

VOLUME THREE

NEUROLOGICAL SURGERY

*a comprehensive reference guide to the
diagnosis and management
of neurosurgical problems*

EDITED BY

JULIAN R. YOUMANS, M.D., Ph.D.

VOLUME THREE

NEUROLOGICAL SURGERY

*a comprehensive reference guide to the
diagnosis and management
of neurosurgical problems*

EDITED BY

JULIAN R. YOUMANS, M.D., Ph.D.

Professor and Chairman, Department of Neurological Surgery,
School of Medicine, University of California,
Davis, California



1973

W. B. Saunders Company · Philadelphia · London · Toronto

W. B. Saunders Company: West Washington Square
Philadelphia, Pa. 19105
12 Dyott Street
London, WC1A 1DB
833 Oxford Street
Toronto 18, Ontario

Neurological Surgery—Volume Three

ISBN 0-7216-9657-0

© 1973 by W. B. Saunders Company. Copyright under the International Copyright Union. All rights reserved. This book is protected by copyright. No part of it may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without written permission from the publisher. Made in the United States of America. Press of W. B. Saunders Company. Library of Congress catalog card number 70-139438.

Print Number: 9 8 7 6 5 4 3 2 1

CONTRIBUTORS

OTMAR W. ALBRAND, M.D., Assistant Professor of Neurological Surgery, School of Medicine, University of California at Davis, Davis, California. Associate Neurological Surgeon, Sacramento Medical Center, Sacramento, California.

MARSHALL B. ALLEN, Jr., M.D., F.A.C.S., Professor of Neurological Surgery, Chief of the Section of Neurological Surgery, School of Medicine, Medical College of Georgia. Chief of Neurological Surgery, Eugene Talmadge Memorial Hospital; Consultant in Neurological Surgery, University Hospital, Veterans Administration Hospital and United States Army Specialized Treatment Center at Fort Gordon Army Hospital, Augusta, Georgia. Consultant in Neurological Surgery, Central State Hospital, Milledgeville, Georgia.

H. THOMAS BALLANTINE, Jr., M.D., F.A.C.S., Associate Clinical Professor of Neurological Surgery, School of Medicine, Harvard University. Neurological Surgeon to the Massachusetts General Hospital, Boston, Massachusetts.

H. J. M. BARNETT, M.D., F.R.C.P.(C.), Professor of Neurology, Chairman of Division of Neurology, School of Medicine, University of Western Ontario. Chief of Neurology, University Hospital, London, Ontario.

FRANK BATLEY, M.B., Ch.B., F.R.C.P.(C.), Professor of Radiology, College of Medicine, Ohio State University. Director of Radiation Therapy, Ohio State University Hospitals, Columbus, Ohio.

JOHN R. BENTSON, M.D., Assistant Professor of Radiology, School of Medicine, University of California at Los Angeles. Radiologist, University of California at Los Angeles Center for the Health Sciences; Consultant in Radiology, Wadsworth Veterans Administration Hospital, Los Angeles, California.

ROGER BOLES, M.D., F.A.C.S., Associate Professor of Otorhinolaryngology, School of Medicine, University of Michigan. Attending Otorhinolaryngologist, University Hospital; Consultant, Otorhinolaryngology, Veterans Administration Hospital; Active Medical Staff, St. Joseph Mercy Hospital, Ann Arbor, Michigan. Consultant in Otorhinolaryngology, Wayne County General Hospital, Eloise, Michigan.

CHARLES E. BRACKETT, M.D., F.A.C.S., Professor of Surgery (Neurosurgery), Chairman of Section of Neurological Surgery, School of Medicine, University of Kansas. Neurological Surgeon-in-Chief, University of Kansas Medical Center, Kansas City, Kansas. Consultant in Neurological Surgery, Veterans Administration Hospital, Kansas City, Missouri.

CHARLES LEON BRANCH, M.D., F.A.C.S., Clinical Associate Professor of Neurological Surgery, School of Medicine, University of Texas at San Antonio. Attending Neurological Surgeon, Southwest Texas Methodist Hospital, Baptist Memorial Hospital, Santa Rosa Medical Center, and Nix Memorial Hospital, San Antonio, Texas.

VERNE L. BRECHNER, M.D., F.A.C.A., Professor of Anesthesiology, Vice Chairman of Department of Anesthesiology, School of Medicine, University of California at Los Angeles. Anesthesiologist, University of California at Los Angeles Center for the Health Sciences, Los Angeles, California.

ROBERT W. BRENNAN, M.D., Associate Professor of Medicine, Chief of Division of Neurology, College of Medicine, Pennsylvania State University. Chief of Neurology Service, The Milton S. Hershey Medical Center, Hershey, Pennsylvania.

ALBERT B. BUTLER, M.D., Assistant Professor of Neurological Surgery, School of Medicine, University of Virginia. Attending Neurological Surgeon, University of Virginia Hospital, Charlottesville, Virginia.

FERNANDO CABIESES, M.D., Ph.D., F.A.C.S., Professor of Neurological Surgery (Ret.), School of Medicine, Universidad de San Marcos. Chief, Neurological Surgery Unit, Peruvian Armed Forces, Anglo-American Hospital, and Hospital 2 de Mayo, Lima, Peru.

ROBERT L. CAMPBELL, M.D., F.A.C.S., Professor of Neurological Surgery, Chairman of Department of Neurological Surgery, School of Medicine, University of Indiana. Neurological Surgeon-in-Chief, Indiana Medical Center, Indianapolis, Indiana.

