LYLE

NEURO-OPHTHALMOLOGY — Second Ed

THOMAS

NEURO–OPHTHALMOLOGY

By

DONALD J. LYLE, B.S., M.D., F.A.C.S.

Professor and Director of the Department of Ophthalmology
College of Medicine, University of Cincinnati
Director of Ophthalmologic Service at Cincinnati General Hospital
Dunham Hospital, Drake Hospital, Children's Hospital
Attending Ophthalmologist to Good Samaritan Hospital
and Christ Hospital
Chief Clinician, Ophthalmologic Service Outpatient Department
Cincinnati General Hospital
Consulting Ophthalmologist to the Children's Convalescent Home
Cincinnati, Ohio
Senior Consultant to Veterans Hospital, Dayton, Ohio

CHARLES C THOMAS · PUBLISHER
Springfield · Illinois · U.S.A.

CHARLES C THOMAS · PUBLISHER
BANNERSTONE HOUSE
301-327 EAST LAWRENCE AVENUE, SPRINGFIELD, ILLINOIS, U.S.A.

Published simultaneously in the British Commonwealth of Nations by
BLACKWELL SCIENTIFIC PUBLICATIONS, LTD., OXFORD, ENGLAND

Published simultaneously in Canada by
THE RYERSON PRESS, TORONTO

First Edition, First Printing, 1945
First Edition, Second Printing, 1947
Second Edition, First Printing, 1954

Library of Congress Catalog Card Number: 54-10788

Printed in the United States of America

NEURO-OPHTHALMOLOGY

PREFACE

"IN RECENT YEARS the ophthalmic surgeon, the earliest surgical specialist, and the neurosurgeon, the latest, have from opposite directions come to meet at the barrier of the optic foramen—each somewhat hesitant to trespass on the other's field of work. They, however, have much to learn from one another and between them an answer should be forthcoming to the moot questions."[1]

"The ophthalmic surgeon because of his ability to restore sight to the blind holds a high position in popular esteem. But ophthalmologists have traditionally restricted their surgical field to the orbit and have not ventured to pursue to their source the disorders of vision whose causes lie within the skull. Had they so pursued the source of choked disc or the source and causes of the primary optic atrophies, they might well enough have long preceded the neurosurgeon in those tasks which permit him to share in the gratifying occupation of restoring vision."[2]

I know of no better introduction to the second edition of this book than to quote these two very appropriate passages from the writings of Harvey Cushing.

Though neuro-ophthalmology was generally neglected by the ophthalmologist it has gained great impetus in the last few years as witness the current programs, discussions, papers and books on the subject. The ophthalmologist has awakened to the fact that the eye is a projection of the brain which has perforce moved toward the surface in order to contact light and perceive images of the outer world. He also has taken cognizance of the fact that the blood supply and drainage is also by way of the cranial cavity. He is aware that the eye is frequently influenced by, and reflects, the various affections of the central nervous system.

Although several excellent treatises on neuro-ophthalmology have been published since the first edition of this book, I feel that certain phases of this comprehensive subject should be further stressed or discussed more in detail, together with recent advances in investigation, and clinical concepts.

In this edition basic knowledge of the subject is further amplified. I feel that pertinent data concerning the anatomy, with histologic detail when necessary and with outline of the normal function of these structures, is imperative for better understanding.

This should be supplemented by a knowledge of pathologic processes, with histo-pathologic studies when necessary, and with detailed investigation of the dysfunction produced. Presenting the material in this manner will be the endeavor throughout this book.

To many, I am indebted and deeply grateful. Soon after the first edition was

---

[1] Harvey Cushing and Louise Eisenhart: *Meningiomas*. Springfield, Charles C Thomas, 1938, p. 283.

[2] Harvey Cushing: *Intracranial Tumors*. Springfield, Charles C Thomas, 1932, pp. 69-70.

published Percival Bailey suggested improvements for a second edition, and with his usual painstaking detail noted the changes he would suggest. These suggestions have been carried out. Frank Mayfield and his associates, Edward Lotspeich and Curwood Hunter, have furnished clinical material and invesigative help in abounding and continuous amount. A number of the illustrations are from their cases.

Joseph Evans has granted me many privileges in the Division of Neurosurgery. Many of the new illustrations are from his division. I have profited by histopathologic studies with Mark Scheinker and have used illustrations from his publications. Alphonse Vonderahe continues his help as he did with my first effort. Many of the old illustrations were culled from his collection. Howard McIntyre has provided a constant source of knowledge and material.

Joseph Homan, Director of the Department of Medical Arts, has given unstintingly of his great ability toward improving the illustrations. Elsworth Cochran and other members of the department have continued their aid. Miss Beatrice Woods, Mrs. Nancy Burnham Johnson and Mrs. Margaret Cook have provided outstanding illustrations.

Indexing of over 3200 bibliographic references, begun by Mrs. Carmenina Tomassini was continued by Lynn Zipin. Mrs. Tomassini helped with translation.

Preparation of the manuscript for the second edition, begun by Mrs. Kathleen Allen, has been continued and finished by Miss Dorothy Roberts. I wish to thank Mrs. Robert C. Nelson for help with the index.

