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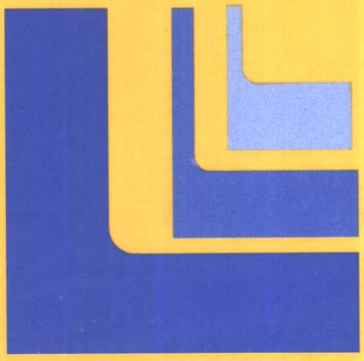
15

fifteenth edition

眼科学总论

General Ophthalmology

Daniel Vaughan
Taylor Asbury
Paul Riordan-Eva



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. . . Now do you not see that the eye embraces the beauty of the whole world? It is the lord of astronomy and the maker of cosmography; it counsels and corrects all the arts of mankind; it leads men to the different parts of the world; it is the prince of mathematics, and the sciences founded on it are absolutely certain. It has measured the distances and sizes of the stars; it has found the elements and their locations; it . . . has given birth to architecture, and to perspective, and to the divine art of painting. Oh excellent thing, superior to all others created by God! . . . What peoples, what tongues will fully describe your true function? The eye is the window of the human body through which it feels its way and enjoys the beauty of the world. Owing to the eye the soul is content to stay in its bodily prison, for without it such bodily prison is torture.

—Leonardo da Vinci (1452–1519)

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Daniel Vaughan, MD
Clinical Professor of Ophthalmology
University of California, San Francisco
Governor, Francis I. Proctor Foundation for
Research in Ophthalmology, San Francisco

Taylor Asbury, MD
Professor of Ophthalmology
Interim Director, Department of Ophthalmology
College of Medicine
University of Cincinnati, Ohio

Paul Riordan-Eva, FRCS, FRCOphth
Consultant Ophthalmologist
Bromley Hospitals NHS Trust, Kent, UK
Honorary Consultant Neuro-ophthalmologist
National Hospital for Neurology and Neurosurgery
and King's College Hospital, London, UK

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Laurel V. Schaubert

This edition of
General Ophthalmology
is dedicated to
Dr. Crowell Beard

Authors

Taylor Asbury, MD
Professor of Ophthalmology, Interim Director, Department of Ophthalmology, College of Medicine, University of Cincinnati, Ohio
Strabismus; Genetic Aspects of Ocular Disorders; Ocular & Orbital Trauma

Roderick Biswell, MD
Associate Clinical Professor of Ophthalmology, University of California, San Francisco
Cornea

David F. Chang, MD
Associate Clinical Professor of Ophthalmology, University of California, San Francisco
Ophthalmologic Examination

J. Brooks Crawford, MD
Clinical Professor of Ophthalmology, University of California, San Francisco
Lids, Lacrimal Apparatus, & Tears; Conjunctiva; Uveal Tract & Sclera; Retina

Emmett T. Cunningham, Jr., MD, PhD, MPH
Assistant Professor and Co-Director, Uveitis Service, Department of Ophthalmology, and Francis I. Proctor Foundation for Research in Ophthalmology, University of California, San Francisco
Internet: emmett@itsa.ucsf.edu
Uveal Tract & Sclera

Philip P. Ellis, MD
Professor, Department of Ophthalmology, University of Colorado Health Sciences Center, Denver
Ophthalmic Therapeutics

Eleanor E. Faye, MD, FACS
Ophthalmologic Consultant, Continuing Education, The Lighthouse, Inc., New York; Attending Ophthalmologist Emeritus, Manhattan Eye and Ear Hospital, New York
Internet: efaye@lighthouse.org
Low Vision; Appendix I. Visual Standards; Appendix II. Practical Factors in Illumination; Appendix III. Resources for Special Services for the Blind & Visually Impaired

Frederick T. Fraunfelder, MD
Professor, Department of Ophthalmology, Casey Eye Institute, Oregon Health Sciences University, Portland
Internet: fraunfel@ohsu.edu
Ophthalmic Therapeutics

Douglas R. Fredrick, MD
Assistant Clinical Professor of Ophthalmology, University of California, San Francisco
Strabismus; Special Subjects of Pediatric Interest