SHELLEY N. CHOU, M.D., Ph.D., F.A.C.S., Professor of Neurological Surgery, School of Medicine, University of Minnesota. Attending Neurological Surgeon, University of Minnesota Hospitals; Consultant, Neurological Surgery Service, Veterans Administration Hospital, Minneapolis, Minnesota.

WILLIAM KEMP CLARK, M.D., F.A.C.S., Professor of Neurological Surgery, Chairman of Division of Neurological Surgery, Southwestern Medical School, University of Texas at Dallas. Director of Neurological Surgery Service, Parkland Memorial Hospital, Presbyterian Hospital, Children's Medical Center, and Veterans Administration Hospital; Consultant in Neurological Surgery, St. Paul's Hospital, Texas Scottish Rite Hospital for Crippled Children, and Baylor University Medical Center, Dallas, Texas.

WILLIAM F. COLLINS, M.D., F.A.C.S., Harvey and Kate Cushing Professor of Surgery, Chairman of Section of Neurological Surgery, School of Medicine, Yale University. Neurological Surgeon-in-Chief, Yale-New Haven Medical Center, New Haven, Connecticut; Consultant in Neurological Surgery, Veterans Administration Hospital, West Haven, Connecticut.

WILLIAM SAUNDERS COXE, M.D., F.A.C.S., Professor of Neurological Surgery, School of Medicine, Washington University. Assistant Neurological Surgeon, Barnes Hospital and St. Louis Children's Hospital; Consultant, Neurological Surgery, Veterans Administration Hospital; Attending Neurological Surgeon, St. Louis City Hospital, St. Louis, Missouri.

THOMAS K. CRAIGMILE, M.D., F.A.C.S., Associate Clinical Professor of Neurological Surgery, School of Medicine, University of Colorado. Attending Neurological Surgeon, Colorado General Hospital, Veterans Administration Hospital, and St. Joseph's Hospital, Denver, Colorado.

COURTLAND HARWELL DAVIS, Jr., M.D., F.A.C.S., Professor of Neurological Surgery, Bowman Gray School of Medicine, Wake Forest University. Attending

Neurological Surgeon, North Carolina Baptist Hospital, Winston-Salem, North Carolina.

IRA C. DENTON, Jr., M.D., Assistant Professor of Neurological Surgery, School of Medicine, West Virginia University. Attending Neurological Surgeon, West Virginia University Medical Center Hospital, Morgantown, West Virginia.

ALBERT D'ERRICO, M.D., F.A.C.S., Clinical Professor of Neurological Surgery, Southwestern Medical School, University of Texas at Dallas. Attending Neurological Surgeon, Baylor University Medical Center, Presbyterian Hospital, Children's Medical Center, and Parkland Memorial Hospital, Dallas, Texas.

ROBERT D. DICKINS, Jr., M.D., F.A.C.S., Teaching Staff in Neurological Surgery, School of Medicine, University of Arkansas. Attending Neurological Surgeon, Baptist Medical Center, St. Vincent's Infirmary, Little Rock, Arkansas.

REED O. DINGMAN, M.D., D.D.S., F.A.C.S., Professor of Surgery, Head of Section of Plastic Surgery, School of Medicine, University of Michigan. Chief of Plastic Surgery, University of Michigan Medical Center and St. Joseph Mercy Hospital; Consultant in Surgery, Veterans Administration Hospital, Ann Arbor, Michigan; Consultant in Plastic Surgery, Sinai Hospital, Detroit, Michigan.

DONALD D. DIRKS, Ph.D., Associate Professor of Head and Neck Surgery (Audiology), School of Medicine, University of California at Los Angeles, Los Angeles, California.

DONALD F. DOHN, M.D., F.A.C.S., Head of Department of Neurological Surgery, Cleveland Clinic. Head of Neurological Surgery Service, Cleveland Clinic Hospital, Cleveland, Ohio.

CHARLES G. DRAKE, M.D., F.R.C.S.(C.), F.A.C.S., Professor of Neurological Surgery, Head of Department of Clinical Neurological Sciences, School of Medicine, University of Western Ontario. Chief of Neurological Surgery Service, University Hospital, London, Ontario.

PETER DYCK, M.D., F.A.C.S., Assistant Clinical Professor of Neurological Surgery, School of Medicine, University of Southern California. Attending Neurological Surgeon, Hospital of the Good Samaritan, St. Vincent's Hospital, Queen of Angels Hospital, Orthopedic Hospital, and Los Angeles County General Hospital, Los Angeles, California.

ROBERT G. FISHER, M.D., Ph.D., F.A.C.S., Professor of Neurological Surgery, Chairman of Department of Neurological Surgery, School of Medicine, University of Oklahoma. Chief of Neurological Surgery, University of Oklahoma Medical Center, Oklahoma City, Oklahoma.

ELDON L. FOLTZ, M.D., F.A.C.S., Professor of Neurological Surgery, Chairman of Division of Neurological Surgery, School of Medicine, University of California at Irvine, Irvine, California. Chief of Neurological Surgery, Orange County Medical Center, Orange, California; Consultant, Veterans Administration Hospital, Long Beach, California.

