



# Scientific Approaches to Clinical Neurology

*Edited by*

Eli S. Goldensohn, M.D.

*Professor of Neurology  
College of Physicians & Surgeons, Columbia University  
Attending Neurologist, Columbia Presbyterian Medical Center  
New York, New York*

Stanley H. Appel, M.D.

*Professor and Chairman, Department of Neurology  
Baylor University College of Medicine  
Director, Neuroscience Program  
Jerry Lewis Neuromuscular Disease Clinic  
Houston, Texas*

VOLUME I

~~(Pages 1-992)~~



LEA & FEBIGER • 1977 • PHILADELPHIA

**Library of Congress Cataloging in Publication Data**

Main entry under title:

Scientific approaches to clinical neurology.

Bibliography.

Includes index.

1. Nervous system—Diseases. I. Goldensohn, Eli S. II. Appel, Stanley H. [DNLM: 1. Nervous system diseases. WL100 S416]

RC346.S36 1977 616.8 75-135684

ISBN 0-8121-0363-7

Copyright © 1977 by Lea & Febiger. Copyright under the International Copyright Union. All Rights Reserved. This book is protected by copyright. No part of it may be reproduced in any manner or by any means without written permission of the publisher.

Library of Congress Catalog Card Number

*Published in Great Britain by Henry Kimpton Publishers, London*

PRINTED IN THE UNITED STATES OF AMERICA

Print Number: 3 2 1



*This book was conceived by Dr. G. Milton Shy and is dedicated to him. Dr. Shy personified the ideal neurologist. He was a superb physician, scientist, teacher and colleague. After his formal training in neurology, at the National Hospital at Queen Square in London and at the Montreal Neurological Institute, he began his academic career at the Medical School of the University of Colorado. His outstanding talents as a teacher and clinician were soon recognized and, two years later, Dr. Shy accepted the challenge of becoming the first clinical director of the National Institute of Neurological Diseases and Blindness. During his ten years at the National Institute, he recruited and directed an outstanding and highly productive group of physicians and scientists while continuing his functions as an investigator, teacher and clinician at the highest levels. In the five*

*years before his death, he held the post of Professor and Chairman of the Department of Neurology at the University of Pennsylvania. At the time of his death, on September 25, 1967, Dr. Shy was Professor and Chairman of the Department of Neurology of the College of Physicians & Surgeons at Columbia University, and Director of the Neurology Service of the Neurological Institute of Presbyterian Hospital.*

*Dr. Shy raised the scientific excellence and teaching of each institution he served to new heights and significantly improved patient care. This book is dedicated to a great teacher, neurologist and investigator who died at the height of his creativity and left a legacy in teaching and research that will long be remembered in the history of neurology.*

# P R E F A C E

---

Shortly before Dr. G. Milton Shy died, he felt the time was opportune to incorporate accumulated scientific knowledge relevant to neurological diseases into a clinical textbook of neurology. Clinical scientists with such expertise were contacted, and this book is a result of those initial efforts. Dr. Shy's untimely death created many problems in assembling this book, but the memory of his past friendship and inspiration has guided the editors and the authors in completing the effort. We all are extremely grateful to the publishers, Lea & Febiger, for their patience, their generosity and their continuing support throughout this period.

When this book was conceived and subsequently when the present editors assumed responsibility, its major focus was on neurological disease processes in which scientific advances had been translated into meaningful approaches to the patient at the bedside. The book was not intended to represent a compendium of all our knowledge of clinical neurology. In the chapters which follow, clinical diseases are discussed with emphasis on basic science advances which contribute to our understanding of etiology and pathogenesis. It is clear that further intensive studies of neurological diseases are urgently needed not only to alleviate human anguish and suffering but also to help us to develop understanding of the nature of brain and behavior and to

deal with the many problems of mankind. Just as the study of basic science helps us understand and thus treat neurological disease, the study of neurological disease may help us gain significant insight into fundamental neuroscience.

Clinical advances in the future depend critically upon neurologists with a keen understanding of both the underlying biological processes and the clinical manifestations of disease. The continued development of individuals learned in clinical and basic science concepts is essential for the future of neurology and for our comprehension of the human brain. At a time of lagging governmental interest in and support of basic neurological science, possibly partly because of the priority given to improving health care delivery, it is important to stress the need for basic neurological investigation to help provide future therapy in neurological disorders.

We hope that some of the contributions in this book will serve as highlights to Dr. Shy's approach to neurology—which was that every patient helps us understand basic science principles, and that we need the maximal use of basic science principles to help us to help our patients.

*New York, New York*

*Houston, Texas*

ELI S. GOLDENSOHN

STANLEY APPEL

# CONTRIBUTORS

---

MILTON ALTER, M.D., Ph.D.