Elizabeth M. Graham, FRCP, FRCOphth
Consultant Medical Ophthalmologist, St. Thomas Hospital and National Hospital for Neurology and Neurosurgery, London, UK
Ocular Disorders Associated With Systemic Diseases

Robert A. Hardy, MD
Associate Clinical Professor of Ophthalmology, University of California School of Medicine, San Francisco; Chief of Ophthalmology, Merrithew Memorial Hospital, Martinez, California
Retina

Richard A. Harper, MD
Assistant Professor of Ophthalmology, University of Arkansas for Medical Sciences, Little Rock
Internet: raharper@acer.uams.edu
Lens

William G. Hodge, MD, MPH, FRCS(C)
Assistant Professor, University of Ottawa Eye Institute, Ottawa, Ontario, Canada
Internet: whodge@ogh.on.ca
Immunologic Diseases of the Eye

William F. Hoyt, MD
Professor of Ophthalmology, Neurology, and Neurosurgery, University of California, San Francisco
Neuro-Ophthalmology

Connor O'Malley, MD
San Jose, California
Internet: ocutom.conor@aol.com
Vitreous

Paul Riordan-Eva, FRCS, FRCOphth
Consultant Ophthalmologist, Bromley Hospitals NHS Trust, Kent, UK; Honorary Consultant Neuro-Ophthalmologist, National Hospital for Neurology and Neurosurgery and King's College Hospital, London, UK
Internet: PaulREva@aol.com
Anatomy & Embryology of the Eye; Glaucoma; Neuro-ophthalmology; Genetic Aspects of Ocular Disorders; Optics & Refraction; Glossary of Terms Relating to the Eye; Abbreviations & Symbols Used in Ophthalmology

Michael D. Sanders, FRCP, FRCS
Consultant Ophthalmologist, National Hospital for Neurology and Neurosurgery, London, UK; Lecturer, University of London
Ocular Disorders Associated With Systemic Diseases

James J. Sanitato, MD
Director of Education, Laser Centers of America, Cincinnati, Ohio
Ocular & Orbital Trauma

Ivan R. Schwab, MD
Professor of Ophthalmology, University of California, Davis
Internet: irschwab@ucdavis.edu
Conjunctiva

John P. Shock, MD
Professor and Chairman, Department of Ophthalmology; Director, Jones Eye Institute, University of Arkansas for Medical Sciences, Little Rock
Internet: jshock@acer.uams.edu
Lens

John H. Sullivan, MD
Clinical Professor of Ophthalmology, University of California, San Francisco
Internet: jsulleye@flash.net
Lids, Lacrimal Apparatus, & Tears; Orbit

Daniel Vaughan, MD
Clinical Professor of Ophthalmology, University of California, San Francisco; Governor, Francis I. Proctor Foundation for Research in Ophthalmology, San Francisco
Glaucoma; Differential Diagnosis of Common Causes of Inflamed Eye

James Berry Wise, MD
Clinical Professor of Ophthalmology, University of Oklahoma, Oklahoma City
Lasers in Ophthalmology

John P. Whitcher, MD, MPH
Professor of Clinical Ophthalmology, University of California, San Francisco; Interim Director, Francis I. Proctor Foundation for Research in Ophthalmology, San Francisco
Lids, Lacrimal Apparatus, & Tears; Preventive Ophthalmology; Blindness

Preface

For four decades, *General Ophthalmology* has served as the most concise, current, and authoritative review of the subject for medical students, ophthalmology residents, practicing ophthalmologists, nurses, optometrists, and colleagues in other fields of medicine and surgery, as well as health related professionals. The fifteenth edition has been revised and updated in keeping with that goal. It contains the following changes from the fourteenth edition:

- Major revisions of the chapters **Uveal Tract & Sclera, Low Vision,** and **Ophthalmic Therapeutics** and **Appendices I–III**
- Significant changes in the chapters **Neuro-ophthalmology, Lasers in Ophthalmology,** and **Ocular Disorders Associated With Systemic Diseases**

As in past revisions, we have relied on the assistance of many authorities in special fields who have given us the benefit of their advice. In particular, we wish to thank our new author, Emmett T. Cunningham, Jr.