LYLE A. FRENCH, M.D., Ph.D., F.A.C.S., Professor of Neurological Surgery, Head of Department of Neurological Surgery, School of Medicine; Vice President for Health Sciences, University of Minnesota. Chief of Neurological Surgery, University Hospital and Veterans Administration Hospital, Minneapolis, Minnesota.

JAMES GARBER GALBRAITH, M.D., F.A.C.S., Professor of Neurological Surgery, Director of Division of Neurological Surgery, School of Medicine, University of Alabama. Chief of Neurological Surgery Service, University of Alabama Hospitals and Clinics, Birmingham, Alabama.

W. JAMES GARDNER, M.D., F.A.C.S., Formerly Head of Department of Neurological Surgery, Cleveland Clinic Foundation and Hospital. Neurological Surgeon to Fairview General Hospital, Huron Road Hospital, and St. Alexis Hospital, Cleveland, Ohio.

CORNELIUS P. GOETZINGER, Ph.D., Professor of Audiology, School of Medicine, University of Kansas. Chief of Audiology, University of Kansas Medical Center, Kansas City, Kansas. Consultant in Audiology, General Hospital and Veterans Administration Hospital, Kansas City, Missouri.

FRANK P. GOLDSTEIN, M.D., F.A.C.S., Assistant Professor of Neurological Surgery, School of Medicine, Medical College of Wisconsin. Attending Neurological Surgeon, Milwaukee County General Hospital, Milwaukee, Wisconsin; Attending Neurological Surgeon, Veterans Administration Hospital, Wood, Wisconsin.

ALBERT LOUIS GOODGOLD, M.D., Associate Professor of Clinical Neurology, School of Medicine, New York University. Associate Attending Neurologist, University Hospital and Bellevue Hospital Center; Attending Neurologist, Veterans Administration Hospital, New York, New York.

JACK K. GOODRICH, M.D., F.A.C.R., Professor of Radiology, School of Medicine, Duke University. Director, Division of Nuclear Medicine, Duke University Medical Center and Veterans Administration Hospital, Durham, North Carolina.

JAMES GREENWOOD, Jr., M.D., F.A.C.S., Clinical Professor of Neurological Surgery, College of Medicine, Baylor University. Chief of Neurological Surgery, Methodist Hospital, Houston, Texas.

GERALD A. GRONERT, M.D., Assistant Professor of Anesthesiology, Mayo Graduate School of Medicine, University of Minnesota. Consultant, Department of Anesthesiology, Mayo Clinic, Rochester, Minnesota.

E. STEPHEN GURDJIAN, M.D., Ph.D., F.A.C.S., Emeritus Professor of Neurological Surgery, School of Medicine, Wayne State University. Consulting Neurological Surgeon, Grace Hospital, Detroit, Michigan.

VOIGT R. HODGSON, Ph.D., Associate Professor of Biomechanics, Department of Neurological Surgery, School of Medicine, Wayne State University, Detroit, Michigan.

EDGAR M. HOUSEPIAN, M.D., F.A.C.S., Associate Professor of Clinical Neurological Surgery, College of Physicians and Surgeons, Columbia University. Associate Attending Neurological Surgeon, New York Neurological Institute and Columbia-Presbyterian Medical Center, New York, New York.

WILLIAM E. HUNT, M.D., F.A.C.S., Professor of Neurological Surgery, Director of Division of Neurological Surgery, College of Medicine, Ohio State University. Chief of Neurological Surgery, Ohio State University Hospitals; Consultant in Neurological Surgery, Children's Hospital, Columbus, Ohio.

EDGAR A. KAHN, M.D., F.A.C.S., Emeritus Professor of Neurological Surgery, Emeritus Chairman of Section of Neurological Surgery, School of Medicine, University of Michigan. Attending Neurological Surgeon, University of Michigan Medical Center and St. Joseph Mercy Hospital, Ann Arbor, Michigan.

STEPHEN A. KIEFFER, M.D., Professor of Radiology, School of Medicine, University of Minnesota. Neuroradiologist, University of Minnesota Hospitals. Chief of Diagnostic Radiology Service, Veterans Administration Hospital, Minneapolis, Minnesota.

E. LEON KIER, M.D., Associate Professor of Radiology, Chief of Section of Neuro-radiology, School of Medicine, Yale University. Chief of Neuroradiology, Yale-New Haven Medical Center, New Haven, Connecticut.

GLENN W. KINDT, M.D., F.A.C.S., Associate Professor of Neurological Surgery, School of Medicine, University of Michigan. Attending Neurological Surgeon, University Medical Center and Veterans Administration Hospital, Ann Arbor, Michigan; Attending Neurological Surgeon, Wayne County General Hospital, Wayne, Michigan.

ROBERT B. KING, M.D., F.A.C.S., Professor of Neurological Surgery, Chairman of Department of Neurological Surgery, School of Medicine, State University of New York, Upstate Medical Center. Chief of Neurological Surgery, State University Hospital of the Upstate Medical Center; Attending Neurological Surgeon, Crouse-Irving Memorial Hospital; Consultant, Neurological Surgery, Veterans Administration Hospital, Syracuse, New York.