Once more it is my pleasure to acknowledge my gratitude to Charles C Thomas and efficient staff for continuing their friendly offices in the production of this second edition.

D. J. L.

CONTENTS

NEURO-OPHTHALMOLOGY

Chapter I

THE VISUAL SYSTEM—THE RETINA

IN THE lowest forms of animal life unicellular or multicellular organisms have the faculty, localized or scattered throughout the entire protoplasm, of sensitivity to light. The amoeba, when placed in a bright light with an adjacent area of darkness, will project its pseudopodia and, upon finding the dark area which corresponds more to its habitat, move into it. The earthworm, among other dark-adapted organisms, possesses the same expression of negative phototropism. Higher forms increasingly localize and develop the response to light perception in certain surface areas or spots—other areas losing this faculty. Eyes of invertebrates may go so far as to develop surface plate, pit or cup formation even to the development of a lens system.

When the vertebrate level is achieved, the control of vision is shifted from the surface to the central nervous system. In lower forms of vertebrates the light penetrates the transparent surface and deeper tissues to reach the photoreceptors in the primitive central nervous system. As evolution proceeds pigment appears and size increases, necessitating the growth of the photosensitive portion of the central nervous system to the surface to meet the light which is unable to penetrate. This is the beginning of the primitive eye, the photoreceptor maintaining its association with the brain of which it is a part (1) (Fig. 1).

As evolution continues the flat boss or ocular plate is indented and cupped and becomes recessed in the head or fore end of the body. Further development constricts the cup margin, fills the chamber with transparent substance and the rim with a primitive lens. Over this the surface becomes transparent to form the cornea. Muscles develop outside the eye to move it to better position for vision and inside the eye to control the size of the pupil and the focus of the lens. Eyelids and other accessory structures are added along with further development of the retina in the interest of better vision.

Embryologic development follows a similar pattern. The development of the human eye, a good example of the vertebrate eye, proceeds through analogous stages. From the fore end of the fore brain the optic vesicle pushes out until it makes contact with the surface ectoderm. It then, having incited the formation of the lens vesicle from its surface contact, invaginates into a two-layered optic cup attached to the fore brain by a tube, the optic stalk, through which, later in development, the axons comprising the optic nerve will pass to the brain. The lens vesicle follows the formation of the optic cup and closely fills the cup margin. The inner layer of the optic cup develops into the layers of the retina from which the optic nerve fibers pass to the brain. The outer layer of the optic cup becomes the pigment layer of the retina (Fig. 2). The lens becomes solid by accretion and from it and the retina the primary vitreous forms. The cornea