*Professor and Chairman*  
Department of Neurology  
Temple University  
Philadelphia, Pennsylvania

MICHAEL ANTHONY, M.D., M.R.C.P., F.R.A.C.P.

*Clinical Lecturer in Medicine*  
University of New South Wales  
*Senior Staff Neurologist*  
Prince Henry Hospital  
Sydney, Australia

STANLEY H. APPEL, M.D.

*Professor and Chairman*  
Department of Neurology  
Baylor University College of Medicine  
*Director, Neuroscience Program*  
Jerry Lewis Neuromuscular Disease Clinic  
Houston, Texas

DAWNA ARMSTRONG, M.D.

*Neuropathologist*  
Hospital for Sick Children  
Toronto, Ontario, Canada

R. M. ARMSTRONG, M.D.

*Assistant Professor of Medicine (Neurology)*  
*Lecturer, Department of Pathology (Neuropathology)*  
University of Toronto  
*Attending Physician*  
Toronto General Hospital  
*Consultant in Neurology*  
Clarke Institute of Psychiatry  
Toronto, Ontario, Canada

BARRY G. W. ARNASON, M.D.

*Professor and Chairman*  
Department of Neurology  
Harvard Medical School

*Associate Neurologist*

Massachusetts General Hospital  
Boston, Massachusetts

ALAN M. ARON, M.D.

*Associate Professor of Clinical Neurology and*  
*Clinical Pediatrics*  
Mt. Sinai School of Medicine  
*Associate Attending Neurologist*  
*Associate Attending Pediatrician*  
*Director, Child Neurology*  
Mt. Sinai Hospital  
New York, New York  
*Consultant, Child Neurology*  
Elmhurst General Hospital  
Elmhurst, Long Island, New York

STANLEY M. ARONSON, B.S., M.A., M.D.

*Professor and Chairman*  
Department of Neurology  
University of Chicago School of Medicine  
Chicago, Illinois

JAMES HENRY AUSTIN, M.D.

*Professor and Chairman*  
Department of Neurology  
University of Colorado Medical Center  
Denver, Colorado

LOUIS V. AVIOLI, M.D.

*Shoenberg Professor of Medicine*  
Washington University School of Medicine  
*Director, Division of Endocrinology*  
The Jewish Hospital of St. Louis  
St. Louis, Missouri

ROGER BANNISTER, M.D.

St. Mary's Hospital  
London, England

**LEWIS A. BARNES, M.D.**

*Professor and Chairman of Pediatrics*  
University of South Florida College of Medicine  
*Staff Member*  
Tampa General Hospital  
St. Joseph's Hospital  
Tampa, Florida  
All Children's Hospital  
St. Petersburg, Florida

**LEONARD BERG, M.D.**

*Professor of Clinical Neurology*  
Washington University School of Medicine  
*Associate Neurologist*  
Barnes Hospital  
Jewish Hospital of St. Louis  
St. Louis Children's Hospital  
*Consultant*  
Shriner's Hospital for Crippled Children  
St. Louis, Missouri

**JOHN E. BEVILACQUA, M.D.**

*Associate Professor of Clinical Medicine*  
University of Pennsylvania School of Medicine  
Philadelphia, Pennsylvania

**DARELL D. BIGNER, M.D., Ph.D.**

*Associate Professor of Pathology (Neuropathology)*  
*Lecturer in Virology and Experimental Surgery*  
Duke University Medical Center  
Durham, North Carolina

**ELENA BODER, M.D.**

*Clinical Professor of Pediatrics (Division of Neurology)*  
University of California at Los Angeles  
*Consultant in Neurology*  
Childrens Hospital of Los Angeles  
*Attending Neuropediatrician-in-Charge*  
Pediatric Neurology Clinic  
Cedars-Sinai Medical Center  
Los Angeles, California

**DONALD L. BORNSTEIN, M.D.**

*Associate Professor of Medicine*  
*Chief, Infectious Disease Section*  
SUNY Upstate Medical Center  
*Attending Physician*  
State University Hospital  
Crouse-Irving Memorial Hospital  
Syracuse Veterans Administration Hospital  
Syracuse, New York

**MURRAY B. BORNSTEIN, M.D.**

*Professor of Neurology*  
Albert Einstein College of Medicine  
Bronx, New York

**ROSCOE O. BRADY, M.D.**

*Adjunct Professor of Biochemistry*  
Georgetown University School of Medicine  
Washington, D.C.