Daniel Vaughan, MD
Taylor Asbury, MD
Paul Riordan-Eva, FRCS, FRCOphth

November, 1998

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Margot Riordan-Eva
Lionel Sorenson
Phillips Thygeson

Differential Diagnosis of Common Causes of Inflamed Eye[1]

	Acute Conjunctivitis	Acute Iritis[2]	Acute Glaucoma[3]	Corneal Trauma or Infection
Incidence	Extremely common	Common	Uncommon	Common
Discharge	Moderate to copious	None	None	Watery or purulent
Vision	No effect on vision	Slightly blurred	Markedly blurred	Usually blurred
Pain	None	Moderate	Severe	Moderate to severe
Conjunctival injection	Diffuse; more toward fornices	Mainly circumcorneal	Mainly circumcorneal	Mainly circumcorneal
Cornea	Clear	Usually clear	Steamy	Change in clarity related to cause
Pupil size	Normal	Small	Moderately dilated and fixed	Normal or small
Pupillary light response	Normal	Poor	None	Normal
Intraocular pressure	Normal	Normal	Elevated	Normal
Smear	Causative organisms	No organisms	No organisms	Organisms found only in corneal ulcers due to infection

[1]Other less common causes of red eyes are noted in the text.
[2]Acute anterior uveitis.
[3]Angle-closure glaucoma.

ABBREVIATIONS & SYMBOLS USED IN OPHTHALMOLOGY

A or Acc	Accommodation
Ax or x	Axis of cylindric lens
Bl or BO	Base-in or base-out (prism)
CF	Counting fingers
C or Cyl	Cylindric lens or cylinder
D	Diopter (lens strength)
E	Esophoria
EOG	Electro-oculography
EOM	Extraocular muscles or movements
ERG	Electroretinography
fc	Footcandles
H	Hyperphoria
HM	Hand movements
HT	Hypertropia
IOP	Intraocular pressure
J1, J2, J3, etc.	Test types (Jaeger) for testing reading vision
KP	Keratic precipitates
LP	Light perception
L proj	Light projection
LR	Light reaction
N	Nasal
NLP	No light perception
NPC	Near point of convergence
OD (R, or RE)	Oculus dexter (right eye)
OS (L, or LE)	Oculus sinister (left eye)
OU	Oculi unitas (both eyes)
PD	Interpupillary distance
PH	Pinhole
PRRE	Pupils round, regular, and equal
S or Sph	Spherical lens
ET	Esotropia (with L or R)
VA	Visual acuity
VE	Visual efficiency
VER	Visual evoked response
X	Exophoria
XT	Exotropia
+	Plus or convex lens
−	Minus or concave lens
⌒	Combined with
∞	Infinity (6 meters [20 feet] or more distance)
°	Degree (measurement of strabismus angle)
Δ	Prism diopter

Contents

Anatomy & Embryology of the Eye

1

Paul Riordan-Eva, FRCS, FRCOphth

A thorough understanding of the anatomy of the eye, orbit, visual pathways, upper cranial nerves, and central pathways for the control of eye movements is a prerequisite for proper interpretation of diseases having ocular manifestations. Furthermore, such anatomic knowledge is essential to the proper planning and safe execution of ocular and orbital surgery. Whereas most knowledge of these matters is based on anatomic dissections, either postmortem or during surgery, noninvasive techniques—particularly MRI and ultrasonography—are increasingly providing additional information. Investigating the embryology of the eye is clearly a more difficult area because of the relative scarcity of suitable human material, and thus there is still great reliance on animal studies, with the inherent difficulties in inferring parallels in human development. Nevertheless, a great deal is known about the embryology of the human eye, and—together with the recent expansion in molecular genetics—this has led to a much deeper understanding of developmental anomalies of the eye.

