject. This has raised the question whether it might be presented in a different way that would produce better results.

The question is, would the average student get a more practical and useful grasp of those parts of optics which are made use of in daily practice, if presented without mathematical formulas—simply learning how the lenses, prisms, mirrors, and the eye itself act on light rays to form images. **After all, it is the image formation on the retina that is of major importance and significance.**

(2) The second way in which current texts fail to produce the desired results is in teaching the student how to measure errors of refraction with the greatest precision. This is far more important than (1). It is a fact that many who have an excellent grasp of the fundamental optical principles and formulas do not do good refractions. **They have never been**

taught the refinements of subjective methods. It is also a fact that some who do not know much about optics are yet able to make good measurements of refractive errors. The space devoted to purely practical techniques, especially the subjective methods of measuring the refraction, is comparatively scanty in the texts. It has seemed to the writer that something of importance might be accomplished here.

(3) The third deficiency is in the measurement and treatment of motility. The major texts on motor neuro-ophthalmology devote most of their space to the other types of motor defects rather than those which are treated in connection with, and at the same time as, the refractive errors. Only a very few devote much of their space to the phorias and their treatment. And this is a subject on which unanimity of opinion has not yet been reached so that contradictory views will have to be weighed by the student.

The writer has felt that an attempt to meet, even imperfectly, these three deficiencies would justify another text on the subject.

This book will be found to devote little space to those parts of the subject that are so well presented in the standard works. There is no need—nor excuse—for repeating them. Reviewers and critical readers will see these omissions and are asked to understand and condone them and concentrate their criticisms on the three subdivisions which are the sole excuse for this volume.

This volume does not aim to supplant but only to make up certain deficiencies which constitute an important but a comparatively brief section of the subject. Thus two important books of some 300 to 380 pages devote less than 10 pages to subjective methods of measuring errors of refraction and motility. These are first-rate books found on any list of texts recommended for students and they cover the other sections of the subject in masterly fashion. Students who may use this book must supplement it by studying one or two of these standard texts for those parts not covered here.

The author's treatment of the subjects is from a special point of view, long a hobby of his. It is, that in teaching medicine

in any of its departments, a predominant function of the teacher is the **selection of what is to be omitted** from the curriculum.

Much must be omitted that one would fain include. Take, for example, optics. This is a large and important field of science with many ramifications. You say, "The more an eye specialist knows about optics the better." Granted, with one proviso. If to know optics thoroughly it is necessary to take so much time and study that other indispensable subjects must be neglected, then the plan is definitely bad and ill-advised. To keep all subjects in proper proportion is the essence of wise planning in any educational field.

The optical part of the book is planned with this in mind. To give the student the most serviceable and useful grasp of the subject which he can get in the time allotted, omitting much that is interesting, much that is valuable, but very little that is indispensable, indispensable that is to the successful dealing with errors of refraction in daily practice. Quite inadequate for the research worker or investigator.

Briefly stated, the aim of this book is to improve the work of the average ophthalmologist in the major subjects of refraction and motility by supplementing the standard works on the subjects.

Grateful acknowledgment is made to the American Optical Company for their generous contribution through Dr. Paul Boeder of a number of drawings for the illustrations, and to Dr. Boeder for advice and assistance in matters pertaining to optics.

W. B. L.

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REFRACTION *and* MOTILITY

PART I

Optics and Physiological Optics

CHAPTER I

Light. Waves. Rays. Vergence of Rays. Diopters. Focus. Combination of Lenses.

THE writer has urged that it is possible, and in many cases desirable, to teach a student to measure and treat errors of refraction without going through the process of trying to learn physical optics as usually taught, that is, as based on the Gauss theorems mathematically expressed in equations involving nodal points, principal points, anterior and posterior foci, etc. Gullstrand calls them "so much useless ballast" (*Physiological Optics*, Helmholtz, Am. Ed. Vol. I, Paragraph 287).

This subject is of immense historical interest and no one can be deemed a well-educated ophthalmologist who does not have some familiarity with it. But experience shows that the majority of fairly successful practitioners could not pass a moderately stiff examination in mathematical, physical and physiological optics, their success **proves** that it is **not** indispensable.*

It seems almost obligatory, therefore, that the writer should point out more definitely how the subject can be taught without equations and without a mathematical approach and following Gullstrand rather than Gauss in dealing with image formation.

Conceptions of the **nature of light** depend on conceptions of the nature of matter. Matter consists of molecules and molecules are made up of atoms, few or many—thousands in large complicated molecules. The properties of any particular kind of matter, that is of any particular kind of molecule, depend on the kinds, the number and the arrangement of the atoms which make up the molecule. There is a limited number of different kinds of

* Prof. A. Seigrist of Berne expressed a similar idea in the preface to his book on "*Refraktion und Akkommodation des Auges*," Berlin, Springer, 1925.