*Branch Chief*

Developmental and Metabolic Neurology Branch  
National Institute of Neurological Diseases and Stroke  
Bethesda, Maryland

**SIDNEY CARTER, M.D.**

*Professor of Neurology and Pediatrics*  
College of Physicians & Surgeons, Columbia University  
*Attending Neurologist*  
Columbia-Presbyterian Medical Center  
New York, New York

**THOMAS N. CHASE, M.D.**

*Director, Intramural Research Program*  
National Institute of Neurological and Communicative  
Disorders and Stroke  
Bethesda, Maryland

**ROBERT M. COHN, M.D.**

*Assistant Professor of Pediatrics*  
University of Pennsylvania School of Medicine  
*Associate Physician*  
Children's Hospital of Philadelphia  
Philadelphia, Pennsylvania

**HADLEY L. CONN, JR., M.D.**

*Chairman, Department of Medicine*  
CMDNJ-Rutgers Medical School  
New Brunswick, New Jersey

**ERMINIO COSTA, M.D.**

*Chief, Laboratory of Preclinical Pharmacology*  
National Institute of Mental Health  
Bethesda, Maryland  
Saint Elizabeths Hospital  
Washington, D.C.

**ALLAN J. D. DALE, M.D., M.S.C.**

*Associate Professor of Neurology*  
Mayo Medical School  
*Consultant in Neurology*  
Mayo Clinic  
Rochester, Minnesota

**DARAB K. DASTUR, M.D., D.Sc., F.A.M.S., M.R.C. Path.**

*Neuropathologist-in-Charge (Professor of Neuropathology)*  
Grant Medical College and J. J. Group of Hospitals  
Neuropathology Unit, Post-Graduate Research  
Laboratories  
J. J. Group of Hospitals  
Bombay, India

**WILLIAM DEMYER, M.D.**

*Professor of Neurology (Child Neurology)*  
Indiana University Medical Center  
*Consultant*  
LaRue D. Carter Memorial Hospital

Muscatatuck State Hospital  
Indianapolis, Indiana

**IVAN DIAMOND, M.D., Ph.D.**

*Associate Professor of Neurology and Pediatrics*  
University of California School of Medicine  
*Attending Neurologist*  
University of California Hospitals  
San Francisco General Hospital  
San Francisco, California

**PHILIP E. DUFFY, M.D.**

*Professor and Director*  
Division of Neuropathology  
College of Physicians & Surgeons, Columbia University  
Columbia-Presbyterian Hospital Medical Center  
New York, New York

**PETER JAMES DYCK, M.D.**

*Professor of Neurology*  
Mayo Medical School  
Rochester, Minnesota

**JOSEPH S. EISENMAN, Ph.D.**

*Associate Professor of Physiology and Biophysics*  
Mt. Sinai Medical School of the City University of New  
York  
New York, New York

**ANDREW S. ENGEL, M.D.**

*Professor of Neurology*  
Mayo Medical School  
Rochester, Minnesota

**W. KING ENGEL, M.D.**

*Clinical Professor of Neurology*  
George Washington University School of Medicine  
Washington, D.C.  
*Chief, Medical Neurology Branch*  
National Institute of Neurological Diseases and Stroke  
Bethesda, Maryland

**ANTONIO V. ESCUETA, M.D.**

*Associate Professor in Residence*  
Department of Neurology  
*Member*  
Brain Research Institute  
University of California at Los Angeles  
*Staff Neurologist*  
Wadsworth Veterans Administration Hospital  
Los Angeles, California

**STANLEY FAHN, M.D.**

*Professor of Neurology*  
College of Physicians & Surgeons, Columbia University  
*Attending Neurologist*  
Neurological Institute of New York  
New York, New York

**JEROME M. FELDMAN, M.D.**

*Associate Professor of Medicine*  
Duke University  
*Chief of Endocrine Section*  
Durham VA Hospital  
Durham, North Carolina

**JAMES J. FERGUSON, JR., M.D.**

*Professor and Chairman, Department of Biochemistry*  
*Professor, Department of Medicine*  
University of Pennsylvania  
*Consultant*  
Hospital of the University of Pennsylvania  
Philadelphia Veterans Administration Hospital  
Philadelphia, Pennsylvania

**M. HAROLD FOGELSON, M.D.**

*Associate Professor of Pediatrics and Neurology*  
University of Cincinnati College of Medicine  
*Child Neurologist*  
Children's Hospital Medical Center for Developmental  
Disorders  
Cincinnati, Ohio

**DONALD S. FREDRICKSON, M.D.**

*Director*  
National Institutes of Health  
Bethesda, Maryland

**HARRY FRIEDMAN, B.S., M.D.**

*Instructor in Neurosurgery*  
University of Tennessee Center for Health Sciences  
Memphis, Tennessee

**GERALD E. GAULL, M.D.**

*Professor of Pediatrics*  
*Chief, Pediatric Research Institute for Basic Research in*  
*Mental Retardation*  
Mount Sinai School of Medicine of the City University of  
New York  
*Attending Physician*  
Mount Sinai Hospital  
New York, New York