DAVID G. KLINE, M.D., F.A.C.S., Associate Professor of Neurological Surgery, Chairman of Division of Neurological Surgery, School of Medicine, Louisiana State University. Chairman of Louisiana State University Neurological Surgery Service, Charity Hospital; Visiting Neurological Surgeon, Southern Baptist Hospital, Touro Infirmary, and Hotel Dieu; Academic Staff in Neurological Surgery, Ochsner Foundation Hospital; Consultant in Neurological Surgery, United States Public Health Service Hospital, New Orleans, Louisiana. Visiting Investigator, Delta Regional Primate Center, Covington, Louisiana. Consultant in Neurological Surgery, Keesler Air Force Base Hospital, Biloxi, Mississippi.

THEODORE KURZE, M.D., F.A.C.S., Professor of Neurological Surgery, Chairman of Department of Neurological Surgery, School of Medicine, University of Southern California. Chief of Neurological Surgery, Los Angeles County Medical Center; Attending Neurological Surgeon, Hospital of the Good Samaritan, White Memorial Hospital, and Children's Hospital, Los Angeles, California.

EDWARD H. LAMBERT, M.D., Ph.D., Professor of Physiology, Mayo Graduate School of Medicine, University of Minnesota, Head of Section of Clinical Electromyography, Mayo Clinic, Rochester, Minnesota.

THOMAS WILLIAM LANGFITT, M.D., F.A.C.S., Charles Frazier Professor of Neurological Surgery, Chairman of Division of Neurological Surgery, School of Medicine, University of Pennsylvania. Chief of Neurological Surgery, Philadelphia General Hospital; Consultant Neurological Surgeon, Children's Hospital and Veterans Administration Hospital, Philadelphia, Pennsylvania.

KENNETH E. LIVINGSTON, M.D., F.A.C.S., Associate Professor of Neurological Surgery and Assistant Professor (Research) of Pharmacology, Faculty of Medicine, University of Toronto. Chief of Division of Neurological Surgery, The Wellesley Hospital, Toronto, Ontario.

DON M. LONG, M.D., Ph.D., F.A.C.S., Associate Professor of Neurological Surgery, School of Medicine, University of Minnesota. Associate Neurological Surgeon, University of Minnesota Hospitals; Consultant, Neurological Surgery Service, Veterans Administration Hospital, Minneapolis, Minnesota.

WILLIAM McMURRAY LOUGHEED, M.D., F.R.C.S.(C.), Associate Professor of Neurological Surgery, Faculty of Medicine, University of Toronto. Associate Neurological Surgeon, Toronto General Hospital; Chairman, Division of Neurosciences, Sunnybrook Hospital; Consultant in Neurological Surgery, Toronto East General Hospital and Scarborough General Hospital, Toronto, Ontario.

J. A. McCRARY III, M.D., Associate Professor of Ophthalmology, Assistant Professor, Neurological Surgery and Neurology, School of Medicine, University of Texas at Galveston. Attending Ophthalmologist, University of Texas Medical Branch Hospitals, Galveston, Texas.

ROBERT L. McLAURIN, M.D., F.A.C.S., Professor of Surgery (Neurosurgery), Chairman of Division of Neurological Surgery, College of Medicine, University of Cincinnati. Chief of Neurological Surgery, Cincinnati General Hospital, Children's Hospital, and Holmes Hospital; Consultant in Neurological Surgery, Veterans Administration Hospital, Cincinnati, Ohio.

VERNON H. MARK, M.D., F.A.C.S., Associate Professor of Neurological Surgery, School of Medicine, Harvard University. Director of Neurological Surgery Service, Boston City Hospitals, Boston, Massachusetts.

BRIAN Mc Q. MARSHALL, M.D., F.R.C.P.(C.), Assistant Professor of Anesthesiology, Faculty of Medicine, University of Toronto. Senior Anesthesiologist, Toronto General Hospital, Toronto, Ontario.

FRANK H. MAYFIELD, M.D., F.A.C.S., Clinical Professor of Neurological Surgery, College of Medicine, University of Cincinnati. Director of Neurological Surgery, The Christ Hospital and Good Samaritan Hospital, Cincinnati, Ohio.

WILLIAM F. MEACHAM, M.D., F.A.C.S., Clinical Professor of Neurological Surgery, Chairman of Department of Neurological Surgery, School of Medicine, Vanderbilt University, and Clinical Professor of Neurological Surgery, School of Medicine, Meharry Medical College. Chief of Neurological Surgery, Vanderbilt University Hospital; Attending Neurological Surgeon, Nashville General Hospital, St. Thomas Hospital, and Baptist Hospital, Nashville, Tennessee.

JOHN D. MICHENFELDER, M.D., Associate Professor of Anesthesiology, Mayo Graduate School of Medicine, University of Minnesota. Consulting Anesthesiologist, Department of Anesthesiology, Mayo Clinic, Rochester, Minnesota.

WILLIAM H. MORETZ, M.D., F.A.C.S., Professor of Surgery, Chairman of Department of Surgery, School of Medicine, Medical College of Georgia. Chief of Surgery, Talmadge Memorial Hospital; Consultant in Surgery, Veterans Administration Hospital and Fort Gordon Army Hospital, Augusta, Georgia.

DONALD E. MORGAN, Ph.D., Assistant Professor of Head and Neck Surgery (Audiology), School of Medicine, University of California at Los Angeles. Director of Audiology Clinic, University of California at Los Angeles Center for the Health Sciences, Los Angeles, California.

T. P. MORLEY, M.D., F.R.C.S.(C.), F.R.C.S. (ENG.), Associate Professor of Neurological Surgery, Chairman of Division of Neurological Surgery, Faculty of Medicine, University of Toronto. Head of Division of Neurological Surgery, Toronto General Hospital, Toronto, Ontario.