I. NORMAL ANATOMY

THE ORBIT (Figures 1–1 and 1–2)

The orbital cavity is schematically represented as a pyramid of four walls that converge posteriorly. The medial walls of the right and left orbit are parallel and are separated by the nose. In each orbit, the lateral and medial walls form an angle of 45 degrees, which re-

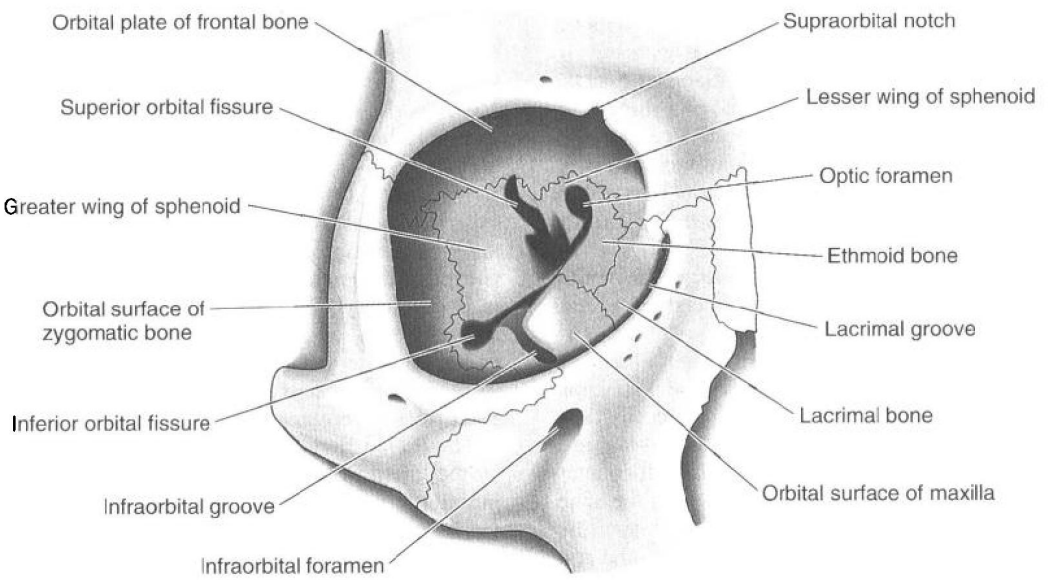

Figure 1–1. Anterior view of bones of right orbit.