**GILBERT H. GLASER, M.D., Med. Sc.D.**

*Professor and Chairman*  
Department of Neurology  
Yale University School of Medicine  
*Neurologist-in-Chief*  
Yale-New Haven Hospital  
New Haven, Connecticut  
*Consultant in Neurology*  
Veterans Administration Hospital  
West Haven, Connecticut

**ARNOLD P. GOLD, M.D.**

*Professor of Clinical Neurology*  
*Professor of Clinical Pediatrics*  
College of Physicians & Surgeons, Columbia University



*Attending Neurologist and Pediatrician*  
Columbia Presbyterian Medical Center  
New York, New York

ELI S. GOLDENSOHN, M.D.

*Professor of Neurology*  
College of Physicians & Surgeons, Columbia University  
*Attending Neurologist*  
Columbia Presbyterian Medical Center  
New York, New York

ANTONIO M. GOTTO, JR., P.Ph., M.D.

*Professor of Medicine and Biochemistry*  
*Chief, Division of Atherosclerosis and Lipoprotein Research*  
Baylor University College of Medicine  
*Attending Physician*  
Methodist Hospital  
*Consulting Physician*  
Ben Taub Hospital and  
Veterans Administration Hospital  
Houston, Texas

LEONARD J. GRAZIANI, M.D.

*Professor of Neurology and Pediatrics*  
Jefferson Medical College of Thomas Jefferson  
University  
*Attending Neurologist and Attending Pediatrician*  
Thomas Jefferson University Hospital  
Philadelphia, Pennsylvania

SIR LUDWIG GUTTMANN, C.B.E., M.D., F.R.C.P., F.R.C.S.

*Professor Ordinarius (Emeritus)*  
University of Cologne, Germany  
At Present: Director of the Stoke Mandeville Sports  
Stadium for the Paralysed and other Disabled  
Harvey Road, Aylesbury, England

GUNTER R. HAASE, M.D.

*Professor of Neurology*  
University of Pennsylvania  
*Director*  
Department of Neurology, Pennsylvania Hospital  
Philadelphia, Pennsylvania

RICHARD N. HARNER, M.D.

*Associate Professor of Neurology*  
University of Pennsylvania  
*Chief, Department of Neurology*  
The Graduate Hospital of the University of Pennsylvania  
*Neurologist*  
Presbyterian-University of Pennsylvania Medical Center  
Philadelphia, Pennsylvania

DONALD H. HARTER, M.D.

*Charles L. Mix Professor and Chairman*  
Department of Neurology  
The Medical School, Northwestern University

*Attending Neurologist and Chairman*  
Department of Neurology  
Northwestern Memorial Hospital  
Chicago, Illinois

JAMES H. HERNDON, JR., M.D.

*Associate Professor of Internal Medicine*  
University of Texas Southwestern Medical School  
*Chairman, Dermatology Division*  
Parkland Memorial Hospital  
*Consultant in Dermatology*  
Children's Medical Center  
Veterans Administration Hospital  
Dallas, Texas

SAMUEL P. HICKS, M.D.

*Professor of Pathology*  
University of Michigan  
University of Michigan Medical Center  
Ann Arbor, Michigan

ANTHONY PHILIP HOPKINS, M.D., M.R.C.P.

*Consultant Neurologist*  
St. Bartholomew's Hospital  
West Smithfield, London, England

ALAN JAY HOROWITZ, M.D.

*Medical Science Training Program Fellow*  
Duke University  
Durham, North Carolina  
*Resident in Psychiatry*  
Medical College of Georgia  
Augusta, Georgia

R. RODNEY HOWELL, M.D.

*Professor of Pediatrics and Genetics*  
*Director of the Program in Pediatrics*  
University of Texas Medical School at Houston  
*Pediatrician-in-Chief*  
Hermann Hospital  
Texas Medical Center  
Houston, Texas

PETER HUDGSON, M.B., M.R.C.P., F.R.A.C.P.

*Principal Research Associate in Neurology*  
University of Newcastle upon Tyne  
*Consultant Neurologist*  
Newcastle University Hospitals Group  
Newcastle upon Tyne, England

HOWARD I. HURTIG, B.A., M.D.

*Assistant Professor of Neurology*  
University of Pennsylvania  
*Assistant Attending Physician*  
Philadelphia General Hospital  
Philadelphia, Pennsylvania

KURT JELLINGER, M.D.