SEAN F. MULLAN, M.D., F.A.C.S., Professor of Neurological Surgery, Director of Division of Neurological Surgery, School of Medicine, University of Chicago. Chief of Neurological Surgery, University of Chicago Hospitals and Clinics; Consulting Neurological Surgeon, Illinois Central Hospital, Chicago, Illinois, Consulting Neurological Surgeon, Great Lakes Naval Station, Great Lakes, Illinois.

JOHN J. MURPHY, M.D., F.A.C.S., Professor of Urology, Chief of Division of Urology, School of Medicine, University of Pennsylvania. Chief of Urology, Hospital of the University of Pennsylvania, Philadelphia, Pennsylvania.

MARTIN G. NETSKY, M.D., Professor of Neuropathology, School of Medicine, University of Virginia. Chief of Neuropathology, University of Virginia Hospital, Charlottesville, Virginia.

- HORACE A. NORRELL, Jr., M.D., F.A.C.S., Professor of Neurological Surgery, Chairman of Department of Neurological Surgery, School of Medicine, University of Kentucky. Chief of Neurological Surgery, University Hospital and Veterans Administration Hospital; Consultant in Neurological Surgery, The United States Public Health Service Clinical Research Center, Lexington, Kentucky. Consultant in Neurological Surgery, Veterans Administration Hospital, Huntington, West Virginia.
- FRANK E. NULSEN, M.D., F.A.C.S., Harvey Huntington Brown, Jr. Professor of Neurological Surgery, Chairman of Division of Neurological Surgery, School of Medicine, Western Reserve University. Chief of Neurological Surgery Service, University Hospital; Consulting Neurological Surgeon, Veterans Administration Hospital; Senior Consultant in Neurological Surgery, Cleveland Metropolitan Hospital, Cleveland, Ohio.
- SIXTO OBRADOR, M.D., Professor of Neurological Surgery, Chairman of Department of Neurological Surgery, Faculty of Medicine, Madrid Autonomous University. Chief of Neurological Surgery Services of the Spanish Social Security (Residencia La Paz) and Jimenez Diaz Foundation, Madrid, Spain.
- GUY L. ODOM, M.D., F.A.C.S., Professor of Neurological Surgery, Chairman of Division of Neurological Surgery, School of Medicine, Duke University. Chief of Neurological Surgery, Duke University Hospital, Durham, North Carolina.
- GEORGE A. OJEMANN, M.D., Associate Professor of Neurological Surgery, School of Medicine, University of Washington. Attending Neurological Surgeon, University Hospital and Harborview Medical Center; Consultant in Neurological Surgery, Veterans Administration Hospital, Seattle, Washington.
- ROBERT G. OJEMANN, M.D., F.A.C.S., Associate Clinical Professor of Neurological Surgery, School of Medicine, Harvard University. Associate Visiting Neurosurgeon, Massachusetts General Hospital, Boston, Massachusetts.
- AYUB KHAN OMMAYA, M.D., F.R.C.S. (ENG.), F.A.C.S., Associate Clinical Professor of Neurological Surgery, School of Medicine, Georgetown University, Washington, D.C. Associate Neurological Surgeon, Branch of Surgical Neurology, National Institute of Neurological Disease and Blindness, National Institutes of Health; Consulting Neurological Surgeon, The Clinical Center, Bethesda, Maryland.
- FRED PLUM, M.D., Anne Parrish Titzell Professor of Neurology, Chairman of Department of Neurology, College of Medicine, Cornell University. Neurologist-in-Chief, The New York Hospital, New York, New York.
- G. O'NEIL PROUD, M.D., Professor of Otorhinolaryngology, School of Medicine, University of Kansas. Chief of Otorhinolaryngology, University of Kansas Medical Center, Kansas City, Kansas.
- ANTHONY J. RAIMONDI, M.D., F.A.C.S., Professor of Neurological Surgery, Chairman of Division of Neurological Surgery, School of Medicine, Northwestern University. Chairman of Division of Neurological Surgery, Children's Memorial Hospital, Chicago, Illinois.
- ROBERT W. RAND, M.D., Ph.D., F.A.C.S., Professor of Neurological Surgery, School of Medicine, University of California at Los Angeles. Attending Neurological Surgeon, University of California Center for the Health Sciences; Consultant in Neurological Surgery, St. John's Hospital and Veterans Administration Hospital, Los Angeles, California.
- JOSEPH RANSOHOFF, M.D., F.A.C.S., Professor of Neurological Surgery and Chairman of Department of Neurological Surgery, School of Medicine, New York University. Director of Neurological Surgery, Bellevue Hospital Center, University Hospital, and Veterans Administration Hospital, New York, New York.

ROBERT A. RATCHESON, M.D., Instructor in Neurological Surgery, School of Medicine, Washington University. Assistant Neurological Surgeon, Barnes Hospital, St. Louis, Missouri.

BRONSON S. RAY, M.D., F.A.C.S., Emeritus Clinical Professor of Neurological Surgery, Emeritus Chairman of Department of Neurological Surgery, College of Medicine, Cornell University. Attending Neurological Surgeon, New York Hospital-Cornell Medical Center, New York, New York.

KAI REHDER, M.D., Assistant Professor of Anesthesiology, Mayo Graduate School of Medicine, University of Minnesota. Anesthesiologist, Department of Anesthesiology, Mayo Clinic, Rochester, Minnesota.