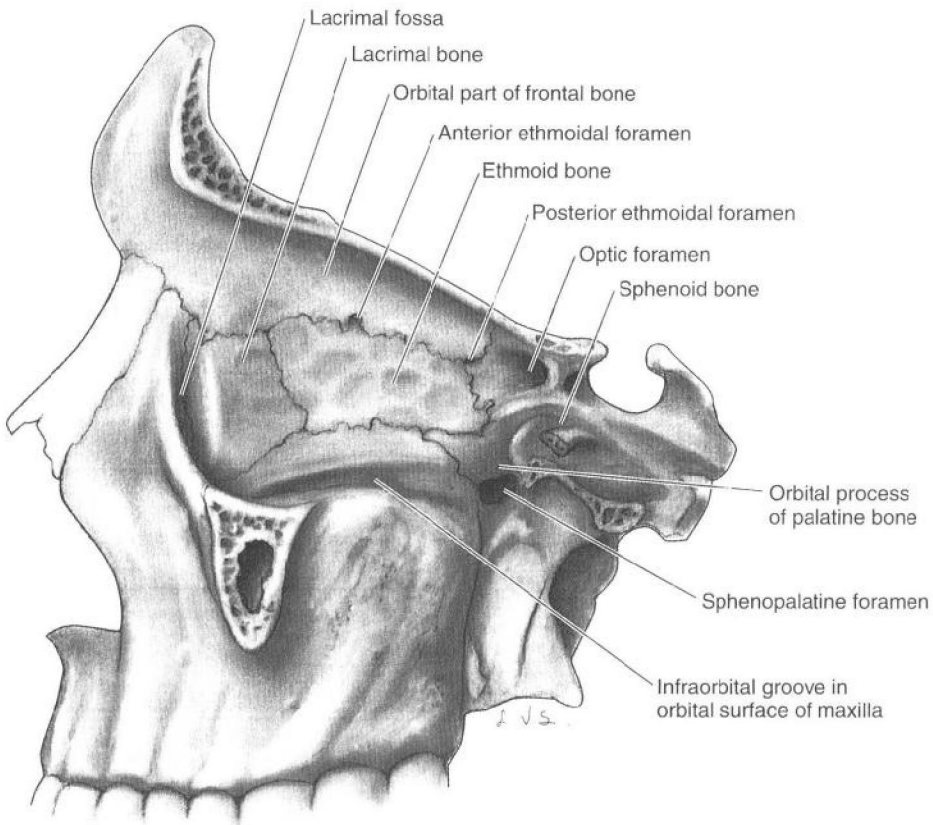

Figure 1–2. Medial view of bony wall of left orbit.

sults in a right angle between the two lateral walls. The orbit is compared to the shape of a pear, with the optic nerve representing its stem. The anterior circumference is somewhat smaller in diameter than the region just within the rim, which makes a sturdy protective margin.

The volume of the adult orbit is approximately 30 mL, and the eyeball occupies only about one-fifth of the space. Fat and muscle account for the bulk of the remainder.

The anterior limit of the orbital cavity is the **orbital septum,** which acts as a barrier between the eyelids and orbit (see below).

The orbits are related to the frontal sinus above, the maxillary sinus below, and the ethmoid and sphenoid sinuses medially. The thin orbital floor is easily damaged by direct trauma to the globe, resulting in a "blowout" fracture with herniation of orbital contents into the maxillary antrum. Infection within the sphenoid and ethmoid sinuses can erode the paper-thin medial wall (lamina papyracea) and involve the contents of the orbit. Defects in the roof (eg, neurofibromatosis) may result in visible pulsations of the globe transmitted from the brain.

Orbital Walls

The roof of the orbit is composed principally of the orbital plate of the **frontal bone.** The lacrimal gland is located in the lacrimal fossa in the anterior lateral aspect of the roof. Posteriorly, the lesser wing of the **sphenoid bone** containing the optic canal completes the roof.

The lateral wall is separated from the roof by the superior orbital fissure, which divides the lesser from the greater wing of the **sphenoid bone.** The anterior portion of the lateral wall is formed by the orbital surface of the **zygomatic (malar) bone.** This is the strongest part of the bony orbit. Suspensory ligaments, the lateral palpebral tendon, and check ligaments have connective tissue attachments to the lateral orbital tubercle.

The orbital floor is separated from the lateral wall by the inferior orbital fissure. The orbital plate of the **maxilla** forms the large central area of the floor and is the region where blowout fractures most frequently occur. The frontal process of the **maxilla** medially and the **zygomatic bone** laterally complete the inferior orbital rim. The orbital process of the **palatine bone** forms a small triangular area in the posterior floor.