*Associate Professor of Neuropathology*  
Neurological Institute of University of Vienna  
Vienna, Austria

**GEORGE A. JERVIS, M.D.**

*Clinical Professor of Psychiatry*  
Columbia University  
*Director*  
New York State Institute for Research in Mental Retardation  
New York, New York

**MICHAEL KATZ, M.D.**

*Reuben S. Carpentier Professor and Chairman*  
Department of Pediatrics  
*Professor of Public Health (Tropical Medicine)*  
College of Physicians and Surgeons, Columbia University  
*Director of Pediatric Service*  
Columbia Presbyterian Medical Center  
New York, New York

**WILLIAM N. KELLEY, M.D.**

*Professor and Chairman*  
Department of Internal Medicine  
University of Michigan Medical School  
Ann Arbor, Michigan

**MARCEL KINSBOURNE, M.D., Ph.D.**

*Professor of Pediatrics and Psychiatry*  
University of Toronto Medical Center  
*Senior Staff Physician*  
The Hospital for Sick Children  
Toronto, Ontario, Canada

**IRWIN J. KOPIN, M.D.**

*Chief, Laboratory of Clinical Science*  
National Institute of Mental Health  
Bethesda, Maryland

**HILARY KOPROWSKI, M.D.**

*Wistar Professor of Research Medicine*  
*Professor of Microbiology*  
University of Pennsylvania  
*Director*  
The Wistar Institute  
Philadelphia, Pennsylvania

**JAMES W. LANCE, M.D., F.R.C.P., F.R.A.C.P.**

*Associate Professor of Medicine*  
University of New South Wales  
*Chairman, Division of Neurology*  
The Prince Henry and Prince of Wales Hospitals  
Sydney, NSW, Australia

**THOMAS W. LANGFITT, M.D.**

*Charles Harrison Frazier Professor of Neurosurgery*  
*Director, Division of Neurosurgery*  
*Vice President for Health Affairs*  
University of Pennsylvania  
*Co-Chief of Neurosurgery*  
Hospital of the University of Pennsylvania  
*Consulting Neurosurgeon*  
Children's Hospital of Philadelphia,

Pennsylvania Hospital, Philadelphia General  
Hospital, Veterans Administration Hospital  
Philadelphia, Pennsylvania

**HAROLD E. LEBOVITZ, M.D.**

*Professor of Medicine*  
*Director, Division of Endocrinology*  
Duke University School of Medicine  
Durham, North Carolina

**HARVEY L. LEVY, M.D.**

*Associate Professor of Neurology*  
Harvard Medical School  
*Assistant in Neurology*  
Massachusetts General Hospital  
Boston, Massachusetts

**LEAH M. LOWENSTEIN, M.D., D.Ph.**

*Professor of Medicine and Biochemistry*  
*Assistant Dean*  
Boston University School of Medicine  
Boston, Massachusetts

**GEORGE D. LUDWIG, M.D., F.A.C.P. (deceased)**

*Professor and Chairman*  
Department of Medicine  
Medical College of Ohio  
*Chief of Medicine*  
Hospital Medical College of Ohio  
Toledo, Ohio

**DAYA K. MANGHANI, M.Sc., Ph.D. (Bombay), Ph.D. (London)**

*Research Fellow in Neurochemistry*  
The National Hospital for Nervous Diseases  
London, England

**WILLIAM S. MASLAND, M.D.**

Neurological Associates of Tucson  
Tucson, Arizona

**PAUL R. MCHUGH, M.D.**

*Professor and Chairman*  
Department of Psychiatry  
University of Oregon Health Sciences Center  
Portland, Oregon

**WILLIAM J. MELLMAN, M.D.**

*Professor and Chairman*  
Department of Human Genetics  
University of Pennsylvania School of Medicine  
*Director*  
University of Pennsylvania Human Genetics  
Center  
University of Pennsylvania  
*Senior Attending Physician*

Children's Hospital of Philadelphia  
Philadelphia, Pennsylvania

**KARL R. MEYERS, M.D.**

*Assistant Professor of Pathology*  
University of Pennsylvania School of Medicine  
*Assistant Pathologist*  
Pennsylvania Hospital  
Philadelphia, Pennsylvania

**JAMES R. MILLER, A.B., M.D.**

*Assistant Professor of Neurology*  
College of Physicians & Surgeons, Columbia  
University  
*Assistant Attending Physician (Neurology)*  
Harlem Hospital Medical Center  
New York, New York

**NTINOS MYRIANTHOPOULOS, B.S., M.S., Ph.D.**

*Associate Clinical Professor of Neurology*  
George Washington University School of Medicine  
Washington, D.C.