RALPH M. REITAN, Ph.D., Professor of Neurological Surgery, School of Medicine, Professor of Psychology, School of Arts and Science, University of Washington. Consulting Psychologist, University Hospital, Seattle, Washington.

ALAN E. RICHARDSON, M.B., B.S., F.R.C.S. (ENG.), F.R.C.S.(E.), Teacher in Neurological Surgery, School of Medicine, London University. Attending Neurological Surgeon, St. George's Hospital and Atkinson Morley's Hospital; Director, Wolfson Medical Rehabilitation Centre, London, England.

JAMES T. ROBERTSON, M.D., F.A.C.S., Associate Professor of Neurological Surgery, Acting Chairman of Department of Neurological Surgery, College of Medicine, University of Tennessee. Attending Neurological Surgeon, City of Memphis Hospitals, Baptist Memorial Hospital, Memphis, Tennessee.

DAVID A. ROTH, M.D., F.A.C.S., Assistant Clinical Professor of Neurological Surgery, School of Medicine, Harvard University. Associate Director of Neurological Surgery Service, Boston City Hospital, Boston, Massachusetts.

SÜLEYMAN SAGLAM, M.D., Assistant Professor of Neurological Surgery, School of Medicine, Hacettepe University. Attending Neurological Surgeon, Hacettepe University Medical Center, Ankara, Turkey.

MARTIN PETER SAYERS, M.D., F.A.C.S., Associate Professor of Neurological Surgery, College of Medicine, Ohio State University. Chief of Division of Neurological Surgery, Columbus Children's Hospital; Attending Neurological Surgeon, University Hospitals and Riverside Methodist Hospital, Columbus, Ohio.

MANNIE M. SCHECHTER, M.D., Professor of Radiology, Albert Einstein College of Medicine, Yeshiva University. Director of Neuroradiology, Hospital of the Albert Einstein College of Medicine and Bronx Municipal Hospital Center, New York, New York.

ROBERT S. SCHWAB, M.D., Late Emeritus Associate Clinical Professor of Neurology, School of Medicine, Harvard University. Late Neurologist and Director Emeritus, Brain Wave Laboratory, Massachusetts General Hospital, Boston, Massachusetts.

EDWARD L. SELJESKOG, M.D., Ph.D., Associate Professor of Neurological Surgery, School of Medicine, University of Minnesota. Attending Neurological Surgeon, University of Minnesota Hospitals and Hennepin County General Hospital, Minneapolis, Minnesota.

JOHN SHILLITO, Jr., M.D., F.A.C.S., Associate Professor of Neurological Surgery, School of Medicine, Harvard University. Senior Associate in Neurological Surgery, Children's Hospital Medical Center, Peter Bent Brigham Hospital, Boston, Massachusetts.

J. LAWTON SMITH, M.D., Professor of Ophthalmology and Neurological Surgery, School of Medicine, University of Miami. Attending Ophthalmologist, Jackson

- Memorial Hospital; Consulting Ophthalmologist, Veterans Administration Hospital, Miami, Florida.
- W. EUGENE STERN, M.D., F.A.C.S., Professor of Surgery (Neurosurgery), Chairman of Division of Neurosurgery, School of Medicine, University of California at Los Angeles. Chief of Neurosurgery, Service, University of California at Los Angeles Center for the Health Sciences, Los Angeles, California.
- O. RHETT TALBERT, M.D., F.A.C.P., Professor of Neurology, Chairman of Department of Neurology, School of Medicine, Medical University of South Carolina. Chief of Neurology, Medical University Hospital, Charleston, South Carolina.
- ARTHUR TAUB, M.D., Ph.D., Associate Professor of Neurophysiology in Neurological Surgery and Associate Professor of Neurology, School of Medicine, Yale University. Associate Neurologist, Yale-New Haven Medical Center, New Haven, Connecticut.
- L. M. THOMAS, M.D., F.A.C.S., Professor of Neurological Surgery, Chairman of Department of Neurological Surgery, Associate Dean for Hospital Affairs, School of Medicine, Wayne State University. Senior Attending Neurological Surgeon, Detroit General Hospital; Attending Neurological Surgeon, Grace Hospital; Consulting Neurological Surgeon, Harper Hospital, Children's Hospital of Michigan, and Veterans Administration Hospital, Detroit, Michigan.
- ROBERT L. TIMMONS, M.D., F.A.C.S., Formerly, Associate Professor of Neurological Surgery, School of Medicine, University of North Carolina; Attending Neurological Surgeon, North Carolina Memorial Hospital, Chapel Hill, North Carolina. Presently, Clinical Professor of Surgery (Neurosurgery), School of Medicine, East Carolina University. Attending Neurological Surgeon, Pitt Memorial Hospital, Greenville, North Carolina.
- GEORGE T. TINDALL, M.D., F.A.C.S., Professor of Neurological Surgery, Chairman of Division of Neurological Surgery, School of Medicine, The University of Texas at Galveston. Chief Neurological Surgeon, University of Texas Medical Branch Hospitals, Galveston, Texas.
- JAMES TITCHENER, M.D., Professor of Psychiatry, College of Medicine, University of Cincinnati. Attending Psychiatrist, Cincinnati General Hospital, Cincinnati, Ohio.
- STEPHEN L. TROKEL, M.D., F.A.C.S., Instructor in Ophthalmology, College of Physicians and Surgeons, Columbia University. Assistant Ophthalmologist, Institute of Ophthalmology and Columbia-Presbyterian Medical Center, New York, New York.
- CHARLES W. TRUE, M.D., Associate Pathologist, Good Samaritan Hospital, Cincinnati, Ohio.
- JOHN S. TYTUS, M.D., F.A.C.S., Clinical Associate Professor of Neurological Surgery, School of Medicine, University of Washington. Chief of Section of Neurological Surgery, The Mason Clinic and Virginia Mason Hospital; Attending Neurological Surgeon, Harborview Medical Center and Children's Orthopedic Hospital, Seattle, Washington.
- JOHN M. VAN BUREN, M.D., Ph.D., Clinical Professor of Surgical Neurology, School of Medicine, George Washington University, Washington, D.C. Chief of Branch of Surgical Neurology and Clinical Director, National Institute of Neurological Diseases and Stroke, National Institutes of Health, Bethesda, Maryland.
- A. EARL WALKER, M.D., F.A.C.S., Professor Emeritus of Neurological Surgery, School of Medicine, Johns Hopkins University, Baltimore, Maryland. Visiting Professor of Neurological Surgery, School of Medicine, The University of New Mexico, Albuquerque, New Mexico.