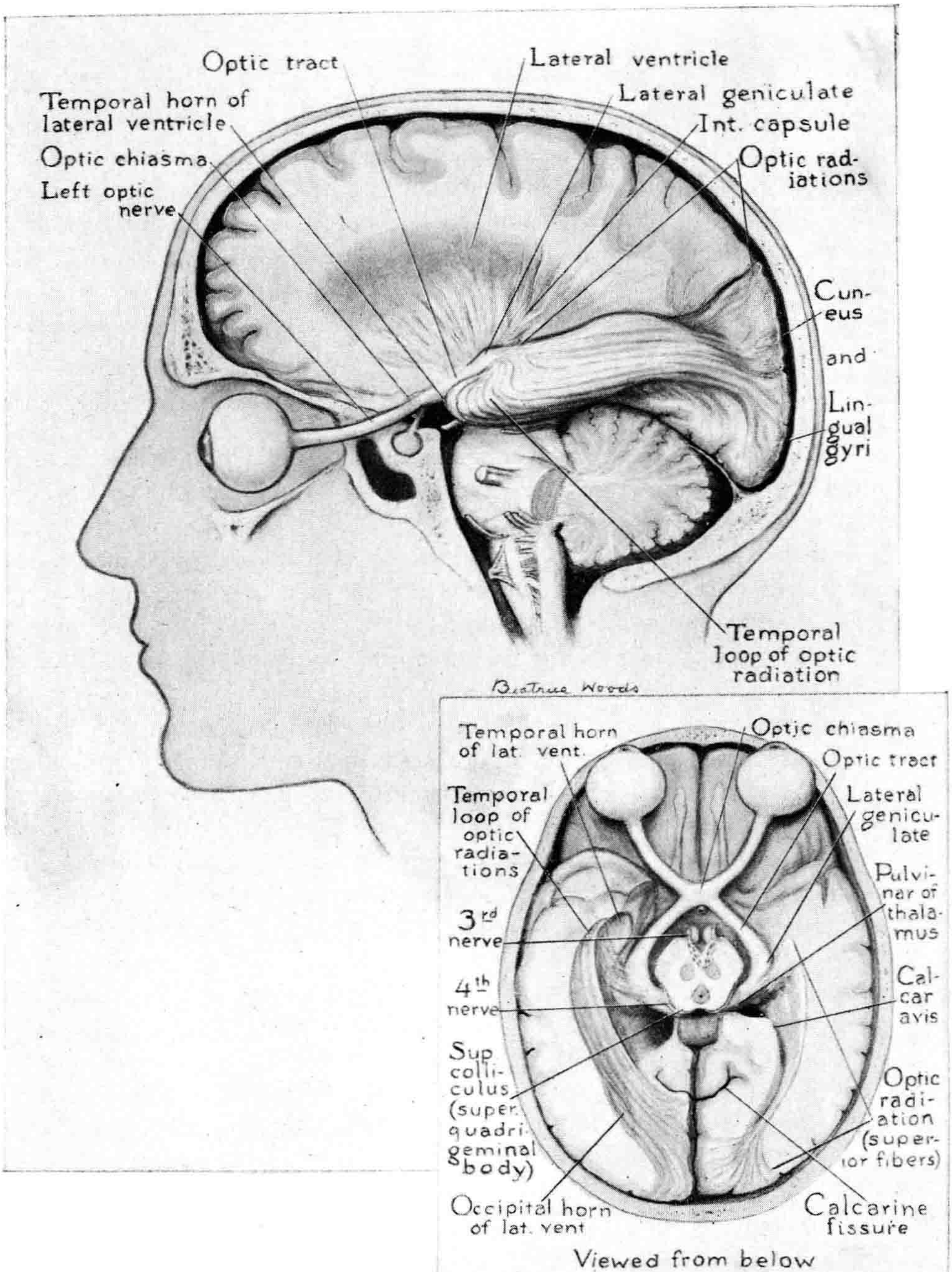

FIG. 1. Drawing of dissection of the brain demonstrating the visual system.

is derived from the surface ectoderm. In this manner the refractive media and the photoreceptive neurons are developed. Other tissues and structures form around this visual matrix to perfect its function (3).

It is necessary to remember that the human eye is the end organ or peripheral receptor, in this case photoreceptor, developed as a projection of the brain with which it is connected by an association tract, the optic nerve and its extensions. To this photoreceptor organ of neuro-ectodermal origin, other structures have been added to improve vision. Through development the primitive visual receptor has been recessed into an orbital cavity for protection and a refractive

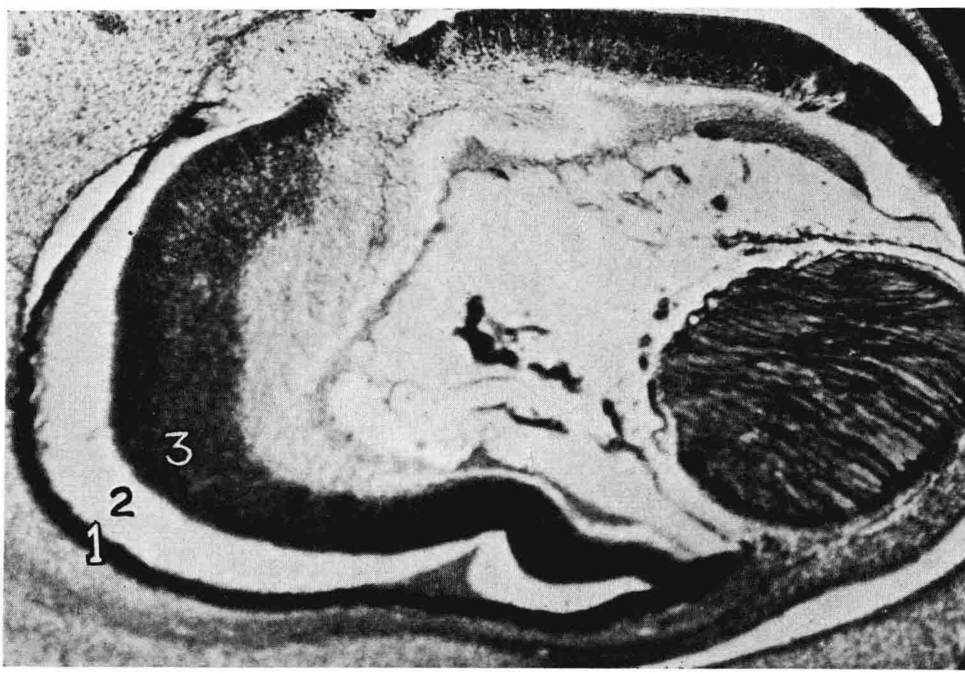

FIG. 2. Section of eye of human embryo (77 mm. early fetal period) showing closing of primary optic vesicle. 1. Outer pigment layer of optic cup. 2. Closing cleft of primary optic vesicle. 3. Inner differentiating retinal layer of optic cup.

system from somatic surface ectoderm has been developed and placed before it for better vision. This transparent media is composed of the cornea and lens, the aqueous and vitreous. Finally, the organ has been endowed with movement and the ability to focus. The walls have been given support and an elaborate blood supply has been developed from the mesodermal elements to provide exceptional nourishment. All of this to accomplish better vision.

The photoreceptors of the retina, those cells which react to light, form and color, are the rods and the cones (Fig. 3). These structures are based upon a thin external limiting membrane through which the rods send fibers to their nuclei in the outer nuclear layer. No space separates the cones from their