**BLAINE S. NASHOLD, JR., M.D.**

*Professor of Neurosurgery*  
Duke University Medical Center  
Durham, North Carolina

**HAROLD C. NEU, M.D.**

*Professor of Medicine*  
*Professor of Pharmacology*  
College of Physicians & Surgeons, Columbia  
University  
*Attending Neurologist*  
Columbia Presbyterian Medical Center  
New York, New York

**WILLIAM T. NORTON, Ph.D.**

*Professor of Neurology (Neurochemistry) and  
Neuroscience*  
Albert Einstein College of Medicine  
Bronx, New York

**STIG H. M. NYSTROM, M.D.**

*Assistant Professor of Neurosurgery*  
Faculty of Medicine  
University of Helsinki  
*Assistant Physician-in-Chief*  
Department of Neurosurgery  
University Central Hospital  
Helsinki, Finland

**STEVEN I. OPPENHEIMER, B.S., M.D.**

Hayward Medical Group  
Hayward, California  
*Consultant in Internal Medicine*  
Fairmont Hospital  
San Leandro, California

**RICHARD D. O'TOOLE**

The Medford Clinic  
Medford, Oregon

**GERALD T. PERKOFF, M.D.**

*Professor of Medicine and Preventive Medicine*  
*Director, Division of Health Care Research*  
Washington University School of Medicine  
*Associate Physician*  
Barnes Hospital  
St. Louis, Missouri

**ROBERT G. PETERSDORF, M.D.**

*Professor and Chairman*  
Department of Medicine  
University of Washington School of Medicine  
*Physician-in-Chief*  
University Hospitals  
Seattle, Washington

**DAVID E. PLEASURE, M.D.**

*Professor of Neurology*  
University of Pennsylvania  
*Attending Neurologist*  
Philadelphia General Hospital  
Philadelphia, Pennsylvania

**STANLEY A. PLOTKIN, M.D.**

*Professor of Pediatrics*  
University of Pennsylvania School of Medicine  
*Director of Infectious Diseases Service*  
Children's Hospital of Philadelphia  
Philadelphia, Pennsylvania

**THOMAS R. PRICE, M.D.**

*Associate Professor of Neurology*  
University of Maryland School of Medicine  
Baltimore, Maryland

**LEON D. PROCKOP, M.D.**

*Professor of Medicine and Chief, Neurology Section*  
College of Medicine  
University of South Florida  
*Consultant*  
Tampa Veterans Administration Hospital  
*Attending Physician*  
Tampa General Hospital  
Tampa, Florida

**NEIL H. RASKIN, M.D.**

*Associate Professor of Neurology*  
University of California School of Medicine  
San Francisco, California

**MARTIN REIVICH, M.D.**

*Professor of Neurology*  
University of Pennsylvania  
*Director of the Cerebrovascular Research Center*  
Hospital of the University of Pennsylvania  
Philadelphia, Pennsylvania

**VICTOR REYES, M.D.**

*Associate Professor of Surgery*  
 College of Medicine  
 University of the Philippines  
*Chief of Neurosurgery*  
 University of the Philippines Health Science Center  
 Manila, Philippine Islands

**CONRAD M. RILEY, M.D.**

*Professor of Pediatrics and Preventive Medicine*  
*Associate Dean for Admissions*  
 University of Colorado School of Medicine  
*Consultant*  
 Colorado General Hospital  
 Denver Children's Hospital  
 Denver, Colorado

**LEWIS P. ROWLAND, M.D.**

*Henry L. and Lucy Moses Professor and Chairman*  
 Department of Neurology  
 College of Physicians & Surgeons, Columbia University  
*Director, Neurological Service*  
 Columbia Presbyterian Medical Center  
 New York, New York

**SAUL M. SCHANBERG, M.D.**

*Professor of Pharmacology*  
*Assistant Professor of Neurology*  
*Chief, Laboratory of Neuroparmacology*  
 Duke University Medical Center  
*Research Investigator*  
 Veterans Administration Hospital  
 Durham, North Carolina

**DONALD L. SCHOTLAND, M.D.**

*Professor of Neurology*  
 University of Pennsylvania  
 Philadelphia, Pennsylvania

**GABRIEL A. SCHWARZ, M.D.**

*Professor of Neurology*  
 University of Pennsylvania School of Medicine  
*Attending Physician*  
 Hospital of the University of Pennsylvania  
 Children's Hospital of Philadelphia  
 Philadelphia, Pennsylvania

**ROBERT P. SEDGWICK, M.D.**

*Associate Clinical Professor of Neurology*  
 University of Southern California School of  
 Medicine  
*Head, Division of Neurology*  
 Children's Hospital  
 Los Angeles, California

**STANTON SEGAL, M.D.**

*Professor of Pediatrics and Medicine*  
 University of Pennsylvania School of Medicine  
*Senior Physician*

Children's Hospital of Philadelphia  
*Attending Physician*  
 Hospital of the University of Pennsylvania  
 Philadelphia, Pennsylvania