JAMES ALLAN WALTERS, M.D., D.P.M., F.R.C.P.(C.), F.A.C.P., Associate Professor of Psychiatry and Medicine, Faculty of Medicine, University of Toronto. Psychiatrist and Physician, The Wellesley Hospital; Consulting Psychiatrist, Toronto General Hospital, Toronto, Ontario.

ARTHUR A. WARD, Jr., M.D., F.A.C.S., Professor of Neurological Surgery, Chairman of Department of Neurological Surgery, School of Medicine, University of Washington. Chief of Neurological Surgery, University Hospital and Harborview Medical Center; Consulting Neurological Surgeon, Veterans Administration Hospital, Seattle, Washington.

CLARK C. WATTS, M.D., Assistant Clinical Professor of Neurological Surgery, Southwestern Medical School, University of Texas at Dallas. Attending Neurological Surgeon, Parkland Memorial Hospital, St. Paul's Hospital, and Children's Medical Center; Consultant in Neurological Surgery, Veterans Administration Hospital, Dallas, Texas.

ALAN J. WEIN, M.D., Instructor in Urology, School of Medicine, University of Pennsylvania. Fellow, Harrison Department of Surgical Research, Philadelphia, Pennsylvania.

KEASLEY WELCH, M.D., F.A.C.S., Franc D. Ingraham Professor of Neurological Surgery, School of Medicine, Harvard University. Neurological Surgeon-in-Chief, Children's Hospital Medical Center; Attending Neurological Surgeon, Peter Bent Brigham Hospital, Boston, Massachusetts.

JAMES C. WHITE, M.D., F.A.C.S., Professor of Surgery, Emeritus, School of Medicine, Harvard University. Senior Consulting Staff in Neurological Surgery, Massachusetts General Hospital, Boston, Massachusetts.

LOWELL ELMOND WHITE, Jr., M.D., Professor of Neuroscience (Neurological Surgery), Chairman of Division of Neuroscience, College of Medicine, University of South Alabama. Attending Neurological Surgeon, Mobile General Hospital, Mobile, Alabama.

ROBERT JOSEPH WHITE, M.D., Ph.D., F.A.C.S., Professor of Neurological Surgery, School of Medicine, Case Western Reserve University. Director of Neurological Surgery and Brain Research Laboratories, Cleveland Metropolitan Hospital; Attending Neurological Surgeon, University Hospitals; Senior Consulting Neurological Surgeon, Veterans Administration Hospital; Neurological Surgery Staff, Lakeside Hospital and Fairview Park General Hospital, Cleveland, Ohio.

ROBERT H. WILKINS, M.D., F.A.C.S., Formerly, Assistant Professor of Neurological Surgery, Duke University. Chief of Neurological Surgery, Veterans Administration Hospital, Durham, North Carolina. Presently, Chairman of Department of Neurological Surgery, Scott and White Clinic, Temple, Texas.

ROBERT H. WILKINSON, Jr., M.D., Associate Professor of Radiology, School of Medicine, Duke University. Staff Radiologist, Duke University Medical Center and Veterans Administration Hospital, Durham, North Carolina.

CHARLES B. WILSON, M.D., F.A.C.S., Professor of Neurological Surgery, Chairman of Department of Neurological Surgery, School of Medicine, University of California at San Francisco. Chief of Neurological Surgery Service, Moffitt Hospital; Attending Neurological Surgeon, San Francisco General Hospital; Consulting Neurological Surgeon, Public Health Service Hospital and Veterans Administration Hospital, San Francisco, California.

EARL F. WOLFMAN, Jr., M.D., F.A.C.S., Professor of Surgery, Chairman of Division of Surgical Sciences, Chairman of Department of Surgery, Associate Dean for Clinical Affairs, University of California at Davis, Davis, California. Chief of Surgical Serv-

ices, Sacramento Medical Center, Sacramento, California; Consultant in Surgery, United States Air Force Medical Center, Travis Air Force Base, California, and United States Public Health Service Hospital, San Francisco, California.