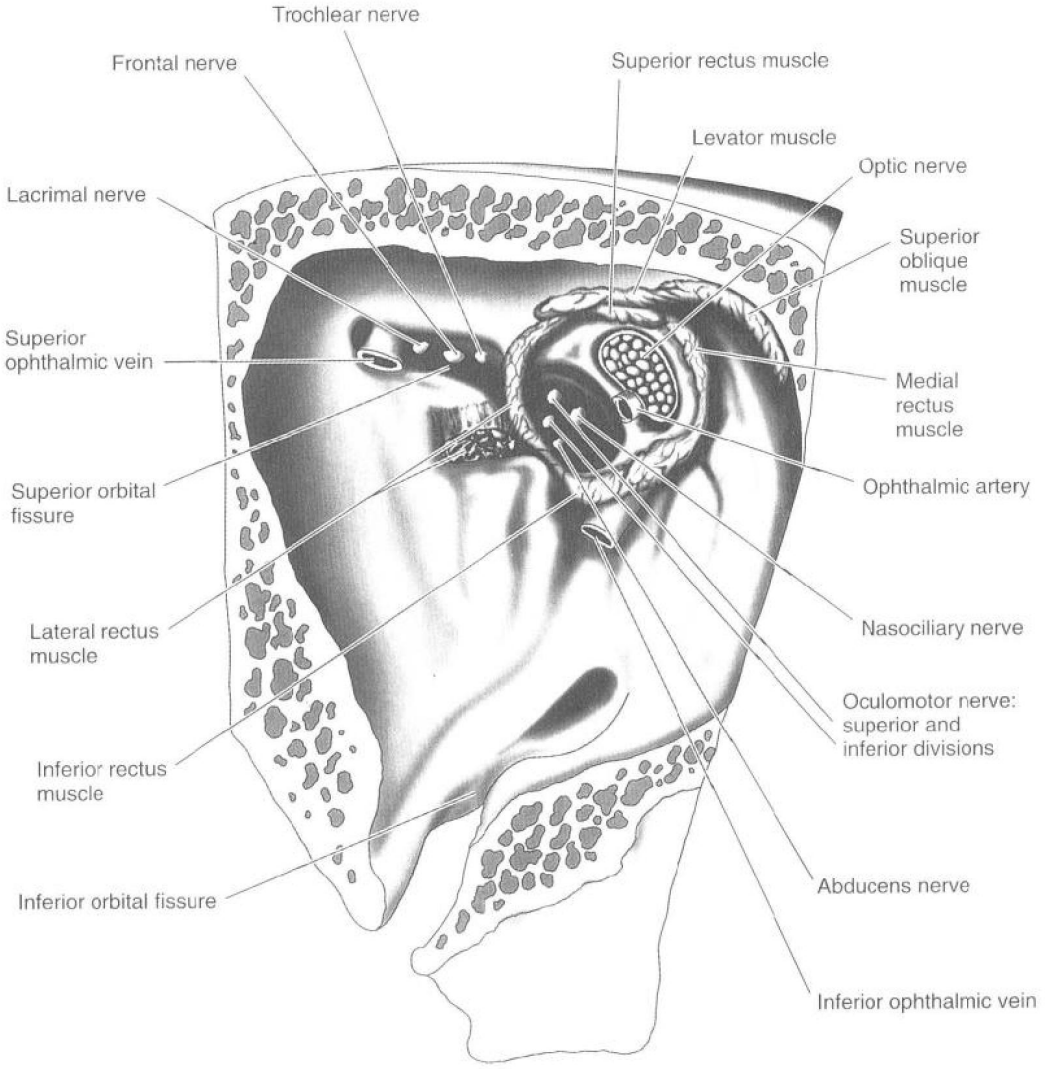

Figure 1–3. Anterior view of apex of right orbit.

The boundaries of the medial wall are less distinct. The **ethmoid bone** is paper-thin but thickens anteriorly as it meets the **lacrimal bone.** The body of the **sphenoid** forms the most posterior aspect of the medial wall, and the angular process of the **frontal bone** forms the upper part of the posterior lacrimal crest. The lower portion of the posterior lacrimal crest is made up of the **lacrimal bone.** The anterior lacrimal crest is easily palpated through the lid and is composed of the frontal process of the **maxilla.** The lacrimal groove lies between the two crests and contains the lacrimal sac.

Orbital Apex (Figure 1–3)

The apex of the orbit is the entry portal for all nerves and vessels to the eye and the site of origin of all extraocular muscles except the inferior oblique. The **superior orbital fissure** lies between the body and the greater and lesser wings of the sphenoid bone. The superior ophthalmic vein and the lacrimal, frontal, and trochlear nerves pass through the lateral portion of the fissure that lies outside the annulus of Zinn. The superior and inferior divisions of the oculomotor nerve and the abducens and nasociliary nerves pass through the medial portion of the fissure within the annulus of Zinn. The optic nerve and ophthalmic artery pass through the optic canal, which also lies within the annulus of Zinn. The inferior ophthalmic vein may pass through any part of the superior orbital fissure, including the portion adjacent to the body of the sphenoid that lies inferomedial to the annulus of Zinn. The inferior ophthalmic vein frequently joins the superior ophthalmic vein before exiting the orbit.