**PROFESSOR DR. FRANZ SEITELBERGER**

*Ordinary Professor of Neurology*  
 University of Vienna  
*Director*  
 Neurologisches Institut der Universitat Wien  
 (Obersteiner Institut)  
 Vienna, Austria

**KENNETH SHULMAN, M.D.**

*Professor and Chairman*  
 Department of Neurological Surgery  
 Albert Einstein College of Medicine  
*Director of Neurological Surgery*  
 Hospital of the Albert Einstein College of Medicine  
 Montefiore Hospital  
 New York, New York

**ROBERT G. SIEKERT, M.D.**

*Professor of Neurology*  
 Mayo Medical School  
*Consultant*  
 Mayo Clinic  
 Rochester, Minnesota

**DONALD H. SILBERBERG, M.D.**

*Professor of Neurology and Ophthalmology*  
 University of Pennsylvania School of Medicine  
*Inpatient Staff*  
 Hospital of the University of Pennsylvania  
*Consultant*  
 Veterans Administration Hospital of Philadelphia  
 Children's Hospital of Philadelphia  
 Presbyterian-University of Pennsylvania Medical Center  
 Philadelphia, Pennsylvania

**HOWARD SILBY, M.D.**

*Instructor in Neurology*  
 George Washington University School of Medicine  
*Attending Neurologist*  
 George Washington University Hospital  
 Washington, D.C.

**LOUIS SOKOLOFF, M.D.**

*Chief, Laboratory of Cerebral Metabolism*  
 National Institute of Mental Health  
 Bethesda, Maryland

**ALFRED J. SPIRO, M.D.**

*Associate Professor of Neurology and Pediatrics*  
 Albert Einstein College of Medicine of Yeshiva  
 University  
*Attending in Neurology and Pediatrics*  
 Bronx Municipal Hospital Center and  
 Hospital of the Albert Einstein College of Medicine  
 Bronx, New York

DANIEL STEINBERG, M.D., Ph.D.

*Professor of Medicine*  
*Head, Division of Metabolic Disease*  
 School of Medicine  
 University of California  
 San Diego, California

RICHARD M. TORACK, M.D.

*Professor of Pathology*  
 Washington University School of Medicine  
*Associate Pathologist*  
 Barnes Hospital  
 St. Louis, Missouri

JOHN P. UTZ, M.D.

*Professor of Medicine and Dean*  
 Georgetown University School of Medicine  
 Washington, D.C.

MAURICE VICTOR, M.D.

*Professor of Neurology*  
 Case-Western Reserve University, School of  
 Medicine  
*Director, Division of Neurology*  
 Cleveland Metropolitan General Hospital  
 Cleveland, Ohio

BRUNO W. VOLK, M.D.

*Clinical Professor of Pathology*  
 State University of New York  
 Downstate Medical Center  
*Director*  
 Isaac Albert Research Institute  
 Brooklyn, New York

PATRICK DAVID WALL, M.A., D.M.

*Professor of Anatomy*  
*Director, Cerebral Functions Group*

University College  
 London, England

JOHN N. WALTON, M.D., D.Sc., F.R.C.P.

*Professor of Neurology and Dean of Medicine*  
 University of Newcastle upon Tyne  
 Newcastle upon Tyne, England

CHARLES L. WISSEMAN, JR., B.A., M.S., M.D.

*Professor and Chairman*  
 Department of Microbiology  
 School of Medicine  
 University of Maryland  
 Baltimore, Maryland

DIXON MILES WOODBURY, Ph.D.

*Professor and Chairman*  
 Department of Pharmacology  
 University of Utah College of Medicine  
 Salt Lake City, Utah

THEODORE E. WOODWARD, M.D., F.A.C.P.

*Professor and Head*  
 Department of Medicine  
*Physician-in-Chief*  
 University of Maryland School of Medicine and Hospital  
 Baltimore, Maryland

JAMES B. WYNGAARDEN, M.D.

*Frederic M. Hanes Professor and Chairman*  
 Department of Medicine  
 Duke University School of Medicine  
 Durham, North Carolina

EARL A. ZIMMERMAN, M.D.