R. LEWIS WRIGHT, M.D., F.A.C.S., Assistant Clinical Professor of Neurological Surgery, School of Medicine, Medical College of Virginia. Attending Neurological Surgeon, St. Mary's Hospital and Richmond Memorial Hospital; Consulting Neurological Surgeon, Veterans Administration Hospital, Retreat Hospital, and Stuart Circle Hospital, Richmond, Virginia.

DAVID YASHON, M.D., F.A.C.S., Associate Professor of Neurological Surgery, College of Medicine, Ohio State University. Attending Neurological Surgeon, The University Hospitals and Children's Hospital, Columbus, Ohio.

JULIAN R. YOUMANS, M.D., Ph.D., F.A.C.S., Professor of Neurological Surgery, Chairman of Department of Neurological Surgery, University of California School of Medicine at Davis, Davis, California. Chief of Neurological Surgery, Sacramento Medical Center, Sacramento, California; Consultant in Neurological Surgery, United States Air Force Medical Center, Travis Air Force Base, California.

GILBERT F. YOUNG, M.D., Professor of Neurology and Pediatrics, School of Medicine, Medical University of South Carolina. Attending Neurologist and Pediatrician, Medical University Hospital, Charleston, South Carolina.

ROBERT R. YOUNG, M.D., Associate Professor of Neurology, School of Medicine, Harvard University. Associate Neurologist and Director of the Clinical Neurophysiology Laboratories, Massachusetts General Hospital, Boston, Massachusetts.

LAWRENCE H. ZINGESSER, M.D., Associate Professor of Radiology, Albert Einstein College of Medicine, Yeshiva University. Radiologist, Hospital of the Albert Einstein College of Medicine and Bronx Municipal Hospital Center, New York, New York.

CONTENTS

VOLUME III

X. TUMORS

Chapter 67

TUMOROUS LESIONS OF THE SKULL..... 123

D. M. Long, S. A. Kieffer, S. N. Chou

Chapter 68

TUMORS OF THE ORBIT..... 1275

E. M. Housepian, S. Trokel

Chapter 69

CLASSIFICATION AND BIOLOGY OF BRAIN TUMORS..... 1297

A. B. Butler, M. G. Netsky

Chapter 70

INTRINSIC TUMORS OF THE CEREBRAL HEMISPHERES..... 1340

T. P. Morley

Chapter 71

TUMORS OF THE CRANIAL MENINGES..... 1388

T. P. Morley

Chapter 72

TUMORS OF THE SELLAR AND PARASELLAR AREA..... 1412

W. E. Hunt, M. P. Sayers, D. Yashon

Chapter 73

ACOUSTIC NEUROMAS..... 1432

R. W. Rand, D. D. Dirks, D. E. Morgan, J. R. Benton

Chapter 74	
POSTERIOR FOSSA TUMORS	1466
<i>M. P. Sayers, W. E. Hunt</i>	
Chapter 75	
CHEMOTHERAPY OF BRAIN TUMORS	1490
<i>C. B. Wilson, H. A. Norrell, Jr.</i>	
Chapter 76	
RADIOTHERAPY OF BRAIN TUMORS	1504
<i>F. Batley</i>	
Chapter 77	
SPINAL CORD TUMORS.....	1514
<i>J. Greenwood, Jr.</i>	
Chapter 78	
RADIOTHERAPY OF TUMORS OF SPINAL CORD.....	1535
<i>F. Batley</i>	
Chapter 79	
TUMORS OF PERIPHERAL AND SYMPATHETIC NERVES.....	1537
<i>R. Campbell</i>	
 XI. INFECTIONS	
Chapter 80	
CRANIAL AND INTRACRANIAL INFECTIONS	1547
<i>A. J. Raimondi, R. L. Wright</i>	
Chapter 81	
VIRAL ENCEPHALITIS	1556
<i>W. S. Cox</i>	
Chapter 82	
PARASITIC AND FUNGAL INFECTIONS OF THE BRAIN	1563
<i>F. Cabieses</i>	
Chapter 83	
TUBERCULOMA AND SYPHILITIC GUMMA	1569
<i>S. Obrador</i>	

Chapter 84	
INFECTIONS OF THE SPINE AND SPINAL CORD.....	1574
<i>R. L. Wright</i>	

XII. PAIN

Chapter 85	
PHYSIOLOGICAL ANATOMY OF PAIN.....	1587
<i>A. Taub, W. F. Collins</i>	

Chapter 86	
PSYCHIATRIC CONSIDERATIONS OF PAIN.....	1615
<i>A. Walters</i>	

Chapter 87	
CEPHALIC PAIN.....	1646
<i>R. B. King</i>	

Chapter 88	
TRIGEMINAL NEURALGIA.....	1662
<i>J. S. Tytus</i>	

Chapter 89	
TREATMENT OF TRIGEMINAL NEURALGIA BY SECTION OF THE SENSORY ROOT IN THE POSTERIOR FOSSA.....	1679
<i>K. Welch</i>	

Chapter 90	
GLOSSOPHARYNGEAL AND GENICULATE NEURALGIAS.....	1683
<i>J. S. Tytus</i>	

Chapter 91	
PAIN OF SPINAL ORIGIN.....	1688
<i>S. Mullan</i>	

Chapter 92	
PAIN OF VISCERAL ORIGIN.....	1697
<i>S. Mullan</i>	

Chapter 93	
NEURALGIAS OF PERIPHERAL NERVES.....	1702
<i>J. C. White</i>	