*Associate Professor of Neurology*  
 College of Physicians & Surgeons, Columbia University  
 New York, New York

# Scientific Approaches to Clinical Neurology

# CONTENTS

---

## SECTION I

### *Metabolic Diseases*

1. Introduction to Metabolic Diseases of the Nervous System STANLEY H. APPEL	2	9. The Gangliosidoses STANLEY M. ARONSON BRUNO W. VOLK	116
2. Phenylketonuria GEORGE A. JERVIS	26	10. Disorders of Glucocerebrosides ROSCOE O. BRADY	140
3. Homocystinuria and Other Disorders of Sulfur Metabolism GERALD E. GAULL	46	11. Disorders of Sphingomyelin ROSCOE O. BRADY	144
4. Maple Syrup Urine Disease (Branched-Chain Keto-Aciduria) STANLEY H. APPEL	55	12. Lafora's Disease: A Disorder of Carbohydrate Metabolism GABRIEL A. SCHWARZ	148
5. Histidinemia R. RODNEY HOWELL	62	13. Genetic Mucopolysaccharidoses M. HAROLD FOGELSON	160
6. Hartnup Disease HARVEY L. LEVY	75	14. The X-Linked Hyperuricacidurias WILLIAM N. KELLEY JAMES B. WYNGAARDEN	178
7. Disorders Related to Urea-Cycle Enzyme Defects LEAH M. LOWENSTEIN STANTON SEGAL	85	15. Combined System Disease LEWIS A. BARNES	193
8. Disorders of Galactose Metabolism ROBERT M. COHN STANTON SEGAL	99	16. Thiamine Deficiency MAURICE VICTOR HOWARD SILBY	204
		17. Amyloidosis and Macroglobulinemia GUNTER R. HAASE	227
		18. Neuronal Disease and Progressive Dementia in Adults RICHARD M. TORACK LEONARD BERG	243

## SECTION II

*Disorders Affecting Myelin*

- |     |   |     |
|-----|---|-----|
| 19. | The Demyelinating Diseases  | 254 |
|     | DAWNA ARMSTRONG   |     |
| 20. | The Myelin Sheath   | 259 |
|     | WILLIAM T. NORTON   |     |
| 21. | Multiple Sclerosis  | 299 |
|     | DONALD H. SILBERBERG  |     |
| 22. | Experimental Allergic Encephalomyelitis   | 325 |
|     | MURRAY B. BORNSTEIN   |     |
| 23. | Some Mechanisms of Disease in Metachromatic Leukodystrophy (MLD)  | 342 |
|     | JAMES H. AUSTIN   |     |
| 24. | Spongy Encephalopathies in Infancy: Spongy Degeneration of CNS and Progressive Infantile Poliodystrophy | 363 |
|     | KURT JELLINGER  |     |
|     | FRANZ SEITELBERGER  |     |

## SECTION III

*Viral Disorders*

- |     |   |     |
|-----|---|-----|
| 25. | Viral Interactions  | 388 |
|     | HILARY KOPROWSKI  |     |
| 26. | Acute Viral Infections  | 390 |
|     | JAMES R. MILLER   |     |
|     | DONALD H. HARTER  |     |
| 27. | Slow-Virus Encephalopathies   | 407 |
|     | MICHAEL KATZ  |     |
|     | HILARY KOPROWSKI  |     |
| 28. | Parainfectious Encephalopathies Associated with Measles, Mumps, Chickenpox and German Measles | 415 |
|     | MICHAEL KATZ  |     |
|     | STANLEY A. PLOTKIN  |     |

## SECTION IV

*Bacterial and Parasitic Disorders*

- |     |  |     |
|-----|--|-----|
| 29. | Introduction to Infections of the Nervous System | 426 |
|     | HAROLD C. NEU                                    |     |
| 30. | Bacterial Meningitis                             | 434 |
|     | STEVEN I. OPPENHEIMER                            |     |
|     | RICHARD D. O'TOOLE                               |     |
|     | ROBERT G. PETERSDORF                             |     |
| 31. | Brain Abscess                                    | 452 |
|     | HAROLD C. NEU                                    |     |
| 32. | Tuberculous Meningitis                           | 461 |
|     | DONALD L. BORNSTEIN                              |     |
| 33. | Neurosyphilis                                    | 482 |
|     | GABRIEL A. SCHWARZ                               |     |
| 34. | Parasitic Diseases of the Nervous System         | 498 |
|     | VICTOR REYES                                     |     |
|     | ANTONIO V. ESCUETA                               |     |
| 35. | Rickettsial Diseases                             | 515 |
|     | THOMAS R. PRICE                                  |     |
|     | CHARLES L. WISSEMAN, JR.                         |     |
|     | THEODORE E. WOODWARD                             |     |
| 36. | Fungal Diseases                                  | 527 |
|     | JOHN P. UTZ                                      |     |
| 37. | Sarcoidosis of the Nervous System                | 541 |
|     | DONALD H. SILBERBERG                             |     |

## SECTION V

*Embryogenic Disorders*

- |     |  |     |
|-----|--|-----|
| 38. | Introduction to Embryogenic Disorders            | 552 |
|     | SAMUEL P. HICKS                                  |     |
| 39. | The Autosomal Trisomies: Trisomies 21, 18 and 13 | 572 |
|     | WILLIAM J. MELLMAN                               |     |



